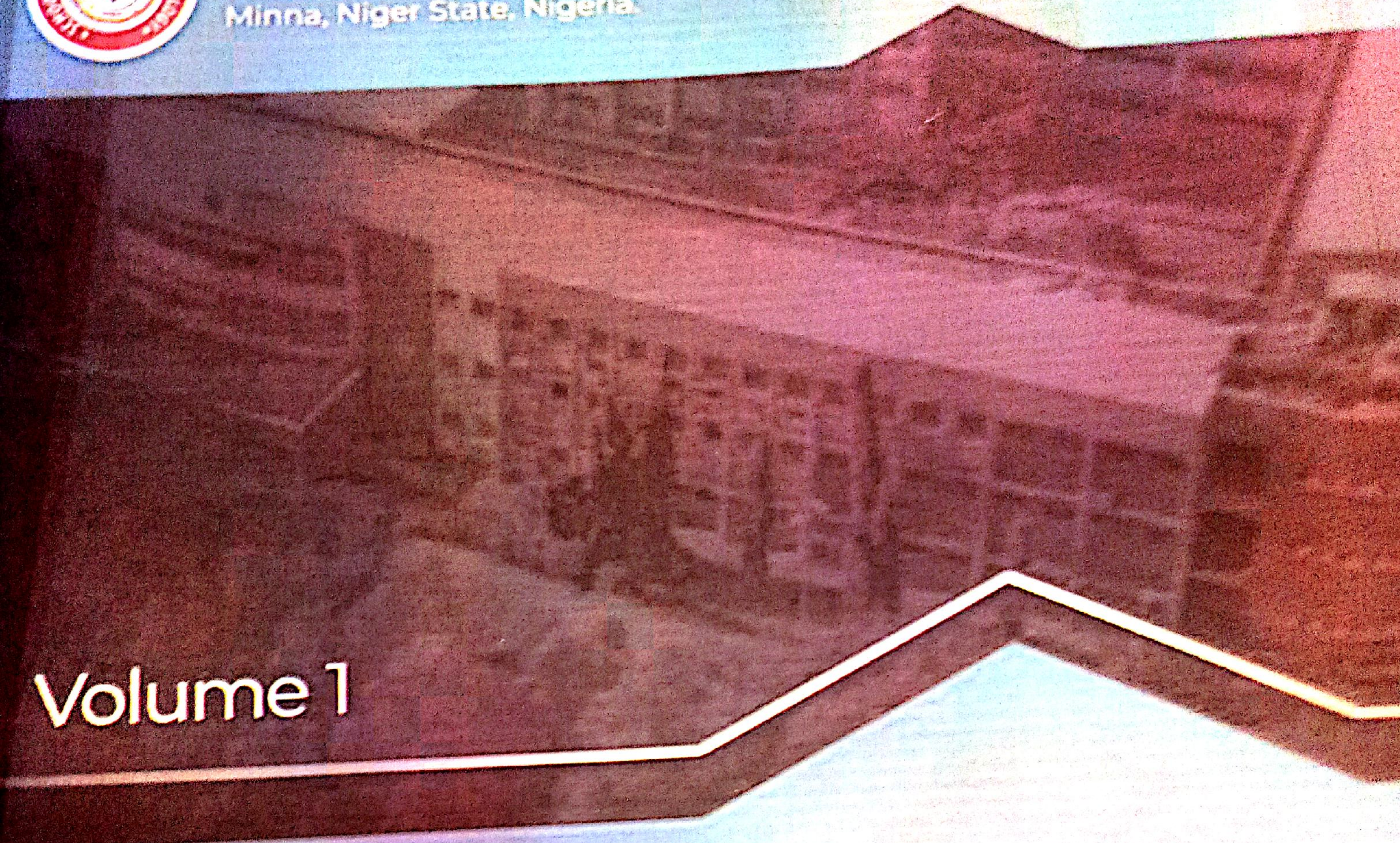
School of Environmental Technology
Federal University of Technology
Minna, Niger State, Nigeria.



Volume 1

PROCEEDINGS OF 5th SETIC 2024

Editors-in-Chief

Assoc. Prof. Dr Ogunbode, Ezekiel Babatunde

Proceedings of SCHOOL OF ENVIRONMENTAL TECHNOLOGY INTERNATIONAL CONFERENCE 2024 (SETIC 2024)

22nd – 24th October, 2024

Federal University of Technology, Minna, Niger State, Nigeria

EDITORS IN CHIEF

E. B. Ogunbode

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PREFACE

The School of Environmental Technology International Conference (SETIC 2024), organized by the School of Environmental Technology, Federal University of Technology Minna, Nigeria, is a prestigious platform that brings together experts from diverse fields to exchange knowledge and drive innovation. This year, the conference is held in collaboration with notable institutions, including the School of Architecture and Design, Lovely Professional University, New Delhi, India; Aboubakar Tafawa Balewa University (ATBU), Bauchi State, Nigeria; the Architectural Engineering Department, Najran University, Najran, Saudi Arabia; Perch Inc Development Consultancy Services, Zimbabwe; Faculty of Health Sciences, Graduate Education Institute, Istanbul Gelişim University, Istanbul, Turkey; Robotics & Additive Technologies Innovation Research Cluster, Transport & Communication Institute, Riga, Latvia; Architectural Engineering Department, College of Engineering, University of Hail, Hail, Saudi Arabia; New Gate University, Minna, Nigeria; and the University of Law Business School, Birmingham, United Kingdom, to mention a few.

This year's theme, "Global Economic Revolution and the Resilience of the Built Environment in an Emerging World," seeks to explore the dynamic relationship between global economic shifts and the adaptability of the built environment. The theme emphasizes the necessity for resilience, sustainability, and innovation in the face of unprecedented challenges and evolving economic landscapes. The sub-themes of the conference delve into crucial aspects such as sustainable design, technological integration, disaster management, and the role of policy in shaping future infrastructures.

The response to this year's conference has been both enthusiastic and far-reaching, with participants from a wide range of countries, including Latvia, India, Turkey, United Kingdom, Malaysia, Saudi Arabia, Zimbabwe, South Africa, and beyond. The hybrid nature of the event offering both virtual and physical participation has enabled an even broader exchange of ideas and perspectives. The conference serves as a vibrant platform for professionals, academics, and researchers to engage with cutting-edge developments in the built environment and related fields, fostering collaborations that will shape the future of global practice.

A wide range of papers, spanning science, engineering, and the social sciences, have been presented at this year's event, highlighting the interdisciplinary nature of challenges we face and the solutions to these challenges.

We would like to express our deep gratitude to the SETIC 2024 Conference

ACKNOWLEDGEMENT

The success of SETIC 2024 is built upon the foundation laid by the previous editions of the School of Environmental Technology International Conference held in 2016, 2018, 2020, and 2022. We owe a great deal to the unwavering support and commitment of many, particularly the Vice-Chancellor of the Federal University of Technology, Minna, and the Dean of the School of Environmental Technology, alongside Dr Dodo Y. A., Dr Ajayi O. G., Dr Moveh S., Dr Kayode I. Adenuga and other esteemed colleagues whose efforts has been instrumental to this success.

It is my privilege, on behalf of the Conference Organizing Committee (COC), to extend a big thank you to all that attended the 5th Biennial SETIC, held between October 22nd to 24th, 2024. We are grateful for the opportunity to witness this grand event, now enhanced by the hybrid format, accommodating both physical and virtual participation—an innovation born from the challenges of the global pandemic.

This year's conference had serves as an international platform where scholars, professionals, and practitioners in the built environment and allied fields converge to tackle critical issues around the theme "Global Economic Revolution and the Resilience of the Built Environment in an Emerging World." The conference offered an opportunity to share best practices, theories, and concepts, fostering meaningful discussions that can shape future research and industry practices.

We were honored to have our distinguished keynote and guest speakers:

Prof. Kamuzhanje Joseph, Perch Inc. Development Consultancy Servic Zimbabwe.

Prof. Bldr. Sani Usman Kunya, Acting Vice Chancellor, Abubakar Tafawa Bal University, Bauchi State, Nigeria.

Prof. Arc. Rajendra Kumah, Director of the School of Architecture and De Lovely Professional University, New Delhi, India.

Prof. Arc. Erekpitan Olá-Adisa, Department of Architecture, University o

Education In

Additionally, we extend our appreciation to the esteemed panelists that participated in the Round Table Talk on "Role of the Built Environment in Promoting Security Food Security (The Role of Building Integrated Agriculture [BIA]) in persons of Assoc. Prof. Dr. Habiba Atta (Nigeria), Assoc. Prof. Dr. Samuel Moveh (Latvia), LAr. Ts. Dr. Nurzuliza B. Jamirsah (Malaysia), Arch. Abdulmalik Aminu (Nigeria) and our amiable moderator, Asst Prof. Yakubu Aminu Dodo. The session with them on innovative architectural and urban design solutions for food security was insightful as it addresses pressing needs in the built environment.

With over 150 papers covering the twelve subthemes of the conference, SETIC 2024 was engaging and enriching experience. Through parallel sessions and poster presentations, participants had the chance to delve into key issues surrounding Global Economic Revolution and the Resilience of the Built Environment in an Emerging World. All attendees were believed to have made use of most of the discussions, collaborations, and networking opportunities available to them.

In closing, I would like to express my sincere gratitude to the Dean of the School of Environmental Technology, the Conference Organizing Committee (COC), and the entire School for their trust and support. To our reviewers and committee members, thank you for your dedication and hard work in making this event possible.

Wishing everyone the best and memorable experience as SETIC 2024 lives on in our heart.

Thank you, and God bless you all.

Assoc. Prof. Ogunbode E. B.
Chairman, Conference Organizing Committee
SETIC 2024

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22nd October 2024

TO WHOM IT MAY CONCERN,

This is to confirm that all papers included in the SETIC 2024 Conference Proceedings have undergone a rigorous peer review process. This process entailed an initial abstract review, followed by a blind review of the full papers by at least two independent referees. The reviewers' feedback was then communicated to the authors for revisions, after which the revised papers were thoroughly evaluated by the Scientific Committee to ensure they meet the highest standards of scholarly quality.

In accordance with the policy of the School of Environmental Technology International Conference (SETIC), only papers that have successfully passed this comprehensive review process and met the requisite criteria for academic integrity are accepted for publication in the conference proceedings. The final decision for publication is based on the recommendations of both the Reviewers and the Scientific Committee.

Selected papers from the conference proceedings will also be considered for publication in reputable academic journals.

Assoc. Prof. Ogunbode E. B.
Chairman, Conference Organizing Committee
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Impacts of Urbanization on Land Use and Land Cover namics in Chanchaga Local Government Area of Niger State, Nigeria

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stract
that urbanization is considered as one of the most significant anthropogenic alterations of the environmental framework.
increasing urbanization generally is brought about by many eco- environmental problems, such as the drastic change of
d use and development of the area. This study analyses the impacts of Urbanization on Land use and land cover dynamics in
nchaga, Niger State, Nigeria. From 1993 to 2023, these were done with the view to determining the effects of changes in
an growth on land use/cover of the area. The primary data were coordinates of geographic features within the study area,
lected through the use of global positioning system. The secondary data were Landsat imagery, Landsat TM/ETM & OLI
ageries for three epochs (1930, 2003, and 2023). Individual components (built-up, grassland, farmlands and surface water
dies). The results revealed that the study area has been growing to a relatively compact urban cluster area. The concentration
f built-up area at the western and the central part of Chanchaga which is study area has been getting larger and more
ggregated. Built-up area increased by 23.46% from 16.75 km2 (24.20%) in 1993 to 33 km2 (47.66%) in 2023 while grassland
decreased by 30.48% from 55.78% in 1993 to 25.30% in 2023. The land cover trend of the study area from the period of 1993-
2023 shows dramatic changes for the dominant land cover types. Findings show that uncontrolled developmental activities
ontribute significantly to environmental deterioration in the study area. Hence, there is need to implement and enforce
sustainable development methods, effective monitoring of urban growth activities through strict adherence to master plan of
the city.

Keywords: Urbanization, Land Use and Land Cover, Remote Sensing, Geographic Information System, Landsat image, OLI

1. Introduction

The Land use and land cover changes are directly related to urbanization, which include the replacement of nat
surfaces, such as vegetative cover, and porous surfaces, such as water bodies, with impervious surfaces like u
buildings constructed with warm concrete (Luo *et al.*, 2022). Factors driving LU/LC change include an increa
human population and population response to economic response. Despite the social and economic benefit of l
change, this conversion of LU/LC usually has an unintended consequence on the natural environment. For ex
LU/LC change has been shown to negatively impact on stream water quality/quantity and stream ecosystem
(Akinbobola, 2019). Changing LULC has also been shown to influence weather patterns and the genera
streamflow (Jande *et al.*, 2020). Developing countries are experiencing a significant population growth, partic
sub-Saharan Africa where the annual rate population growth exceeds 2 % (Dimnwobi *et al.*, 2021).
The knowledge of land use/land cover change is important to understand some occurrences in the earth's bi
ion of natural types of land to uses associated with the growth of popul
rious urban lands termed cities

ging as a key environmental issue and on a regional scale is one of the major research endeavors in global
es. These changes encompass the greatest environmental concerns of human populations today, including
ge, biodiversity loss and the pollution of water, soils and air. LULC change studies have resulted in diverse
ding the extensive modification of Earth's ecosystems. The impact of human activities is becoming more
ible in the natural environment. One of the most important and obvious areas of concern of these activities
ge.

esents changes in land use and land cover pattern between 1993 and 2023 for the study area. This study
nalysis of impacts of urbanization on land use and land cover dynamics in Chanchaga local government
tate, Nigeria through a geospatial approach so as to achieve these specific objectives:

Map the types and extent of LULC classes in the study area.

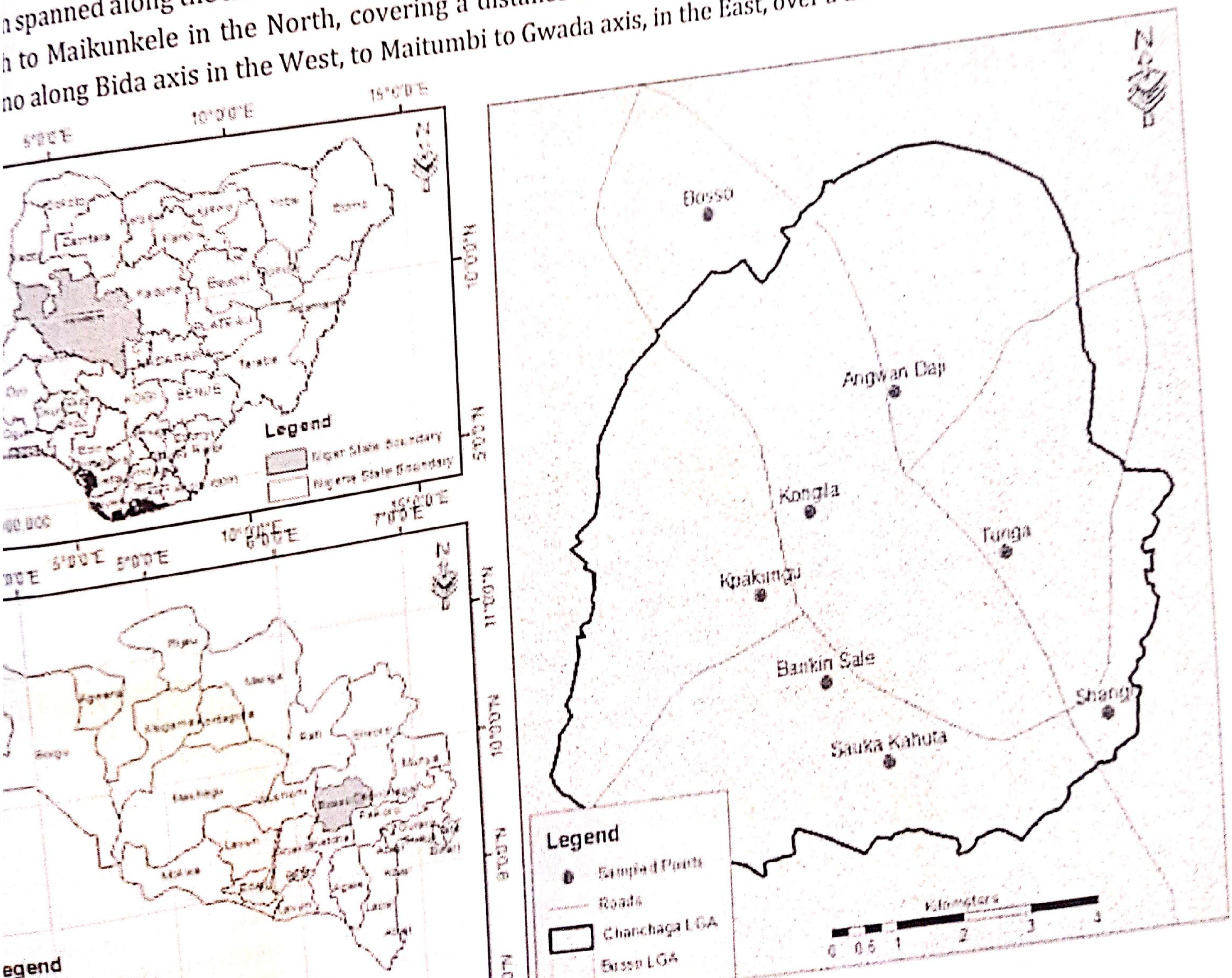
ii. Analyse the trend and rate of LULC changes between 1993 and 2023.

arch Methodology

y Area

tion of the Study Area

ated in Chanchaga which is the capital of Niger State. It is one of the twenty-five local government areas in with its headquarters in Minna with a land mass of 1,592 km² (Dalil *et al.*, 2015). Minna lies between 33' and 9°40' North of the Equator and Longitudes 6°29' and 6°35' East of the Greenwich Meridian (Figure n spanned along the main spine road that separates the city into West and East. This road is from Chanchaga h to Maikunkele in the North, covering a distance of about 20 km. The West-East pattern, spanned from no along Bida axis in the West, to Maitumbi to Gwada axis, in the East, over a distance of 15 km (Figure 1).



mapping shows the study area is underlain by granite and schist with granite occupying a greater portion. Specifically, three major soils types can be found in Bosso LGA. These include the Ferruginous tropical soils, hic soils, and ferrosols. Hydromorphic or waterlogged soils are largely found in the extensive flood plain of ain (Adeoye *et al.*, 2011).

ation is mainly guinea savanna which is characterized by grasses shrubs and trees. The study area lies within e belt of Nigeria which is a transitional zone between the rainforest of southern Nigeria and the guinea f northern Nigeria. This is characterized by tall grasses with light forest, evenly distributed trees along the er channel.

systems are pathways created naturally or artificially to address the increasing problems of diffuse sewage ff over an area. The run-off whether deliberate or accidental can be a major cause of flooding and polluted water in urban environment (Dalil *et al.*, 2015). Two kinds of drainage System are available in the entire Bosso e the artificial drainage system (constructed drainage system) and the natural drainage system (originated occurrence of erosion or flooding).

ta Requirement and Collection

a for this research was derived from primary and secondary sources. The primary data consist of first-hand ation and comprises personal observation, taking pictures; and taking of location of points using handheld Positioning System (GPS). The GPS was also used for ground trothing during image classification. The secondary nsists of Satellite Remote Sensing imageries. The Satellite imageries used included Landsat TM (1993 and 2003) perational Land Imager (OLI) (2023). The Landsat imagery dataset were downloaded from the United States gical Surveys (USGS) using the Earth explorer online platform.
eason images of the three data sets were acquired from January to March in order to reduce the effects of clouds are prevalent during the rainy season. Because the images are from the same season and comparable climatic itions, it enhanced the classification as the spectral reflection of most features are easily comparable across the rent images. In addition, high resolution Google earth images were used to aid in classification. Table 1 shows the mary of the characteristics of the satellite images.

le 1 Details of Satellite Data Used

/N	Sensor	Path / Row	Source	Year of Acquisition	Scale/ Resolution
	TM	189/053	Earth explorer	1993	30
2	ETM+	189/053	Earth explorer	2003	30
3	OLI	189/053		2023	30

ource: Author's Analysis, 2024

The tools used for carrying out the research were:

i. ArcGIS 10.2 used for pre-processing of images and vector data.
ii. Idrisi Selva, used for change detection analysis
iii. Google Earth Image, used to compliment image analysis
iv. Global Positioning System-This was used for classification and data validation

3. Mapping the types and extent of LULC cover classes in Chanchaga

This objective was achieved by examining Landsat TM of 1990, Landsat ETM+ of 2010 and Landsat OLI of 2020 images acquired and their subsequent classification. In order to map the types and extent of LULC classes, the data were subjected to these processing and analytical procedures.

i) **Data Pre-processing:** the Landsat images were pre-processed, so that inherent errors and formatting that are required for further direct processing of the data will be done. The downloaded Landsat images were in separate bands and need to be layer stacked. This is a process whereby different bands of an image are joined together to form a single multispectral image. Specifically, the three (3) satellite imageries of 1993, 2003) and Landsat OLI 2023) were corrected radiometrically through haze removal operations

ancement: Image enhancement is concerned with the alteration of images to make them more suited ... Irrespective of the extent of digital intervention, visual interpretation plays ... In order to improve visual quality and outloo ... among differe values that are associated with certain surface features. A band combination of 4, 3, 2 (for RGB) was ...e Landsat TM and ETM images and 5, 4, 3 for OLI images as this produced superior results. It is suitable ...application and delineating land, water and vegetation boundaries.

...ssification: A per-pixel image classification method for ground cover analysis was used through a ...d classification algorithm which is a procedure for categorizing spectrally similar areas on an image by ...g "training" sites of known targets and then generalizing those spectral signatures to other areas of ...hat are unknown (Hashem and Balakrishnan, 2015). It is a process of using samples whose identity is ...to categorize samples whose identity is unknown. A Maximum Likelihood algorithm of supervised ...ation was adopted because of the author's familiarity with the terrain. This method was chosen because it ...r to accomplish and more so, the large volume of images to be interpreted could not warrant the use of ...on-screen interpretations. The Maximum Likelihood is one of the most commonly used supervised ...ers, which uses the Gaussian threshold stored in each class signature to assign every pixel a class (Huang *et* ...09). Maximum Likelihood classification assumes that the probability distributions for the classes follow the ...l distribution model (Richards and Jia, 2006).

...ysis of the extent and rate of urbanization in the study Area

...nt of land use change was analysed by subtracting the reference year (2020) from the base year. It is ...ted mathematically as:

...= the base year (1993)

...=the reference year (2023)

...=total extent of forest land

...hange analysis by area calculation

...are three steps in calculating change detection by area calculation

...e first step is the calculation of the magnitude of change, which is derived by subtracting observed change of each ...d of years from the previous period of years.

...The second step was the calculation of the trends, that is, the percentage change of each of the land-use, by ...racting the percentage of the previous land-use from the recent land-use divided by the previous land-use and ...tiplied by 100 (B-A/Ax100).

...The last is the calculation of the annual rate of change by dividing the percentage change by 100 and multiplied by ...number of the study years, that is, 30 years (1993-2023).

. Results and Discussion

.1 Analysis of the various Land use/Land cover (1993, 2003 and 2023)

...The classification results for the LULC changes of the study area (Chanchaga) was presented using charts and figures ...for illustration and interpretation of all land use/land cover classes of the study area.

4.1.1 Land use and land cover Analysis of 1990 imagery

Figure 4.1 shows the landuse land cover (LULC) change map of the study area in 1990, it reveals that grassland which covers an area of 38.63 km² (55.78%) was the dominant land cover features on the study area. This can be found on every section of the map but more at the centres of the study area. This is followed by built up areas land cover features covering about 16.75km² (24.20%) of the area.

Most of the cultivated lands were located majorly at the south eastern and northern fringes. Similarly, on the other farmlands covers an area of 13.59km² (19.63%) at the base year located centrally and in other sections of the map areas while water bodies covers 0.27km² (0.39%). The total land area of the study area is 69.22km²

Landuse and landcover Analysis of 2003 imagery

...nd land cover (LULC) map of the study area for 2003, findings ...over categories. It was revealed that ... the second

...ds were located majorly at the southern eastern and northern fringes ...
...2020 indicating a reduction of 0.27%.

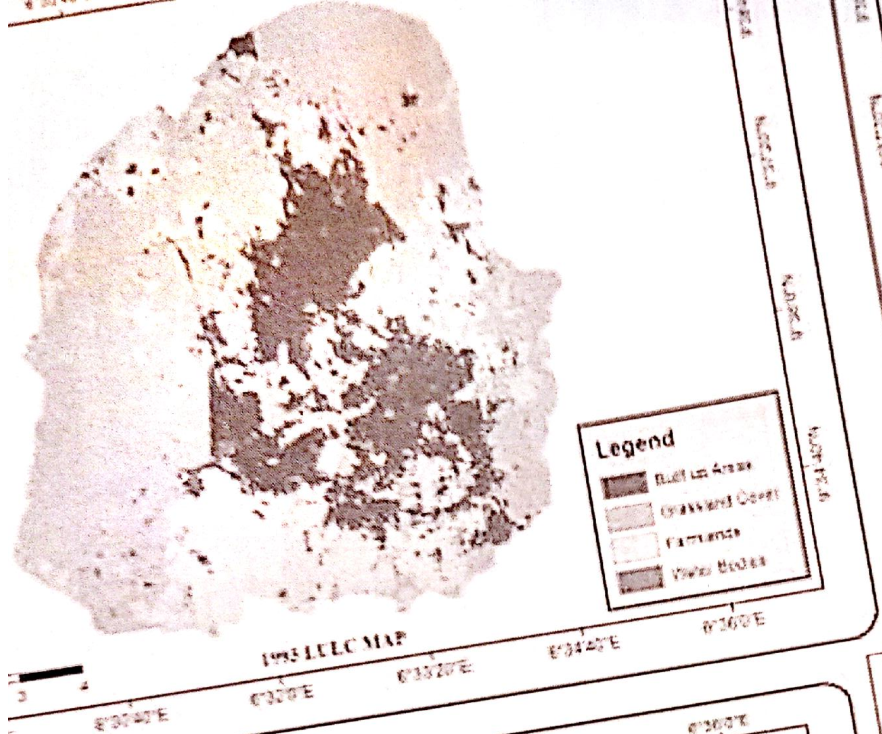
Landuse and landcover Analysis of 2023 imagery

...ows the result of the analysed landuse and land cover (LULC) map of the study area for 2023, findings ...hat there were more drastic changes among the various land use and cover categories most especially on ...eas. It reveals that built up areas continues to increase drastically from 20.00 km² (28.88%) in 2003 to 33.00 ...%) in 2023 indicating the most dominate land cover features. The increase in built up areas can be attributed ...that the area is the state capital, centre of economic and administrative activities as well as host to several ...ducational institutions.

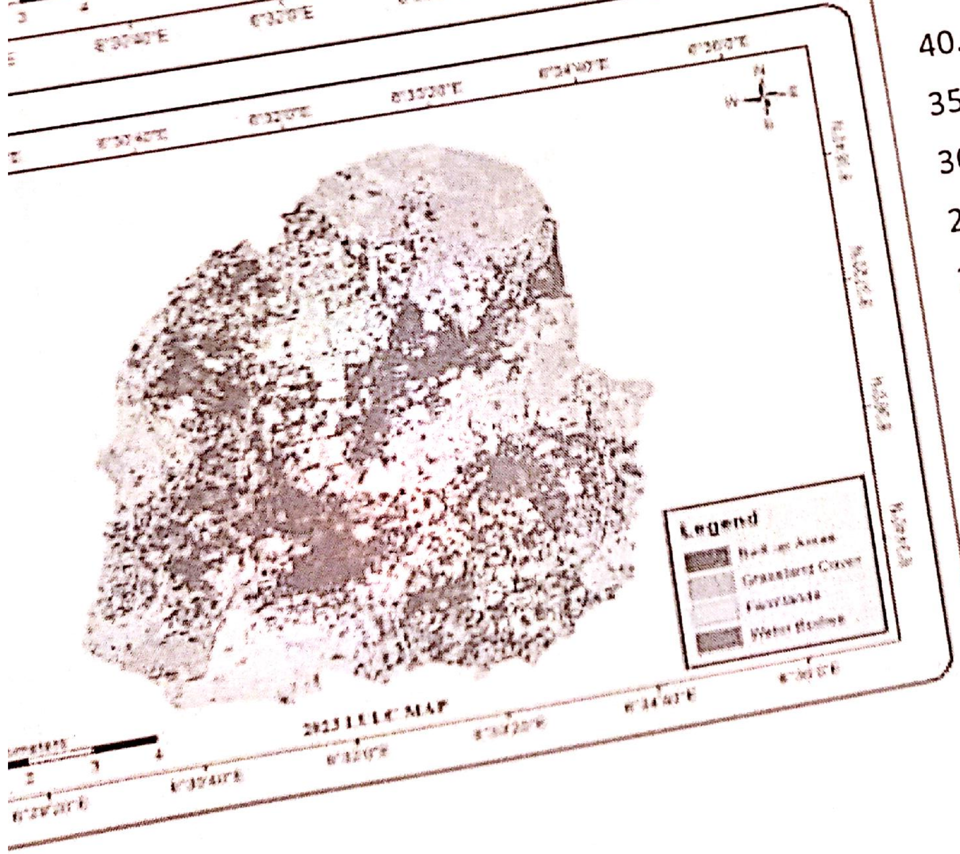
...owed by grassland cover covering an area of 26.09 km² (37.68%) in 2003 but reduce slightly to 17.52 km² ...) in 2023. Farmlands on the other hand covers an area of 23.08 km² (33.32%) in 2023 but reduction to 18.38 ...54%) in a 2023. Most of the farmlands were located parches at fringes areas. Finally, water bodies covers ...(0.50%) in 2020 indicating a reduction of 0.38%. The areal statistics for each of the land use and land cover ...es are summarised on table 4.1. Furthermore, figure 4.4 shows the land use and land cover trend chart for the ...rea.

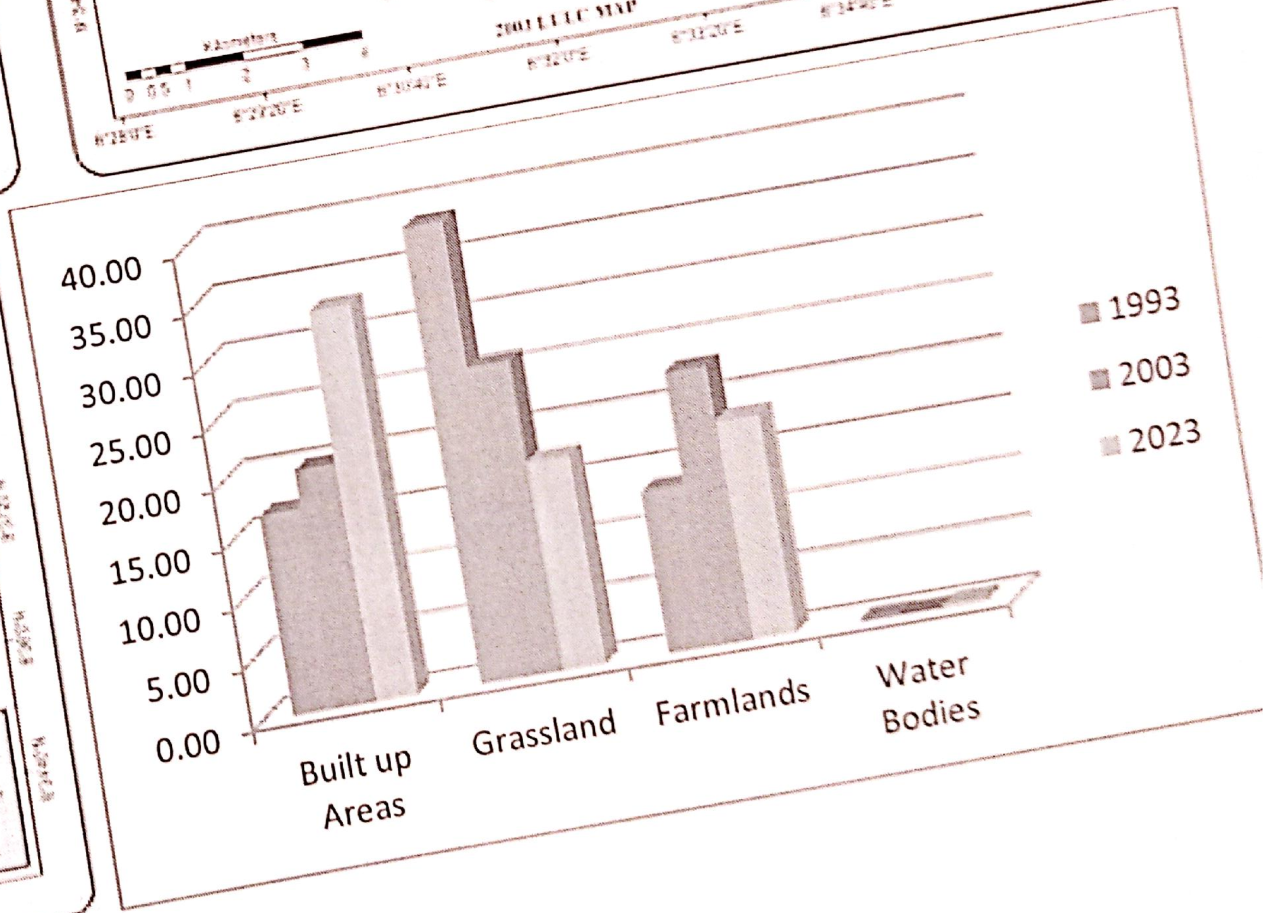
...: LULC Distribution between 1993 and 2023

...Cover	1993		2003		2023	
...gory	Area (km²)	Area (%)	Area (km²)	Area (%)	Area (km²)	Area (%)
...lt up Areas	16.75	24.20	20.00	28.88	33.00	47.66
...ssland	38.63	55.78	26.09	37.68	17.52	25.30
...mlands	13.59	19.63	23.08	33.32	18.38	26.54
...ter Bodies	0.27	0.39	0.08	0.12	0.35	0.50
...tal	**69.25**	**100.00**	**69.25**	**100.00**	**69.25**	**100.00**


Legend
Built up Areas
Grassland Cover
Farmlands
Water Bodies
1993 LULC MAP


Legend
Built up Areas
Grassland Cover
Farmlands
Water Bodies
2003 LULC MAP


Legend
Built up Areas
Grassland Cover
Farmlands
Water Bodies
2023 LULC MAP


40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Built up Areas
Grassland
Farmlands
Water Bodies
1993
2003
2023

...ude and Percentage of Change in Land Use/Landover between 1993 and 2003

...gnitude of change of built up area for 10 years between 1993 to 2003 shows that built up areas increased by ... representing a change (19.36%) of the total change for the period as shown on Table 3. farmlands has the ...st annual rates of change of 6.98% while water bodies has the least annual rate of change of -6.85%. The period ...itnessed a decrease in grassland. The grassland decreased by -3.24km² representing -32.44% of the total ...e.

...3: Magnitude and Percentage of Change in LULC between 1993 and 2003

...Class	1993 Extent (km²)	2003 Extent (km²)	Magnitude of Change (km²)	Percentage of Change	Annual Rate of Change %
...up Areas	16.75	20.00	3.24	19.36	1.94
...sland	38.63	26.09	-12.53	-32.44	-3.24
...lands	13.59	23.08	9.48	69.77	6.98
...r Bodies	0.27	0.08	-0.18	-68.46	-6.85

...itude and Percentage of Change in Land Use/Landover between 2003 and 2023

...agnitude of change of built up areas for 10 years between 2003 to 2023 shows that built up areas increased ...01km² representing a change (9.77%) of the total change with annual rate of change of 3.25% for the period ...wn on Table 4. Water bodies have one of the highest annual rates of change of 15.43% while farmlands has ...l rate of change of −1.02%. The period also witnessed a decrease in cultivated lands. The grassland decreased ...2.86km² representing -1.64% of the total change with annual rate of -1.64%.

...4: Magnitude and Percentage of Change in LULC between 2003 and 2023

...C Class	2003 Extent (km²)	2023Extent (km²)	Magnitude of Change (km²)	Percentage of Change	Annual Rate change (%...
...ilt up Areas	20.00	33.00	13.01	65.03	3.25
...assland	26.09	17.52	-8.58	-32.86	-1.64
...rmlands	23.08	18.38	-4.70	-20.37	-1.02
...ater Bodies	0.08	0.35	0.26	308.51	15.43

...gnitude and Percentage of Change in Land Use/Landover between 1993 and 2023

...e magnitude of change of the various land use and cover categories for 30 years between 1993 to 2023. Findings ...ows that built up has the highest annual rates of change of 3.23%. This is followed by farmlands which has the ...ghest annual gain of areas to build up and other categories at 1.17%. Water bodies has annual rate of change of ...96%. Grassland decreased by -21.11km² representing a change (-54.65%) of the total change with annual rate of ...hange of -1.82% for the period as shown on Table 5. The period also witnessed a decrease in cultivated lands.

Table 5: Magnitude and Percentage of Change in LULC between 1993 and 2023

LULC Class	1993 Extent (km²)	2023 Extent (km²)	Magnitude of Change (km²)	Percentage of Change	Annual R... Chang...
Built up Areas	16.75	33.00	16.25	96.99	3.2...
Grassland	38.63	17.52	-21.11	-54.65	-1....
Farmlands	13.59	18.38	4.78	35.19	1....
Water Bodies	0.27	0.35	0.08	28.86	0...

...lation ...tion of urban expansion and its impact on ...han LULC ch...

...atmospheric warming thereby controlling the microclimate of the area. Also, ...
...with physical planning and development regulations within the study area.

...es

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