100 YEARS OF URBANIZATION IN NIGERIA

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One Hundred Years of Urbanization in Nigeria (1914 - 2014)

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Acknowledgement

The evolution of the Nigerian state has gone through series of developmentsbegining from 1914 with the amalgamation of the Southern and Northern protectorates by the colonial masters.Since then, there have been tremendous developments leading to the emergence of large and medium sized cities across the country. This publication on the 100 years of the urbanization in Nigerian is therefore apt and timely in looking into some of these changes within the built environment over this one century. The publication is a concerted effort by various scholars and professionals from different parts of the country to whom we are grateful.

The School of Environmental Technology acknowledges the invaluable contributions of the Federal University of Technology, Minna, for the opportunity to use the platform of the University to publish the book. The School also acknowledges the roles of the former Dean of the School of Environmental Technology Professor Y.A Sanusi for his effort in initiating the book project and ensuring that hands were put on the desk for the realization of the dream. It is also noteworthy to acknowledge the support and the zeal with which the current Dean,Professor A.M Junaid, took up the responsibility of ensuring that the dream of publishing this book was not killed. The School acknowledges all professors and staff of the School of Environmental Technology who are too numerous to mention because of the exigency of space and time.The School also remains grateful to all the academics who helped to review the chapters to ensure the quality and originality of the various chapters.

We are grateful to the University Management led by the Vice-Chancellor Prof. M.A. Akanji for the unwaviering support in publishing this book.The effort of Prof. S.N Zubairu for her contribution in writing the introduction and editing the work at various times and that of theeditorial team is acknowledged.

On a final note, the School is grateful to all individuals, particularly Prof. O.O.A. Fasanya, the Chairman of the Univerity Publishing Unit who have assisted in ensuring the success of this laudable book project.

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Foreword

One of the core mandates of School of Environmental Technology, as an integral part of Federal University of Technology, Minna, is to expand the frontiers of knowledge through the creation of awareness and training of high capacity man-power on contemporary issues in the built environment. This publication,***100 Years of Urbanization in Nigeria***,aims at projecting and profiling the various issues relating to urbanization and the built environment in Nigeria from 1914 to 2014. The year 1914 was significant in the nationhood of Nigeria as it marked the political and legal beginning of the country. As a result, it can be regarded as the peak of integration of the Nigerian settlments into the global system. It is also the year when the first national law on urban and regional planning was enacted by the Colonial government. These historical events reached 100 years by 2014. As a School devoted to the understanding and providing conceptual bases for reframing and reinventing the human settlements, the School found it impelling to critically examine urbanization of Nigeria and the activities associated with it within this period. The School, under the Deanship of Prof. Y. A. Sanusi, initated the book in 2013 and called for contributions from experts across the country and beyond.

The objectives of the book are:

1. To bring to the fore the role of urbanization in the transformation of Nigeria in the last 100 years.
2. To assess changes in the urban setting from the point of its architecture, planning, economy, property value and investments, social characteristics, construction, and technology of understanding and managing urban space.
3. To assess major policy issues underlying urban planning and development.
4. To examine the state of development of Nigerian cities and their contributions to local, national and global competition.

The submissions and selections of papers have reflected these objectives. The book is the contribution of the School to urban debate and therecollection of historical and contemporary issues of urbanization and urban development in Nigeria. It is hoped that the efforts of the contributors, the editors and that of the School will be found rewarding by scholars, students, practitioners and all people interested in urban affairs.

Prof. Y. A. Sanusi
Former Dean, School of Environmental Technology
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Preface

Nigeria came into existence as a single entity in 1914 following the amalgamation of the Northern and the Southern Protectorates by the British Colonialists on the 1st of January, 1914. The year 2014 marked the 100th year of existence of Nigeria as a united country. The Nigerian nation celebrated her centenary anniversary in several ways in February, 2014. One of the identified ways to mark this important event in Nigeria is to cast a look at the past, analyze and document events that unfolded in the past 10 decades. This historical approach is to enable Nigeria to understand the past, comprehend the present and formulate strategies for future development.

The year 2014 is significant to the practitioners in the Built Environment as it marked 100 years of man-environment interactions that produced the villages, towns and cities of the 21st century. The idea of this centenary book was muted by the School of Environmental Technology, Federal University of Technology, Minna, in the last quarter of year 2013. The book is the School's modest contribution to the centenary celebration in Nigeria. The aim is to construct the history of physical and socio-economic development in Nigeria in the last 100 years with a view to understanding the development trend and the challenges faced by Nigeria as a nation. The ultimate objective is to provide well-researched information and strategies for sustaining the past development gains and for resolving the present and future development challenges.

The papers in this Centenary Book cover a wide range of topics. The book is structured into twomain thematic areas. The first section covers issues of urbanization and urban development and features articles in the areas of settlement growth, urban development trends and settlement hierarchies. Section two is focused on issues of urban landscapes, and infrastructure, covering issues of transport and telecommunication as well as housing development and delivery. In line with the spirit of the centenary celebration, many of the articles in this book examined the past in Nigeria as a basis for understanding the present situation and as a prognosis for the future. The papers have brought out the salient development issues in Nigeria, the major challenges and have recommended measures for addressing the Nation's development challenges.

The contributions in the book provide a resource base for students, academics, professionals, bureaucrats and policy makers in Nigeria and abroad. I am confident that readers will find the contents of this book useful. The book is therefore recommended for all and sundry.

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DECLARATION

Peer Review and Scientific Publishing Policy Statement

10th October 2017

TO WHOM IT MAY CONCERN

We wish to state that all the papers published in 100 Years of Urbanization in Nigeria Book have passed through the peer review process which involved an initial review of chapter proposals, blind review of full chapter by minimum of two reviewers, forwarding of reviewers' comments to authors, submission of revised chapter by authors and subsequent evaluation of submitted chapters by the Editors to determine content quality and thematic scope adherence.

It is the policy of the School of Environmental Technology that for Chapters to be accepted for inclusion in the 100 Years of Urbanization in Nigeria Book it must have undergone the blind review process and passed. All papers are only published based on the recommendation of the reviewers and the Book editors.

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CHAPTER FIVE

Spatial Growth Assessment of Minna, Niger State and Its Effect on Vegetal Cover

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Introduction

Rapid population increase has remained the principal factor that has triggered an unprecedented growth in most of our urban cities, increase in birth rate and rural-urban migration have always been attributed to this phenomenon by many scholars. According to Dalil et al (2013) and Oyeleye (2013), increase in population as a result of high birth rate and urban drift has led to an increase in urban growth. Urban growth can be referred to as the rate of growth of an urban population or a growth that makes intensive use of land for the location of buildings and impermeable surfaces (Oyeleye, 2013). It was estimated that one third of the world's population lived in cities in 1976 and 30 years later (2006), this rose to one-half of the entire humankind and by the target for the millennium development goals (MDG's), cities in the world are estimated to grow to two third which is, 6 billion people by 2050 (Tibajuka, 2006 and UN-Habitat, 2006). This implies that, as the population continues to increase, more natural vegetation would be destroyed because of man's quest for space for developmental activities. IITA (2010) reported that a total of 350,000-400,000 ha of vegetation is lost in Nigeria with 3.5% rate of deforestation yearly. IITA (2010) further unveils that between 1990 and 2005 alone, the world lost 3.3% of its forests while Nigeria lost 21%. This indicates that loss of vegetation is not peculiar to Nigeria alone, but a global issue.

Harrison (1993) also maintained that rapid urban growth has resulted in many environment problems leading to loss of vegetation in the urban fringe. Agadagba (2002), reported that, as population increases, more lands are cleared for farming, building of houses, road construction and less is left to forest or fallow. Omisore et al (2003) and Ogunleye (2005) share the view that loss of Vegetation to Spatial growth does not have effect on Agriculture land alone but also on habitat and species and that rapid urban growth has brought about degradation of the Physical Urban environment which exists in the nature of loss of biodiversity and agricultural land.

This rapid population growth has resulted in the loss of forestland and land resources. Urban growth has outpaced adequate housing, livelihood, roads, transport, water, sanitation, waste disposal and health services. These problems have forced people to settle on urban fringes thereby clearing forests for buildings and construction works (Harrison, 1993). All these problems mentioned are evident in Minna the Niger State Capital where increase in anthropogenic activities such as bush burning, increase in construction activities, and indiscriminate waste disposal have led to the alteration of the vegetal cover.

Urban growth has led to the outward expansion of cities and this expansion in turn has led to the conversion of vegetation into other uses. Against this background, the paper aims at examining the effects of urban growth on vegetal cover in Minna, Niger State from 1990 to 2013using Remote Sensing. This is because, over the years, remote sensing has proven more effective in assessing and monitoring the changes in vegetal cover.Itprovides a unique opportunity to assess and monitor the effects of urban growth on vegetal cover over a long period of timeand also provides complimentary information to field survey (FAO, 2007).

Focus of the research:

- To determine the type of land uses in Minna;
- To assess the trend of growth between 1990 - 2013;
- To examine the implications of the growth on Vegetal cover;
- To calculate the NDVI of Minna for the period under study.

Study Area

Minna, Niger State capital is located between latitudes 9°36'N - 9° 37' N and longitudes 6° 30'E - 6° 34'E (Fifure 1), on geographical base of undifferentiated basement complex rock of mainly quiets and magnetite situated at the base of prominent hills in an undulating plain. Between these two hills paid and

Minna Gwari hills run the valley of the Suka River which only flows duri raining season. The whole of Minna surrounding is very rocky. The typic climate of the middle belt zone of Nigeria is a good reflection of Minn climate, with rain season settling in around April and last till October wi mean annual rains of 1334mm inSeptember, recording the highest in Marc at 300mm.

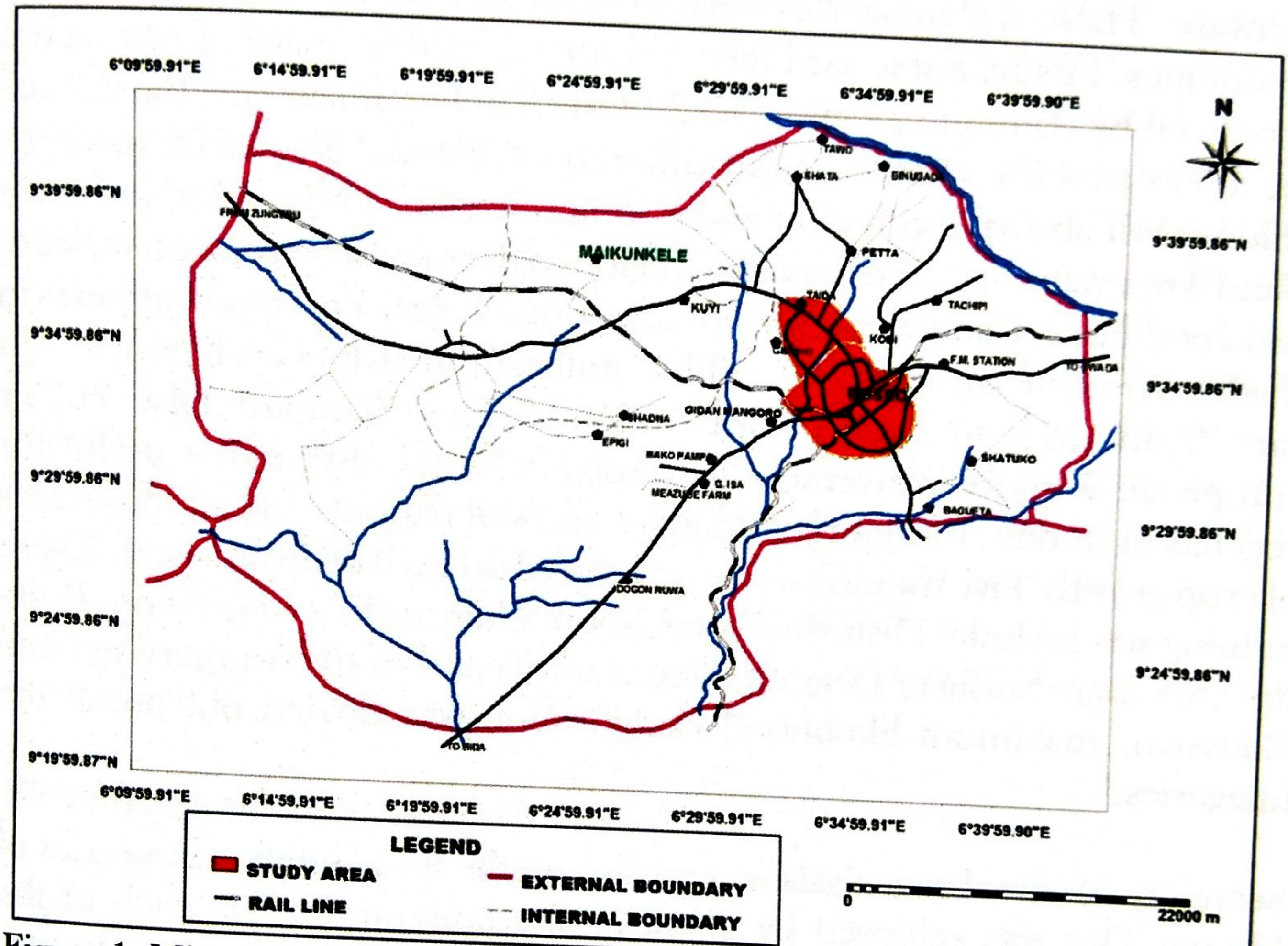

Figure 1: Minna in local context
Source: Department of urban and Regional planning, FUTMINNA

Methodology

Since this study involves change detection, that is, a form of temporal study that requires the use of imageries taken at different times; three sets of satellite imagery for Minna for 1990, 2000 and 2013 was used. The 1990 and 2000 are the American Landsat series of Thematic Mapper and the Enhance Thematic Mapper respectively, while the 2013 image is the Nigeria sat-X. The American Landsat series were obtained from Global Land Cover

Facility while the Nigeria sat-X was obtained from the National Centre for Remote Sensing, Jos Plateau State. The imageries were captured on path 189 and row 53.

Post-Processing

The imageries captured on path 189 and row 53 were "sub-mapped" using ILWIS (Integrated Land Water Information System) Academic 3.3 software. These raw imageries were subjected to various image processing techniques. Firstly, a standard false colour composite image of Minna was produced by combining bands 4,3,2 of the Satellite imageries. Band 2 has the ability to sense water turbidity differences, Band 3 is sensitive to strong chlorophyll absorption region and strong reflectance region for soil while Band 4 operates in the best spectral region to distinguish vegetation varieties and conditions. Using this band combination (4,3,2), Vegetation appears in shades of red, urban areas in cyan blue, water surfaces appears blue and soils vary from dark to light browns colours. This Standard false colour composite is more convenient to resolve with the eye and is useful for vegetation studies, monitoring drainage and soil patterns and various stages of crop growth. Five training sets were created on each of the imagery. These training sets include: Disturbed Vegetation, Undisturbed Vegetation, Built-up Area, Bare Surface/ Degraded Land and Water Body. A supervised (full Gaussian) maximum likelihood classification was carried out on all the imageries.

Secondly, an overlay analysis was carried on the three satellite imageries of Minna. This was achieved by digitizing the built-up area on each of the imageries (i.e, imageries for 1990, 2000 and 2013). The digitized feature were converted to polygons and these polygons were then overlaid from the target year (2013) to the base year (1990). The overlay analysis shows the spatial trend of growth in Minna between 1990 and 2013. These tasks were performed using the Integrated Land Water and Information System software (ILWIS 3.3 academic). Thirdly, the normalized differential vegetation index was carried out on each of these imageries in order to ascertain the changes in vegetal loss. In calculating the NVDI, the near infrared (band 4) and the visible band (band 3) were used, this was done using the NDVI tool on the operation list by in-putting the Near Infrared Band and the Visible Band.

The Normalized Differential Vegetation Index (NDVI)

The Normalized Differential Vegetation Index (NDVI) is a simple numerical indicator that can be used to analyze remote sensing measurements, typically but not necessarily from a space platform, and assess whether the target being observed contains live green vegetation or not, (Kumar, 2010). NDVI, which is a combination of red and NIR reflectance measurements, is one of the most widely used vegetation indices in the world and has been used extensively as an indicator of the state of vegetation over many spatial and temporal resolutions. It is based on the difference between the maximum absorption of radiation in the red spectral band and the maximum reflection of radiation in the near-infrared spectral bands. The NDVI Values range between –1.0 and +1.0, but are usually positive for soil and vegetation. For bare soils alone, depending on composition and wetness, NDVI varies between 0.1 and 0.2 (Ghorbani et al, 2012)with 0 representing the approximate value of no vegetation.Musa et al. (2011) believes that Normalize Differential 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. In calculating the NDVI, this formula was used:

NDVI= (NIR-RED) / (NIR+RED).

The NDVI technique was adopted to assess vegetal cover loss in the study area during the period of study (1990 - 2013).

Findings and Discussion

A supervised (full Gaussian) maximum likelihood classification was implemented for the three imageries and the final classification products provide an overview of the major land use / land cover features of Minna for the year 1990, 2000 and 2013. Five categories of land use / land cover were identified; these are: Bare Surface/ Degraded Land, Built-up Area, Disturbed Vegetation, Undisturbed Vegetation and Water Body. Figures2 , 3 and 4 illustrates the Land Use/Land Cover of Minna for the year 1990, 2000 and 2013 where Bare Surface/ Degraded lands are represented with Gray colour, Built-up areas with Red colour, Water Bodies with Blue colour while Disturbed and Undisturbed Vegetation are represented with colour Green and Yellow respectively.

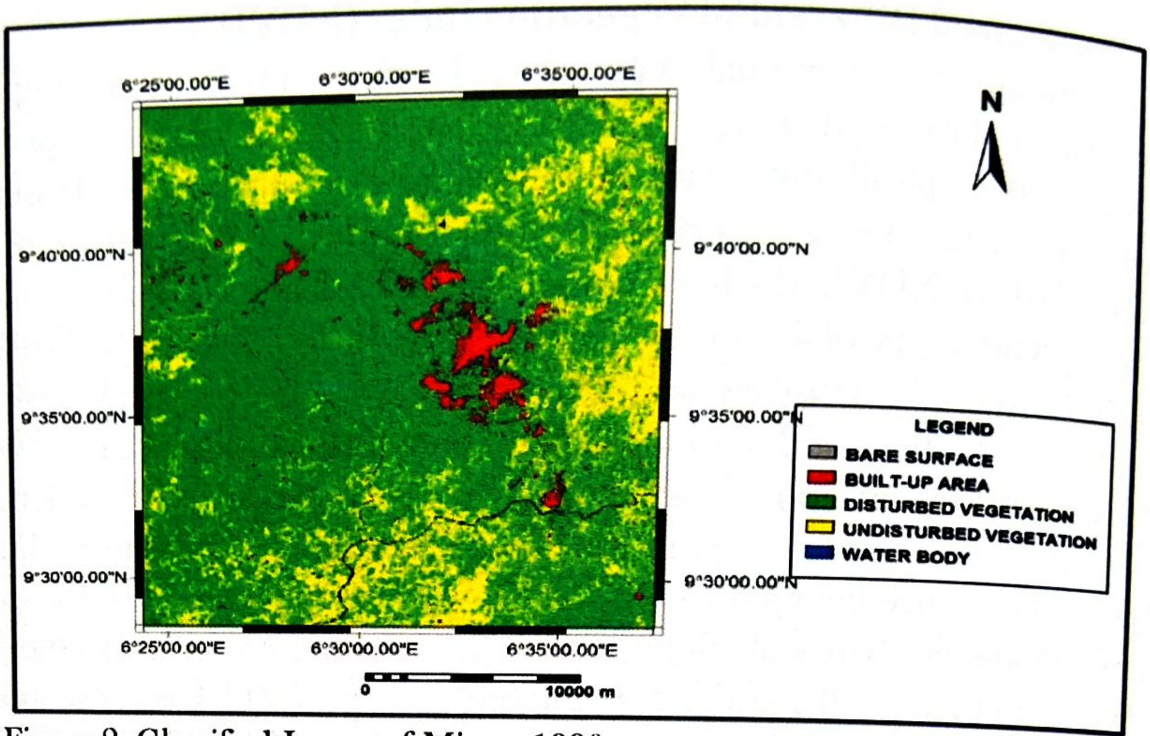

Figure 2: Classified Image of Minna 1990
Source: Author, 2014.

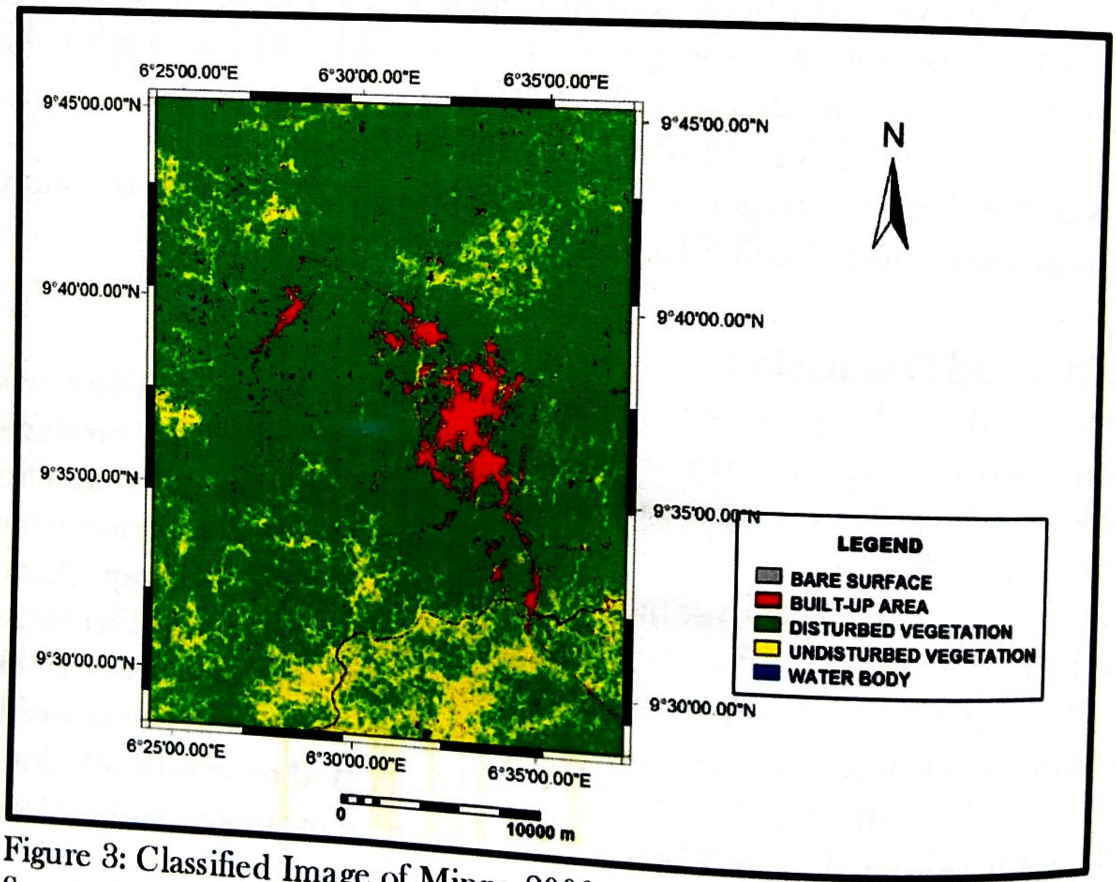

Figure 3: Classified Image of Minna 2000
Source: Author, 2014.

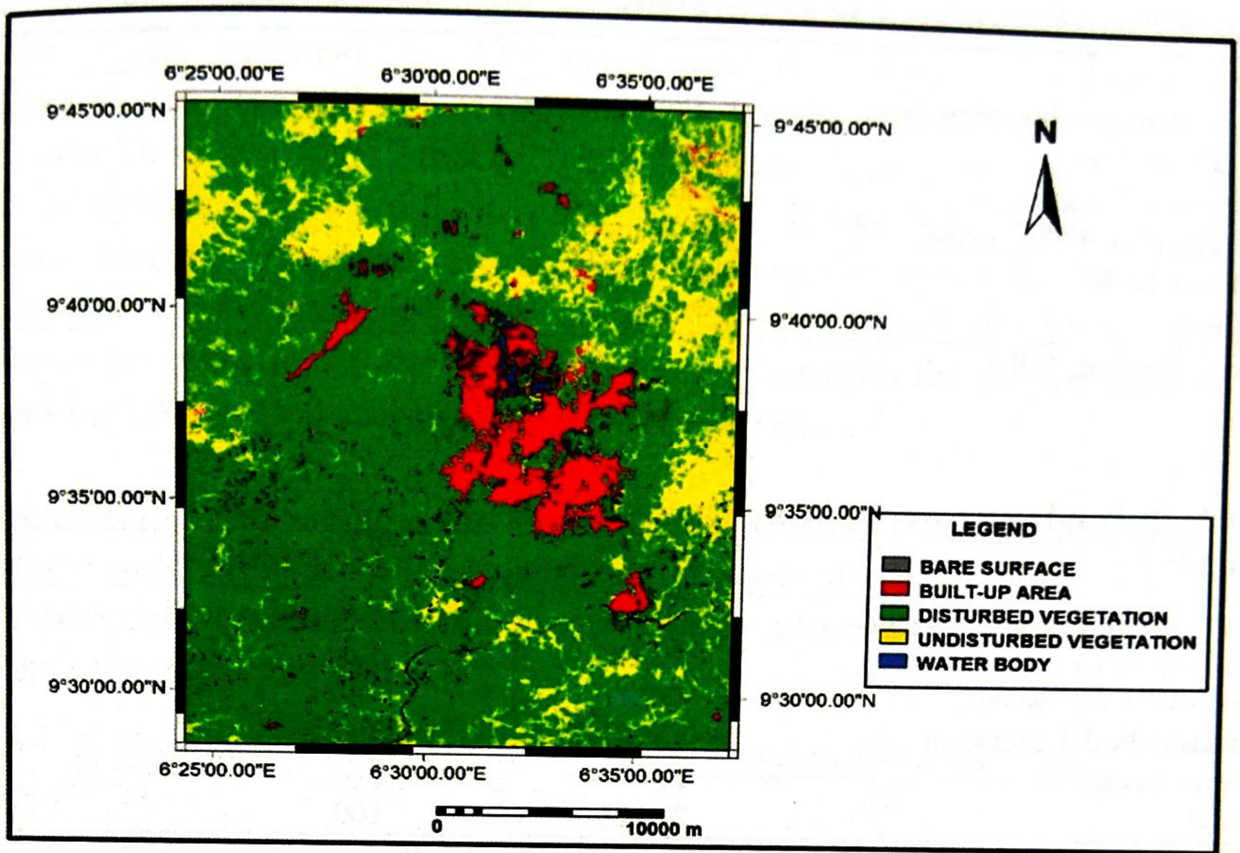

Figure 4: Classified Image of Minna 2013
Source: Author, 2014.

Table 1 shows that bare surface/ degraded area in 1990 was 8.98km^2(1.22%), the built-up area covers a total land area of 21.34km^2 (2.89%), this shows the spatial extent of the study area in 1990. Disturbed vegetation area was recorded as 428.12km^2 with a percentage of 58.01. Undisturbed vegetation and water body covers a land area of 277.53km2 and 2.01km2 respectively. The built-up area of Minna increased in 2000, with a spatial growth of 28.34km2. The spatial growth had a negative effect on the vegetal cover of Minna, 11.73km ^{2} (1.59%) and 459.16 km^2 (62.21%) were degraded and disturbed respectively in the said year (2000). The resultant effect of the degraded land/bare surface led to an increase in the size of the water body in the study area because most eroded points and mining points were turned into an artificial lake. Water body covered a land area of 12.87km^2 in the year 2000 (Table 2).

Table 1: Land use cover of Minna in 1990

Sample Set	Area (km^2)	Percentage (%)
Bare Surface/degraded land	8.98	1.22
Built-up Area	21.34	2.89
Disturbed vegetation	428.12	58.01
Undisturbed Vegetation	277.53	37.61
Water body	2.01	0.27
Total	737.98	100

Source: Author, 2014.

Table 2: Land use cover of Minna in 2000

Sample Set	Area (km^2)	Percentage (%)
Bare Surface/ degraded land	11.73	1.59
Built-up Area	28.34	3.83
Disturbed vegetation	459.16	62.21
Undisturbed Vegetation	225.99	30.62
Water body	12.87	1.74
Total	738.09	100

Source: Author, 2014.

Table 3 shows that the increase in spatial growth resulted to an increase in the area of disturbed vegetation. This implies that as the study area is expanding as more vegetal cover are being distorted. The built area covers a land area of 50.74km^2 as against the 28.34km^2 recorded in the year 2000 while disturbed vegetation has a total area of 499.23km^2. The bare surface/ degraded land also increased from 11.73km^2 in the year 2000 to 16.84km^2 in the year 2013, this increase can be attributed to the anthropogenic activities in Minna. There was also an increase in the size of water body from 12.87km^2 in 2000 to19.21km^2 in 2013. The land area of undisturbed vegetation also reduced from 225.99 km^2 in 2000 to 152.27km^2 in 2013.

Table 3: Land use cover of Minna in 2013

Sample Set	Area (km^2)	Percentage (%)
Bare Surface/degraded land	16.84	2.28
Built-up Area	50.74	6.87
Disturbed vegetation	499.23	67.64
Undisturbed Vegetation	152.27	20.63
Water body	19.21	2.60
Total	738.09	100

Source: Author, 2014.

Table 4 and Table 4.5 show the magnitude of change for 1990 - 2000 and 2000 - 2013 respectively. The magnitude of change is calculated by subtracting the area of each Sample set type for the year 1990 from 2000 and the year 2000 from 2013 that is, (B-A) absolute. The percentage of change (E) is calculated by dividing the magnitude of change (C) of each sample set by the figure of the base year then multiplying the result by 100. Annual frequency of change is gotten by dividing the magnitude of change of each sample set category by the number of years between the period that is, 10 years for 1990 - 2000 and 13 years for 2000 -2013.

The results of the analysis show a tremendous change in the Land cover of the study area during the 23 years period from 1990 - 2013. It was noted that the percentage change in the proportionsof some Sample sets increased while others decreased.

Table 4: Magnitude and percentage of change between 1990 and 2000.

Sample Set	A 1990	B 2000	C Magnitude of change (B-A) abs	D Annual Frequency of Change C/10	E Percentage of Change C/A x 100
Bare Surface	8.98	11.73	2.75	0.28	30.62
Degraded landed Built-up Area	21.34	28.34	7.00	10.00	32.80
Disturbed vegetation	428.12	459.16	31.04	3.10	7.25
Undisturbed Vegetation	277.53	225.99	-51.54	-5.15	-18.57
Water body	2.01	12.87	10.86	1.09	540.30
Total	737.98	738.09	0.11	9.32	-592.2

Source: Author, 2014.

Table 4 reveals that disturbed vegetation has a magnitude of change of 31.04km^2 between 1990 and 2000 with an annual frequency change of 3.10km^2. This annual frequency change implies that only 3.10km^2 of the vegetal cover are forested annually for the 10 years period (1990 - 2000). This period also shows a loss in vegetal cover, the percentage of change for undisturbed vegetation was -18.57 km^2 and the annual frequency of change was - 5.15km^2, this means that 5.15km^2 of vegetal cover are lost annually.

This decrease is attributed to increase in population, demand of land for farming, firewood demand and commercial purposes. Many houses were built and the process of road construction also led to the clearing of vegetal cover.

Table 5 shows a tremendous growth in built-up area with a percentage of change of 79.04km^2 with a magnitude of change of 22.40km^2 (2000-2013) as against 7.00km^2 recorded in 1990-2000. Within this period (2000 - 2013), 5.67 km^2 of vegetal cover is lost annually. Urban expansion (Figure 4) in the study area also gave rise to land degradation, bare surface/ degraded land recorded a magnitude of change of 5.11km^2 and an annual frequency of change of 0.39km^2. For the period under study, disturbed vegetated area showed an increase in coverage with a magnitude of change of 40.07km^2 between 2000 2013.

Table 5: Magnitude and Percentage of Change between 2000 and 2013

Sample Set	A 2000	B 2013	C Magnitude of change (A-B) abs	D Annual Frequency of Change C/13	E Percentage of Change C/A x 100
Bare Surface/ Degraded landed	11.73	16.84	5.11	0.39	43.56
Built-up Area	28.34	50.74	22.40	1.72	79.04
Disturbed vegetation	459.16	499.23	40.07	3.08	8.72
Undisturbed Vegetation	225.99	152.27	-73.72	- 5.67	-32.62
Water body	12.87	19.21	6.34	0.48	7.77
Total	738.09	738.09	0.2	0	106.47

Source: Author, 2014.

Figure 5 shows the spatial extent of Minna between 1990 and 2013. The overlay analysis indicate that Minna is expanding in three directions that is, in the northern direction, eastern direction and western direction. The expansion of Minna within the period under study can be attributed to increase in population.

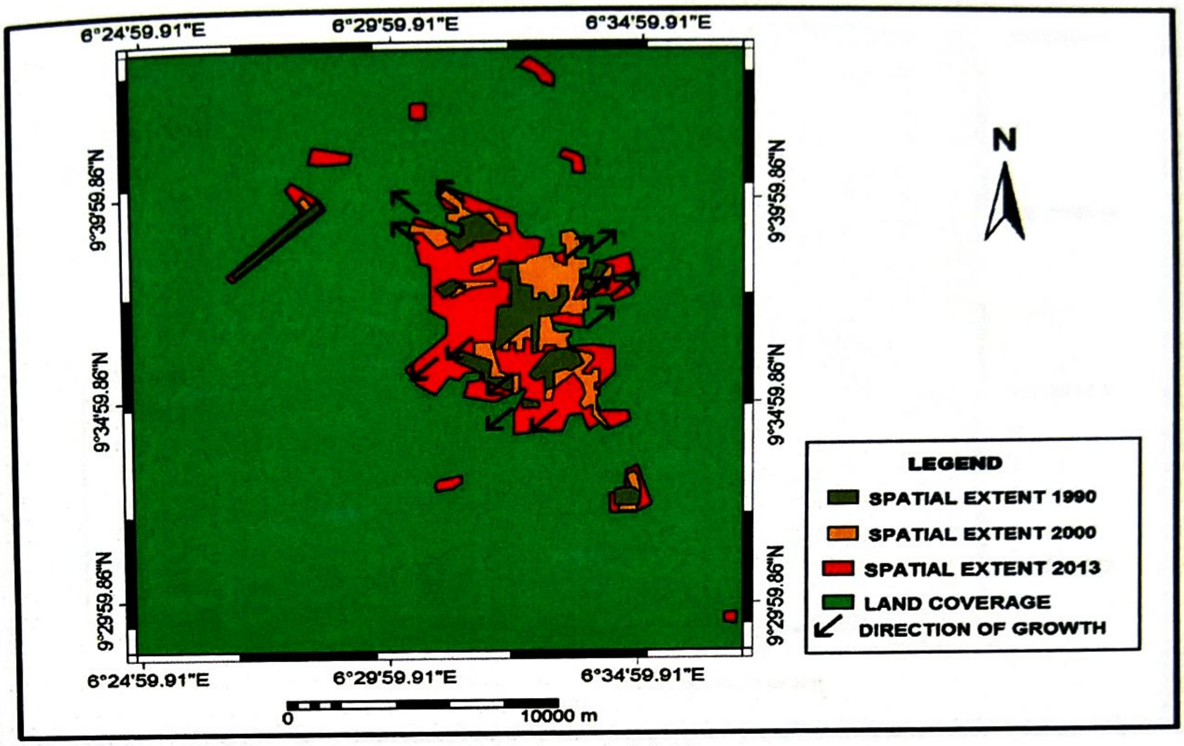

Figure 5: Spatial growth between 1990 and 2013
Source: Author, 2014.

In 1990, The non-vegetated surfaces range between -0.21 to -0.01, while the vegetated surfaces range from 0.01 to0.46 (Figure 6) indicating substantial level greenness in the study area for this period. There was a decline in vegetal cover in 2000 (ten years period) . The analysis shows that non- vegetated surfaces increases from the range of -0.21 to - 0.01 to -37 to - 0.1. This decrease can be attributed to bush burning, mining and high construction activities within the period. The vegetal cover within this period (2000) ranges from 0.01 to 0.43 showing level of substantial vegetation within the study area (Figure 7). In 2010, there was a drastic decline in vegetal cover with the non-vegetated cover ranging from -0.65 to - 0.1, at this period the built-up area increased and more lands were degraded (Figure 8). Decline noticed in vegetal cover in 2013 can also be attributed to high anthropogenic activities in Minna. The vegetated cover in this period (2013) ranges from 0.1 to 0.45 showing some substantial greenness.

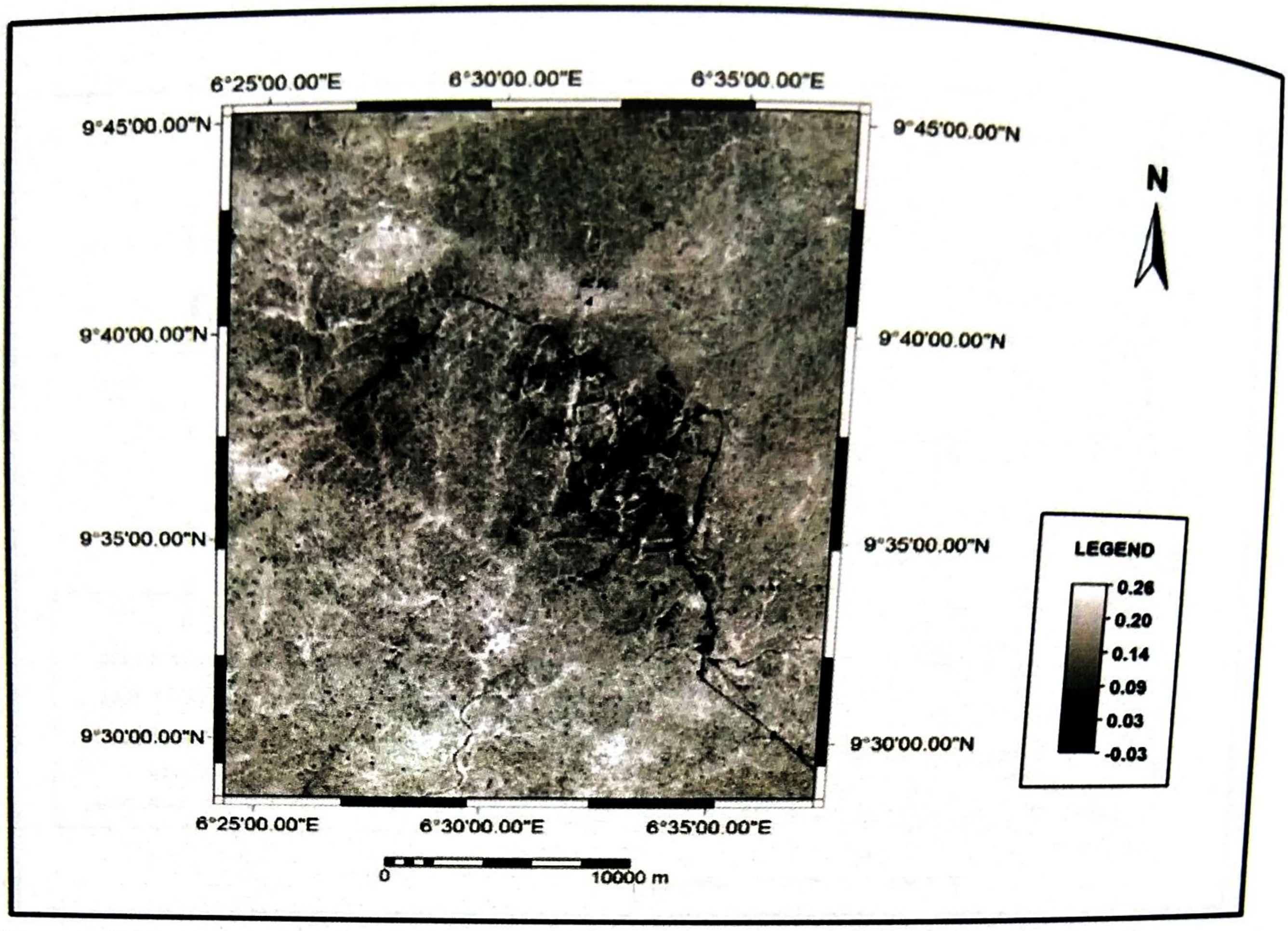

Figure 6: NDVI for Minna in 1990
Source: Author, 2014.

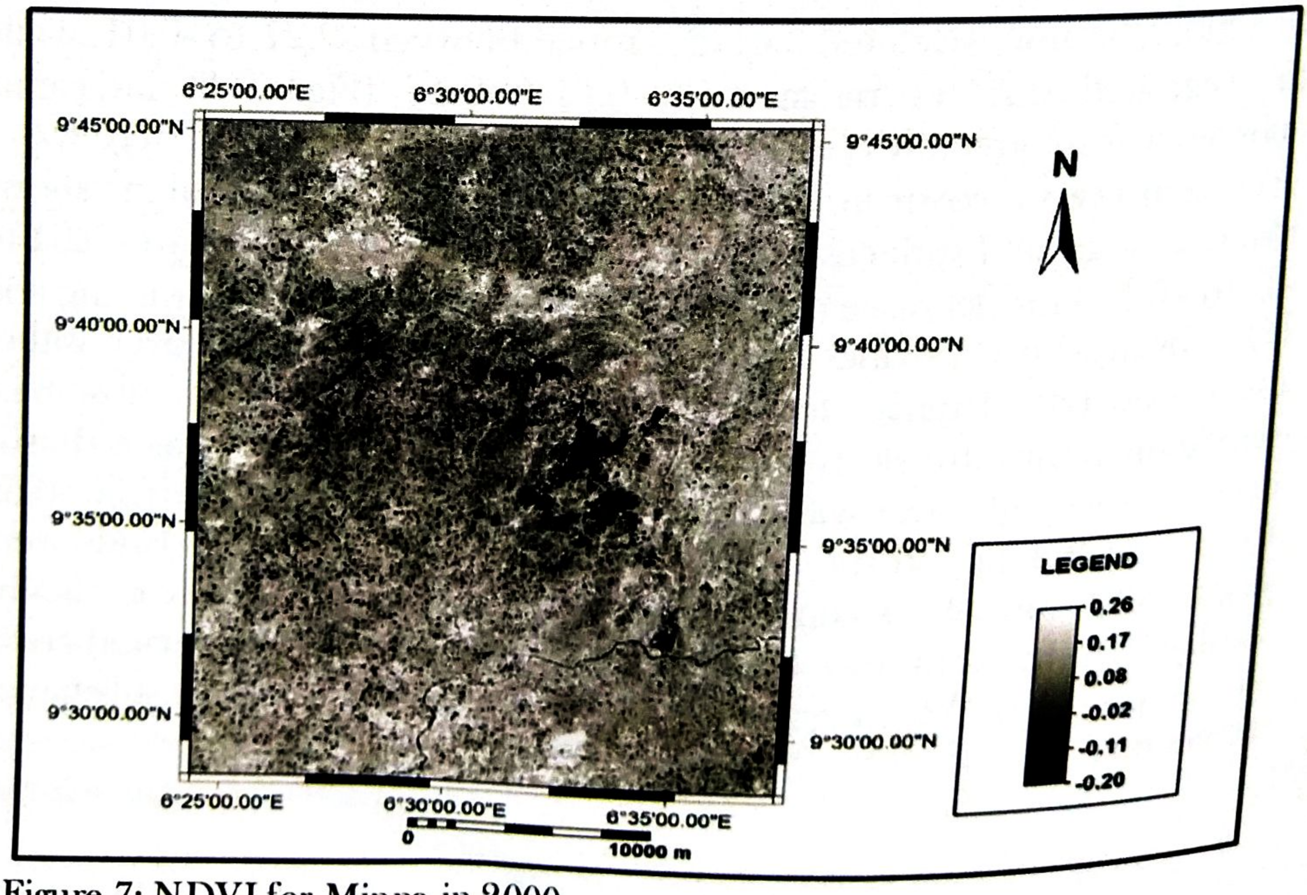

Figure 7: NDVI for Minna in 2000
Source: Author, 2014.

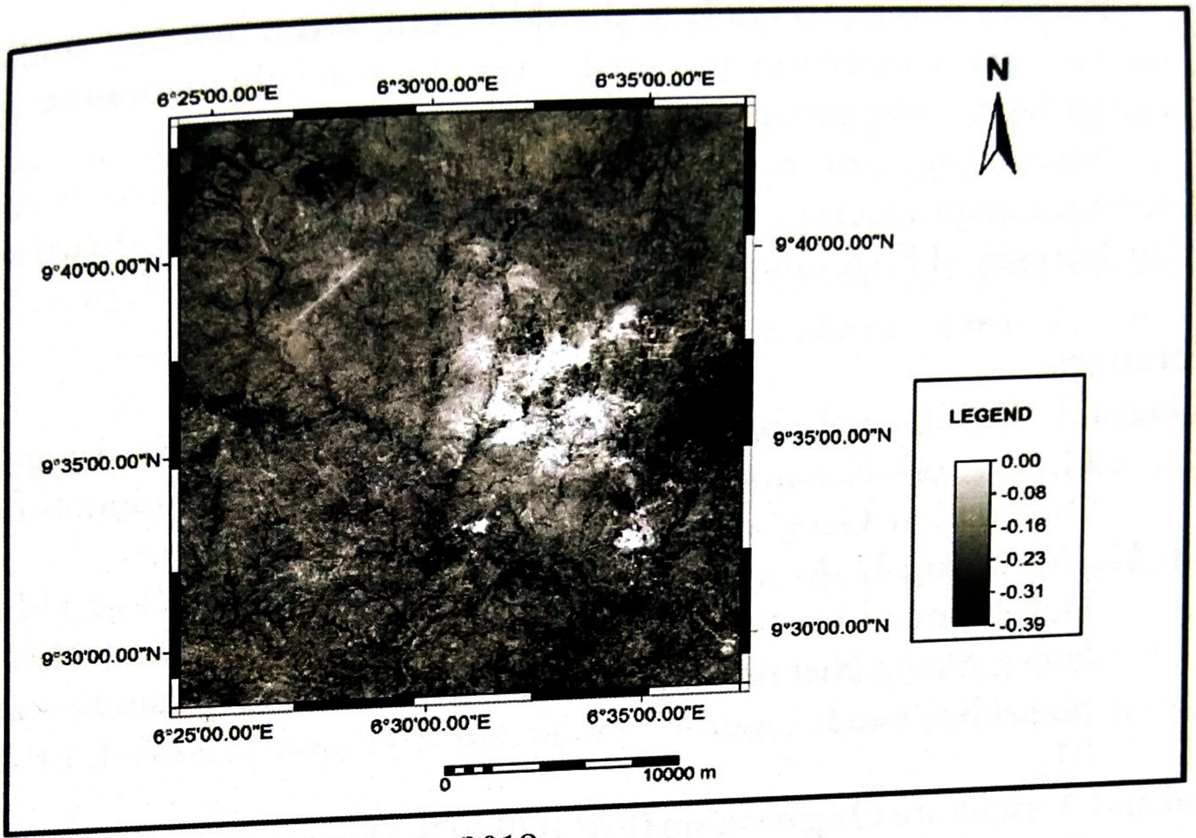

Figure 8: NDVI for Minna in 2013
Source: Author, 2014.

Conclusion

Urban growth has greatly affected the vegetal cover of Minna as large percentage of the Vegetal cover have been degraded as a result of increase in human activities such as road constructions, building constructions, mining, fuel wood consumption and bush burning. All these activities have stripped the vegetal cover off its nutrients there by exposing the surface soil required for agriculture to erosion. The study also shows that as the spatial extent of the study area is increasing, more arable land are being disturbed at an alarming rate mostly through bush burning.

Recommendations

The following are hereby recommended as ways forward in tackling the effects of spatial growth on vegetal cover in Minna.

- Strict measure and policy should be put in place in preserving forest reserves and the illicit act of bush burning should be checked by the government.
- The use of renewable energy such as biomass and solar should be ... to reduce the rate of fuel wood consumption.

- Remote sensing technology should be employed in major studies, such as change detection in vegetal cover, this will help to monitor and curtail the rate ofvegetal cover degradation.
- Niger State Government should procure appropriate remote sensing equipment for use in both the Urban Development Board and the Ministry of Environment as this will help conserve vegetal cover.

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