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ASSESSMENT OF URBANIZATION IN AWKA TOWN, ANAMBRA STATE, NIGERIA, OVER A 32-YEAR PERIOD (1990 – 2022) USING REMOTE SENSING AND GIS APPLICATIONS.

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ABSTRACT

The nature of urbanization as evident in the case of Awka the Capital City of Anambra State, Nigeria cannot be over-emphasized. Although some scholars have studied the rate of urban growth in Awka in the past, but none had gone beyond year 2018. There is need therefore to get a more recent understanding of the nature of urbanization in Awka. This study seeks to assess urbanization within the Awka Town of Anambra State from year 1990 to 2022 with the objectives to assess the rate of urban growth for the last 32 years (1990 – 2022), ascertain the difference in areas, trend of change and the annual rate of change of the land cover/land use classes during this period. Satellite image collections were based on Landsat 5 Thematic Mapper (supervised classification of 1990, Landsat 7 Enhanced thematic Mapper Plus (supervised classification) of 1999 and 2008, Landsat 8 Operational land Imager (supervised classification) of 2017 and finally Sentinel-2 (supervised classification) of 2022. The Landsat images were analyzed using a classification scheme modified after that of Anderson (1967) that gave a broad classification where the land use was identified by a single digit. The land uses were classified into four categories – urban area, vegetation, open space and water body. The result showed that vegetation decreased from about 50.0% of the total area in 1990 to 40.08% in 2022. Open Space decreased from 12.82% in 1990 to 11.50% in 2022, while water body increased from 9.26% in 1990 to 9.96% in 2022. Urban area recorded the highest of change from 27.92% in 1990 to 38.45% in 2022. The study recommended, among other things, the strict enforcement of housing development plan and land-use zoning regulations by the Awka Capital Territory Development Authority (ACTDA) and adequate provision and efficient management of urban infrastructure.

Keywords: Urbanization, Land use, Land cover, Satellite imagery, Remote sensing

INTRODUCTION

1.1 Background to the Study

There are usually disparities in the nature and trend of development between rural and urban areas. These disparities in the areas of socio-cultural backgrounds, professions, socio-economy and population disparities are what differentiate a rural area from an urban area. Urban areas are usually characterized by certain developments such as commercial hub, places of employment, seat of government and several others which serve as pull factors drawing population into the urban areas. Also, the urban areas are usually equipped with infrastructure, public facilities as well as offered more job opportunities compared to the rural areas. This situation has attracted more people from rural areas to migrate and live in the city in order to get a job to improve their lives. This process is what gives rise to urbanization. Urbanization therefore refers to the population shift from rural to urban

areas, the corresponding decrease in the proportion of people living in rural areas, and the ways in which societies adapt to this change. It is predominantly the process by which towns and cities are formed and become larger as more people begin living and working in central areas. According to Kuddus, Tynan & McBryde (2020), urbanization refers to the mass movement of populations from rural to urban settings and the consequent physical changes to urban settings.

The urban land use change as a result of urbanization can proficiently be obtained from air and space borne Remote Sensing which makes it possible to acquire pre-and post-project land use data in consistent manner. Remote sensing satellite data in Multi-resolution and Multi-spectral provide spatial information for land use at different levels for various aspects as built-up land, vegetation, bare lands, tarred surfaces and water bodies etc. The use of Geographic Information System (GIS) has made it possible to integrate this Multi-source and Multi-date for the generation of changes detection in urban land use involving information such as the trend, rate and location of the changes (Gibson & Power, 2000; Abdulrahaman, 2014).

1.2 Statement of the Problem

Awka Town since its emergence as the capital city of Anambra State in 1991 has witnessed a tremendous urban growth which has caused spatial land use and land cover changes. The population census conducted by Nigeria Population Commission (NPC) in 1991, shows that Awka Town had a total population of about 50,225. This figure was projected to 76,000 in 2006 using the then growth rate of 2.8% which was further projected to the current year, 2023 using the current growth rate of 3.2% to a total figure of 129,830 (NPC Awka Office, 2023). This immense figure is mainly due to migration from rural to city in search of better quality of life generated by urban activities and services. However, an increase of urban population has forced Awka town to expand vertically or horizontally, encroaching into agricultural land and natural boundaries, and changing land use and land-cover without us realizing it. Population migration into cities brings about the expansion of urban centers. The expansion of urban areas does impact on the quality of the environment.

1.3 Aim and Objectives

This study aims at assessing urbanization in Awka Town over a 32-year period (1990 – 2022) with a view to determining the variation across the years.

This study intends to achieve its aim through the following objectives:

1. to assess the rate of urban growth for the last 32 years (1990 – 2022),
2. to ascertain the difference in areas and trend of change within that period, and
3. to determine the annual rate of change of the land cover/land use classes during this period.

1.4 Study Area

Awka is the administrative capital city of the new Anambra State. It lies between latitude 6°06 and 6°15'N and longitudes 7°0S°E and 7°15'E. It is majorly an annex of two Local Government Areas (Awka North and South) as

shown in figure below. Awka town is comprised of 33 villages. Awka as an administrative, commercial and educational town is a rapidly growing urban center with a large percentage of migrant settlers.

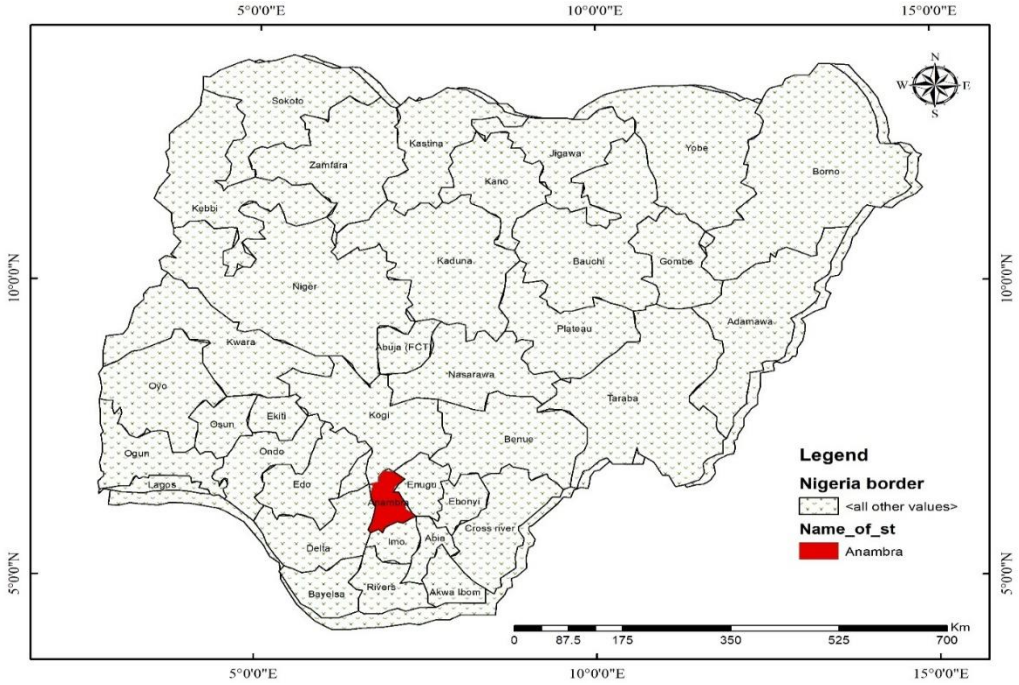


Fig 1.1: Map of Nigeria Showing Anambra State
Source: Cartographic Unit, Department of Surveying and Geoinformatics, NAU.

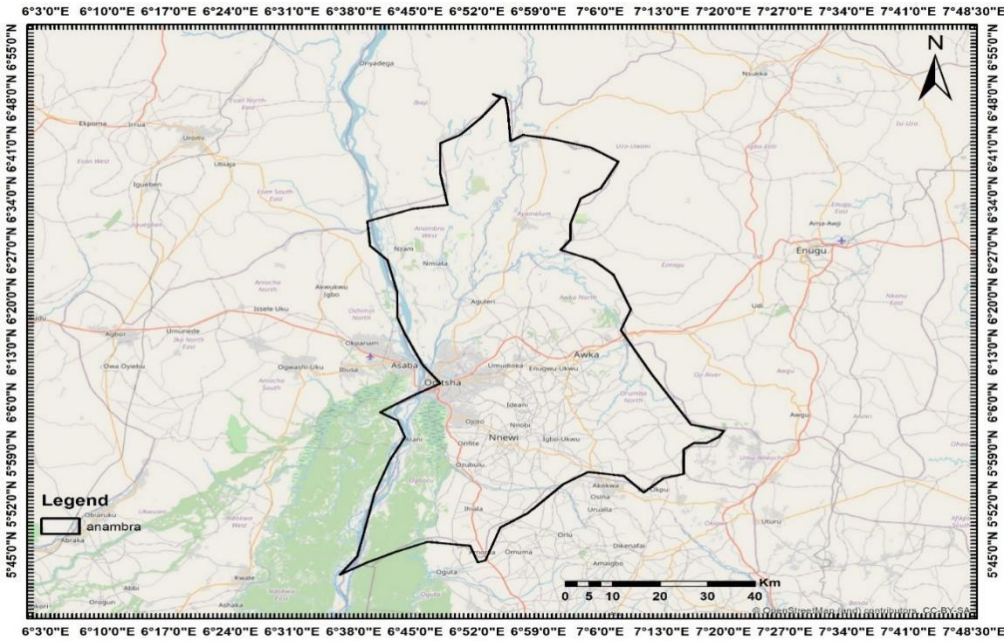


Fig 1.2: Map of Anambra State
Source: Cartographic Unit, Department of Surveying and Geoinformatics, NAU.

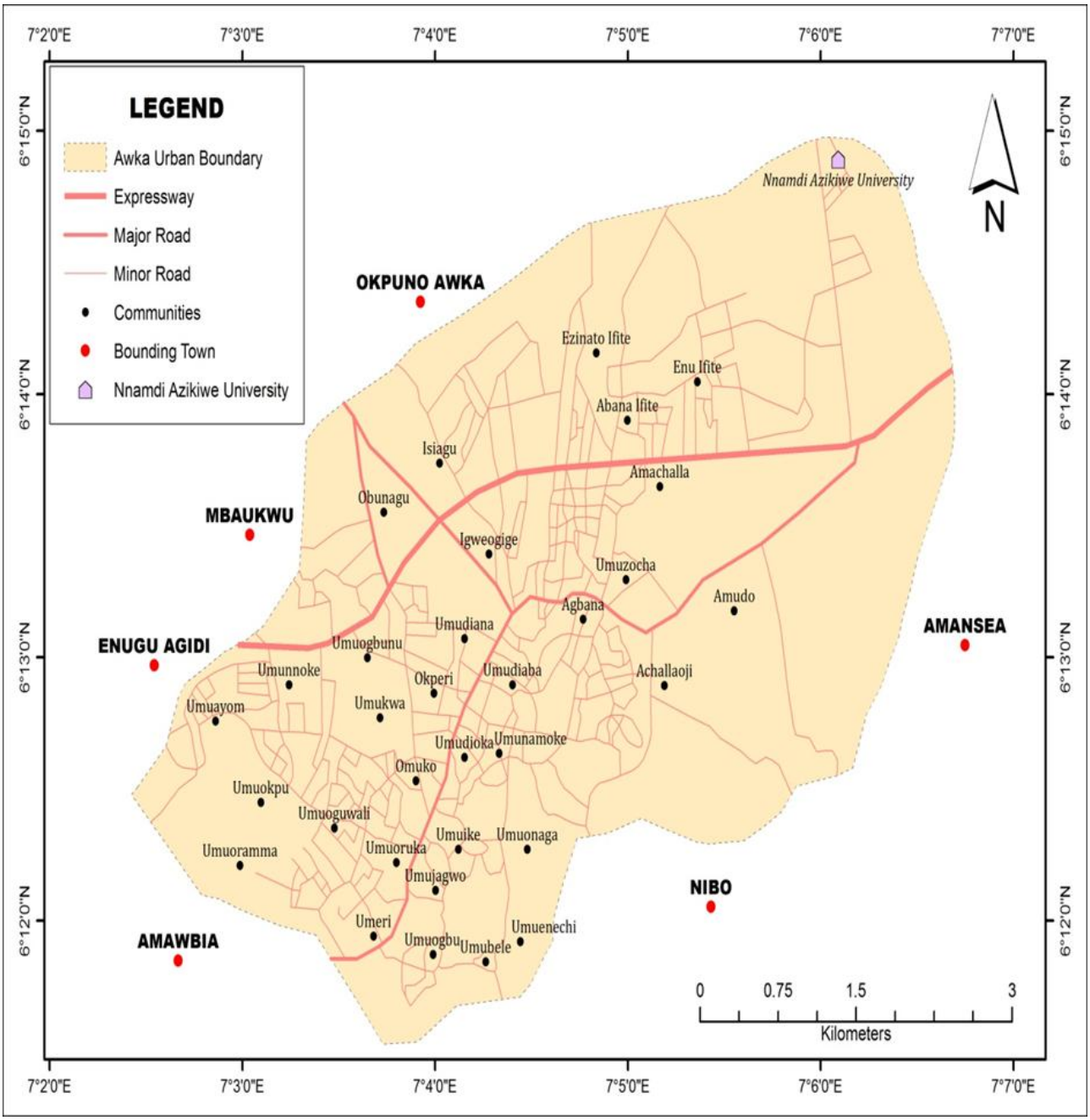


Fig 1.4: Map of Awka Town
Source: Cartographic Unit, Department of Surveying and Geoinformatics, NAU.

2.0 Literature Review

Urbanization is a recent phenomenon in human history and is unique to the past few centuries. Prior to 1600, the estimated share of the world population living in urban settings was less than 5 percent; after 1600, the number reached 7 percent in 1800, and 16 percent by 1900 (Ritchie & Roger, 2018). In 1950, the population living in urban areas was 30 percent, which increased to 55 percent by 2018. (United Nations, 2018). In 2050, it is

projected that 68 percent of the world's population will live in an urban setting (Ritchie & Roger, 2018; Birdsall, 2020). Also, it is predicted that by 2050 about 64% of the developing world and 86% of the developed world will be urbanized. That is equivalent to approximately 3 billion urbanites by 2050, much of which will occur in Africa and Asia (Wikipedia, 2023). Notably, the United Nations has also recently projected that nearly all global population growth from 2017 to 2030 will be by cities, with about 1.1 billion new urbanites over the next 10 years.

According to Abdulrahaman (2014), urbanization can be traced to the industrial revolution era, when workers moved towards manufacturing hubs in cities to obtain jobs in factories as agricultural jobs became less common. Urbanization is therefore the outcome of social, economic and political developments that lead to urban concentration and growth of large cities, changes in land use and transformation from rural to metropolitan pattern of organization and governance. However, as urbanization continues to take place, sporadic changes in different land uses of the urban area is witnessed. Land uses are different uses or purposes to which land is put which ranges from commercial, residential, institutional, agricultural, industrial, transportation, recreational, green spaces, waste disposal and so on.

In a study by Chunwate *et al.* (2019), it was revealed that Awka metropolis witnessed a remarkable growth between 1986 and 2016 from mere 3444.48 Km^2 in 1986 to about 11,452.46 Km^2 in 2016. The growth contributed to the sharp decline in farmland from 19.13% in 1986 to 13.60% in 2000 and further declined to 10.01% in 2016. Bare surfaces witnessed an increase over the years of the study. This increase is as a result of clearing of natural vegetation for urban development, thereby exposing the land to direct contact with rainfall, leading to gully erosion in the area. Light vegetation also witnessed a sharp decreased from 38.53% in 1986 to 8.53% in 2000. It further decreased 8.53% to 4.62% in 2016. They therefore concluded that increase in population led to the increase in urban sprawl in the study area. Similarly, Igbokwe *et al.,* (2020) in their study had found out that urban area in Awka grew from 27.92% in 1990 to 37.24% in 2017. And their prediction of the future urban development dynamics of Awka Capital Territory in 2048 revealed that urban areas is expected to increase to 49.41% i.e. from area coverage of 17798.44 hectares to 22871.51 hectares. In addition, Ojiakor *et al*. (2018) had also confirmed that for the years between 1995 - 2016, Awka had undergone extensive land use change. According to their research, the built-up area in the city had grown from 13,693.85 hectares in 1995 to 16,993.58 hectares in 2005 and to 22,653.83hectares in 2016.

However, despite the availability of past studies in this subject, none had covered more recent years beyond 2018. There is therefore the need to understand the current rate and trend of urbanization in Awka Town so as to inform relevant stakeholders on the appropriate urban and infrastructural management policies to put in place.

3.0 Materials and Methods

Materials

Global Positioning System (GPS) device was used to obtain the coordinates (Longitudes and Latitudes) of the study area.

Satellite image collection was based on 1990 Landsat 5 TM (supervised classification), 1999 Landsat 7 ETM+ (supervised classification), 2008 Landsat 7 ETM+ (supervised classification), 2017 Landsat 8 OLI (supervised classification), and 2022 Sentinel-2 (supervised classification).

Methods

Coordinates of the study area was collected with the use of Ground Positioning System (GPS). This was achieved by opening Google Map on my computer, Right-clicking the place on the map. This opened a pop-up window. The latitude and longitude of the study area was traced in degrees, minutes and seconds format at the top. By left-clicking on the latitudes and longitudes differently, the coordinates were copied automatically. Remotely Sensed data were acquired. Remote sensing data refers to the information collected from various sources such as u and aircraft to study social phenomena, land use dynamics, and changes in landscapes for scientific analysis and modeling purposes in the field of Computer Science. The remotely sensed data were acquired from the USGS Earth Explorer by simply navigating to the data portal https://earthexplorer.usgs.gov/, entering the area of interest (Awka Town) using the coordinates (Lat.6° 14' 15.23"N, Long. 7° 1' 36.38"E) and date range, and then downloading the desired Landsat image from the list of imageries available.

The images were processed with the use of computer having ArcGIS 10.1 software. The coordinates were obtained to locate the study area for both the Landsat and high-resolution image, in order to acquire accurate location point on the remote sensed data for the research work. The coordinates picked from the field were imported into ArcMap as a shapefile and converted to KML with a saving location. The images were geometrically corrected to Universal Transverse Mercator (UTM) coordinate system using the coordinates of the study area that was obtained. The satellite imageries were geo-referenced using the coordinate system WGS 1984 UTM Zone 32N where the study area falls into. This was done by importing the image one after the other into ArcMap 10.1, including the coordinates of the study area that was obtained from GPS which was stored in notepad to ease the process of geo referencing.

Method of Data Analysis

Maximum Likelihood Classification was based on the prior knowledge of the study area and with additional information from previous research in the study area, a classification scheme was developed for the study area after Anderson (1976). The classification scheme developed gave a rather broad classification where the land use was identified by a single digit. The classification scheme given in the table below is a modification of Anderson (1976).

Table 2.1 Land-use/land-cover classification scheme

CODE	LAND-USE / LAND-COVER CATEGORIES
1	Urban Area

2	Vegetation
3	Open Space
4	Water Body

Calculation of the area in hectares of the resulting land use types for each study was generated: The comparison of the land use statistics assists in identifying the percentage change, trend and rate of change were determined. Percentage change to determine the trend of change was calculated by dividing observed change by sum of changes multiplied by 100. In obtaining annual rate of change, the percentage change was divided by 100 and multiplied by the number of study year.

(Trend) percentage change $= \frac{\text{Observed Change X 100}}{Sum\ of\ Change}$

4.0 Presentation and Discussion of Findings

Landcover/landuse mapping of Awka and its Environs in 1990

The landcover/landuse distribution in 1990 for Awka and its surrounding areas, as depicted in figure 3.1 and table 3.1, reveals that vegetation dominated the landscape, encompassing approximately 50% of the total land area, which equates to around 23,144.9 hectares. The urban region accounted for 27.92% of the landcover/use, occupying an area of 12,922.45 hectares. Conversely, open space and water bodies constituted the smallest portions, comprising 12.82% (5,936.22 hectares) and 9.26% (4,286.22 hectares) respectively.

Table 3.1: Landcover/Landuse distribution for 1990

Class Name	Percentage (%)
Urban area	27.92
Vegetation	50.00
Open space	12.82
Water body	9.26
Total	100

Source: Researcher's Lab. Work, 2024.

To determine the precision of the classified images, an accuracy assessment was conducted by comparing the classified Landsat image with reference pixels of known landcover/landuse. The results of this assessment are presented in Table 3.2

Table 3.2: Accuracy assessment for 1990 Landsat 5 TM (supervised classification)

ACCURACY TOTALS						KAPPA (K^) STATISTICS
Class	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy	Kappa

Urban area	80	81	78	97.50%	96.30%	0.9461
Vegetation	73	69	67	91.78%	97.10%	0.9595
Open space	99	102	99	100.00%	97.06%	0.952
Water body	4	4	4	100.00%	100.00%	1
Totals	256	256	248			Overall K^ =
Overall Classification Accuracy = 96.88%						0.9534

Source: Researcher's Lab work, 2024.

Landcover/landuse mapping of Awka and its Environs in 1999

The landcover/landuse distribution of Awka and its surroundings in 1999, illustrated in table 3.3 and figure 3.2, revealed the following findings: Vegetation constituted the largest land cover/use, accounting for approximately 46.73% of the total area, equivalent to about 21,629.79 hectares. The urban area comprised 31.19% of the landcover/use, covering an area of 14,437.68 hectares. Conversely, open space and water bodies exhibited the lowest coverage, constituting 12.30% (5,693.72 hectares) and 9.78% (4,528.6 hectares) respectively.

Table 3.3: Landcover/Landuse distribution for 1999

Class Name	Area (Hectares)	Percentage (%)
Urban area	14437.68	31.19
Vegetation	21629.79	46.73
Open space	5693.72	12.30
Water body	4528.6	9.78
Total	46289.79	100

Source: Researcher's Lab. work, 2024.

Table 3.4: Accuracy assessment for 1999 Landsat 7 ETM+ (supervised classification)

ACCURACY TOTALS						KAPPA (K^) STATISTICS
Class	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy	Kappa
Urban area	187	184	181	96.79%	98.37%	0.9395

Vegetation	57	61	57	100.00%	93.44%	0.9156
Open space	9	7	6	66.67%	85.71%	0.8519
Water body	3	4	3	100.00%	75.00%	0.747
Totals	256	256	247			Overall K^ =
Overall Classification Accuracy = 96.48%						0.9164

Source: Researcher's Lab. work, 2024.

Landcover/landuse mapping of Awka and its Environs in 2008

The landcover/landuse distribution of Awka and its surrounding areas in 2008, as depicted in table 3.5 and figure 3.3, revealed the following observations: Vegetation represented the largest landcover/landuse category, accounting for approximately 44.47% of the total area, equivalent to around 20,583.59 hectares. The urban area constituted 33.67% of the landcover/landuse, covering an area of 15,586.73 hectares. On the other hand, water bodies and open spaces exhibited the lowest proportions, comprising 9.78% (4,529.8 hectares) and 12.07% (5,589.67 hectares) respectively.

Table 3.5: Landcover/Landuse distribution for 2008

Class Name	Area (Hectares)	Percentage (%)
Urban area	15586.73	33.67
Vegetation	20583.59	44.46
Open space	5589.67	12.07
Water body	4529.8	9.78
Total	46289.79	100

Source: Researcher's Lab. work, 2024.

Table 3.6: Accuracy assessment for 2008 Landsat 7 ETM+ (supervised classification)

ACCURACY TOTALS						KAPPA (K^) STATISTICS
Class	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy	Kappa
Urban area	87	85	82	94.25%	96.47%	0.9465
Vegetation	85	83	80	94.12%	96.39%	0.9459

Open space	72	76	72	100.00%	94.74%	0.9268
Water body	10	10	10	100.00%	100.00%	1
Totals	256	256	246			Overall K^ =
Overall Classification Accuracy = 96.09%						0.9437

Source: Researcher's Lab. work, 2024.

Landcover/landuse mapping of Awka and its Environs in 2017

The landcover/landuse distribution of Awka and its surrounding areas in 2017, as illustrated in table 3.7 and figure 3.4, showcased the following findings: Vegetation remained the dominant land cover/use category, constituting approximately 41.29% of the total area, which corresponds to around 19,115.32 hectares. The urban area accounted for 37.24% of the landcover/landuse, covering an area of 17,237.45 hectares. Water bodies and open spaces constituted 9.94% (4,601.35 hectares) and 11.54% (5,334.67 hectares) respectively, representing the lowest proportions.

Table 3.7: Landcover/Landuse distribution for 2017

Class Name	R	Percentage (%)
Urban area	17237.45	37.24
Vegetation	19115.32	41.29
Open space	5334.67	11.52
Water body	4602.35	9.94
Total	46289.79	100

Source: Researcher's Lab. work, 2024.

Table 3.8: Accuracy assessment for 2017 Landsat 8 OLI (supervised classification)

ACCURACY TOTALS						KAPPA (K^) STATISTICS
Class	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy	Kappa
Urban area	189	189	189	100.00%	100.00%	1

Vegeta-tion	22	22	21	95.45%	95.45%	0.9534
Open space	28	28	28	100.00%	100.00%	1
Water body	17	17	16	94.11%	94.11%	0.9601
Totals	256	256	254			Overall K^ =
Overall Classification Accuracy = 99.22%						0.9710

Source: Researcher's Lab. work, 2024.

Landcover/landuse mapping of Awka and its Environs in 2022

The landcover/landuse distribution of Awka and its surrounding areas in 2022, as presented in table 3.9 and figure 3.5, demonstrated the following outcomes: Vegetation remained the predominant landcover/landuse category, representing approximately 40.08% of the total area, which amounts to around 18,555.33 hectares. The urban area accounted for 38.45% of the landcover/landuse, covering an area of 17,798.44 hectares. Water bodies and open spaces constituted 9.96% (4,611.35 hectares) and 11.50% (5,324.67 hectares) respectively, forming the lowest proportions in the distribution.

Table 3.9: Landcover/Landuse distribution for 2022

Class Name	Area (Hectares)	Percentage (%)
Urban area	17798.44	38.450034
Vegetation	18555.33	40.085146
Open space	5324.67	11.502904
Water body	4611.35	9.961916
Total	46289.79	100

Source: Researcher's Lab. work, 2024.

Table 3.10: Accuracy assessment for 2022 Sentinel-2 (supervised classification)

ACCURACY TOTALS						KAPPA (K^) STATISTICS
Class	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy	Kappa
Urban area	111	111	110	99.10%	99.10%	0.9906
Vegetation	73	73	73	100.00%	100.00%	1
Open space	42	42	41	97.62%	97.62%	0.9789
Water body	30	30	30	100.00%	100.00%	1
Totals	256	256	254			Overall K^ =
Overall Classification Accuracy = 99.22%						0.9924

Source: Researcher's Lab. work, 2024.

Summary of landcover/landuse analysis of Awka and its Environs from 1990 to 2022

The summary of landcover/landuse analysis of Awka and its Environs is displayed in table 3.11 and summarily discussed below.

Table 3.11: Landcover/landuse distribution of Awka and its Environs from 1990 to 2022

Class Name	1990		1999		2008		2017		2022	
	Area	%	Area	%	Area	%	Area	%	Area	%
Urban area	12922.45	27.92	14437.68	31.19	15586.73	33.67	17237.45	37.24	17798.44	38.45
Vegetation	23144.9	50.00	21629.79	46.73	20583.59	44.46	19115.32	41.29	18555.33	40.08
Open space	5936.22	12.82	5693.72	12.30	5589.67	12.07	5334.67	11.52	5324.67	11.50
Water body	4286.22	9.26	4528.6	9.78	4529.8	9.78	4602.35	9.94	4611.35	9.96
Total	46289.79	100	46289.79	100	46289.79	100	46289.79	100	46289.79	100

Source: Researcher's Lab. work, 2024.

Difference in Area Between 1990 and 2022

Between 1990 and 2022, the total area of urban land increased gradually. The area for urban land was 27,360.13 hectares between 1990 and 1999, 30,024.41 hectares between 1999 and 2008, 32,824.18 hectares between 2008 and 2017, and 35,035.89 hectares between 2017 and 2020.

Conversely, the total area for vegetation showed a decline between 1990 and 2022. The area for vegetation was 44,774.69 hectares between 1990 and 1999, 42213.38 hectares between 1999 and 2008, 39698.91 hectares between 2008 and 2017, and 37,670.65 hectares between 2017 and 2022.

Similarly, the total area for open space exhibited a decline between 1990 and 2022. The area for open space was 11,629.94 hectares between 1990 and 1999, 11,283.39 hectares between 1990 and 2008, 10,924.34 hectares between 2008 and 2017, and 10,659.34 hectares between 2017 and 2022.

In contrast, the total area for water bodies showed an increase between 1990 and 2022. The area for water bodies was 8,814.82 hectares between 1990 and 1999, 9,058.4 hectares between 1990 and 2008, 9,132.15 hectares between 2008 and 2017, and 9,213.7 hectares between 2017 and 2022, as shown in table 3.12.

Table 3.12: Difference in area between 1990 and 2022

Class Name	Difference 1990-1999	Difference 1999-2008	Difference 2008-2017	Difference 2017-2022
Urban area	1515.23	1149.05	1650.72	-560.99
Vegetation	-1515.11	-1046.2	-1468.27	559.99
Open space	-242.5	-104.05	-255	10
Water body	242.38	1.2	72.55	-9

Source: Researcher's Lab. work, 2024.

Trend of Change

The trend of change for the different landcover/landuse types between 1990 and 2022 was analyzed. The trend of change for urban areas was 5.53% between 1990 and 1999, 3.83% between 1999 and 2008, 5.03% between 2008 and 2017, and 2% between 2017 and 2022.

For vegetation, the trend of change between 1990 and 2022 was -3.38% between 1990 and 1999, -2.48% between 1999 and 2008, -3.69% between 2008 and 2017, and 1.5% between 2017 and 2022.

The trend of change for open spaces between 1990 and 2022 was -2.085% between 1990 and 1999, -0.92% between 1999 and 2008, -2.33% between 2008 and 2017, and 0.09% between 2017 and 2022.

Lastly, the trend of change for water bodies was 2.75% between 1990 and 1999, 0.01%

between 1999 and 2008, 0.79% between 2008 and 2017, and -0.09% between 2017 and 2022. As shown in table 3.13.

Table 3.13: Trend of change between 1990 and 2022

Class Name	Trend of Change 1990 – 1999	Trend of Change 1999 - 2008	Trend of Change 2008 – 2017	Trend of Change 2017 – 2022
Urban area	5.53	3.82	5.02	2
Vegetation	-3.38	-2.47	-3.69	1.5
Open space	-2.08	-0.92	-2.33	0.09
Water body	2.74	0.01	0.79	-0.09

Annual Rate of Change

The annual rates of change between 1990 and 2022 for different land-cover/land-use types were analyzed. The annual rate of change for urban areas was 0.62% between 1990 and 1999, 0.43% between 1999 and 2008, 0.56% between 2008 and 2017, and 0.4% between 2017 and 2022.

In the case of vegetation, the annual growth rates were -0.37% between 1990 and 1999, -0.27% between 1999 and 2008, -0.41% between 2008 and 2017, and 0.3% between 2017 and 2022.

For open spaces, the annual rates of change were -0.23% between 1990 and 1999, -0.10% between 1990 and 2008, -0.25% between 2008 and 2017, and 0.018% between 2017 and 2022.

Regarding water bodies, the annual rates of change were 0.30% between 1990 and 1999, 0.001% between 1999 and 2008, 0.08% between 2008 and 2017, and -0.018% between 2017 and 2022. as shown in table 3.14.

Table 3.14: Annual rate of change between 1990 and 2022

Class Name	Annual Rate of change 1990 – 1999	Annual Rate of change 1999 – 2008	Annual Rate of change 2008 – 2017	Annual Rate of change 2017 – 2022
Urban area	0.61	0.42	0.55	0.4
Vegetation	-0.37	-0.27	-0.41	0.3
Open space	-0.23	-0.10	-0.25	0.018
Water body	0.30	0.001	0.08	-0.018

Source: Researcher's Lab. work, 2024.

DISCUSSION

The percentage of each category of land-use witnessed a great change most especially the urban area which increased steadily from 1990 to 2022. Similarly, the classification showed that vegetation decreased from about 23144.9 hectare (50.0%) in 1990 to an area of 18555.33 hectares (40.08%) in 2022. Open Space decreased from an area of 5936.22 hectares (12.82%) in 1990 to an area of 5324.67 hectares (11.50%) in 2022, while water body increased from 4286.22 hectares (9.26%) in 1990 to an area of 4611.35 hectares (9.96%) in 2022. Urban area recorded the highest of change from an area of 12922.45 hectares (27.92%) in 1990 to an area of 17798.44 hectares (38.45%) in 2022.

This finding is in agreement to the earlier study of Chunwate *et al.* (2019) where they had discovered that Awka metropolis had witnessed a remarkable growth between 1986 and 2016 from mere 3444.48 Km^2 in 1986 to about 11,452.46 Km^2 in 2016. Also, light vegetation witnessed a sharp decreased from (38.53%) in 1986 to (8.53%) in 2000. It further decreased (8.53%) to (4.62%) in 2016. Also, in their separate study, Igbokwe *et al.* (2019) had found out that in Awka, urban area grew from 27.92% to 31.19%, to an of area of 14437.68 hectares between 1990 and 1999, 31.19% to 33.67%, to an area of 15586.73 hectares between 1999 and 2008, and 33.67% to 37.24%, to an area of 17237.45 hectares between 2008 and 2017. Therefore, increase in population had continuously led to the increase in urban sprawl in the study area (Chunwate *et al.*, 2019).

Conclusion

Awka Town has witnessed a tremendous rural – urban migration from year 1990 to 2022. This has caused urbanization leading to spatial land use and land cover changes. The land use/ land cover analysis showed that both vegetation and open spaces decreased across the years, water bodies increased slightly while the urban area witnessed a tremendous increase across the years between 1990 to 2022.

Recommendation

Based on the findings of this study, the following recommendations are put forward:

1. Due to the high rate of urbanization in Awka, the Awka Capital Territory Development Authority (ACTDA), the Anambra State Physical Planning Board and the Anambra State Housing Development Authority should step-up their efforts in enforcing physical development plans and managing urban development.
2. Anambra State Government through the relevant agencies should ensure regular monitoring of urban sprawl and development in Awka Town especially with the aid of geospatial techniques for better decision making.
3. There is need for effective infrastructure provision and management to meet up with the demands of the current urban population.

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