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Spatiotemporal dynamics of land-use changes in Yenagoa city

Abstract

The study aimed to assess the dynamics of land use changes in the urban environment of Yenagoa City, Nigeria as to understand the changes, consequences and ameliorate the changes. Objectives of the study are to determine land use changes that are evident in the study between 1996 to 2020; identify and assess the causes and dynamics of the land use changes that are evident in the study area; ddetermine the consequences of land use changes in the urban environment of the study area; and provide physical planning measures to monitor, control and manage land use changes in Yenagoa City to promote the sustainable urban environment. The study employed a Mixed Methods Research approach of concurrent triangulation and longitudinal research designs for the collection and analyses of data in the study. The study also employed remote sensing technique, Geographic Information Systems, and time series analysis techniques to collect and analyse data for the study. Stratified and simple random sampling techniques were employed for the collection of data. A total of 9 communities were chosen and sampled and 396 respondents (households) were determined and interviewed as sample size using the Taro Yamane formula. Key informants from government agencies and professionals were interviewed using their responses as themes and concepts for content analysis. The study revealed that there are significant land-use changes such as water bodies, vegetation, and built-up areas between 1996-2020. The study also identified population increases and the demand for land for urban development. The study also identified the dynamics that have caused these changes including an increase in the household size, nearness to the workplace, improve security, cheap rent, increase in migrants, employment opportunities and lack of implementation of the development plan. The consequences identified by the study include constant changes in water bodies, vegetation and built-up areas, the prevalence of flooding, encroachment to marginal lands, slum and squatter development, constant pollution, and modification of the social environment. The study recommends that; to achieve a sustainable urban development including the Yenagoa Master Plan of 2004 should be reviewed and implemented guide, control and manage urban land-use changes, the establishment of an urban land-use framework that will foster synergy of all physical planning agencies and institutions, planning and re-planning of new neighbourhoods and existing communities, continuous urban studies of land-use and environment management and encourage citizen education and participation in environmental management in the city.

Keywords: dynamics, land-use change, urban environment, Yenegoa city

Volume 6 Issue 4 - 2021

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Received: June 11, 2021 | **Published:** July 06, 2021

Background of the study

The earth in recent times is experiencing rapid growth in urban population and spatial form.[1] These transformations are occurring more in urban areas of developing countries of Africa and Asia.[2] This increase has led to rapid urbanisation and urban land and spaces demand development to meet human activities.[3] The location activities and development of infrastructures, facilities and structures in the urban space have led to the transformation of the landscape from its natural form to a social environment.

Urbanisation statistics globally present world population has increased from 737 million in 1950 to 3.5 billion in 2016 and estimated that 54.5% of this world population by the UN are living in urban areas.[4] Recently, as recorded in 2018 urban population globally stand at 4.2 billion people.[5] This rapid population growth poses threat to the management and planning of urban areas in developing countries, equally African urban areas exposed to this detrimental condition that may limit her attainment of sustainable urban development. African urban areas that are accompanied by the emergence of rapid urbanisation and informality in settlements without adequate infrastructure and services and increasing poor and vulnerable populations are presented with a more complex and dynamic system to handle.[6] These conditions are the same in most urban areas in Nigeria, likewise the city of Yenagoa which is a fast and rapid urbanising urban area in the Niger Delta region of Nigeria. Thus, decisions made over time to manage the city growth reflects the magnitude of orderliness and or chaos found in urban areas.[7]

Yenagoa, which was made the capital city of Bayelsa State in 1996, is experiencing rapid urbanisation. The city is witnessing changes in the landscape of the urban environment without proper management and planning. Though, as the new state capital in the state of Nigeria, it is expected to overcome the challenges faced by many old cities and urban areas in Nigeria, but the reverse is a manifestation of spatial changes that are occurring without the consideration of sustainable development and the green agenda principles and targets for developing an urban area. These spatial changes occurring have to posit questions to researchers, scholars, governments, and other urban stakeholders such as Town Planners and other professionals in the built environment. There is a need to assess the dynamics of land-use changes in the urban environment of Yenagoa City, Nigeria

and provide physical planning measures that will control and manage these changes that are occurring in the city environment to achieve a sustainable urban environment.

Statement of the problem

Bayelsa State was created in 1996 and Yenagoa City Local Government Area became the capital city of the state but formally was a Local Government Area in old Rivers State.[8] This transition from a Local Government Area to the capital city of a state has attracted people, investors, and other forms of development. The city has evolved from the old traditional Yenagoa settlement to a destination choice for migrants around its fringes and other settlements outside the state in search of better living conditions and economic opportunities. This condition has caused an increase in the human population and spatial expansion. There is a rapid palpable increase in population and spatial expansion that has resulted in the land-use change from its natural state to a more social environment. There is no proper urban policy framework to monitor, control and manage these rapid changes that are occurring in the city, even though there is a master plan prepared for the city in 2004 by Bayelsa State Government. Hence, this condition has changed the dynamics of the urban environment and projected some consequences to the environment and the inhabitants of the city. There is a need to assess the causes of the land-use changes occurring in the city and the dynamics of these changes. The study will help to understand the dynamics of urban environmental land-use changes that are occurring and provide physical planning measures as an urban policy framework to ameliorate the consequences and promote sustainable urban development. This study will also add to the body of knowledge in urban land-use changes, consequences and dynamics in the urban environment that are caused by rapid urbanisation.

Aim and objectives of the study

The study aims to assess the dynamics of land-use changes in the urban environment of Yenagoa City, Nigeria as to understand the changes, consequences and ameliorate the changes.

The specific objectives of the study are to:

I. Determine land-use changes that are evident in the study between 1996 to 2020;

II. Identify and assess the causes and dynamics of the land-use changes that are evident in the study area,

III. Determine the consequences of land-use changes in the urban environment of the study area; and

IV. Provide physical planning measures to monitor, control and manage land-use changes in Yenagoa City to promote a sustainable urban environment.

Scope of the study

The study geographically covers Yenagoa City in Bayelsa State, Nigeria (Figure 1) (Figure 2). The study in the content will determine land-use changes that are evident in the study between 1996 to 2020; identify and assess the causes and dynamics of land-use changes that are evident in the study area; determine the consequences of land-use changes in the urban environment of the study area; and provide physical planning measures to monitor, control and manage land-use changes in Yenagoa City to promote the sustainable urban environment.

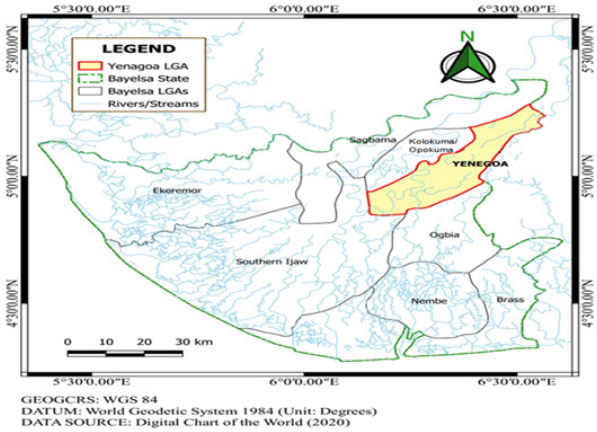

Figure 1 Map of Bayelsa State

Source: Surveyor General's Office, Bayelsa State, 2020.

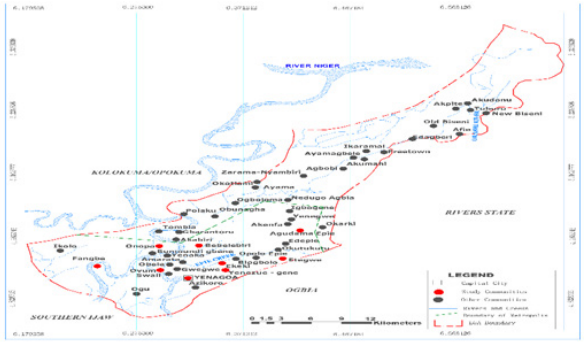

Figure 2 Yenagoa city showing communities and selected sampled communities in the study area.

Source: Fieldwork, 2021.

Causes and dynamics of land-use change in urban environment

Urban areas are fast-growing at an unprecedented rate and these growths are triggered by several identified factors. Bhatta[9] and Savani & Bhatt[10] in their studies highlighted that population growth is a major factor that contributes to and causes urban growth leading to land-use changes experienced in many cities. This is a result of the phenomenal migration of people to urban areas and the natural increase in population through birth as healthcare facilities and services improve in the urban areas.[10] This causes the increase in demand for urban land for housing development and further increases densification of the inner city and spread outwardly to the urban peripheries.[3]

The existence of economic resources and opportunities in urban areas attracts investments and development industries within its confines. This creates an agglomeration of industries by diversifying opportunities that attract people and other forms of businesses.[3,9] This condition presents the demand for housing and other social and economic infrastructure and services to industries and people needs that occupy the urban area.[3,11] This encourages urban growth and development leading to land-use changes and trigger rapid urbanisation.[3] The construction of new roads makes movement within a settlement easy and also connects different land-uses and reduce journey between inner-city area and open the urban periphery. This expansion thus helps to contribute to an increase in the urban area in size and form thereby encourage changes in land-use in the urban

Citation: Ebinemi IE, Tari E, Ibama B. Spatiotemporal dynamics of land-use changes in Yenagoa city. *MOJ Eco Environ Sci.* 2021;6(4):127–134.
DOI: 10.15406/mojes.2021.06.00225

area.[9] Leapfrog development also contributes to the urban area expansion and reconfiguration to change the urban landscape.[12]

Uncoordinated urban policies and regulations by the government in urban areas is a contributory factor to urban sprawl and uncontrolled urbanisation. Since government policies and programmes in developing countries are not clearly defined, changes in land-use occur without coordination.[9] The lapses from poor implementation and supervision of development plans exacerbate changes in land-use[9] and encourage land speculation by investors especially at the urban peripheries because of cheap cost of land and property tax is very low.[10] This will enable poor urban dwellers to access land easily to develop their buildings and also rent cheap accommodation, hence increase the spread of spatial area and changes land-use 2016.[9] The living cost and property cost in the inner-city area are higher than in the suburb due to congestion, overcrowding and high densification. These conditions promote the demand for land in the suburbs as households seek single-family homes and more living space for residence since land is cheap and available. This further increases the spatial area and causes land-use changes.[9]

Determinants and consequences of land-use changes in urban environment

Human activities in the urban areas have a direct impact on the urban environment. Issues of rapid urbanisation, formation of slums and squatter developments, urban sprawl and promote land-use changes and poor urban environment.[3] Thus, poor physical planning mechanisms depicting many urban environments with challenges.[13] These conditions occurred because of improper coordination of spatial planning and control of the urban population by the government through physical planning. Development is springing up sporadically without control outwardly to different directions beyond the peripheries of the urban area boundaries and reconfigure the landscape and causes changes in land-use.[9]

Rapid urban growth without proper planning, management and control spurs the formation and proliferation of slum and squatter developments in different parts of the urban environment.[3] These developments are major consequences of poorly managed urbanisation as inner-city areas being saturated, congested and become delay in physical, social, and economic form. The rapid rural-urban and urban-urban migration promotes the proliferation of slum and squatter formations in urban areas thereby changing the urban landscape.[3,9] The continuous expansion of urban areas especially with human activities encourage changes in land-use and increases the pollution level in the urban environments. Green areas and open spaces are converted to a concrete and impervious surface which increases the temperature level of the urban environment causing urban heat islands, greenhouse effects and climate change.[14] Also, human activities such as industrial development, vehicular movement and effluence from domestic activities increase pollution in the environment.[3]

The urban expansion increases changes in land-use in the urban environment. Areas with a social class of people are sometimes left unattended by the government which encourage the manifestation of urban decay and or deteriorates fast.[9] The encroachment of urban development on natural and open spaces in the urban area changes the cityscape and impact the urban environment (Grimm, Grove, Pickett and Redman, 2000). Such development destroys farmlands, forests, woodlands and reduces the economic values of such environment and its resources.[15]

Management measures to land-use changes in urban environment

Management of urban settlements and growth in a city is important to the sustainable growth and development of the city. Many urban centres have initiated policies, programmes and plans for the effective and efficient management and control of growth in their cities. One prominent and current environmental management framework for urban growth management is the Sustainable Urban Development Framework (SUDF).[16] Its concerns include the nature, trends, resources management and infrastructure provision which determines the strategies of growth management in urban areas. These factors are used to determine draw-up an environmental management framework to manage and control urban growth and land-use changes.[16]

Another framework for managing the urban environment is the Integrated Urban Management and Environmental Planning (IUMEP) which involve measuring the performance of cities through the strategic planning process[17] and using specific environmental indicators to determine the environmental quality and changes in land-use and the cityscape.[17] The framework helps policymakers, urban planners, and other urban stakeholders to prioritise and set environmental goals and objectives to achieve sustainable urban development. This measure and monitor the performance of urban areas, environmental accountability, and urban governance system.[17]

Urban Environmental Management (UEM) framework has been developed to manage the urban environment in Southeast Asian countries (Edelman, 2016). The framework identified urban-related issues like poverty, effects of industrialisation, transportation, water pollution, as well as finance and energy in resolving the urban growth and environmental management issues which can cause changes in the urban land-use system (Edelman, 2016). The framework applied physical planning and the urban development process to confront the challenges in urban areas caused by urbanisation and climate change. The UEM framework provides mitigation and monitoring processes to managing urban growth and environmental problems caused by rapid urbanisation and other urban issues by urban planners to guide decision-makers on how to handle urbanisation and the environment to benefit the populace.[18] All these frameworks have highlighted processes and indicators that should be adopted to monitor and manage the urban environment that is frequently changing due to rapid urbanisation and improper physical planning.

Methodology

As a longitudinal research, the study adopted the Mixed Method Research (MMR) approach with concurrent triangulation. The study also employed remote sensing, Geographic Information System (GIS) techniques and time series analysis to collect and analyse data for the study. Stratified and simple random sampling techniques were deployed to collect the data in the study area. To determine the sample size, the study identified twenty-nine (29) communities in the study area, stratified (classified) the communities according to their population size out of which nine (9) communities representing 30% of the communities were randomly selected and sampled. The study applied the Taro Yamane formula to determine the sample size. A total of three hundred and ninety-six (396) heads of households were interviewed. The average household size of 5 persons was used to determine the total number of households in the study area (Table 1). Open and close-ended questionnaires were to heads of households to collect primary data in the study area. Key informants from government agencies and some built environment professionals

concerning land-use changes and urban environment were also interviewed using their responses served as themes for the content analysis. Thereafter, the collation and analysis of the data for the study was carried out using times series analysis, Geographic Information System (GIS), and remote sensing techniques.

Table 1 Sample size for the study

S/No.	Sampled communities	1991 population	2020 population projection	No. of household (5 persons per HH)	No. of households sampled
1	Bebelebiri	219	1,277	255	3
2	Etegwe	524	3,055	611	7
3	Ekeki	1622	9,458	1892	21
4	Yenizue-Gene	2086	12,164	2433	27
5	Agudama-Epie	3002	17,505	3501	38
6	Onopa	3371	19,656	3931	43
7	Famgbe	5229	30,490	6098	66
8	Ovom	6320	36,851	7370.2	80
9	Yenagoa	8723	50,864	10173	111
	Total	31096	181,320	36264	396

Source: NPC, 1991; NPC, 2018; NBS, 2016; Fieldwork, 2021

Results and findings

Land-use changes evident between 1996 to 2020

The study has identified and detected there is evidence of land-use changes between 1996-2020 from satellite imageries observed during this period. When Bayelsa State was created and Yenagoa became its capital city in 1996, the urban environment was more of natural features such as waterbodies and vegetation, though a little percentage of built-up area (Figures 3–6). The study area covered 20,915.38 Ha of land including water bodies, vegetation, and built-up area which land-use change has occurred significantly, affecting the urban environment landscape and form. The satellite imagery of 1996 showed development was concentrated within the central area of Yenagoa with little development scattered at peripheries of north-eastern part of the study area. This was observed in Table 2 and Figure 7 as land-use features including waterbody, vegetation and built-up area remain 709.20 Ha, 17,708.31 Ha and 2,497.89 Ha representing 3.4%, 84.7% and 11.4% respectively. In 2004, development started spreading further to other parts of the city especially towards the western part and densely in the central area and land-use changes started occurring rapidly. This is observed from the land-use features that were analysed as waterbody became 712.98 Ha, vegetation is 15,647.67 Ha while the built-up area 4,554.73 Ha accounting for 3.4%, 74.8% and 21.8% respectively. The showed that the built-up area in the city has increased more than 10% as of 1996 while water body and vegetation have reduced in sizes.

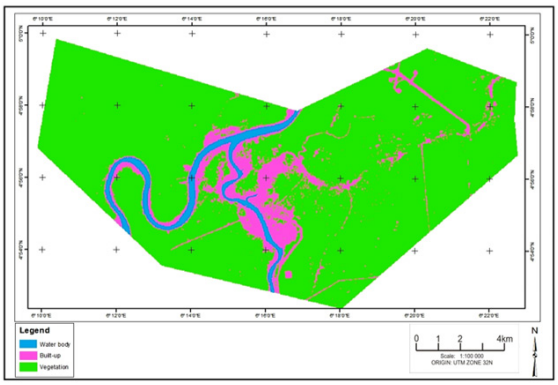

Figure 3 Land-use and classification of Yenagoa city in 1996.

Source: Fieldwork, 2021

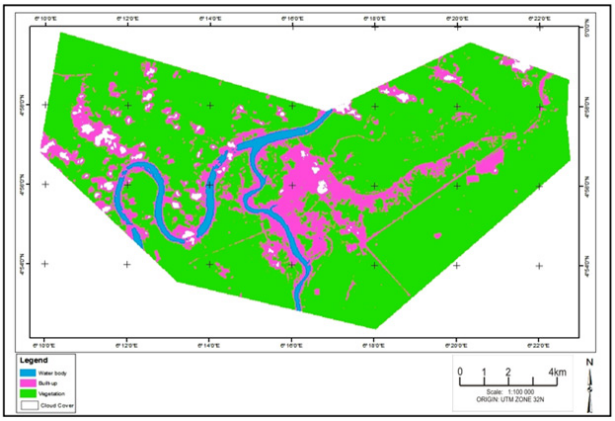

Figure 4 Land-use and classification of Yenagoa city in 2004.

Source: Fieldwork, 2021

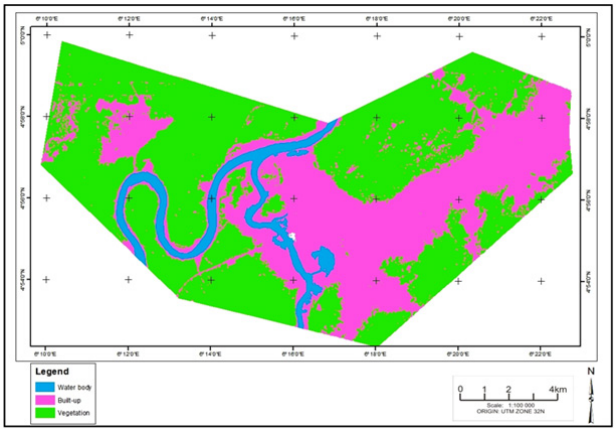

Figure 5 Land-use and classification of Yenagoa city in 2012.

Source: Fieldwork, 2021

In 2012, the same phenomenon occurred as land-use changes were detected from the satellite imagery of 2012. This period of development has moved back towards the north-eastern and southern parts and increasing urban densification in the study area as these areas have more stable land for development. It is observed, water body

indicated 1088.35 Ha, vegetation was 12,022.73 and built-up area was 7,804.30 this equally represent 5.2%, 57.4% and 37.4% respectively (Figure 5) (Figure 7) (Table 2). The increase in a water body as a result of the 2012 flooding that ravaged many parts of Nigeria as the southern part which is deltaic was the recipient of the water from the upstream of the country to empty into the Atlantic Ocean. Though, the land-use changes in vegetation and the built-up area continue as vegetation features continue to shrink while the built-up area increased in size by more than 15%. In 2020, the satellite imagery indicated that land-use changes and physical development spread further rapidly to all directions of the city but lower in the northern part. Data from observation showed water body and vegetation has reduced to 867.10 Ha and 9,578.18 Ha representing 4.1% and 45.8% respectively. But the built-up area has increased significantly to 10,477.50 Ha representing 50.1% (Figure 6) (Figure 7) (Table 2).

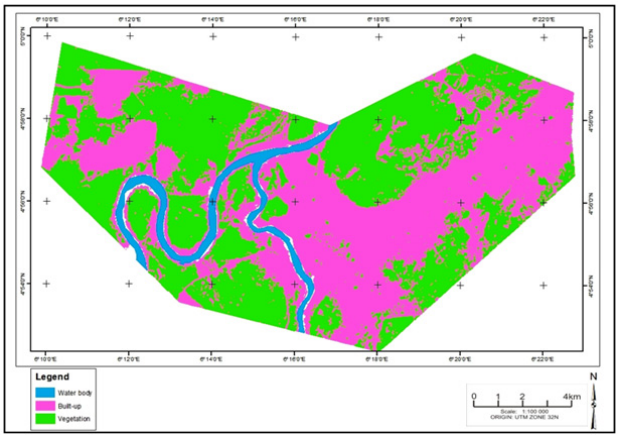

Figure 6 Land-use and classification of Yenagoa city in 1996.
Source: Fieldwork, 2021

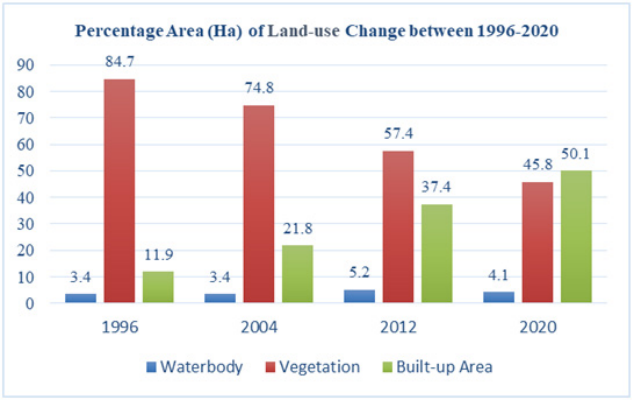

Figure 7 Percentage Area (Ha) of land-use change between 1996-2020.
Source: Fieldwork, 2020

Table 3 from observations indicated that there are spatial changes detected in the land-use features of the study area. The data showed between 1996-2004 in waterbody showed a positive increase to +3.78 Ha, vegetation negative increase to -2,060.64 Ha (reduction) while the built-up area positive increase +2,056.86 Ha. The period between 2004-2012 showed further positive increase in the water body to +375.37 Ha, vegetation negative increase to -3,624.94 Ha (reduction) while built-up area positive increase to +3,249.57 Ha. However, between 2012-2020, the water body and vegetation have reduced negatively to -221.25 Ha and -2.451.95 Ha respectively, while the built-up area has further increased positively to +2,673.20 Ha. The has demonstrated that there are significant changes in land-uses within the study area in the study period of 1996-2020 from satellite imageries and observations as detected from the study area.

Table 2 Land-use changes between 1988-2020 in the study area (Ha)

Land-use	1996	2004	2012	2020
Waterbody	709.2	712.98	1088.35	867.1
Vegetation	17,708.31	15,647.67	12,022.73	9,570.18
Built-up Area	2,497.87	4,554.73	7,804.30	10,477.50
Total (Ha)	20,915.38	20,915.38	20,915.38	20,915.38

Source: Fieldwork, 2021

Table 3 Spatial change detection in area (Ha) of land-use between 1996-2020

Land-use	1996-2004	2004-2012	2012-2020
Waterbody	3.78	375.37	-221.25
Vegetation	-2,060.64	-3,624.94	-2.451.95
Built-up Area	2,056.86	3,249.57	2,673.20

Source: Fieldwork, 2021

Identified causes and dynamics of land-use changes

The study has identified several factors that have caused and dynamic land-use changes that occurred in the study area. One prominent factor that causes a land-use change in the study area identified is the increase in population size through natural increase (childbirth) and migration process. This is observed from the population projection calculated for the study from 1991-2020 as shown in Table 1. As the household number is increasing between the average of 2-3, 4-5 and 6-7 persons, demand for land has increased (Table 4). This has further led to the demand for land for developing residential, commercial, industrial, recreational, and infrastructural facilities and services development in the study area.

Table 4 Number of persons in household

no. of persons	no.	%
1	36	9.1
2–3	144	36.5
4–5	133	33.7
6–7	51	12.9
8–9	19	4.8
NA	12	3
Total	395	100

Source: Fieldwork, 2021

However, reasons given by respondents as revealed in the study that has caused land-use changes that are observed rapidly in recent times are nearness to the workplace (36.7), good infrastructure and services (16.7%), improve security (15.9%), cheaper rent (10.1%), good access roads (9.1%) and nearness to market (4.6%) as indicated in Table 5. The study revealed about 50% of the residents are non-indigenes of Bayelsa State (outside Niger Delta region and other nationalities) that migrated to the city as they were from outside the Yenagoa City but within Bayelsa State, other states in the Niger Delta region (Figure 8). Over half of the respondents are indigenes of the state while 42% are non-indigenes showing that people are attracted to the city which has made it grow spatially and demographically.

Table 5 Reasons for choosing to reside in this community

S/No.	Reasons	No.	%
1	Nearness to workplace	145	36.7
2	Good infrastructure and services	64	16.2
3	Improve security	63	15.9
4	Good access road	36	9.1
5	Cheaper rent	40	10.1
6	Nearness to market	29	7.3
7	Others (Specify)	18	4.6
	Total	395	100

Source: Fieldwork, 2021

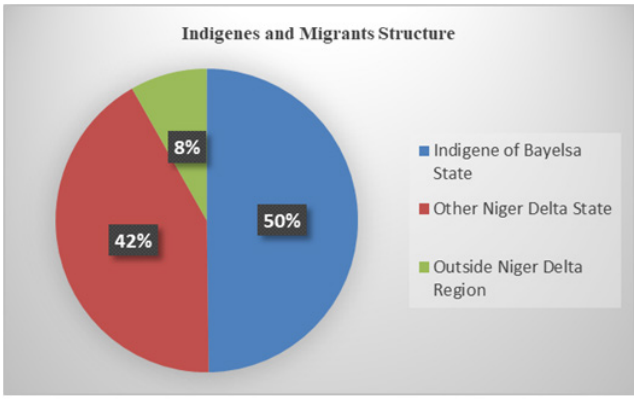

Figure 8 Indigene and migrants structure.

Source: Fieldwork, 2021

Employment opportunities have been identified and attributed to having caused land-use changes in the study area. The study revealed Yenagoa City host many residents as they engaged in different trades and economic activities presented as opportunities for the inhabitants. The study recorded that some of the types of employment engaged by residents are in the public and private sectors. These employments include civil servants, organised private sector, self-employed (technicians and artisans, farmers, fishermen, traders/businessmen, religious leaders, medical personnel, and engineers) as the city has attracted migrants. The employments have given reason to residents to demand land for housing development (owner-occupier and renter accommodation) and other economic activities where their business will strive. The reasons given by respondents are cheaper land found at the urban fringes accounting for 34%. Other reasons indicated by respondents include conducive neighbourhood, the good road network in the communities and the city and crime-free neighbourhoods accounting for 27%, 19% and 13% respectively (Figure 9). The development of urban infrastructure and services has made attracted people to the city. Some of these developments identified in the study area include healthcare, educational (primary and secondary schools), shopping, recreational, worship and improved transportation facilities and services such as Sani Abacha, Isaac Boro, D.S.P. Alamieyeseigha, Kpansia, Tombia, Elebele/Ogbia Roads and Swali Bridge in the city. Experts also revealed in the study that uncoordinated and ineffective development control activities by physical planning agencies are major contributing factors to land-use changes occurring in the city. The failure of government agencies to implement the existing development plan of the city (Yenagoa Master Plan, 2004) and also the non-preparation of planning and development schemes have further exacerbated the unplanned land-use changes experienced in the study area. This is triggered by inadequate funding, inadequate personnel and political will towards urban planning, development, and management in the city. These factors have provided the dynamics that have caused land-use changes in the city promoted by more human factors and sometimes a natural phenomenon that has elicited concern for sustainable urban development.

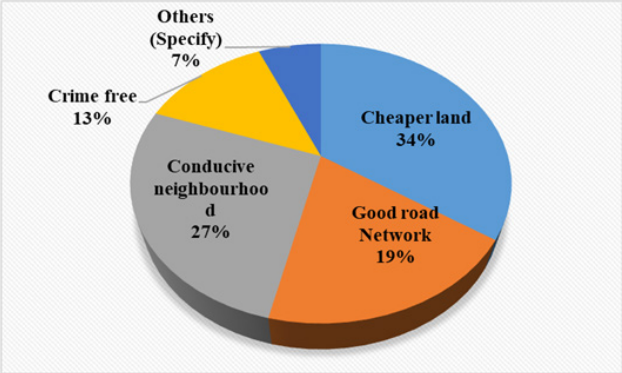

Figure 9 Reasons for choosing to develop structure in study areas.

Source: Fieldwork, 2021

Consequences of land-use changes in the urban environment

The study revealed that the development of residential, industrial, commercial, recreational, and other infrastructure and services in Yenagoa City have caused consequences in urban land-use changes. The satellite imageries collected between 1996-2020 have presented recurrent changes. The imageries and observations showed that water bodies and vegetation have reduced drastically continuously in the spatial area and percentage. Contrary, the built-up area has increased rapidly in the spatial area and percentage in the study area (Figures 3–6) (Table 2) (Table 3). The development of housing and other urban infrastructure and services have increased the prevalence of flooding notably in 2012 as marginal lands and creeks are encroached upon by reclamation for development purposes. Many communities and streets in the city are not provided with drains thereby exacerbating flooding prevalence. These conditions have prompted frequent land-use changes in the study area.

Figure 10 Slum development in Yenagoa city.

Source: Fieldwork, 2021

There is a consequence of unplanned and uncoordinated urban development and management by the government and its planning agencies has led to the development of slums and squatter settlements in many parts of the city due to lack of implementation of the city's master plan and other expected planning schemes for new neighbourhoods (Figure 10). It is revealed in the study residents are developing indiscriminately without planning regulations and

standards in many marginal lands. It is expected that the trend will continue if corrective measures are not taken soonest. Many lands that serve as river basin and water retention for receiving overflow from upper regions have been built upon and further caused land-use changes and loss of valuable natural resources found in the urban environment of Yenagoa City as the area have been modified to more of the social environment. The study revealed that a large section of the city has been paved with concrete surface thereby increased flooding and temperature of the urban environment (Figure 11). With the increase in population, there is also an increase in waste generation in the study area as many wastes disposed of indiscriminately in unauthorised sites increasing the pollution level which further change the land-use of the urban environment.[19–22]

Figure 11 Flooded urban community in Yenagoa city.

Source: Fieldwork, 2021

Conclusion

Changes in land-use is a continuous process in the urban environment. This process is usually determined by evidence of changes, factors that causes these changes, dynamics of these changes and consequences of these changes to the urban environment. Governments, policymakers, urban planners, urban stakeholders including investors, communities and individuals must acknowledge these changes by reorganising and redirecting their urban policies and development programmes and plans to the benefit of the inhabitants and the environment. The Yenagoa City case has brought to the forebear some of the evidence, causes, dynamic and consequences of the rapid urban land-use changes that are occurring within its landscape considering her peculiar environment and level of development. The study has highlighted evidence of land-use changes between 1996-2020 on waterbodies, vegetation, and the built-up areas. The causes of these changes including population increase and urban land demand for development. The dynamics that have brought have these changes are an increase in household size, nearness to the workplace, good infrastructure, and services, improve security, cheaper rent, access roads, nearness to market, increase in migrants, employment opportunities, and lack of implementation of the development plan. Some of the consequences of these changes are on waterbodies, vegetation, and the built-up areas. Other consequences include the prevalence of flooding, encroachment on marginal lands, slum and squatter development, loss of valuable natural resources, pollution, and constant modification of the social environment of the study area. This study will provide physical planning measures to monitor, control and manage these changes to achieve a sustainable urban environment. The study has contributed to the advancement of the body of knowledge in urban land-use changes and provide opportunities for further study of the subject matter.

Recommendations

I. The Yenagoa Master Plan of 2004 should be reviewed and implemented to guide, control and manage urban land-use changes and environmental management in the city;

II. There should be an urban land-use framework that will foster synergy of all physical planning agencies and institutions in the city for sustainable utilisation of natural resources within the city to check environmental degradation resulting from rapid changing land-use.

III. Proper planning and re-planning of new neighbourhoods and existing communities to check population growth and direct urban growth to halt the emergence of slums, squatters, sprawl and leapfrog developments in the city environment.

IV. There should be continuous urban studies in the area of land-use and environment management for proper modelling and forecasting to predict and mitigate consequences of land-use trends of the city; and

V. Proper citizen education should be advocated for to encourage citizen participation in environmental management matters to strengthen urban governance and promote sustainable development in the city.

Acknowledgments

None.

Funding

None.

Conflicts of interest

The authors declare that there is no conflict of interest.

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Citation: Ebinemi IE, Tari E, Ibama B. Spatiotemporal dynamics of land-use changes in Yenagoa city. *MOJ Eco Environ Sci.* 2021;6(4):127–134.
DOI: 10.15406/mojes.2021.06.00225