SPATIO-TEMPORAL CHANGES IN LAND USE/LAND COVER DYNAMICS IN THE DEVELOPMENT PRESSURE AREA OF OGUN STATE, NIGERIA

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Land use/land cover, geo-spatial, Development Pressure Area, Ogun state

ABSTRACT
Land use/land cover (LULC) character constitutes an important component affecting human interactions to live, work and recreate in the physical environment. Examines changes in LULC in the Development Pressure Area (DPA) of Ogun State, Nigeria covering a period of 30 years (1990 to 2020). Geographic Information System was used to identify, classify, analyse, categorise and situate LULC characteristics. Empirical observations revealed changes in the land use/land cover character in the DPA sub-region of Ogun State, Southwest Nigeria. A spatio-temporal analysis of the morphology was a phenomenal (88.04%) expansion of built-up area from 13,354km2 in 1990 to 111.691 km2 in 2020, while forests and agricultural lands declined by 46.5% in same period causing deficit in land resources availability. Built development has usurped other relevant land uses like open spaces, green belts and wet lands around the metropolitan areas of the DPA. Growing population and increasing influence of unplanned developmental processes are the main forces behind the major shift of forests and agricultural lands into physically built-up categories. Effective planning policy should be enacted to checkmate the growth of the area.

Introduction

The configuration of the physical environment at any point in time influences human interaction with it and impacts how the occupants of the environment live, work and recreate. The process of human-environment interaction produces the kinds and dimensions of human impact on the environment in terms of houses built, neighbourhoods created, cities developed and the socio-spatial relationships among the components. The morphological expression of the ensuing landscape obtaining at any point in time within the spatial fabric induces a spatio-temporal analysis to elicit the land use and land cover (LULC) characteristics in any delimited area (Aguda and Adegboyega, 2013). Land use is the process (functional role) and land cover is the product (physical attributes) of human interaction with the physical, social and economic environments (Agbola et al., 2014; Nanda et al., 2014) and both influence each other to produce the emergent landscape across both space and time.

Sinha (2018) argues that sprawl is an undesirable form of development because negative externalities are associated with it.

Infrastructure and facilities are always the byproduct of any development characteristics of urban landscape. Studies on such infrastructures as health facilities, water supply, housing, transportation, waste management, telecommunication amongst others have been documented (Jimoh and Wahab 2016, Jimoh 2022, Jimoh and Famewo 2022, Jimoh and Abdullahi 2022, Jimoh and Famewo 2022, Jimoh and Famewo 2023 Jimoh and Balogun 2022, Jimoh 2018, Jimoh 2021) and have continually constitute the concrete part of the development bulk. It is within the ambit of these infrastructural development dynamics that this study attracts a significant focus.

Statement of the Problem

In a bid to explore the environment, human activities of mining have had effect on the underlying geology for building and industrial materials, lowlands are filled, mountains are reduced and valleys levelled to create building and living conveniences for man, the drainage is affected by dredging or sand filling to suit the overriding interests of potential land developers, vegetation is affected by bush clearing for farming, lumbering and logging for building materials, roads, rails and tracks are constructed on land surfaces, the seas, oceans and space are navigated and a host of other exploration and intervening activities.

Furthermore, the associated low development costs of land in the DPA pulls attraction from the proximate over congested Lagos megalopolis which shares political but physically blurred boundaries with the region immediately south of the DPA, particularly along areas such as Ojodu, Alagbole, Akute, Ijoko, Oke-Aro Alagbado, Alakuko, Sango-Ota axes, which have grown to a conundrum. The infilling of new entrants into the DPA stimulates increasingly unplanned urban built densities associated with spontaneous expansion of settlements and diminishing public space causing fragmentation, disconnectedness and without corresponding economic transformation.

In addition, the high rate of in-migration from Lagos and other parts of Nigeria coupled with natural population increase have contributed to the sporadic upsurge in the monumental lateral expansion of built development of residential housing, industrial factories and large religious holdings in the DPA within the last few decades. This trend of population explosion is most likely to continue as it was projected that by the year 2025, one-third of the entire population of Ogun State will reside in the DPA alone which is just about one-twentieth of the Ogun State landmass (Ogun DPA Report, 2005). The over-arching implications of this are obvious.

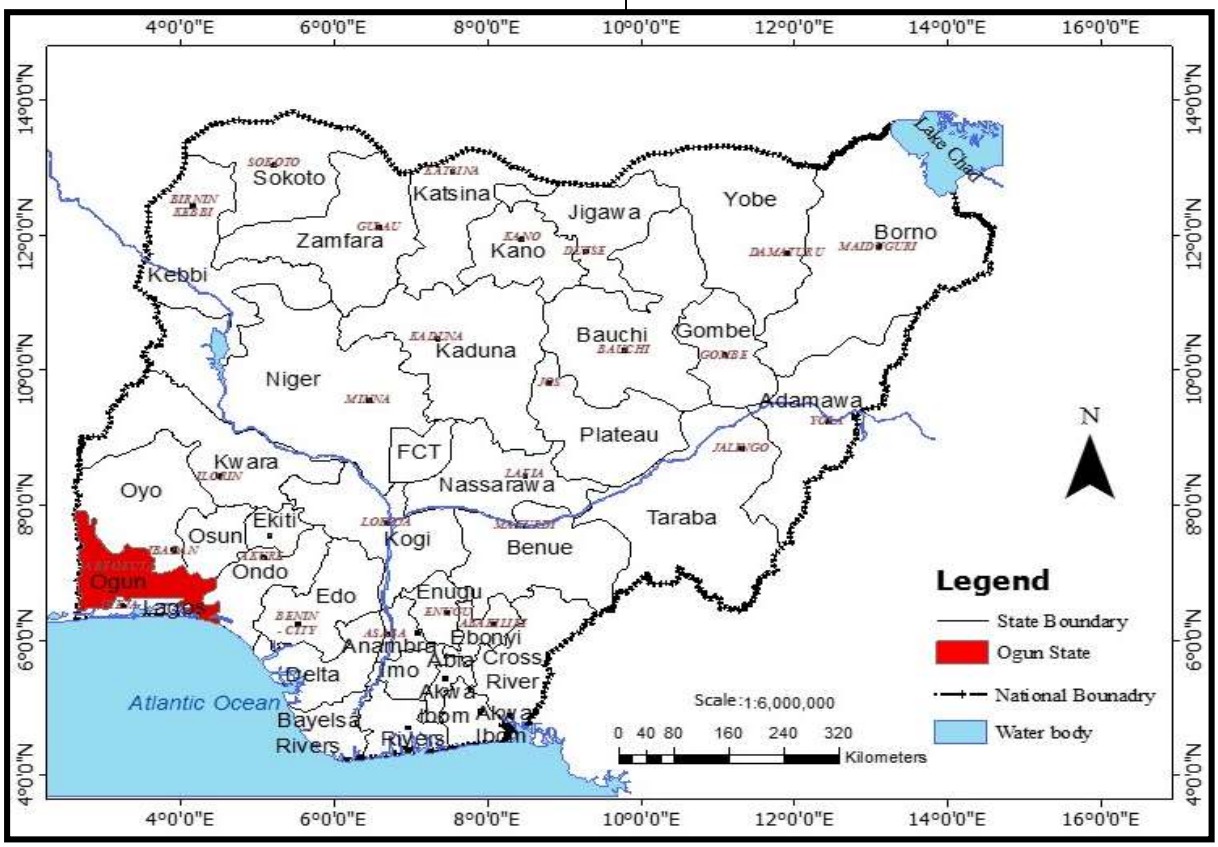
Meanwhile literature on land use/land cover change abound. For instance, Ozdogan (2020) focuses on remote sensing, land cover mapping and machine learning and explores the application of deep learning techniques for accurate land cover mapping. However, Song (2020) revolves around urbanization, LULC and ecosystem services examining the effects of urban expansion on ecosystem services. Goldblatt (2021) centres around remote sensing, land cover mapping, machine learning and urbanization, discussing the potential of machine learning algorithms for predicting land cover changes while Vadrevu (2022) investigates the effects of LULC changes on ecosystem services in Africa. The intersections demonstrate a shared focus on understanding complex relationships between human activities, environmental changes and technological innovations.

Despite all the aforementioned studies on land use/land cover change, there are still a dart of empirical investigation on the dynamics and interplay of development in pressured areas. This study therefore, examines the spatio-temporal trend in LULC changes dynamics in the DPA of Ogun State from 1990 to 2020 and relates how these have accentuated urban sprawl.

The Study Area

The study area for this research is the Development Pressure Area of Ogun State in South Western Nigeria. Ogun State lies approximately between longitudes 20 45′ E and 40 45′ E; and latitudes 60 15′ N and 70 60′ N. With a land area of about 16,980 square kilometres, representing around 1.8 percent of Nigeria's total land mass of 924,000 square kilometres, Ogun State is ranked 24th largest of the 36 States in terms of land mass in Nigeria. It is bounded to the west by the Republic of Benin, to the south by Lagos State and a 20-kilometre stretch of the Atlantic Ocean, to the east by Ondo and Osun States and to the north by Oyo State (Figure 1). It is accessible to other States in Nigeria and the outside world through the International Airport and sea ports in Lagos State as well as international road network within the West African sub region.

The Ogun State Development Pressure Area, (DPA), as defined by the Ogun State Regional Plan, is the area immediately north of Lagos and under a severe development pressure particularly from the neighbouring Lagos metropolis. It covers about 30 kilometres radius from the Lagos-Ibadan Expressway and Ogun River intersection at Isheri (Ogun State Development Pressure Area Report, 2005) (Fig. 2).



FiMangure 1: Ogun State within the national context

Source: Ogun State Regional Plan Main Report, March 2007

The DPA under reference, as defined by the Ogun State Regional Plan, is roughly delineated by an imaginary arc extending in a clockwise configuration from Ajilete-Igbodo axis to the south west, Ilogbo-Ifo axis to the west, Mokoloki-Ofada axis to the north and Mosimi-Ogijo axis to the east. The area, which cuts across portions of five local government areas of Ado Odo/Ota, Ewekoro, Ifo, Obafemi-Owode and Sagamu (Fig. 2), covers about 950 square kilometres. The DPA is one among the six sub-regions designated by the Ogun State Regional Plan. According to the Ogun State Regional Plan 2005-2025 DPA Report, three factors were identified as being responsible for the existence of a development pressure in the area: First, the rapidly increasing in-flow of people from Lagos metropolis into the area, especially the poor people who cannot afford the rent demanded in Lagos and need to move into more affordable locations. Second, there is pressure from property developers in search of land for development and sale of landed properties. Third, Religious groups have also found the area attractive for its availability of large affordable land for their developments. (Ogun DPA Report, 2005).

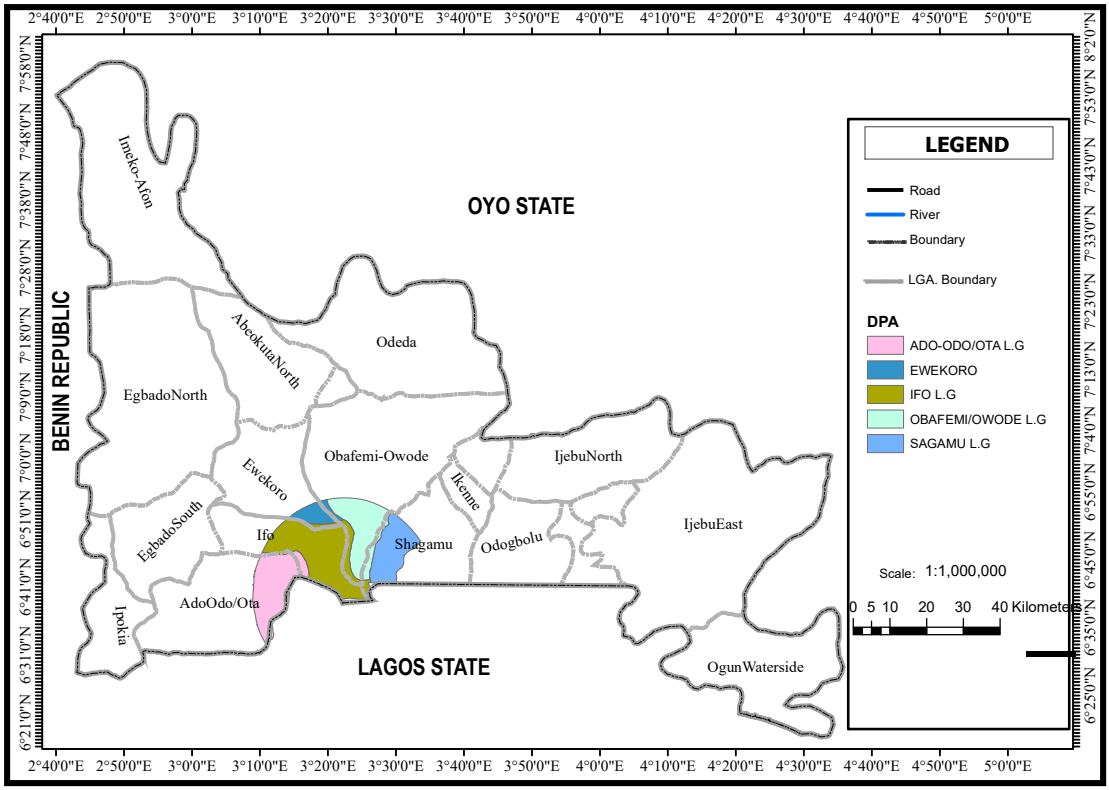


Figure 2: The study area in the context of Ogun State
Source: Ogun State Development Pressure Area Report, June 2005

Materials and Methods

The spatio-temporal analysis of the study area detailing the spatial configuration of the study area between 1990 and 2020 was carried out by means of Geographic Information System (GIS) enabled technique. The application of geo-spatial techniques of Landsat remote sensing enabled the description of the time-dimensional application for the creation of the land use and land cover maps to assess the extent of urban built development. The process involved Satellite data selection, preprocessing, classification, interpretation and final land use/land cover maps.

With the application of geo-spatial techniques of Landsat remote sensing, the following list describes the adopted sequence applied in this study, for the creation of the land use/land cover maps to assess the extent of built development:

1. Satellite data selection

2. Satellite data preprocessing

3. Satellite data classification

4. Satellite data interpretation

5. Final land cover maps.

Satellite data were selected from the year 1990 to 2020 at 10 years' interval. The satellites images collected are:

- Landsat 4-5 thematic mapper for 1990. Landsat 4-5 TM image data files consist of seven spectral bands. The resolution is 30 meters for bands 1 to 7.

- The Landsat 7 Enhanced Thematic Mapper Plus (ETM+) sensor for 2000 and 2010. Landsat 7 ETM+ images consist of eight spectral bands with a spatial resolution of 30 meters for bands 1 to 7.

For Satellite data pre-processing, the Universal Transverse Mercator Coordinate System (UTM)-WGS 1984 Zone 31 was deployed. All Landsat 7 scenes collected since May 30, 2003 have data gaps due to the Scan Line Corrector (SLC) failure therefore Focal Analysis algorithm tool was deployed to fill the line gaps using the ERDAS Imagine 14 package. Landsat TM enhanced false colour composites RGB (red, green, blue) were used for the interpretation and delimitation of the land cover classes.

For the classification the ISODATA method was applied in ERDAS Imagine 14 to identify area of the same pixel values. For Satellite data interpretation thematic maps were produced using ERDAS to show the different land cover classes differentiated using colours as seen in the image. LULC type of the same colour has a total number of pixel values. The total number of pixels' value is therefore multiplied by the pixel resolution (30, 30) for Landsat TM. The total area was used to calculate the percentage change of each class of the different years. For final land cover maps the results of the supervised classification provide a basis for visual interpretation. The final maps were therefore embellished in ArcGIS 10.1.

Results and Discussions

Descriptive explanations were made hereunder to expatiate on the landscape features revealed in the maps provided. Each year of study was taken in turn to present a livid discussion on the images captured on the diagrams and the related statistical analyses drawn from them in the relevant Tables. Each of the major components of the LULC classification and characteristics were examined and discussed. Classification and categorization of land use/land cover are usually purpose-driven based on the materials involved as well as purpose of the study. For instance, Ade and Afolabi (2013) in their study of urban sprawl in the Federal Capital Territory of Nigeria aggregated four categories of Built-up, Rock Outcrop, Vegetation and Water Body. However, Nanda, et al (2014), in their Vishav drainage basin of the Pir Panjul range in India case study report of LULC dynamics, identified nine classes of Dense Forest, Sparse Forest, Agricultural Land, Horticulture, Built-up, Water Body, Snow/Glacier, Wetland, Grassland, and Wasteland. This study identifies five broad classes of LULC and they include: Dense Forest, Secondary Forest, Built-up Area, Agricultural Land and Water Body.

The classified images of the study area in 1990 (Figure 3) shows a low level of built-up area. Tracts of settlements were dotted along the major routes of Alagbado-Ota-Ifo axis to the west, Mokore-Magboro-Ibafo-Loburo axis to the east and Ofada-Mokoloki axis to the north of the study area. A comparative analysis of the classification (Table 1) shows that the built-up area constitutes 5.94 per cent while dense forest covers the greatest chunk of 56.77 per cent. The secondary forest covers 29.56 per cent; agricultural land covers 6.79 per cent while water body covers 0.94 per cent. The 1990 LULC displays a large area of green space which reflects a conservation of about 86.33 per cent of the total land coverage accounted for by dense and secondary forests.

The threat to the natural habitat as at 1990 was only 12.73 per cent of the total landscape. Within the 87.27 per cent apparently free from the threat, 65.76 per cent was accounted for by dense forest, 32.23 per cent by secondary forest and 0.94 per cent by water. Within the quantum of land use constituting threat to the natural habitat, 46.68 per cent was accounted for by built-up area while 53.32 per cent was taken up by agricultural activities. The unfolding narratives indicate that there is a relatively high carrying capacity of the natural habitat for human, fauna and flora activities in the study area. The land cover profile for 1990 assures of positive ecological balance and engenders fresh air, availability of ample land for agriculture, forestry, wildlife, housing and urban development that are capable of enhancing quality of live and well-being of the inhabitants.

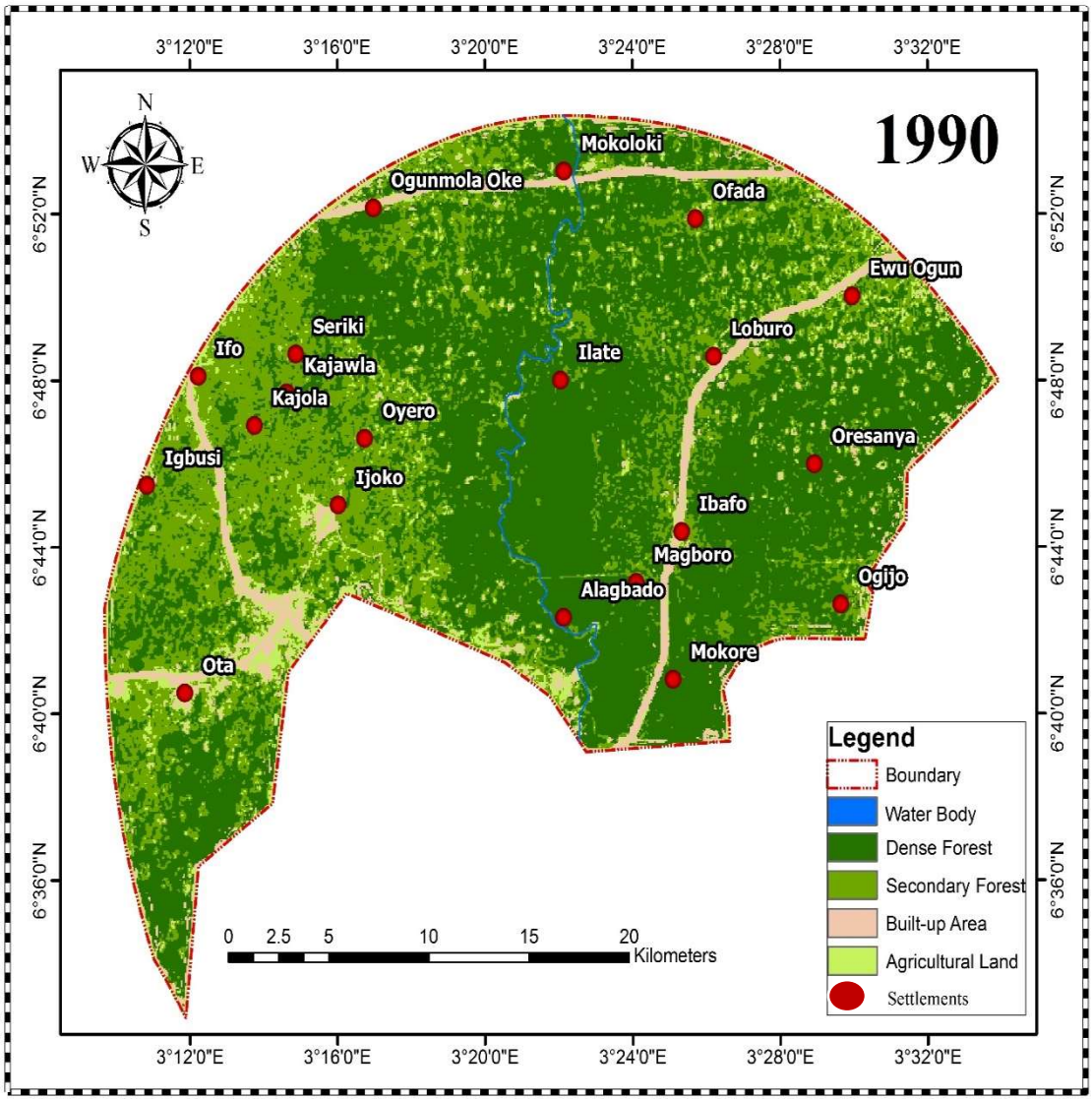


Figure 3: Land cover pattern for 1990
Source: Author's Field Analysis

The LULC classification for 2000 (Figure 4) displays a marked expansion of the built-up area along the three major axes of Alagbado-Ota-Ifo, Mokore-Magboro-Ibafo-Loburo and Ofada-Mokoloki. The settlements expansion pattern has become more nucleated filling up the relatively dispersed characteristic feature of the 1990s. The built-up area (Table 1) accounts for 17.87 per cent, the dense forest covers 40.45 per cent, the secondary forest covers 32.81 per cent, and agricultural land covers 7.93 per cent while water body accounts for 0.94 per cent. A gradual expansion of the built-up area is noticeable visually and corroborated statistically as the study revealed 73.26 per cent land conservation in 2000, a decrease of 13.07 per cent from 86.33 per cent in 1990. Consequently, urban sprawl was beginning to take its toll in the study area in the 2000s at the rate of 17.87 per cent up from 5.94 per cent in the 1990s.

The built-up area attracted the greatest boost among other land uses by 11.53 per cent over the 5.94 per cent coverage for 1990, secondary forest increased by 3.25 per cent and agricultural land by 1.14 per cent, while dense forest declined by 16.32 per cent and water body remains constant at 0.94 per cent. Therefore, the

consumptive propensity of human activities generated by expanding built-up area was on the rise at the expense of forest reserves and agricultural land and other natural resources. Hence, optimal liveability of the inhabitants is threatened, by way of diminishing land and natural resources that constitute common good and natural conservation. The scenario infers a dwindling supply of the earth's finite resources as against an increasing demand for use and consumption of available community resources

Table 1 Summary of land use/cover classification statistics for 1990, 2000, 2010 and 2020 in the development pressure area of Ogun State

Class Name	1990		2000		2010		2020	
	km^2	%	km^2	%	km^2	%	km^2	%
Dense Forest	127.561	56.77	90.895	40.45	80.150	35.67	56.338	25.07
Secondary Forest	66.416	29.56	73.721	32.81	60.004	26.70	37.604	16.74
Built-up Area	13.354	5.94	40.148	17.87	58.250	25.92	111.691	49.71
Agricultural Land	15.249	6.79	24.603	7.93	23.281	10.36	16.827	7.49
Water Body	2.114	0.94	2.114	0.94	3.054	1.34	2.396	0.99
Total	224.694	100	224.694	100	224.694	100	224.694	100

Source: Author's Field Analysis

The 2010 character of urban sprawl displays two expanding conundrums to the west and east of the study area respectively. The western sector built-up area sprawls from Alagbado through Ijoko to Ota and then to Ifo while the eastern sector extends densely from Mokore along Ibafo, Mowe to Loburo and another budding expanse around Ogijo. The two sectors are dissected by River Ogun somehow dividing the study area into almost two equal halves (Figure 5). The built-up area has taken about a quarter (25.92%) of the total area (Table 1).

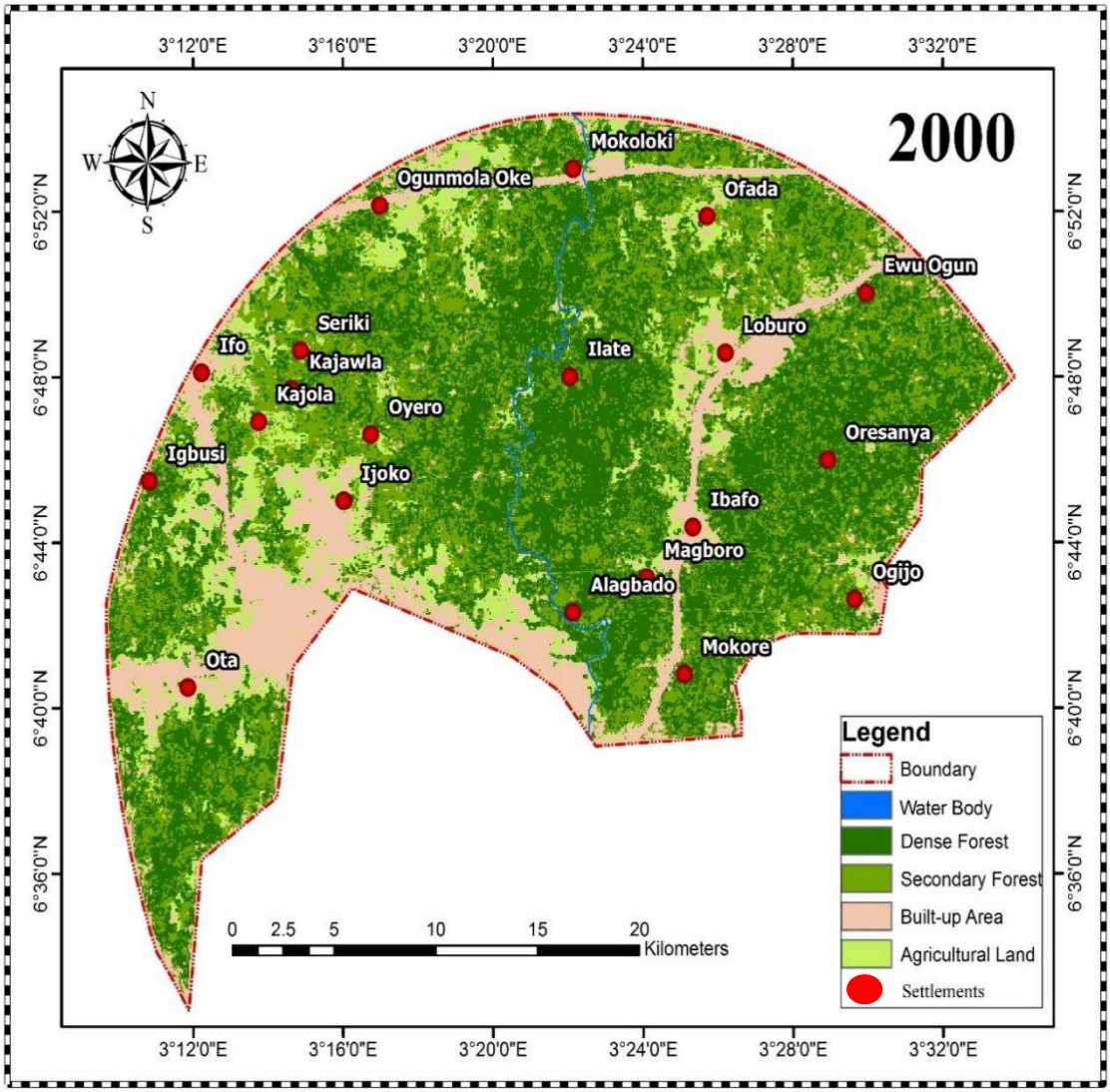


Figure 4: Land cover pattern for 2000
Source: Author's Field Analysis

The area left as green belt conservation has reduced to 62.37 per cent in 2010 from 73.26 per cent in 2000. The toll on the natural habitat calls for concern with respect to the depletion of natural resources particularly as the dense and secondary vegetation were giving way to expanding built-up area. It is also striking to note the increase in area covered by water body from 2.114km2 (0.94%) in 2000 to 3.054km2 (1.34%) in 2010. This could be a result of some explanatory factors that borders on natural influences such as global warming induced increase in precipitation resulting in natural flooding through heavy downpours of rainfall, and anthropogenic influences of human activities induced expansion of built-up areas and increased constructional activities causing reduction in natural infiltration, increased surface water run-off and retention, increased impermeability of the soils, industrial water discharge, dredging of river channels, channelization, sand-filling, industrial and municipal water discharges, land-fill sites and others.

The continuous expansion of the built-up area as a result of in-migration of people and natural population increase were eating into other land uses. As the built-up area increases, the green space for agriculture and flora and fauna preservation decreases. This reduces ecological resources as evident in this research

with the empirical data indicating a progressively diminishing earth's finite resources as against an increasing composite-built development consumption of the biophysical environment. The upsurge in the population causes increased consumption of land resources; soil, water and vegetation and social amenities; housing, commuting, schooling, healthcare, security, electricity, and other allied services. This is evident in the loss of green space by 10.89 per cent between 2000 and 2010.

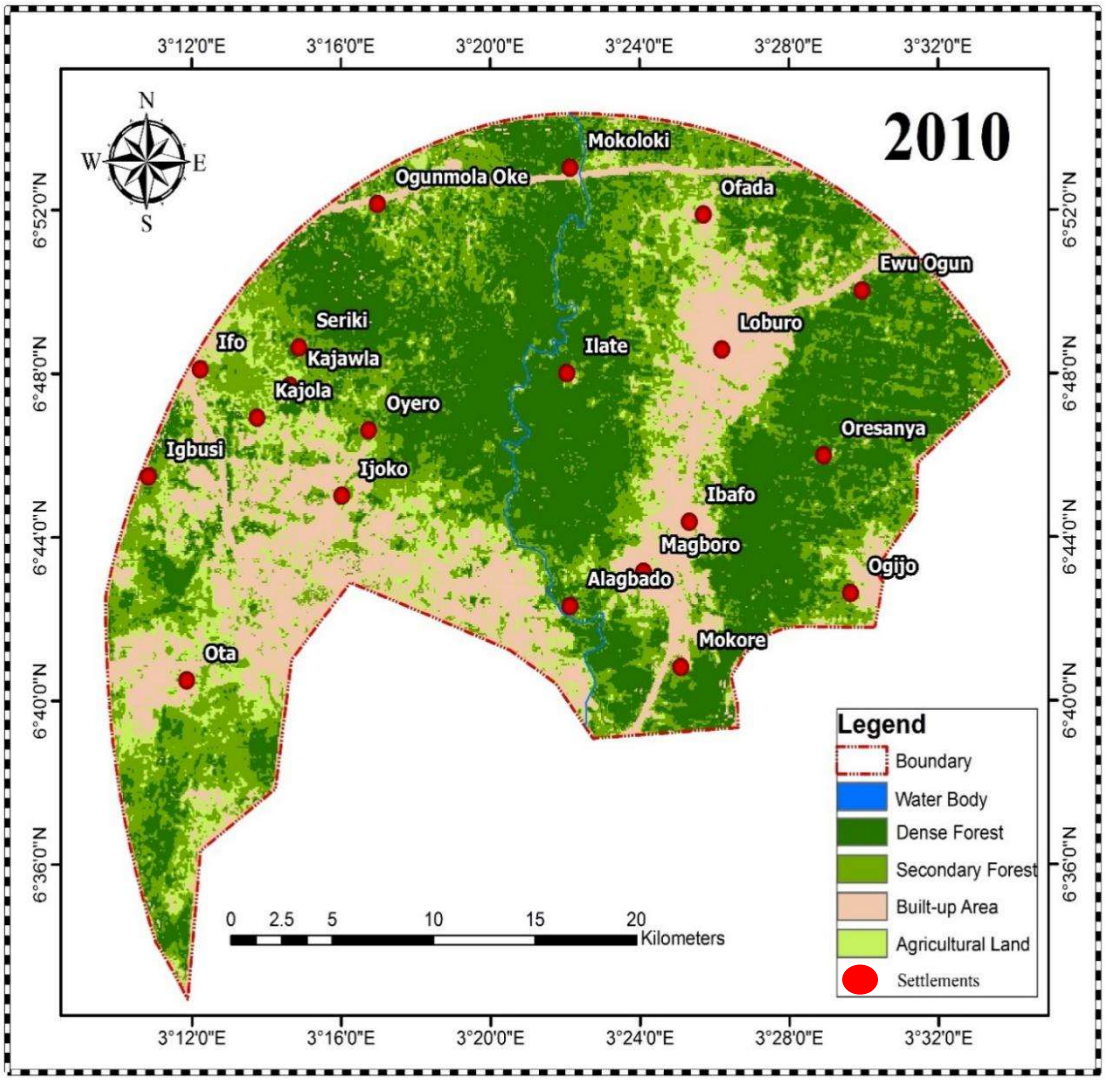


Figure 5: Land cover pattern for 2010
Source: Author's Field Analysis

The 2020 land use/land cover displays a classification profile that has almost half of the entire study area (49.71%) as built-up area. This phenomenal increase in the built-up area has increased the density of infilling of the buildable area. As can be viewed in Figure 6, urban sprawl has spread to the erstwhile forests and the brink of rivers and streams. Almost all available space has been built up. The conurbation has been densified along Ota-Ifo-Ijoko back to Alagbado axis and along Mokore-Magboro-Ibafo Mowe-Ofada axis. Only tracts of other land uses were restricted to the central portion straddling River

Ogun and its tributaries and on the eastern portion of the study area.

The other land use/land cover coverage is: Dense Forest; 25.07 per cent, Secondary Forest; 16.74 per cent, Agricultural Land; 7.49 per cent and Water Body; 0.99 per cent. Another striking feature of the 2020 profile is the reduction in agricultural land use/land cover from 10.36 per cent in 2010 to 7.49 per cent in 2020 and of water body from 1.34 per cent in 2010 to 0.99 per cent in 2020 (Table 1). The reduction in agricultural land use shows lesser engagement of the land for agriculture. The reduction in water body might be due to lowering of groundwater levels which affects water supply. Increased human activities have equally decreased the amount of water body possibly by over-abstraction, water being consumed more quickly than it is being replaced, in the period under reference. A graphic analysis of the features of land use and land cover (Figure 7) shows the relationship among the various land uses classified for the study.

To showcase the successive transformation in the land use/land cover in the period under review, a comparative display of the emergent situation across the years selected is shown in Figure 7. The successive decline of forest cover as against the successive increment of the built-up area is glaringly evident. A progressive expansion of the built development is apparent along the major communication routes. This trend of built development is traceable in the 1990 profile to a ratio of about 1:20 of the total area coverage, being 13.354 of 224.694 square kilometres. This grew in prominence into conurbations in the succeeding years up to 2020 expanding to a ratio of about 10:20 of the total area coverage being 111.691 square kilometres of the total land area of 224.694 square kilometres (Table 1).

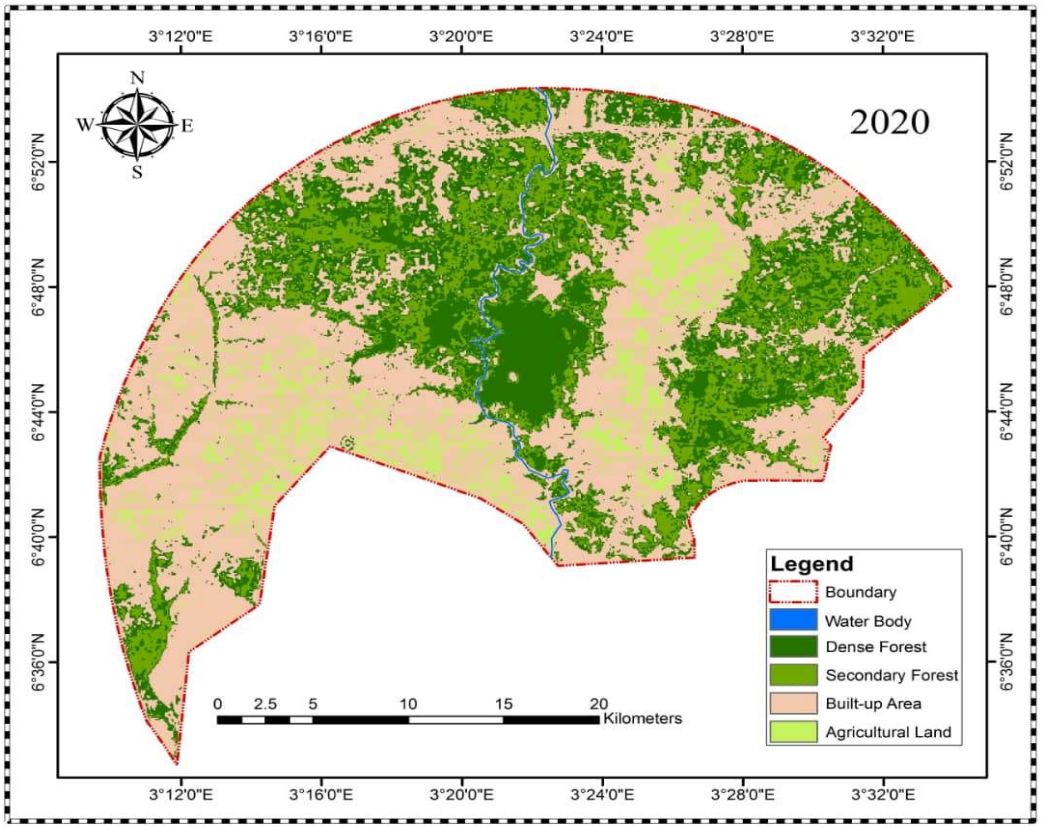


Figure 6: Land cover pattern for 2020
Source: Author's Field Analysis

The built development that evolved in the 1990s as a budding leaf around Sango-Ota axis, as dotted spots along the outlining areas from Sango-Ota to Ifo, Ijoko and Alagbado axes and as a strip or string along Mowe-Ibafo transportation route has grown steadily through 2000s and 2010s into expansive densities of sprawling developments. The trend has culminated in the 2020s as a conundrum, particularly along the Alagbado-Ijoko-Sango-Ota-Ifo axes and the Isheri-Mowe-Ibafo corridors. Other adjoining areas within the DPA landscape were not spared the encroachment of built development into other land uses. Apparently, the excessive proliferation of built development has progressively transformed the erstwhile land cover from green to brown. Increasing human activities of building and construction for housing and settlement development accounted for the expansion of the built-up area over other land uses.

A close examination of the proportional distribution characteristics of the major LULC components shows a consistent decline in the forested land cover from 1990 to 2020 (see Figure 8). On the contrary, there is also a consistent upsurge in the growth of built development at a greater scale or proportion than other land uses, lending credence to the fact of development pressure on the available resources. In the absence of meaningful urban planning to regulate the spate of the exploding urban physical expansion, the associated social and environmental consequences of incongruous land use, environmental degradation, compromised aesthetics and urban blight may be irreversible

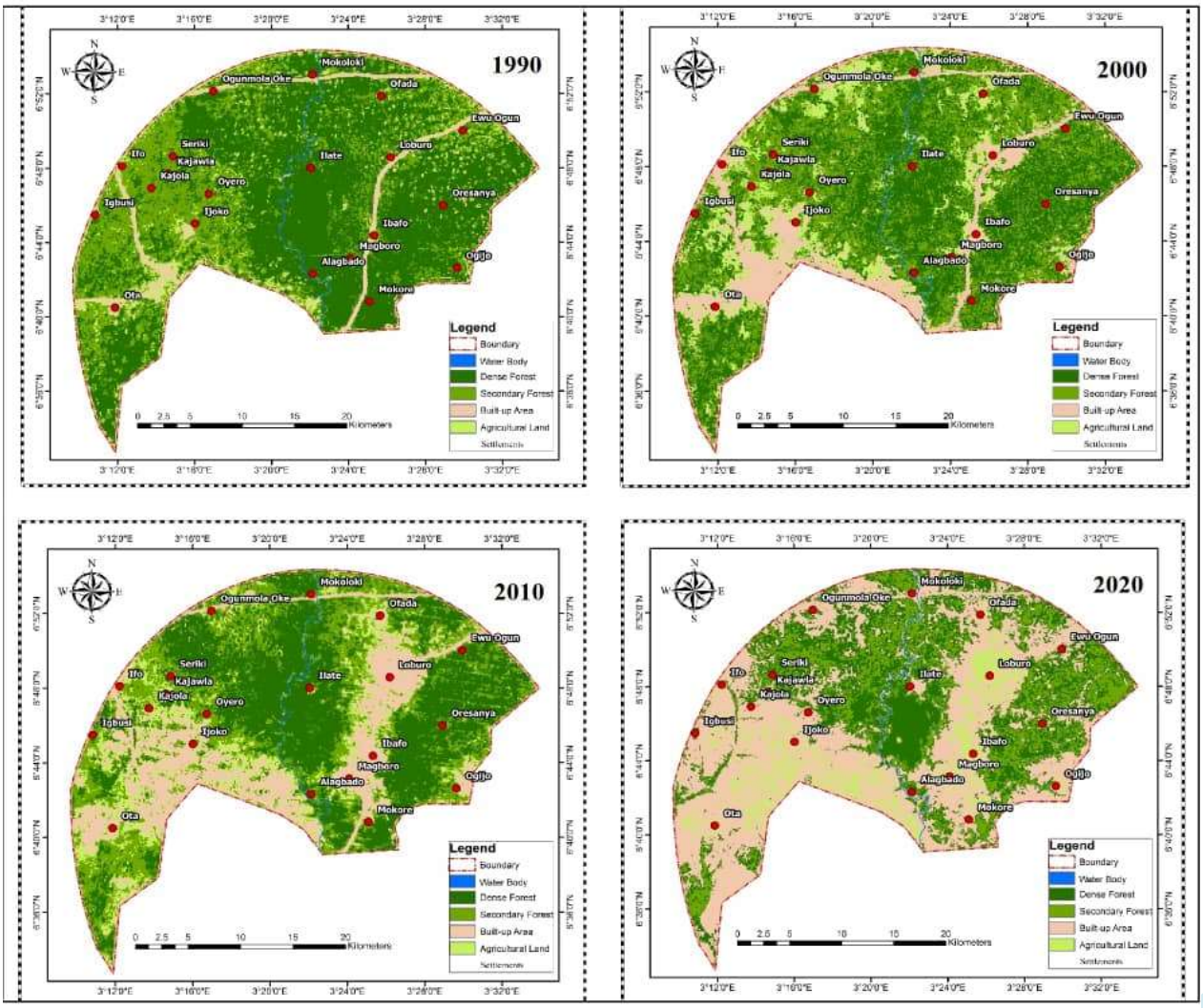


Figure 7: Comparative land use/cover pattern
Source: Author's Field Analysis

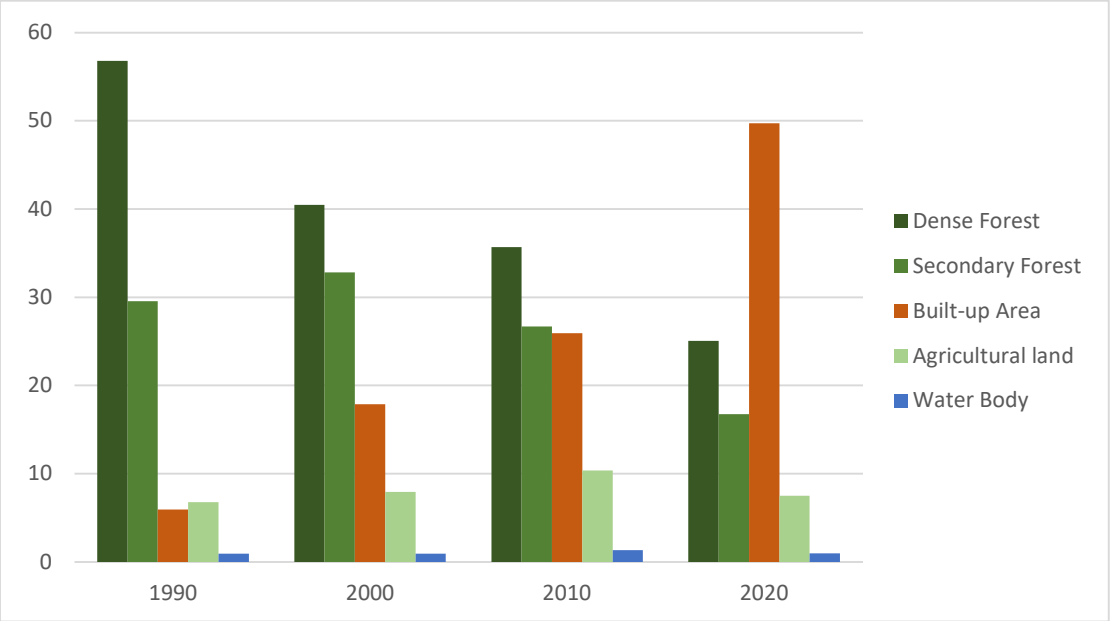


Figure 8: Proportional distribution of land use/cover between 1990 and 2020
Source: Author's Field Analysis

A further insight into the changing dynamics of land use/land cover in this study is the analysis of the degree and direction of the change over the time of the review. The trend of change was examined by observing the products of periodical change per land use component divided by the total sum of change for all components per period as a multiple of a hundred to express the change as a percentage. The evolved character of periodical changes in the land use in the study area is such that as much as 36.666 square kilometres of dense forest representing 45.71 per cent of the relationship was lost within the 1990 to 2000 period. However, the built-up area was expanded within the same period by 26.794 square kilometres being 33.46 per cent of the total for that component (Table 2). This pattern of change continued between 2000 and 2010 where the dense and secondary forested land cover diminished by 23.97 and 30.60 per cent respectively, whereas the built-up area component alone shored up by 40.38 per cent within the same period (Table 2). A graphical illustration of the evolved trend of the changing landscape features of land use/land cover pattern is also charted (Figure 9).

Considering the overall change between the base and apex year, 1990 and 2020, almost half of the entire land mass, 49.96 per cent of dense and secondary forest has been conceded in contradistinction to the built-up area which has expanded also by almost half being 49.11 per cent. The remaining 0.93 per cent was accounted for by agricultural land (0.79 per cent) and water body (0.14 per cent). A graphical illustration of the evolved characteristics of change in LULC under discourse is depicted to reflect the pattern in a positive and negative comparison of direction of the changes among the various LULC components (see Figure 10). The equilibrium is set at zero (0), the negative side is the quantum of loss of land per component in square kilometres while the positive side reflects the amount of land consumed by expansion or growth of the particular land use/land cover component.

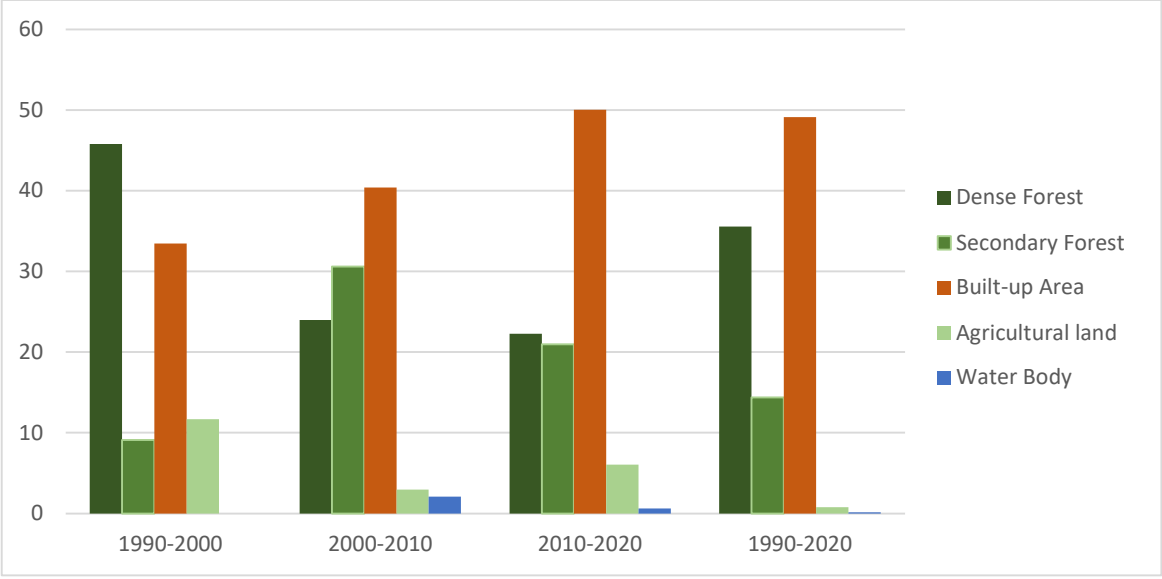


Figure 9 Chart showing trend of land use/land cover change over time

Source: Author's Field Analysis

Table 2 Trend of land use/land cover change in the study area

Class Name	1990 – 2000		2000 – 2010		2010 – 2020		1990 - 2020	
	Area Change km²	% Change	Area Change km²	% Change	Area Change km²	% Change	Area Change km²	% Change
Dense Forest	-36.666	45.77	-10.745	23.97	-23.812	22.39	-71.223	35.57
Secondary Forest	7.305	9.09	-13.717	30.60	-22.400	20.98	-28.812	14.39
Built-up Area	26.794	33.46	18.102	40.38	53.441	50.05	98.337	49.11
Agricultural Land	9.354	11.68	-1.322	2.95	-6.454	6.05	1.578	0.79
Water Body	No Change	No Change	0.94	2.10	-0.658	0.63	0.282	0.14
Total	80.119	100.00	44.826	100.00	106.765	100.00	200.232	100.00

(*Trend*) percentage change = observed change ÷ sum of change x 100

Source: Author's Field Analysis

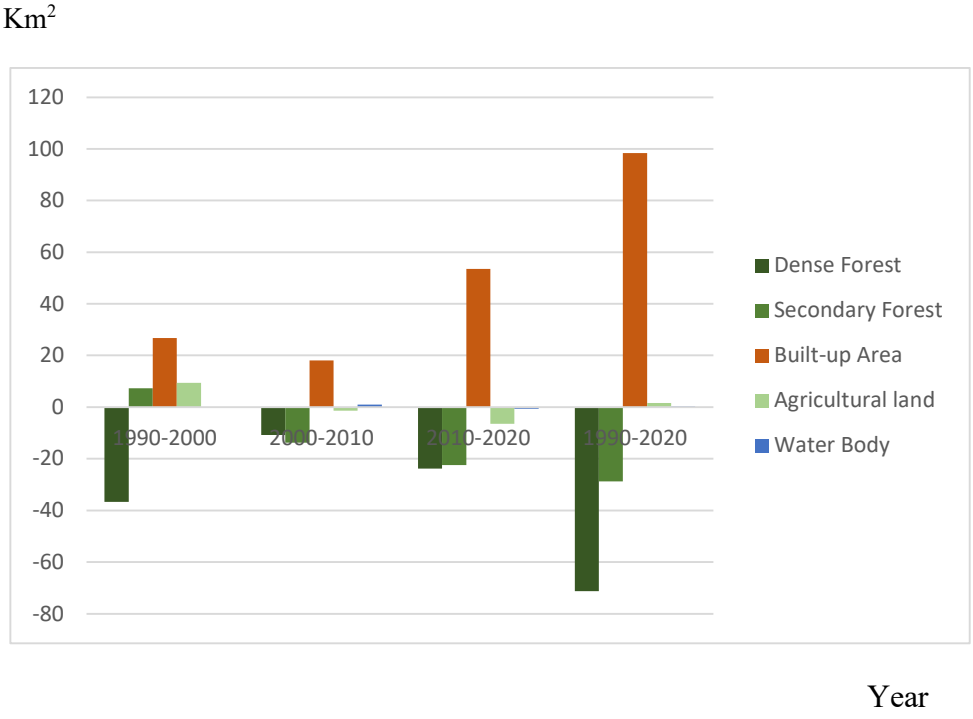


Figure 10 Proportional direction of change in land use/land cover in the study area
Source: Author's Field Analysis

The evolving settlement pattern over the time series evaluated in this study and its effect on the land use/land cover and liveability of the study area puts to perspective the changing landscape, the habitation generated and the consequences on the environment. The ensuing pattern of habitation giving rise to the nature of urban/built-up development reflects a continuous growth and expansion of sprawling-built development across the length and breadth of the DPA (see Figure 11). A look at the character of the urban/built-up area shows a massive settlement expansion through the years from 1990 to 2020 with the developed built form almost surpassing the yet to be developed land.

Considering the scale and dimension of urban built-up development in this study, it is deduced from this discourse that within the span of thirty years, built development grew rapidly from 13.354 square kilometres in 1990 to 111.691 square kilometres in 2020 (Table 3). This represents a concomitant increase of 88 per cent within the time frame under review. If this rate of urban built-up expansion is related to the entire 224.694 square kilometres, about half of the entire landscape of the study area is completely built as at 2020. This trend also displays a successive expansion of the built-up development with average decennial increase of not less than 3 per cent (Table 3). A close examination of the composite land use/land cover imagery shows the complexity of the interrelationship of the evolving landscape through the periods under review (Figure 12). It shows built development extending to all possible areas almost unrestricted.

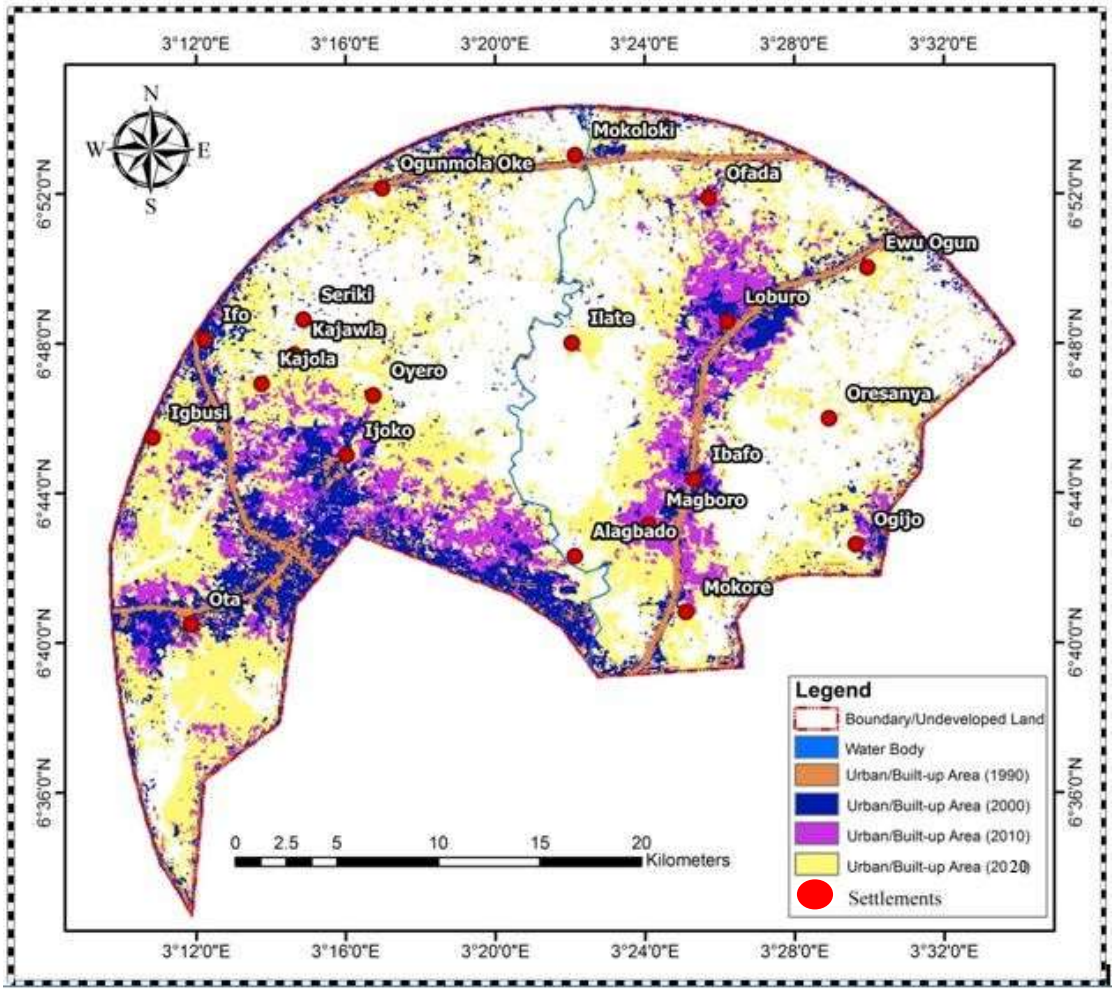


Figure 11 Pattern of built development

Source: Author's Field Analysis

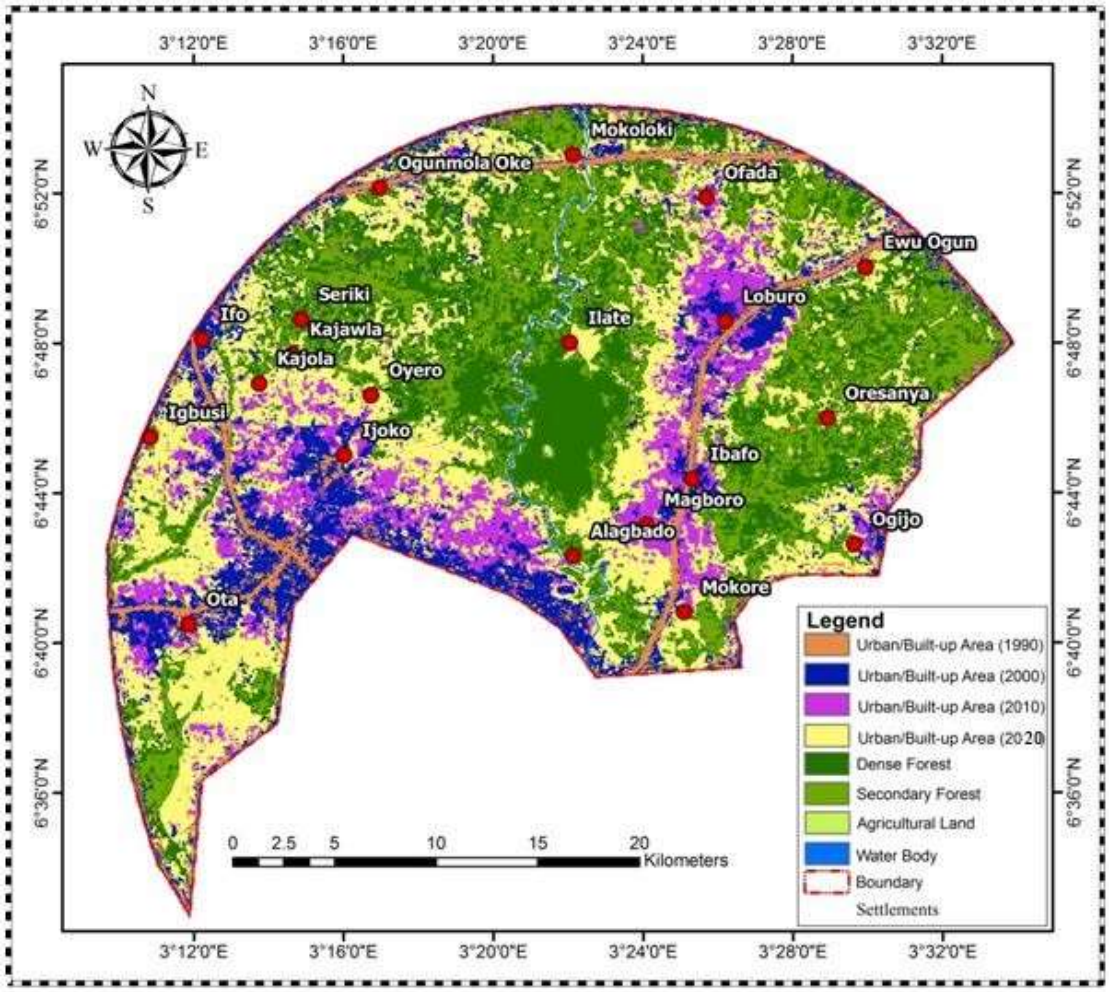


Figure 12 Composite land use/cover for 1990, 2000, 2010 and 2020

Source: Author's Field Analysis

Table 3 Urban sprawl quantitative analysis

Year	Extent of urban area (km²)	Total area	Rate of change km²	% Change	Decennial rate of Change km²	Decennial rate of Change %
1990	13.354	224.694	--	5.94	--	--
1990 – 2000	40.148	224.694	26.794	17.87	2.679	3.35
2000 – 2010	58.250	224.694	18.102	25.92	1.181	4.04
2010 – 2020	111.691	224.694	53.441	49.71	5.344	3.24

Source: Author's Field Analysis

Pattern of Built Development

The pattern of built development in the DPA displays a sprawling configuration. The sprawling occurs along the major transport corridors. This character buttresses multiple nuclei theory of invasion of transport routes generated by agglomeration. The explosion of settlement expansion from Lagos metropolis has spread into the study area giving rise to conundrums along the Lagos-Sango Otta-Ifo axis and Lagos-Ibafo-Mowe axis. The morphology of the settlement spread is such that is characterized by a mixture of densely built-up urban centres interspersed with leap frog extension of built-up areas into the urban fringes. Generally, the image captured reflects a progressive expansion of the built-up area from 5.94% in 1990 to 49.71% in 2020. This was a marked contrast to other major components of land uses and land cover namely; dense forest, secondary forest, agricultural land and water bodies, which altogether accounted for 94.06% in 1990 and 50.29% in 2020. The emergent picture of land use/land cover development indicates an advanced stage of horizontal extension, a stage of discontinuity. The future therefore portends the consolidation of the present situation to prevent urban blight. Actionable measures should be taken to forestall undesirable consequences of uncontrolled urban development.

The relationship between the major components of land uses and land cover is such that the built-up area was expanding almost ten times whereas other land uses and land cover components have reduced by almost two times within the same period of about three decades. To this effect, it can be safely inferred that the built-up area was expanding in a geometrical progression while other land use components were sliding to give way for the increasingly expanding built-up area. However, the performance of the other land use components is such that the dense forest slides from 56.77 per cent in 1990 to 25.07 per cent in 2018, secondary forest slides from 29.56 per cent in 1990 to 16.74 per cent in 2020, while agricultural land and water body increased slightly from 6.79 per cent in 1990 to 7.4 per cent in 2020 and 0.94 per cent in 1990 to 0.99 per cent in 2020 respectively.

Effect of sprawl on the natural and built environment

The toll of the depleting natural resources and conservation area (dense and secondary forests) on the natural habitats is variously astounding. The interplay between the built-up area as a consumptive component of LULC and forests, agricultural land and water body as conservation component of LULC accounts for the process and product of the natural and built environment.

There is the perceived increasing loss of green space for agriculture, flora and fauna preservation as a result of urban sprawl which intuitively threatens ecological balance. Settlement expansion has caused an increase in the consumption of land resources; soil, water and vegetation, and social amenities; commuting, schooling, health care, security, electricity and others, resulting in resource and amenity deficits. All these triggers the threat to the natural habitat, the decline in the quantum of land for agriculture, forestry, wildlife, housing and urban development and negative impact on the quality of life and well-being of residents along those land uses.

The intervening process of urban sprawl has created a widespread usurpation of rural land space by accelerated proliferation of urban development in the study area. The changing landscape is dictated by human behavioural attitudes which seek to maximize benefits from the physical, social, cultural and economic environments as the common good upon which the social dynamics to build infrastructure for human survival and sustenance rests.

Consequently, many of the original dispersed settlements were fast disappearing and being overrun by unprecedented urban settlement expansion in the study area. Some of the erstwhile dispersed settlements have been dismembered. They were no longer identified by their original names and identities. Beyond this, many of the residents in this category suffer acute accessibility problems as access to their settlements or neighbourhoods were hindered by imposed prevention of thoroughfare across acquired large land holdings. The emergent land use causes route diversion which led to prolonged inter-township journeys, increased transport costs and restricted modal choice of transportation. Although some of the villages were transformed by way of resettling them in newly built modern houses, as was the case of Oloparun Satellite Village by the Redeemed Christian Church of God. However, some of the residents were feeling insecure from the

psychological point of view. They expressed social, economic and environmental deprivations.

The emergent settlements were nucleated continuum forming conundrum along Agbara-Atan-Sango Otta-Arigbajo-Ifo axis, Magbon-Akeran-Mowe-Ibafo-Loburo axis, and Ogijo-Odonguyan axis. These settlement expansions were merely intersected or limited by Ogun River course to the western and central area, and by Owiwi river course to the eastern area of the DPA.

Conclusion

The essence of the foregoing discourse is to provoke awareness of the associated potential debilitating effects of the seemingly unrestricted and unregulated built development in the Ogun State DPA. Thus, the pattern and dimension of the changing land use/land cover have been identified, classified, categorized and the main forces behind them analysed in this discourse. This spotlights the implication of the pattern of settlement spread as a determinant of the person-environment relationship. The pattern influences residents' access to land and other natural resources for housing, transportation and other socio-economic activities.

The cluster pattern of buildings and built-up areas impact land use, land conservation and reticulation of municipal facilities and services which influences the liveability of the environment. The consequences of urban sprawl characterized by rapid expansion of built development are: increasing pressure on available infrastructure, disappearance of green belts and open spaces, expansion of impervious areas and loss of wet land. Others are unlimited outward development in low density and leapfrog form at the outer reaches of a metropolitan area, premature or poorly planned conversion of rural land to other uses. These are exacerbated by the lack of central ownership or planning and highly fragmented land use governance. If the trend continues, there is bound to be the continuous destruction of the country side being stripped of natural vegetation, promotion of pollution of different sorts of soil, water, air and noise within the ambient sprawling environment and the vitality of existing urban areas undermined. The fact remains that the land area is finite and could not be expanded beyond some defined limits.

In effect, there is the auspicious need to initiate positive pro-active measures to forge a favourable balance between the ever-consumptive human induced built development and the susceptible natural habitat. Efforts should not be spared to create actionable measures capable of regenerating the ambient environment to support and sustain the expanding-built development. Regulatory agencies in land use and built development must be strengthened and made vibrant enough to enshrine and implement appropriate strategies to govern land use within designated political constituents. The systemic policy framework for planning should embrace established legal framework, planning norms and regulations for guiding and nurturing physical development. The legal framework constitutes the available enabling laws, ordinances, official prescriptions deployed by government for urban and regional planning related activities. People-centred policies and procedures for land acquisition and use can be explored within neighbourhood units to be formulated among community-based organizations.

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