Modelling Urban Green Spaces Depletion in Akure, Nigeria

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Abstract: The fast progress of urbanization and the accompanying dominance of concrete spaces over natural spaces are fundamental to current debates on urban planning and sustainable development in Nigeria and the world at large. It is worth noting that natural landscapes and greenery are critical to man's quality of life; yet, the majority of the population are going to reside in urban areas, to the detriment of urban green spaces, known as the "lungs of the city." A detailed account urban green spaces in Akure. Using Geographic Information System (GIS) and remote sensing techniques needs to be done. This study examines the status of urban green spaces in Akure, Nigeria to determine the rate of depletion and encroachment green spaces. The spatio-temporal analysis of green spaces in Akure was carried out between 1984 and 2022 using Supervised maximum likelihood classification procedure on Landsat 8 OLI/TIRS, Landsat 7 EMT+ and Landsat 4-5 TM Imageries. It took cognizance of attributes of vegetative cover at varying degrees such as Grasses and Shrubs, Light Vegetation, Secondary Vegetation, and Dense Vegetation. The rate of depletion of green areas, change statistic, socio-economic implication as well as planning implications were addressed. It is believed that assessing and analyzing its social, economic, and environmental impacts on urban inhabitants and their livelihoods would serve as a tool to educate and enlighten urban citizens about the need of including green space scheme into urban designs and planning in Akure.

Keywords: urbanization, green, spaces, depletion, sustainable, encroachment, landscapes

Received: November 25, 2022. Revised: August 21, 2023. Accepted: September 15, 2023. Published: November 7, 2023.

1. Introduction

Global urban discourse is of utmost concern as regards urbanization and its associated negative repercussions. With the majority of the world's population desiring to and yearning to live in cities, the trend of urbanization is accelerating at an alarming rate. The global urbanization trend is accelerating, with cities currently housing the majority of the world's population. Cities and their decision-makers face numerous complicated challenges today in balancing urban expansion and its environmental impact. Consequently, the demand for new infrastructure construction is expected to increase commensurately (Dreiseitl, Wanschura, Wörlen, Moldaschl, & Wescoat, 2016); in the view of this, land and space developments in cities have led to complex challenges that are associated with balancing the planning and sustainability of landuses (Enoguanbhor, 2021).

According to Liu et al. (2021), increased landuse development, particularly in urban areas, has resulted in a decrease in green spaces; construction of buildings, roads, transportation terminals, bridges, land reclamation, and concrete platforms are taking the place of greens (vegetation). Complex population changes, urbanization dynamics, climate change, and environmental degradation have all become important challenges that urban planners must address immediately. In a rising climate, urban environmental stresses are exacerbated by population growth and the induced development of structures such as grey infrastructure, which typically leaves limited space for green elements and processes (Sanjana, *et al.* 2019). The rate of green spaces depletion and the accelerated rate of encroachment of urban land use on the urban green remains a crucial subject matter to physical developments of urban areas. There is need to maintain a balance in the land use allocation and

planning as city grows and alters its urban ecosystems.

Omole et al (2018) pointed out that cities in developing nations like Nigeria are known with a common trait of uncoordinated development leading to urban sprawl and while urban centers are rapidly and haphazardly growing their spatial planning and management strategies remain largely underdeveloped (Omole, Enisan, Adeniran, & Adebisi, 2018). According to Olanrewaju and Oyinloye asserted that livability constitutes one of the failures of Nigeria urban centers and this is blamed on the "process of our development (Olanrewaju & Oyinloye, 2018). Rakhshandehroo *et al*., (2015) divulged that there is a rapid process of urbanization and subsequent domination of concrete spaces over natural spaces; since natural landscape and greenery are crucially important to our quality of life and the majority of the population are going to settle down in urban areas, urban open green spaces as the 'lungs of the city' should be at the center of the debate on any urban planning and sustainable development (Rakhshandehroo, Mohdyusof, Tahirholder, & Yunos, 2015). However, Owoeye & Ibitoye (2016) revealed that the existing Master plan of Akure was produced in 1980 and has become inactive, old, and superseded; they suggested that a review of the comprehensive regional plan to guide the development and spatial growth of the entire region (Owoeye & Ibitoye, 2016).

Urban Green spaces in Akure took a back seat and is seldom given required attention due to competing economic interests and demand on land for various purposes such as residential, commercial, industrial and institutional (Oyinloye, 2013). In the view of this, green spaces in the city suffer land availability, distribution, quantity, quality, accessibility, lack of intended purpose and stakeholder participation. In this study, green spaces are seen as publicly accessible and private green space, natural or incidental green space (remnants of native vegetation). Examples of these elements include grassed areas, rain gardens, trees, shrubs, gallery forest, parks and vegetated waters. The escalating depletion of urban green spaces is of global major concern; hence the need for policy makers and planners in emphasizing and adopting measures to restore green and natural spaces.

Liu, Xiu, & Song, (2019) opined that earth systems are urbanized at an unsustainable pace, ecosystems and biodiversity undergo large-scale destruction and human well-being is threatened (Liu, Xiu, & Song, 2019). Due to this phenomenon, urban areas are experiencing unprecedented challenges which are the resultant effects of urbanization progression; in this case Akure is no exception. The study aims to monitor the depletion of urban green spaces within Akure metropolis in order to enhance its preservation, conservation and effect management which is germane to livability, resilience and sustainability of an urban center; which is the core interest of this study. Thus, idea is critical towards ensuring the long-term sustainability of nature and people living in urban area and achieving the Sustainable Development Goals, especially Goal 11. This study also assesses the urban green spaces with a view of developing a model showing changing patterns of green depletion in Akure metropolis and determining the rate of green space depletion in the study area.

The specific objectives of this study are to:

a) assess the spatio-temporal pattern of green spaces in the study area between 1984 and 2022;
b) examine the rate of depletion of green spaces in the study area; and
c) ascertain the planning implications of green spaces depletion in Akure.

2. The Study Area

Akure is the study area of this research work. The spatio-temporal pattern of green spaces in Akure

metropolis covered a period of 38 years (between 1984 and 2022). 1984 was chosen as the base year for this study due to the availability of imagery in the archive (Landsat Images, United State Geologic Survey). Akure is a city situated in the south-western Nigeria, and is the largest city and capital of Ondo State. Akure is a city in Nigeria located on longitude 5.081 to 5.487 decimal degree and latitude 7.078 to 7.436 decimal degree, with a population of 360,268 persons in 2006 (National Population of Commission, NPC, 2006). The vegetation type of Akure is forest vegetation, which is categorized as: forests, Gallery forests and Forest reserves. In these forests, typical rain forest trees such as Mahogany, Obeche, Iroko, Afara, etc. are present and used for timber. Other economic trees include African pear, Bamboo, Raffia palm, Oil palm, Orange, Mango and Coconut. The persistent clearance of the vegetation in and around Akure has led to the development of derived forest around the town (Fadairo, 2008).

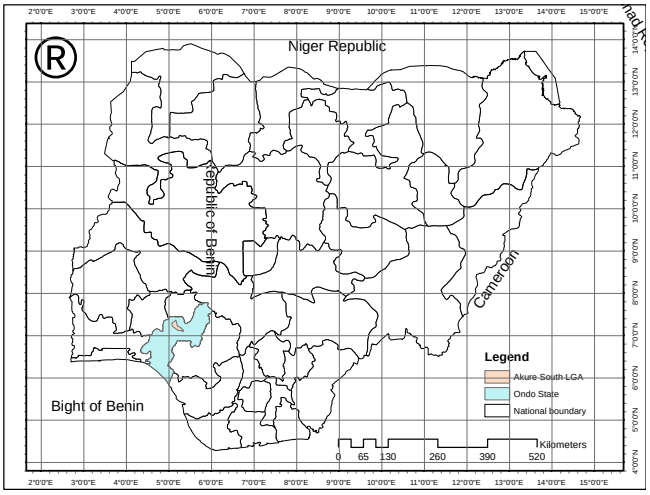

Figure 1: Map of Akure in its National Setting
Source: Ondo State Ministry of Physical Planning and Urban Development,

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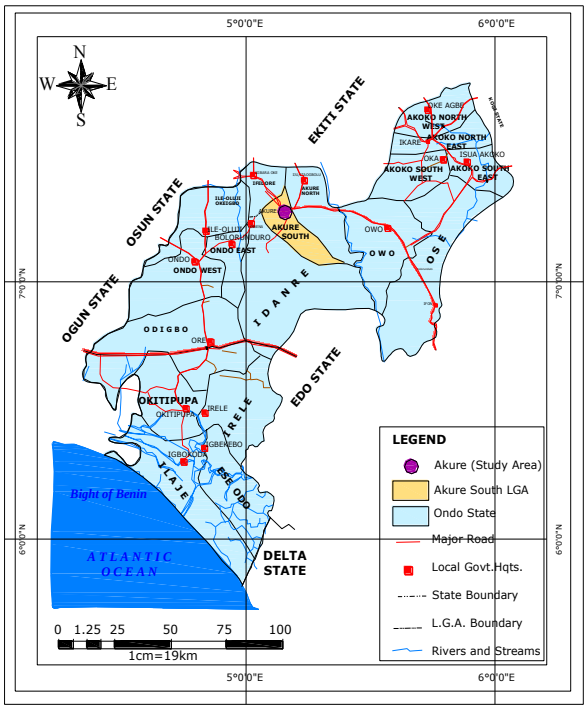

Figure 2: Map of Akure in its regional setting

Figure 3: Map of Akure Township showing network of waterbodies and major roads; Source: Adapted from Google Earth Map source (Digitized by the Author, 2022)

3. Data Acquisition and Methodology

The study is interested in modelling the changing patterns of green space depletion in Akure. The study deployed method of analysis which include map analysis involving geo-data collection and analysis of spatio-temporal pattern of green spaces. The sources of data used for the study were secondary sources. Published and unpublished materials were consulted for the study. To achieve the study's goal, Geospatial data analysis was conducted on the landuse/Landcover cover change for a period of 38 years (1984-2022). The Satellite imageries of Akure were acquired for 1984, 1991,2002, 2015 and 2022 and processed. The processes included image composition, rectification, enhancement and classification. These satellite imageries underwent process of image classification in order to complement the visual analysis of the image data with quantitative techniques for automating the identification of features in the study area. For the purpose of this study, attention was focused on analysis of greens and non-green spaces. Supervised maximum likelihood classification procedure on Landsat 8 OLI/TIRS, Landsat 7 EMT+ and Landsat 4-5 TM Imageries was used to determine the green spaces identity of each pixel in the Landsat imagery as well as its rate of depletion. A supervised classification with a Maximum Likelihood analysis was successful after creating six classes of interest with training sample area per class. These included: built-up, bare surface, grasses and shrubs, light vegetation, Secondary vegetation, and dense vegetation categories as regions of interest. Descriptive analysis was done to present change detection results and other the change statistical data.

4. Results and Discussion

The study uncovered changes in Akure metropolis' green spaces (vegetative covers) and built-up regions between 1984 and 2022. The

study spanned 38 years, as demonstrated by the tables1 and maps of 1984, 1991, 2002, 2015, and 2022. However, the total area of each class was computed. Table 1 shows a breakdown of the area coverage in terms of percentages of vegetative cover and built-up area under consideration.

Table 1: Estimation of area coverage of Green space classes and built-up area between 1984 and 2022.

	Classes	Area (sqm)	Area (km2)	Area (%)
1984	Built-Up area	12,531,600	12.5316	6.99
	Grasses and Shrubs	36,630,900	36.6309	20.42
	Light Vegetation	42,490,800	42.4908	23.68
	Secondary Vegetation	18,474,300	18.4743	10.30
	Dense Vegetation	68,781,600	68.7816	38.34
	Bare Surface	492,300	0.4923	0.27
	Total area	**179,401,500**	**179.4015**	**100.00**
1991	Built-Up area	20,871,900	20.8719	11.63
	Bare surface	4,504,500	4.5045	2.51
	Grasses and Shrubs	17,454,600	17.4546	9.73
	Light Vegetation	60,577,200	60.5772	33.77
	Secondary Vegetation	13,202,100	13.2021	7.36
	Dense Vegetation	62,791,200	62.7912	35.00
	Total area	**179,401,500**	**179.4015**	**100.00**
2002	Built-Up area	40,365,000	40.365	22.49981
	Bare surface	2,792,700	2.7927	1.556676
	Grasses and Shrubs	42,307,200	42.3072	23.58241
	Light Vegetation	41,787,000	41.787	23.29245
	Secondary Vegetation	44,425,800	44.4258	24.76334
	Dense Vegetation	7,723,800	7.7238	4.305315
	Total area	**179,401,500**	**179.4015**	**100.00**
2015	Built-Up area	57,412,800	57.4128	32.00
	Bare surface	8,393,400	8.3934	4.68
	Grasses and Shrubs	80,508,600	80.5086	44.88
	Light Vegetation	11,778,300	11.7783	6.57
	Secondary Vegetation	18,711,000	18.7110	10.43
	Dense Vegetation	2,597,400	2.5974	1.45
	Total area	**179,401,500**	**179.4015**	**100.00**
2022	Built-Up area	118,674,900	118.6749	66.15045
	Bare surface	29,179,800	29.1798	16.26508
	Grasses and Shrubs	3,869,100	3.8691	2.156671
	Light Vegetation	9,878,400	9.8784	5.506308
	Secondary Vegetation	17,029,800	17.0298	9.492563
	Dense Vegetation	769,500	0.7695	0.428926
	Total area	**179,401,500**	**179.4015**	**100.00**

Source: Field work, 2022

The total land area of the study is 179.4015sqkm covering the nine political wards bouudaries in Akure metropolis. The study is subjected to capturing the landuse/landcover attributes within Akure metropolis taking into consideration six training areas such built-up, bare surface, grasses and shrubs, light vegetation, Secondary vegetation, and dense vegetation. The study revealed that the built-up area was 6.99% (12.531sqkm) of the total area covered (179.4sqkm) in 1984; dense vegetation had the largest percentage land cover with 38.34% (68.782sqkm), this was followed by light vegetation with 23.68% (approximately 42.4908sqkm). Grasses/shrubs and secondary vegetation covered 20.42% (36.631sqkm) and

10.30% (18.474sqkm) of the total landmass of the study area (Akure) respectively as shown in table 1. Bare surface was 0.27% (0.492sqkm) as at 1984 and this can be attributable to dominance of vegetative covers in Akure. Akure was found to be an agrarian region where huge population depended on farming/agricultural practices. It is in the history that the engagement of the people of Akure in cocoa, oil palm and yam farming were very significant due to their traditions and culture.

Figure 4 shows the image classification of green space attributes and their spatial distribution in the study area (Akure) in 1984. The figure depicts a concentric picture of image classes having the built-up area at center surrounded by grasses/shrubs, light vegetation, secondary and dense vegetation consistently; with few bare surface areas. The image indicated high prevalence of green spaces in Akure as at 1984.

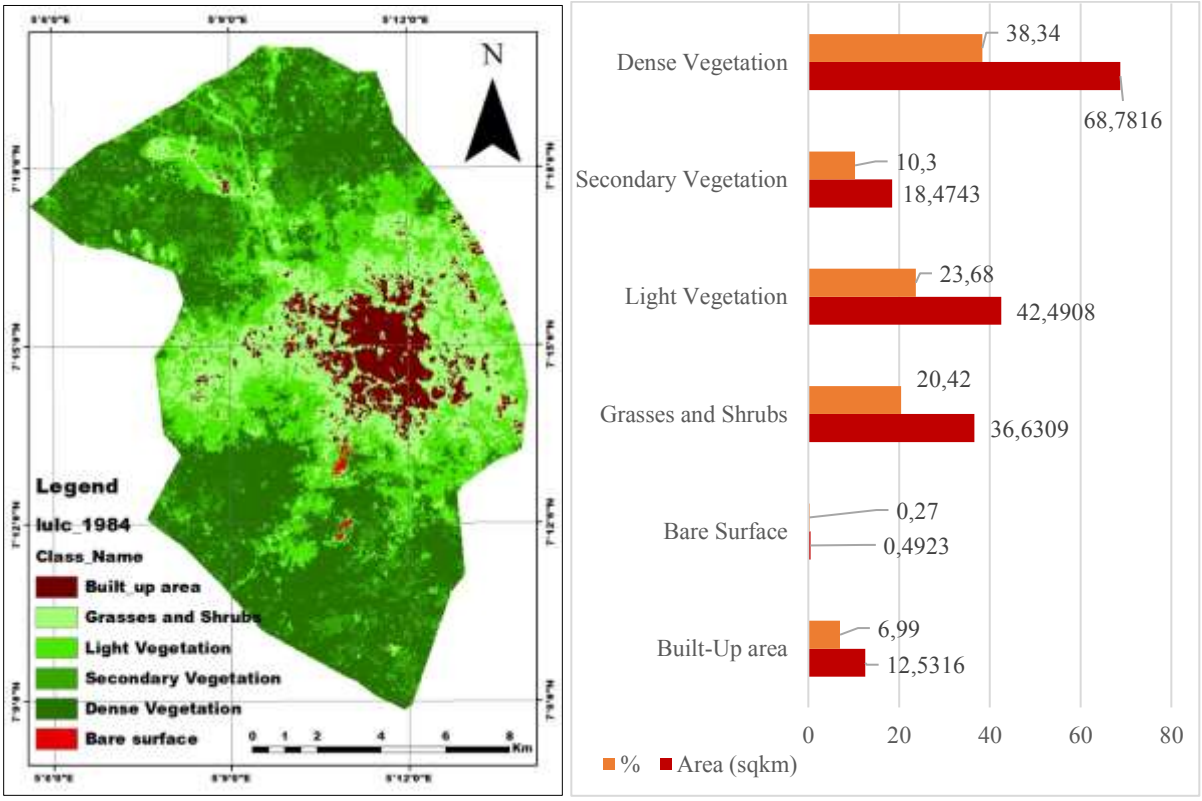

Figure 4: The image classification and chart green space attributes and built-up areas of Akure in 1984
Source: Author, 2022

Findings revealed a 66.6% increase in the area covered by the built-up class within a period of 7 years. As shown in table 1 as at December, 1991. Built-up area had covered 11.63% (20.87sqkm) of the total area of the Akure metropolis. This showed a significant reduction of grasses and shrubs area coverage, light vegetation and secondary vegetation. Figure 5 shows appearance of more bare surface area with 2.1.51% (4.51sqkm); dense vegetation had a slight reduction from 38.34% (68.78sqkm) in 1984 to 35% (62.79sqkm) in 1991. The massive loss of area coverage in the light vegetation was gained to light vegetation; hence, secondary vegetation lost some square kilometres of land to the light vegetation.

Grasses and shrub class lost some coverage of land to built-up area; Secondary vegetation lost large portions of landcover to the light vegetation; this shows a significant drift and encroachment into vegetation reserves (dense and secondary vegetation). However, this can be attributed to increase in physical development being triggered by urbanization and population density. The figure 5 shows the extent of built-up encroachment and the depletion of green spaces in the study area. The built-up area had a significant spread onto the grasses and shrubs as well as light vegetation areas initiating appearance of bare surface areas such as open grounds, rock outcrops and stones features in red color as shown in figure 5. The chart indicates significant variations in the previous years' data result and the year 1991 findings where light vegetation lost substantial land cover.

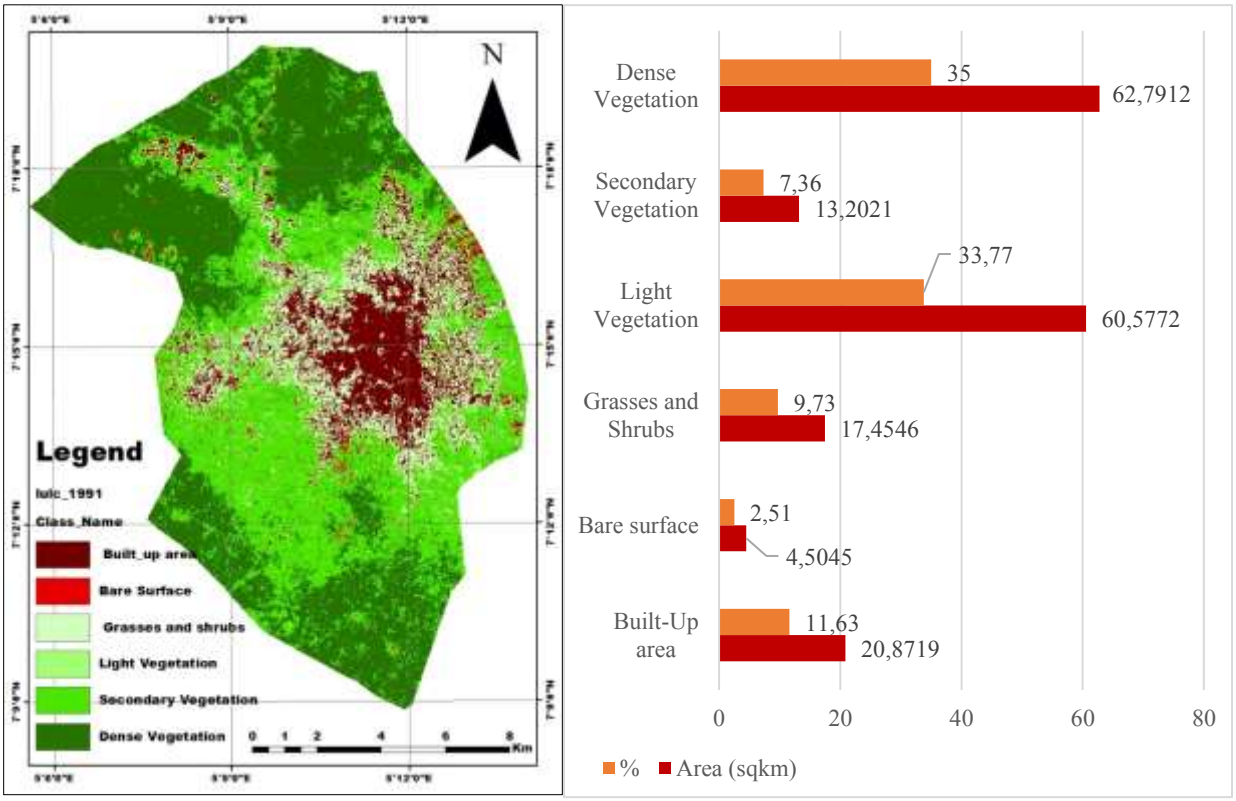

Figure 5: The image classification and chart green space attributes and built-up areas of Akure in 1991
Source: Author, 2022

As shown in table 1, built-up area in the year 2002 increased significantly with 93.4% rise. The area coverage of built-up area as at 2002 was 22.5% (40.365sqkm) of 179.401sqkm. This study showed that there were substantial loss of vegetation covers and their status within a span of eleven years. Dense vegetation which the largest area coverage in 1984 and 1991 lost its status with an extreme reduction to 4.31% of total area of the study area (Akure). This shift was taken over by secondary vegetation, light vegetation and grasses and shrubs with 24.7% (44.4sqkm), 23.3% (41.787sqkm) and 23.6% (42.307sqkm) respectively. Between 1991 and 2002, there was

influx of people into farming practices due to stress on the economy, thus, dense vegetation was encroached into, tall and canopy trees were destroyed, as well as cocoa plantation and replaced with arable farm crops. Light vegetation expanded and spread into secondary vegetation, while the secondary vegetation also enlarged into the dense vegetation. However, due to land clearance, physical development and cultivation, rock outcrops and bare land surface were exposed leading to appearance of bare surface class area coverage with 1.56% (2.78sqkm). Dense vegetation reduced from 38.34% (68.782sqkm) in 1984 to 4.31% (7.724sqkm) in 2002. The massive loss of area coverage in the dense vegetation was gained to secondary vegetation; hence, secondary vegetation lost some square kilometres of land to the light vegetation.

Even though the class of grasses and shrubs lost some land to built-up area in 2002, a bigger portion of land space was reclaimed from light vegetation; while light vegetation had a drift and encroachment onto forest reserves (dense and secondary vegetation). However, this can be attributed to increase in physical development triggered by urbanization and population density. The rate of vegetation loss in Akure is significant, which necessitates investigation by those with a stake in the matter. Figure 6 shows graphical and spatial representations of the amount of the loss of green spaces as well as the factors that have contributed to this loss. It demonstrates the degree of invasion by the built environment and the reduction of green spaces in the study area. The built-up area had a significant spread onto the grasses and shrubs as well as light vegetation areas instigating appearance of bare surface areas such as open grounds, rock outcrops and stones features in red color as shown in figure 6. The chart indicates significant variations in the area coverages of the classes of vegetation and built-up area.

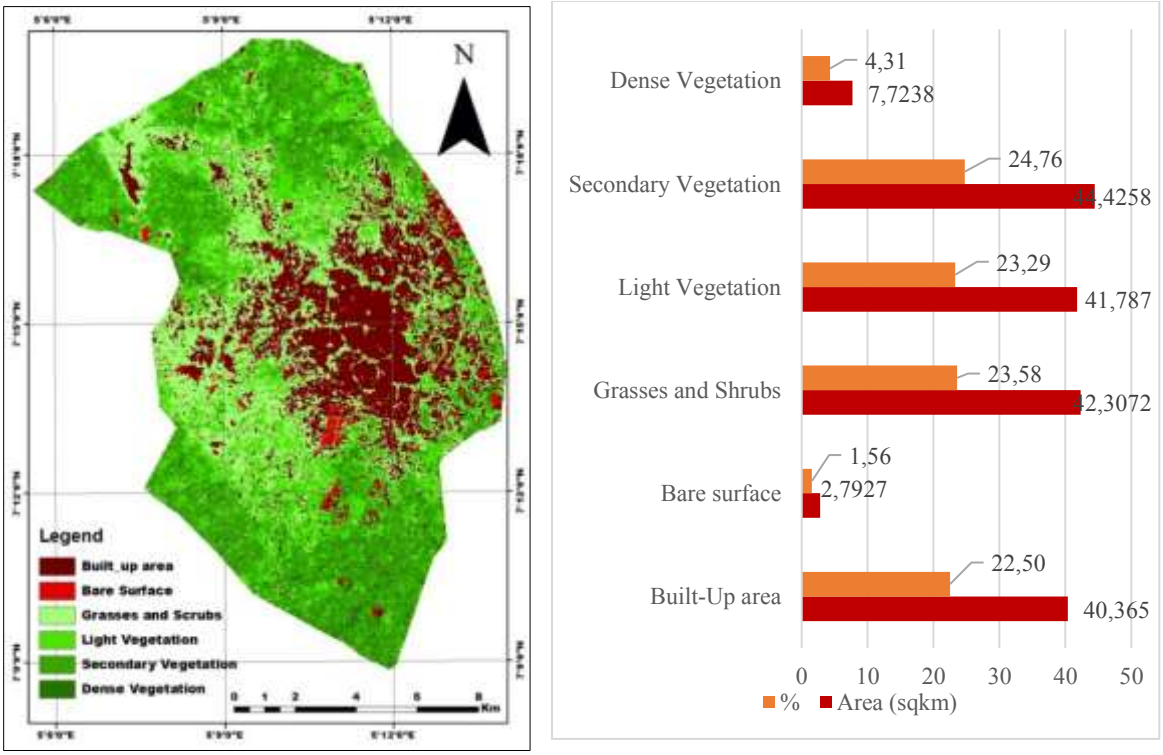

Figure 6: The image classification and chart green space attributes and built-up areas of Akure in 2002
Source: Author, 2022

In the year 2015, it was recorded that the built-up area had a significant change in term of spatial expansion into light vegetation as well as areas covered by grasses and shrubs. Cultivated land are being replaced with building and construction. Anthropogenic activities caused disappearance of lots of vegetation cover in the study area as shown in the figure 7. The built-up area in brown color became obvious on the image; though, the figure shows a dominance of green spaces being grasses/shrubs and light vegetation. The chart in the figure 7 indicated an intensification of land exposure to bare surface with 4.68% (8.393sqkm) and a substantial increase in the Built-up area with 37% (57.413sqkm) out of 179.4045sqkm. The degradation of natural vegetation cover in Akure is attributable to population growth and urban sprawl resulting to anthropogenic activities most especially on the species of plants and trees in the forest. It is important to note that the current pace of vegetative extinction caused by humans is believed to be higher than the background rate of extinction that was likely caused by farming and cultivation methods in the past. This is in agreement with Adel Moatamed (2021), who claimed that urbanization caused by economic development and accelerated population growth puts pressure on the populated land areas and thus determines the pattern, direction, and rate of change influencing the green spaces/landscapes. Construction of concrete projects, mining in the forest, and deforestation projects all contribute to this enormous degradation of natural vegetative components. This claim, however, is corroborated by the distribution of green areas on the spatiotemporal classified image for 2015 (see figure 7).

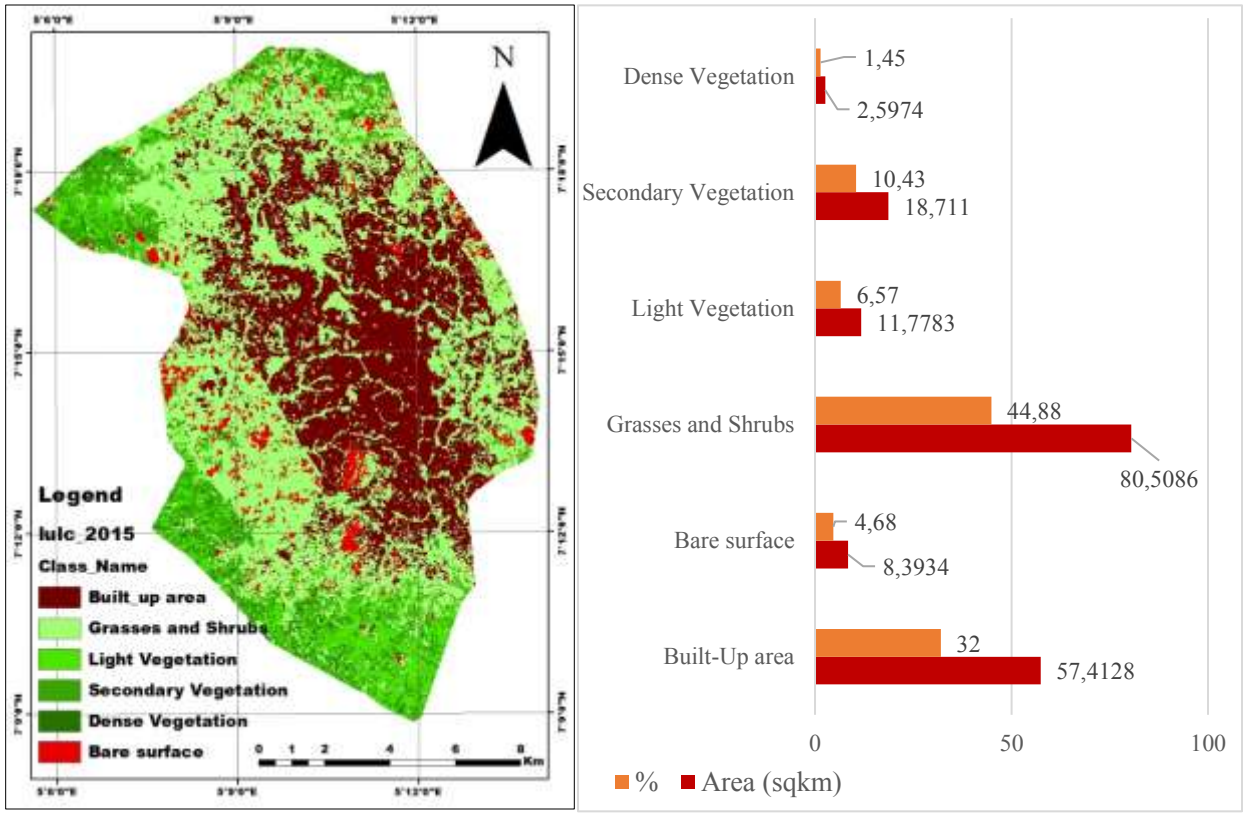

Figure 7: The image classification and chart green space attributes and built-up areas of Akure in 2015
Source: Author, 2022

Figure 8 and Table 1 revealed extensive dominance of built-up area and ample disappearance of dense and secondary vegetation in Akure metropolis as at year 2022. Findings revealed that significant amount of urban green spaces was lost to built-up area between 2015 and 2022; built-up area had 106.7% increase in area coverage. Grasses and shrubs, light, secondary and dense vegetation showed a colossal loss in land coverage. This loss is evident in dense vegetation revealing ample disappearance to 0.43% of the total land area of Akure metropolis.

As shown in Figure 6, Secondary and grasses/shrub which had a substantial land coverage of 51.91% and 28.63% of the total land area of 179.4015sqkm respectively as at 1984; was left with 9.49% and 2.16%. The dominance of Built-up area in brown color is conspicuous on the 2022 image classification indicating the magnitude of the spread of physical development in Akure. This calls for attention of urban planners, politician, decision makers and all stakeholders in the sector to assuage the disappearance of green spaces in Akure.

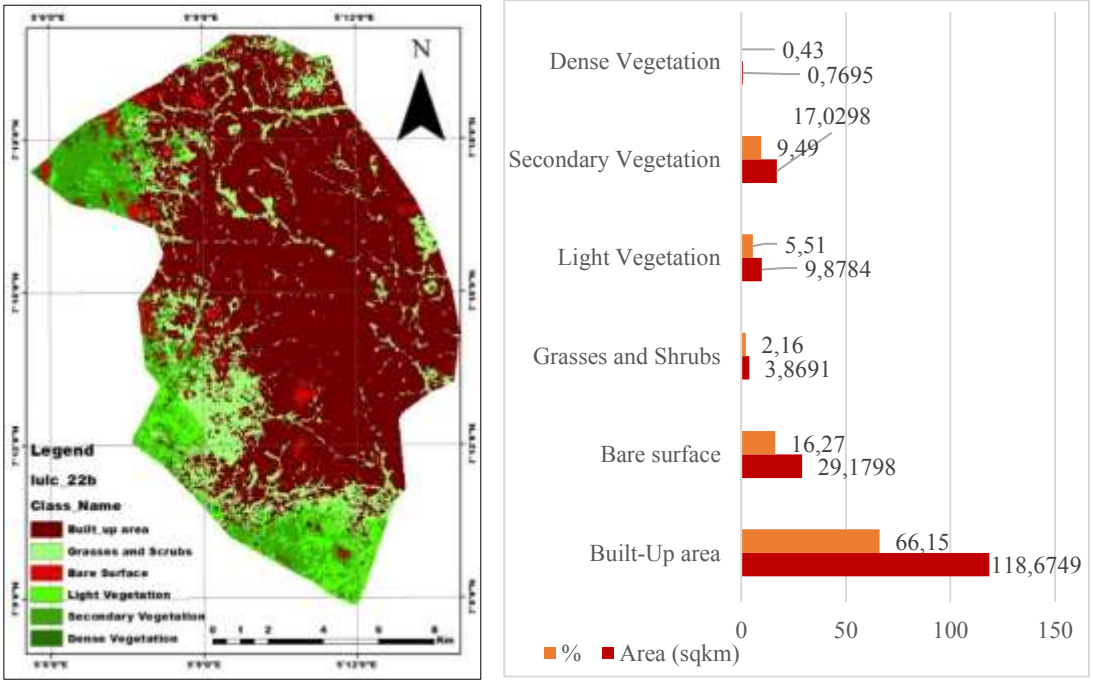

Figure 8: The image classification and chart green space attributes and built-up areas of Akure in 2022
Source: Author, 2022

This study reveals the extent of depletion in all classes of urban green spaces within a confined border of Akure metropolis. This was done to see and know what is lost and what is left of the urban green spaces of Akure metropolis. The chart and image below indicated that bareland surface increased as more rock outcrops and land are exposed due to anthropogenic activities in Akure with 16.27% (29.18sqkm) area covered. The chart below indicates the pattern of skewness of built-up area and green space distribution. The rise in the magnitude of frequency coverage is skewed to the side of built-up area.

5. Comparative Analysis of Green space depletion

Comparing the vegetative cover of Akure in 1984 (the base year for the study) with the built-up area, it can be inferred that vegetative cover had a complete dominance of 92.74% of the total landmass of Akure over the built-up area and bare

surface. In 1984, Akure was eight years old as the capital city of Ondo state; physical developments were still in the early stages, with the majority of the resident engaged in subsistence farming and cocoa cultivation in the light and secondary forest. There were high degree and agricultural practices despite low population density. Akure population was dominated by farmers and civil servants who also engage in farming. Farming beside and at backyards of residences were most prevalent. However, trend analysis revealed that the Akure metropolis' built-up area began to expand and rise in density over decades, while its green spaces depleted significantly at a decreasing rate. Landuse developments and expansion in Akure metropolis are taking place at the detriment of green spaces. The considerable and rapid loss in dense, secondary, and light vegetation, as well as grasses and shrubs, around the concentric boundaries of Akure metropolis' built-up area has put strain on the city's natural ecosystems. Rapid urbanization, combined with the absence of and/or poor planning by planning authorities and green space champions/practitioners, leads to the extinction and degradation of vulnerable environmental factors such as flora vegetation and water bodies. Saghir and Santoro (2018) have found similar results also found similar result in their study.

Due to its significant density and encroachment on the adjacent green spaces in Akure metropolis, built-up expansion is a remarkable indicator revealing the rate of green space depletion. In 1984, it was estimated that built-up area covered 12.5316 sq km. In 1991, it increased, rising to 20.8719 sq km, which is approximately 66.6% more. This rise continued without no fluctuation till the year 2022; for 2002, 2015 and 2022 it was estimated to be 40.365sqkm, 57.413sqkm and 118.675sqkm respectively. The surrounding light vegetation (grasses, shrubs, galleries forest, and riparian vegetation) will suffer as a result of this expansion, which will have a commensurate impact on the secondary and dense vegetation.

Figure 9 shows that the area covered by dense vegetation (natural vegetation) significantly decreased at an exponential rate from 68.782 square kilometers in 1984 to 62.791 square kilometers in 1991. The area continued to decrease, reaching 0.7695 sq km in 2022, which is approximately 8938.48% less than in 1984. The analysis of the satellite image from 2002 revealed that the contraction had worsened significantly since 1991, with urban green spaces (grasses, shrubs, light vegetation, secondary vegetation, and dense vegetation) significantly degraded as a result of various landuse developments in Akure metropolis.

Table 2: Percentage distribution of Green space depletion and Built-up areas between 1984 and 2022 in Akure Metropolis

Classes	Area Coverage (Sqkm)									
	1984	%	1991	%	2002	%	2015	%	2022	%
Built-Up area	12.5316		20.8719		40.3650		57.4128	32	118.6749	66.15
Bare Surface	0.4923		4.5045		2.7927		8.3934	4.68	29.1798	16.27
Grasses and Shrubs	36.6309		17.4546		42.3072		80.5086	44.88	3.8691	2.16
Light Vegetation	42.4908		60.5772		41.787		11.7783	6.57	9.8784	5.51
Secondary Vegetation	18.4743		13.2021		44.4258		18.7110	10.43	17.0298	9.49
Dense Vegetation	68.7816		62.7912		7.7238		2.5974	1.45	0.7695	0.43
Total	**179.4015**		**179.4015**		**179.4015**		**179.4015**	100.00	**179.4015**	100.00

Source: Author, 2023

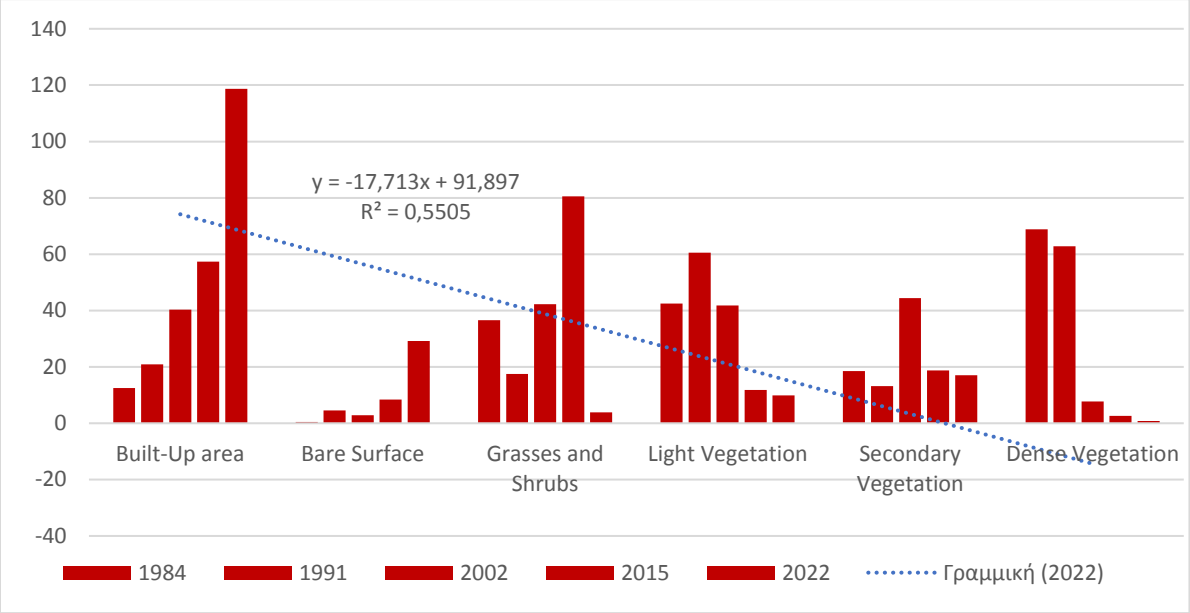

Figure 9: Trend Analysis of Green space depletion and Built-up area Source: Author, 2023

6. Planning Implication of Green space depletion in Akure

It is worth noting that Akure has experienced remarkable physical development since 1976, when it became the capital city of Ondo state. The administrative status induced a population influx into Akure because it provided job opportunities and social amenities; and with urbanization comes an increase in building construction, industrial activities, economic and mining activities; cutting down of trees (Omodehin, 2015) and encroachment into adjoining vegetation covers in order to meet the demand of urbanization, thereby damaging fragile natural green and landscape components. According to Owoeye and Ibitoye (2016), the depletion of these vegetative resources and deterioration of the environment are the result of landuse expansion accompanied by incompatible changes in landuse patterns and uncontrolled urban development. Some sites designated for open space development have been converted to commercial or residential uses. Ilula recreation centre in Oshinle area was an example of this; the center had previously been sold out for a Petrol station facility. It took the intervention of the community's members and the government to return it to its original open space development. A few instances of landuse conversion in the Akure area are the Omoluorogbo Grammar School farm, which was transformed into a Mother and Child Hospital, and the green conservation area behind the State Secretariat, which was converted into the Akure International Cultural and Event Centre (The Dome). The implication of these developments is the trade-off of green spaces for heated surfaces. Extreme heat poses an increasing threat to public health, particularly in areas with high urbanization and development.

A notable driver of the observed changes in Akure urban green spaces is the growth in the city's economic, industrial, political, educational, national and administrative functions. Diversity in the job industry particularly light industries such as sawmill factories, block industries; service industries, manufacturing, construction, trade, among others coupled with social amenities, high property value, development policy and being the state capital attract population from other regions across the state and migrants (especially rural-urban) into the city. However, the study results show significant

changes in the landscape of Akure metropolis especially in the peripheries; places like Ijoka/Igisogba, New Town district/Oba Afunbiowo estates, Ajipowo/Olokuta districts, Oke-Odu/Ilere, Olu-foam/Igoba, Federal Secretariat/Alagbaka extension and Apatapiti-FUTA/Ipinsa area were all covered with greens in the form of secondary and dense vegetation in 1984 (see figure 4). These classes of vegetative covers have given way for built-up areas in different directions and patterns as shown in figure 8. These areas known for farming of perennial crops like cocoa, rubbers plantations, and dominated by diverse forest resources are being converted to residential, private and public institution landuses; this has also exerted pressure on available urban lands.

Urban habitat is meant to be shaped and planned to offer a livable, habitable and sustainable environment to live and work. The survival of any living entity, whether human, animal, or other living organism, in any ecosystem is dependent on the condition of the particular ecosystem in which they exist. According to Cheng et al. (2017), the survival of one-fifth of the world's population is fully dependent on the ecosystem services given by both rural and urban landscapes. By engaging in sustainable urban and environmental planning, man has the ability to influence, select and control what their environment delivers. Urban landscape growth is essential, yet unchecked development at the expense of essential environmental elements may cause unneeded environmental issues. Lack of green space protection legislation, ignorance of the potential and benefits of green space, ineffective development control enforcement, government compulsory land acquisition for public uses at the expense of urban agricultural lands and open spaces, demand for land for commercial uses (neighbourhood markets), and conversion of organized open space and incidental open spaces to other uses are the main causes of the loss of green space in Akure metropolis. However, this has led to land degradation, loss of ecosystems and destruction of fragile resources within and outside Akure urban landscape. This is reflected in the figure 9 indicating decreasing trends in green vegetation classes.

According to the study, dense vegetation area dominated by forest vegetative species of tall, big, and canopy trees has disappeared to the tune of 0.43% of total land coverage in Akure metropolis due to pressure from landuse development, resulting in parcelization and fragmentation of land. Individual/family owners have cut enormous areas of forest land for industrial and residential plan developments. According to this study, deforestation was substantial in Akure between 1984 and 2002; dense forest land (vegetation) coverage was 68.7816sqkm in 1984, but it decreased to 7.7238sqkm in 18 years (2002). This was a huge loss to local, national and global ecosystem. Fragmentation occurs when the forest canopy is cut up for houses, lawns, roadways, and other infrastructure. The increased presence of people increases the likelihood of destruction of fragile floral species. According to a study, the amount of land covered by forests worldwide has decreased by 2 million square miles (3.1 million square kilometers) since 1990. As "carbon sinks," forests absorb in CO2 and convert it into the oxygen we breathe. More than one billion acres of forest have been removed to make space for strip mining, cattle grazing, and industrial sprawl, it further emphasized. Deforestation is one of the main causes of rising greenhouse gas emissions.

Additionally, the destruction of green spaces like grasses, shrubs, light, secondary, and dense vegetation has exacerbated erosion to varying degrees in Akure metropolis, leading to erosion of exposed fragile soils and lands, earthen roads, and building foundations of the majority of traditional buildings, especially in the core area of Akure metropolis. The loss of ecological values of the study area's green space component is a critical implication of green space depletion. According to the study, the constituents of green spaces, such as floral components, provide medical benefits by supplying medicinal plants (herbs) for healing and treatment, as well as ornamental trees and flowers for urbanites. Cities' beauty and aesthetic values can be enhanced by providing a unique, balanced, and environmentally friendly place to live and work. Children's playgrounds, recreational centers, parks, and gardens provide places for leisure, recreation, and relaxation, helping to alleviate

boredom, mental stress and anxiety, boost emotions, and reduce aggression levels. However, given the rate at which green spaces are depleting in the study region, the Akure urban environment is at risk of losing its beneficial social and ecological values

7. Conclusion and Recommendation

The finding revealed significant changes in the proportion of green spaces in the city's central business district. High levels of deforestation are occurring in the periphery in order to make way for new residential housing developments without planned open areas. In 1984, the city of Akure had an equitable distribution of vegetation (grasses and bushes, light, secondary, and dense vegetation), with considerable green space designation concentrations everywhere throughout the city. Green space coverage started to decline in 1991, and it continued to decline until 2022, losing ground to bare ground and built-up areas. This is in agreement with Gaisie et al., (2019), as it is obvious that green spaces in the study area were lost and degraded in favor of built-up areas as a result of urban pressure from a growing population and increased densification.

Human activities are mostly to blame for the depletion found in the study area. The most powerful elements leading to the degradation of the study area's urban green spaces include population growth, changing socio-economic characteristics of the people, building construction, administrative policies and regulations. Population increase necessitates the development of new residential and commercial areas, as well as public services and modes of transportation. Also, urbanization necessitates an alteration in the original use of green spaces such as forest areas, agricultural lands, and fragile soils, resulting in changes in both land use pattern and patterns of green spaces in the city. This is in agreement with Rahman (2016) who asserted that degradation of natural vegetation is attributed to uncontrolled landuse expansion and urbanization.

The study estimates a continual depletion of green areas in Akure metropolitan as of 2022, and this is likely to continue as demand for land rises owing to urbanisation and accompanying activities. It is worth noting that if not mitigated, the depletion of urban green spaces (vegetative covers) will have a substantial detrimental impact on the functioning and integrity of urban natural ecosystems, as well as sustainable urban development. It is recommended however, that planning authorities ensure the inclusion and implementation of green space schemes in the city's masterplan; introduce requirement of green spaces in all new developments in the city; create awareness of the benefits and potential of green spaces in their environment; develop and improve community education engagement, education and outreach programmes on the planting, conservation and preservation of green spaces within and around their environment. This is in agreement with Janssen et al., 2012, who stated that growing and preserving more street trees in the Metropolis should be a fundamental part of its planning process due to their multiple social and ecological values in establishing sustainable cities and communities (Janssen et al., 2012).

It is also essential to ensure better coordination at all levels of government, a broader range of funding, and the establishment of more urban recreation parks and gardens at the neighbourhood, district, and city levels. Green space elements, without a doubt, play an essential part in regulating and balancing ecosystem patterns, promoting human health, providing food security, and blessing the environment for living organisms. As a result, there is a need to encourage more green space champions and practitioners in the industry; encourage a continued research into processes and functionality of green space developments. Also, it is important to continuously monitor the status and patterns of change overtime, impact and challenges of urban green spaces in Akure metropolis due to pressures from urban landscapes.

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Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)

The authors equally contributed in the present research, at all stages from the formulation of the problem to the final findings and solution.

Sources of Funding for Research Presented in a Scientific Article or Scientific Article Itself

No funding was received for conducting this study.

Conflict of Interest

The authors have no conflicts of interest to declare that are relevant to the content of this article.