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AN ASSESSMENT OF URBAN CHANGE AND ITS DRIVERS IN SULEJA LOCAL GOVERNMENT AREA OF NIGER STATE, NIGERIA

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ABSTRACT

The knowledge of urban change is critical to the management and planning of urban areas. Robust geospatial technologies have increasingly enhanced our understanding of urban change. This paper employs remote sensing and GIS data from the earth explorer data archive to assess the character and pattern of urban change in Suleja Local Government Area (Niger State in Nigeria) and its drives from 1987 to 2019. The nature and character of urban change are examined from the lens of the urban intensity index and the urban land use/cover change. Data from the geospatial techniques were corroborated with secondary data from the Niger State Regional Plan, Suleja Master Plan, and the Abuja Master Plan. The underlying drivers of urban change within this period were also examined. This study reveals that Suleja Local Government Area experienced unprecedented growth in its urban area from 1987 to 2019. Using Qiuying's mathematical model for the urban change intensity index, the study revealed that the urban change intensity index of Suleja developed from low urban intensity (0.16) to highly rapid urban intensity (0.73). The highly rapid urban intensity index witnessed in Suleja was dominated by an edge expansion urban form of change associated with urban sprawl. This study further reveals that the present physical development activities in Suleja are not sustainable. This study, therefore, recommends articulated urban planning for Suleja LGA; also, the outdated Niger State Regional Development Plan and Suleja Master Plan should be reviewed by the Niger State Government.

Keywords: Population; Suleja; Urban Change; Urban Density; Urban Sprawl

1. INTRODUCTION

Cities of the world are experiencing rapid urbanization due to an increase in urban population growth (He, 2018; UN, 2018). It is envisaged that by the year 2050, 72% (6.3 billion) of the world's population will be living in an urban area (UN, 2018), which means that more urban land will be required for physical development in the future. The rapid urbanization experienced in cities would also define the future urban change forms, influencing the urban infrastructure layout, agglomeration of socio-economic activities, and future urban land uses (He et al., 2018).

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Edge expansion describes the new development along an existing development; infilling defines the latest development within an already established urban area while outlying (Leapfrog) development occurs away from the current built-up areas separated by open spaces (Forman, 1995). Urban changes due to urbanization can be limited to the changes in urban form alone and the alteration of the urban landscape (Fabeku et al., 2018; Senanayake et al., 2013; Yu & Zhou, 2017). Landscape alterations are frequently evident in the land use land cover changes in urban areas influenced by increasing anthropogenic activities (Buba et al., 2016; Weng, 2007). The urban changes in urban forms and landscape alteration manifest in various Nigerian cities, accompanied by urban planning problems such as congestion, deterioration of infrastructures, and uncoordinated urban planning (Olujimi, 2009). Suleja Local Government Area of Niger State is faced with similar planning problems.

The Nigerian Federal Government urban policy of 1976 declaring Abuja the new Federal Capital City (FCC) brought Suleja Local Government Area to the limelight due to its proximity to Abuja. Since the relocation of the FCC from Lagos to Abuja in 1991, Suleja LGA has been experiencing unprecedented urbanization. Due to the resettlement scheme of the Federal Capital Development Authority between 1979 and 2007, Suleja witnessed a large influx of people from the new capital territory (Maxlock, 1979; Maxlock, 1987; The Center on Housing Rights and Evictions Social and Economic Right Action Center, 2008). Also, individuals seeking economic opportunities from other parts of the country see Suleja as a dormitory town owing to the low accommodation cost (Auta, 2021; Buba et al., 2016). The rapid urbanization witnessed in Suleja has led to slum emergence, overcrowding, and near infrastructure collapse.

Previous Studies in Suleja LGA by Buba et al., 2016, and Ejaro & Abdullahi, 2013 covered the spatial extent of Suleja from 1980 – 2015 and 1987 – 2012, respectively. These studies focused on the rate of change in Land use within a target period of 2013 and 2015 using Landsat imageries of three epochs. The Study by Buba et al. (2016) further simulated the population and the land use of Suleja LGA to 2035 to monitor future changes. These two studies had inadequate Spatiotemporal coverage for Suleja land use and less emphasized the processes of urban land change and the resultant patterns of change. The methodological gaps identified in the previous studies (Buba et al., 2016; Ejaro & Abdullahi, 2013) were filled in this study, as against the three multi-temporal satellite imageries used by the previous studies. Four different multi-temporal satellite imageries (1987, 1999, 2007, and 2019) were used for this study to have better Spatiotemporal coverage of land uses and to describe the processes of urban change and the pattern of urban transformations that have taken place during the study period (1987-2019).

This study also harnessed the robustness of remote sensing and geographical information system tools. Over the years, remote sensing and GIS tools have proven effective in analyzing and detecting changes in urban areas at local, regional, and global scales (Deng et al., 2009; Lambin et al., 2003). The robustness of remote sensing and GIS can be seen in their ability to offer historical multispectral data sets that cover a study area with precise spatial position and high temporal frequency (XIAO et al., 2006 in Yin, 2010). Accurate temporal mapping using remote sensing and GIS is essential for better urban management and the development of sustainable cities by urban planners (Li et al., 2015). Against this background, this study assessed the urban change in Suleja from 1987 to 2019. To carry out this assessment, the trend of urban change and its change pattern was analyzed from 1987 to 2019. The drivers of urban transformation in Suleja were also examined to achieve the aim of the study.

2. LITERATURE STUDY

2.1. Concept of Urban Change

Urban change is referred to the process responsible for the changing forms of urban centers (Fabiyi, 2006). The term urban change has been conceptualized in different ways by various authors. For instance, urban change is explained in terms of the increasing urban population density due to migration (rural-urban), thereby changing a region's urban center or metropolitan area (Rawding, 2012). Similarly, to the definition of urban change by the authors mentioned above Ehlers & Floor (1993); Phadke (2014) defined urban change as an increase in population density of an urban area, change in spatial extent, and reorganization of urban space. Ehlers & Floor (1993) went further to integrate the economic changes that have taken place in a region in conceptualizing urban change. On the other hand, urban change was conceptualized in terms of changing urban policies and evolving development plans in a metropolitan area (Nas & Theuns, 2005; Nkambwee, 1982; Mukwaya et al., 2010). The urban and development plans could include urban renewal, land, and housing reforms.

Though the concept of urban change may vary among authors (He et al., 2018; Liu et al., 2010; Wilson et al., 2003; Yu & Zhou, 2017), the pattern/forms of urban change manifest themselves in three patterns which are infilling, edge expansion and outlying expansion. The infilling is defined as a new development occurring within previously developed areas. An edge expansion occurs when new developments arise close to the edge of the fringe of existing development; such a pattern or form of growth is called outlying growth. According to He et al. (2018), a more dispersed urban form is noticed in edge and outlying expansions, while infilling leads to a more compact urban form.

However, from the deductions made from previous studies, the term urban change was conceptualized as an increase in population growth and the spatial shift that has occurred in an urban area over the years, with changes taking the form of infilling edge and outlying.

2.2. Study Area and Scope

Suleja is a traditional Emirate located in Southeast Niger State with attractive inselbergs (Maxlock, 1987). Suleja is situated between latitude 9º 08'00.16" N to 9º16'00.17" N and Longitude 7º08'00.13" E to 7º12'00.13" E (See Figure 1). Suleja has ten administrative wards, namely; Bagama' A', Bagama' B', Wambai, Hashimi' A', Hashimi' B', Iku South I, Iku South II, Magajiya, Maje, and Kurmin Sarki. The proclamation of Abuja in 1976 as the Federal Capital Territory gave Suleja Local Government Area more prominence, with the urban area becoming a satellite town to the new capital city. A regional plan and a master plan were prepared to guide its development in 1979 and 1987, respectively, by the Niger State government. Suleja is about 20 kilometers (km) north of Abuja, the Federal Capital City of Nigeria. This study was limited to the ten administrative wards aforementioned, while the pattern/forms of change considered for this study were edge, infill, and outlying.

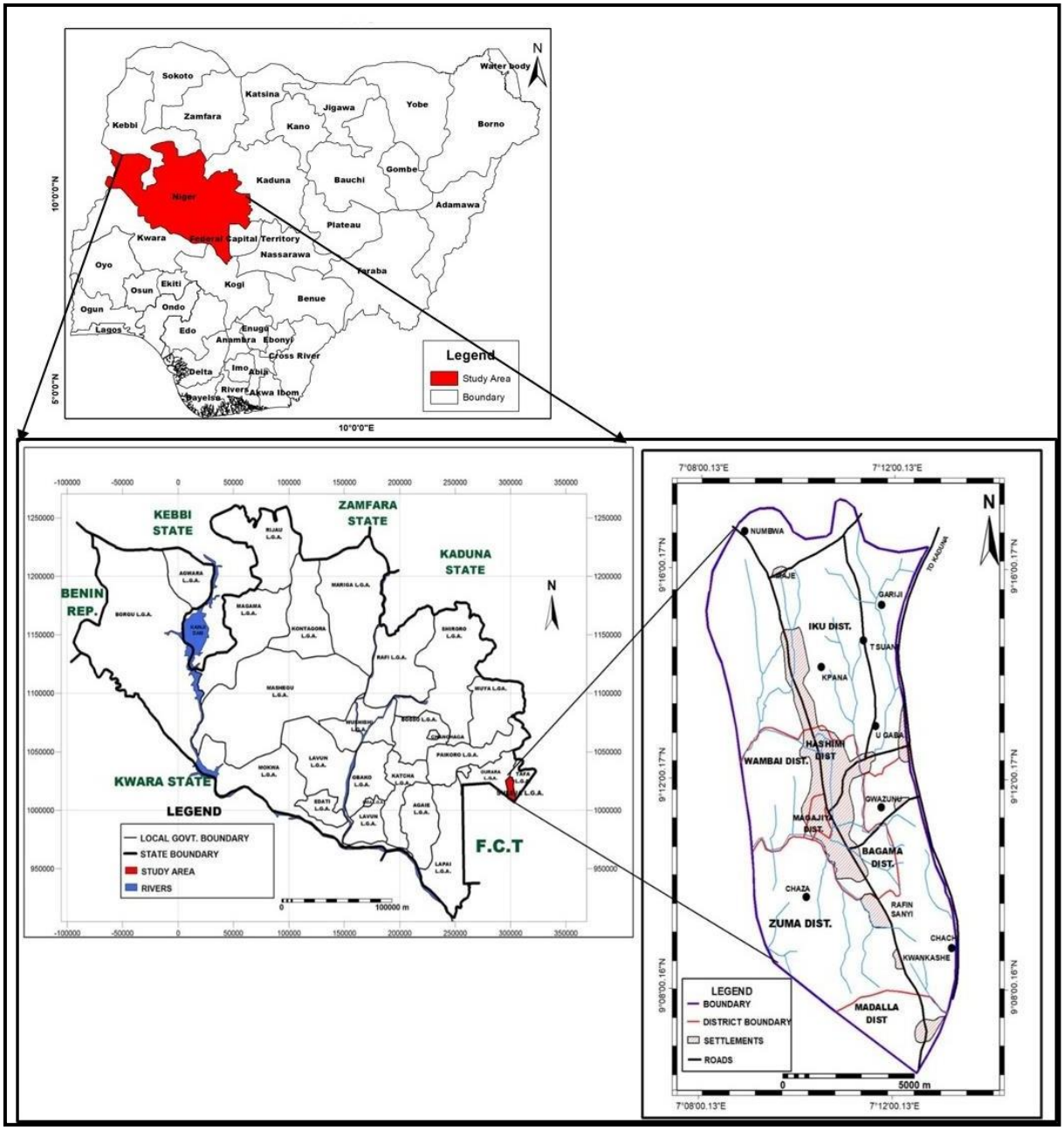

Figure 1 Suleja Local Government Area – Niger State, Nigeria
(Source: Department of Urban and Regional Planning, FutMinna, 2021)

2.3. Data Source, Post-Processing, and Sample Size

A longitudinal design was adopted for this study since it involves a time series analysis. Based on availability, the Landsat data sets were used for this study. Horizontal land uses land cover data were extracted from three sets of Landsat imageries covering a 32-years period. The Landsat data sets used were the thematic mapper (1987), the Enhance thematic mapper (1999), the Enhance thematic mapper plus (2007), and the Operational land imager (2019). These imageries were downloaded from the US Geological Survey (earthexplorer.usgs.gov). The gap mark of the imagery of 2007 was corrected using the "fill no data" tool on QGIS 3.14.16. Bands 3, 2, and 1 were used to form the false color composite for the imagery of 1987. The false color composite for the imageries of the years 1999 and 2007 was developed using bands 4, 3, and 2. Bands 5, 3, and 2 were used to form the false color composite of the imagery of the year 2019 (Figure 2).

The areas of interest were subsets, and five training sets were created on each of the subset imagery. The training sets created are forest land, built-up areas, farmlands, waterbodies, and bare surfaces (Table 1). These training sets were further classified using the maximum likelihood classifier on ArcGIS 10.2 software. The methodological flow chart of this study is represented in Figure 3.

The Open Data Kit (ODK) was used to collect data on the neighborhood quality of Suleja LGA residents. The household population of 53,902 served as the sample frame for the study area. The sample size of each of the ten administrative wards of Suleja was calculated using the Miller & Brewer (2003) mathematical model with a confidence level of 95% and a confidence interval of 5%. A total of 149 sample size was inferred for the entire study area. The proportional sampled technique was used to administer the 149 questionnaires to the household heads randomly selected from each administrative ward.

Table 1 Description of Training Sets of Suleja

Training Sets	Description
Built-up Areas	Land used for residential (Settlements), commercial, industries, institutions, transportation routes, and other impervious surfaces.
Water Body	Land covered with water.

(Source: Adopted from the administrative map of Suleja)

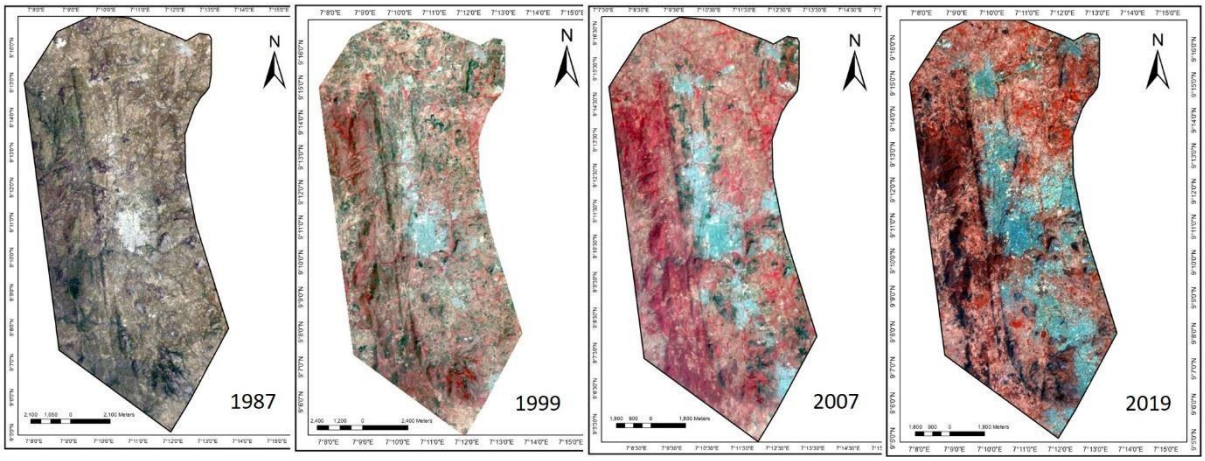

Figure 2 Subset False Color Composite of Suleja
(Source: Author's Analysis, 2021)

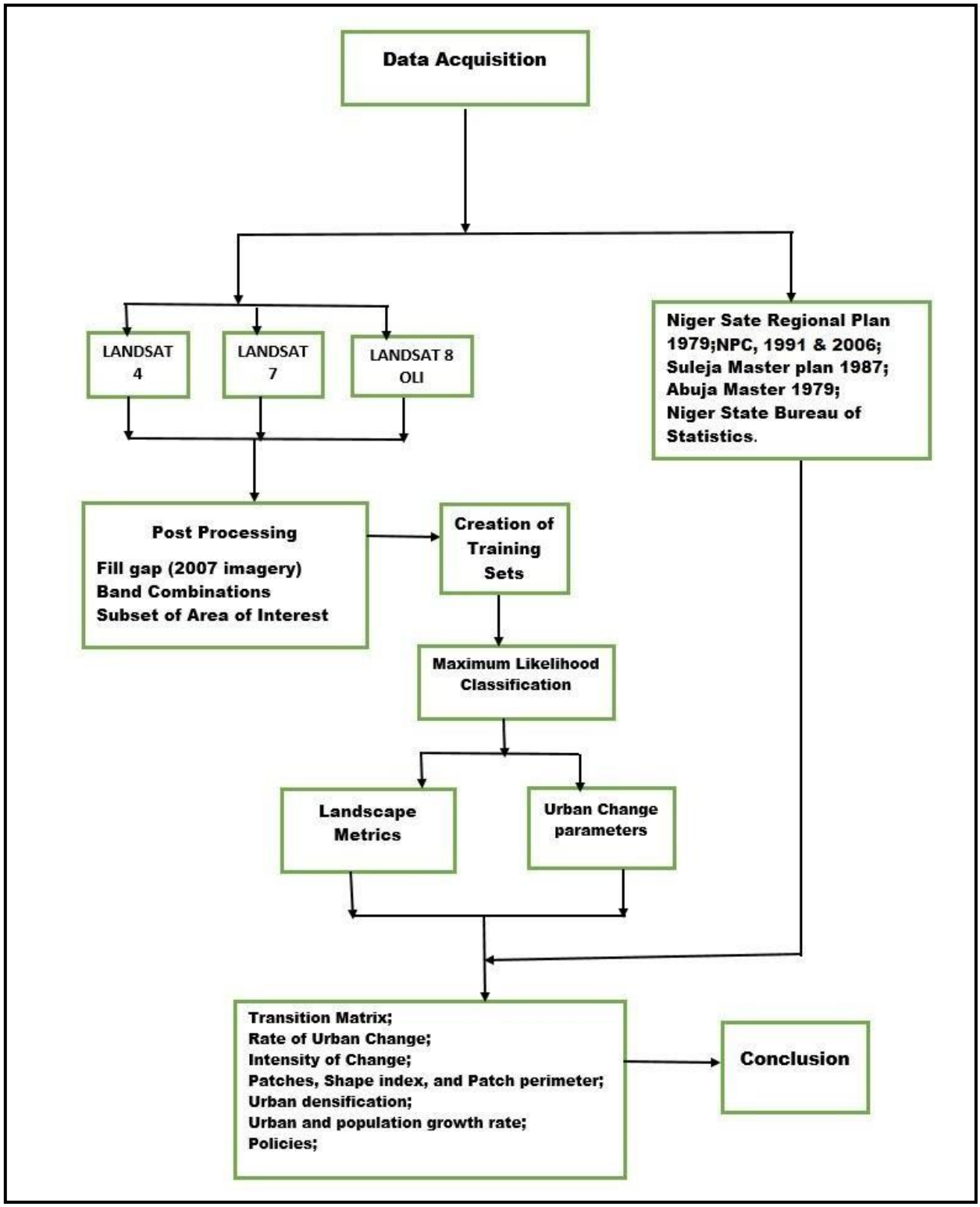

Figure 3 Flow Chart of Methodology
(Source: Author's Construct, 2021)

3. METHODS

3.1. Urban Change Process

3.1.1 Urban Land Transition Matrix

This matrix was used to analyze the transition of urban lands into other land use/ cover features in Suleja by cross-tabulating land use land cover statistics for different years. The transition

matrix shows the growth and losses of each land use land cover throughout the study periods. The urban land transition matrix is often used to manage land use/ land cover for sustainable urban planning (Al-sharif et al., 2017; Shifaw et al., 2018). The transition matrix for this study was generated using the land change modeler on Terrset 17.0 software.

3.1.2. Annual Average Rate of Urban Change

A mathematical model adopted from Shifaw et al. (2018) was used to calculate the annual average rate of urban change in Suleja, and this model is expressed as follows:

$$AARUC = \left(\frac{A_2 - A_1}{A_1}\right) \times \frac{1}{N} \times 100$$

Where; A_2 is the urban areas at the end of a target year. $A_1$is the beginning of a period while N is the number of years between $A_2 - A_1$

3.1.3. Annual Average Urban Change Intensity Index

The Qiuying et al. (2015) equation was used to determine the annual average urban change intensity of Suleja within the 32 years study period. The yearly average urban change intensity comprises five indices which are; very low [< 0.1], low [0.1 – 0.2], moderate [0.2 – 0.4], rapid [0.4 – 0.7] and highly rapid [≥ 0.7]. The Qiuying et al. (2015) equation is expressed as:

$$UCII = \left(\frac{A_2 - A_1}{A_1}\right) \times \frac{100}{\mathrm{TA}}$$

where,

A_2 is the urban areas at the end of a period

A_1 is the urban areas at the beginning of a period

N is the number of years between the end of a period (A_2) and the beginning of a period (A_1), TA is the total land area.

3.1.4. Urban Change Type

Three forms of urban change (Edge, Outlying, and Infilling) were considered in Suleja LGA. Edge changes occur on the fringe of an existing urban area; Outlying urban changes are the form of urban change far from an existing urban area. At the same time, the infilling urban changes were noticed within a current urban area. These changes were determined in Suleja LGA by an overlay analysis of the existing urban area (previous years) and the newly formed urban areas within the study period.

3.2. Secondary Source of Data

Historical information on the socio-economic data of Suleja L.G.A. was sourced from the Niger State Regional Plan of 1979, the Suleja Masterplan of 1987, the Abuja Masterplan of 1979, and the Niger State Bureau of Statistics. Population data from the 1991 population census and 2006 population were obtained from the Nation Population Commission (NPC, 1991; NPC, 2006). The population Figure for 1991 was projected to 1999 using a growth rate of 2.5. The population Figure of 2006 was projected for 2007 and 2019, with a growth rate of 2.5. The population Figures were cast using the Malthusian exponential population projection model. The Malthusian exponential population projection equation is a standard model used to describe the population growth of a unit or region. This model defines population growth as an increase in the size of a population over a specific period using two factors of time and number of people. Unlike other

projection models, the Malthusian exponential model is useful for developing intuitive ideas and estimations about populations of a given region.

The Malthusian exponential population projection model is given as:

$$P(t) = P_0 e^{rt}$$

Where: P_t and P_0 are the estimated population and base year population, respectively; r represents the annual growth rate, while t stand for the difference in the time lag between the present population and the target year.

4. RESULTS

4.1. Trend of Change in Suleja between 1987 and 2019

4.1.1. Land Use/Land Cover of Suleja between 1987 and 2019

The land use of the land cover of 1987 portrays Suleja as an Agrarian settlement with forest lands and farmlands covering ample of the total land area (Table 2). Low built-up areas (2.98%) were also recorded in this epoch; according to the Master plan of 1987, the residents of Suleja at that time were mainly indigenes whose primary occupation was farming (Maxlock, 1987). The relocation of the Federal Capital Territory from Lagos to Abuja in 1991 impacted the land use land cover of Suleja in 1999. During this period (1999), the Built-up area increased to 11.75 square kilometers （km^2）as against the 7.14 km^2 recorded in 1987. The magnitude of change in built-up areas between 1987 and 1999 was 4.61 km^2. The increase in built-up areas in 1999 was also consequential to the rise in farmlands and decrease in forest lands. It is because competing land use, such as human settlements and demand for charcoal and fuelwood leads to deforestation (Ejaro & Abdullahi, 2013). As a result of weathering and other anthropogenic activities such as mining, the waterbodies in Suleja expanded in land areas in 1999 to 32.86 km^2 as against 13.69 km^2 recorded in 1987. Also, due to increased anthropogenic activities in 1999, bare surfaces stretched in land areas with a magnitude of change of 1.64 km^2.

Table 2 Trend of Urban Change in Suleja between 1987 and 2019

Year Class	1987		1999		2007		2019	
	Land Area (km^2)	%	Land Area (km^2)	%	Land Area (km^2)	%	Land Area (km^2)	%
Built-up Area	7.14	2.98	11.75	4.92	18.51	7.75	39.41	16.50
Bare Surface	1.20	0.50	2.84	1.19	2.08	0.87	1.77	0.74
Waterbody	13.69	5.73	32.86	13.76	22.55	9.44	21.09	8.83
Farm Land	92.19	38.60	148.95	62.37	154.16	64.55	146.23	61.23
Forest Land	124.59	52.17	42.41	17.76	41.51	17.38	30.30	12.69
Total	238.81	100	238.81	100	238.81	100	238.81	100

Source: Author's Analysis, 2021

The sizes of built-up areas in Suleja increased from 11.75 km^2 to 18.51 km^2 in 2007 (Table 2). Settlements such as Kwamba, Maji, Diko, and Gwazunu, formally hamlets in 1987, were fully grown into compact/cluster settlements in 2007. The areas of farmlands also expanded in 2007 with new land areas of 154.16 km^2. The rising urban population in 2007 also impacted the forest lands, as 1 km^2 of forest land was lost to anthropogenic activities such as constructing and felling

trees for fuel. A substantial increase in built-up areas was recorded due to the residential pressure from the federal capital territory Abuja. The resultant effect of the increase in built-up areas was a continuous decline in forest lands. In this period (2019), the forest land declined to 30.30 km^2 against the 41.51 km^2 recorded in 2007. It means that 11.21 km^2 of forest lands were lost to the quest for relative flatlands for physical development and the demand for fuel. Slight declines in farmlands were similarly recorded in 2019. The encroachment of built-up areas into farmlands in this period is attributed to the slight decrease in farmlands. The transition matrix analysis (Table 3) reveals that 15.81 km^2 of farmlands were converted to built-up areas between 2007 and 2019.

The horizontal land use land cover of Suleja LGA between 1987 and 2019 is represented in Figure 4. In this figure, built-up areas (Urban land) are illustrated in red; waterbodies appear in blue; forestland is green, while farmland and bare surfaces are represented in yellow and grey, respectively.

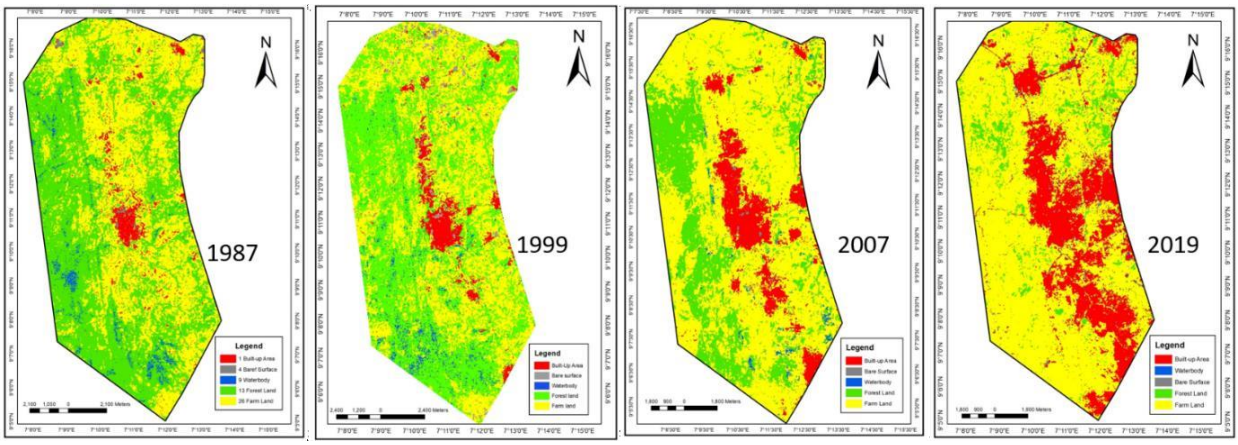

Figure 4 Classified imageries of Suleja between 1987 and 2019
(Source Author's analysis, 2021)

4.1.2. Urban Change Transition

The transition matrix (Table 3) reveals how the different variations in land use and land covers of Suleja have been transforming inwardly and outwardly during the 32 years (1987- 2019). The transition matrix reveals that within the 32-year study periods, built-up areas have had inward and outward changes in their land areas. Though three land uses land cover types (Bare Surface, Farmland, and forest land) were responsible for the urban land within the 32-year study periods, only farmlands had a significant change on the urban land/built-up areas. 30.15 km^2 of farmlands transformed into built-up areas between 1987 and 2019. The transition matrix also revealed progressive transformation from farmlands to built-up areas.

Similarly, farmland also had three land use land cover types influencing its changes, and these land use land covers were forest land, bare surface, and water bodies. Unlike the built-up areas with both inward and outward expansion, farmlands had an outward expansion. Between 1987 and 2019, forest land, water bodies, and bare surfaces with areas of 115.17 km^2, 29.69 km^2, and 2.89 km^2 respectively, were transformed into farmlands.

Farmlands and waterbodies influenced the outward expansion of forest land within the study periods. A total of 19.43 km^2 of waterbodies were transformed into forest lands; in the same vein, a total of 32.73 km^2 of farmlands were changed to forest lands. Furthermore, the transition matrix reveals that of all the land use, land cover types transformed, and only farmlands formed the highest proportion of built-up areas (urban land) changed in Suleja between 1987 and 2019.

Table 3 Urban Change Transition in Four Temporal Periods in Suleja

		1987 - 1999		1999 - 2007		2007 - 2019		Total
'From Class'	'TO Class'	Area km^2	%	Area km^2	%	Area km^2	%	km^2
Forest land	Built-up Area	1.60	0.67	0.19	0.08	0.79	0.33	2.58
	Farm Land	70.39	29.48	12.64	5.29	32.14	13.46	115.17
	Bare Surface	0.47	0.20	0.02	0.01	0.05	0.02	0.54
	Waterbody	23.64	9.90	1.69	0.71	3.08	1.29	28.41
Farmland	Forest land	7.29	3.05	14.08	5.90	11.36	4.76	32.73
	Built-up Area	6.13	2.57	8.21	3.44	15.81	6.62	30.15
	Bare Surface	1.93	0.81	1.26	0.53	1.11	0.46	4.30
Bare Surface	Farmland	0.58	0.24	1.59	0.67	0.72	0.30	2.89
	Built-up Area	0.40	1.17	0.63	0.26	0.81	0.34	1.84

(Source: Author's Analysis, 2021)

4.1.3. Urban Land Change Processes

Based on the Qiuying et al. (2015) urban change intensity model, the corresponding values of <0.10, 0.10 – 0.20, 0.21 – 0.40, 0.41 – 0.70, and ≥0.71 denote very low, low, moderate, rapid and highly rapid respectively. The urban change intensity index of Suleja between 1987 and 2019 reveals a progressive change in the size of urban land. Urban change transcends from the low intensity of urban transformation to a highly rapid intensity of urban change. The moderate and rapid intensity of urban change was experienced in Suleja between 1999 - 2007 and 2007 - 2019, respectively (See table 4), resulting from an increase in urban population and physical development influenced by the State government and Federal government urban policies.

Table 4 Rate of Urban Change and Its Intensity

Year	**1987 -1999**	**1999 - 2007**	**2007 - 2019**	**1987 - 2019**
Annual Average Rate of Urban Change (%)	5.20	7.54	9.04	3.13
Urban Change Intensity Index	0.16	0.36	0.73	0.42
Category of Urban Change	Low	Moderate	Highly Rapid	Rapid

(Source: Author's Analysis, 2021)

4.1.4. Form of Urban Change in Suleja from 1987 – 2019

The forms of urban change noticed in Suleja local government area within the study period were classified into three forms. These forms are edge expansion, Infill change, and outlying change. The infilling changes in the study area are characterized by new development occurring within a previously developed urban area. The edge changes are the physical development on the fringe or edge of the existing urban area in Suleja LGA. In contrast, the outlying urban changes are the physical development activities that are developed far away from the existing urban area in Suleja LGA. The three forms of urban changes in the study area from 1987 – 1999, 1999 – 2007, and 2007 – 2019 are explained in Figure 5 and Figure 6. The edge expansion is represented in red color, and the Infill change is represented in green color. In contrast, the existing urban area and outlying changes are described in black and yellow, respectively.

The analysis also reveals that urban edge change contributes significantly to the urban change pattern in Suleja LGA from 1987 to 2019. The edge expansion rate of urban change in the study area evolved from 2.66 km² (1987) to 17.03 km² in 2019. Throughout the study periods (1987 -

2019), urban infill change was responsible for a minimum contribution of urban change in Suleja LGA.

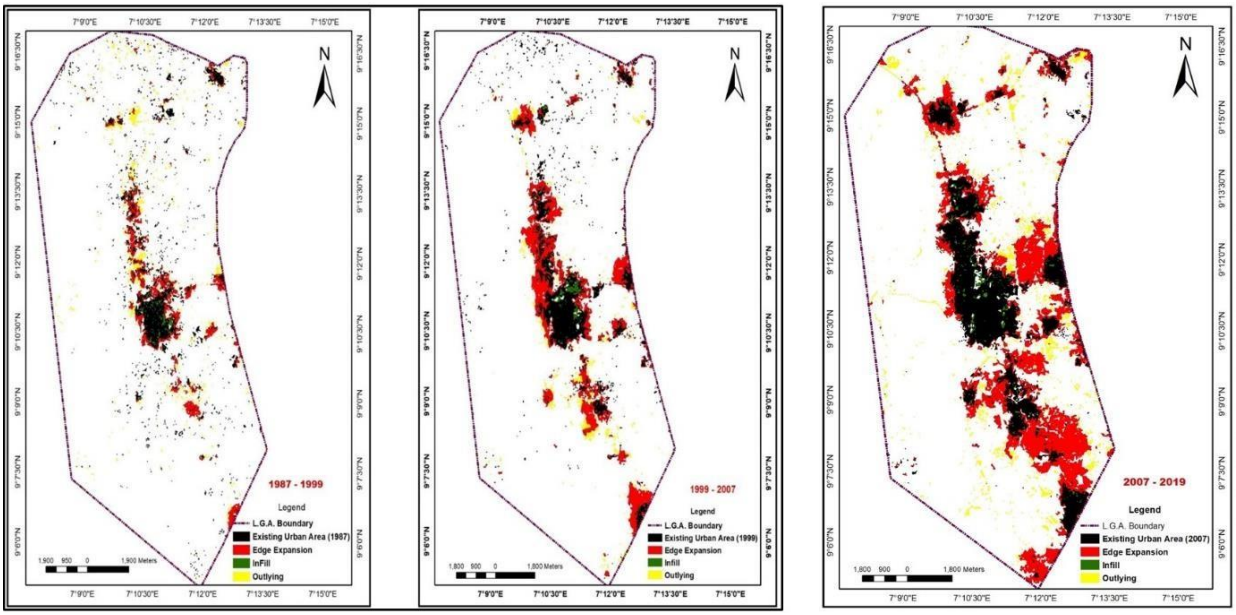

Figure 5 Spatiotemporal Distribution of Urban Change Types in Suleja LGA between 1987 – 1999 and 1999 – 2007 (Source: Author's Analysis, 2021)

At the same time, the outlying forms of urban change were slightly higher than the urban infill change. The outlying urban change decreased in expansion from 1.63 km^2 (1987 - 1999) to 1.43 km^2 (1999 - 2007). Due to the increase in population growth and physical development, an upsurge in the outlying urban change was recorded between 2007 and 2019.

4.2. Drivers of Urban Change in Suleja LGA

The drivers of urban change noted in Suleja LGA were population growth, urban policy, proximity to the FCC, and Neighbourhood quality (Figure 6). These factors influenced the urban change of the study area in various forms, which include increased population growth and density, the dispersed pattern of development, an increase in the spatial extent of the built-up regions, agglomeration of businesses, and improved infrastructures.

Figure 6 Drivers of Urban Change and Its implication

4.2.1. Population Growth and Urban Densification of Suleja Local Government Area

The population growth experienced in Suleja was consequential to the increase in the population of urban residents per unit area of urban land. Table 5 reveals that the population per unit area in Suleja continues to increase simultaneously with the increase in urban lands (built-up areas). The continuous increase in population means that urban demand for space for physical development will increase, and physical development will continue to change the urban form (Dempsey et al., 2010). An increase in population density was also recorded in the study epochs. The increase in population density in Suleja can be used to promote urban sustainability. A high population density encourages recycling, mass public transportation, and local electricity generation (Force & Rogers, 1999). The study also reveals that hotspot areas of population density were concentrated in the core (Magajiya and Hashima A) of the study area.

Table 5 Population Density and Urban Density Index of Suleja Between 1987 and 2019

Year	Population	Percentage of Increase	Population Density	Urban Density Index
1987	53,731		224.99	0.030
1999	184,586	243.54	772.94	0.049
2007	223,942	21.32	923.12	0.078
2019	296,803	32.54	1242.84	0.165

(Source: Author's analysis, 2021)

The population measure of urban growth in Suleja L.G.A. is explained in Figure 7. This Figure reveals that the percentage of urban areas in 1987-1999 was less than the population growth rate. This means that the growth of Suleja within this period was compact. The study also reveals that urban land growth rates were frequently higher than the population growth rate from 1999 - 2007

and 2007 – 2019. This also indicates that Suleja is experiencing a dispersed growth pattern, meaning urban sprawl. The narrative from 1987 – 2019 was quite different from the scenario recorded in the previous epochs. The urban change between 1987 and 2019 shows a tendency of compactness in the form of urban in Suleja. The compactness of the urban change experienced in Suleja between 1987 and 1999 also implies coordinated urban planning.

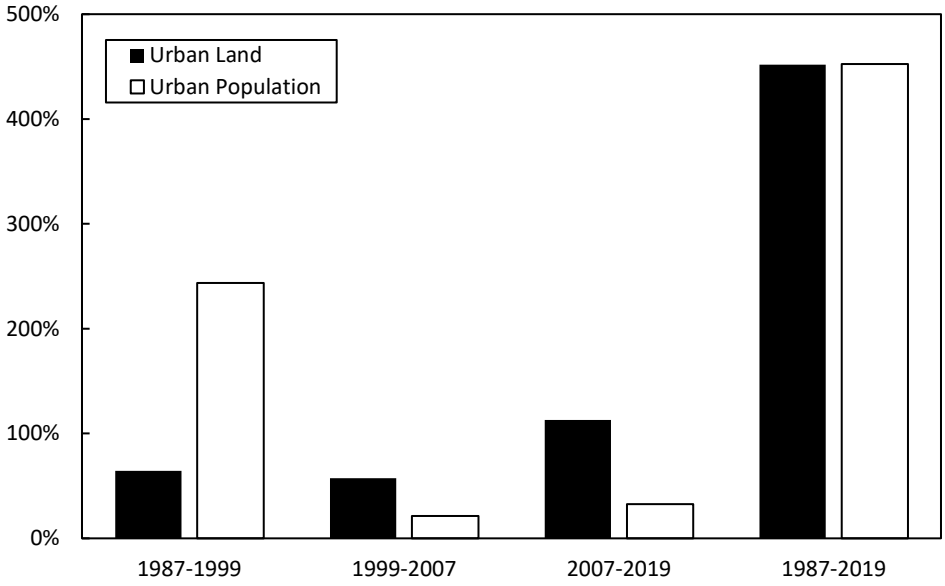

Figure 7 Population Measure of Urban Growth between 1987and 2019

4.2.2. Policy Factor to Urban Change in Suleja Local Government Area and its Implication

The Federal Government policy of 1976 relocating the Federal Capital Territory from Lagos to Abuja changed the morphology of the old Abuja (now Suleja) from an agrarian Settlement into a satellite town of the new capital territory (International Planning Association, 1979). Over the years, the relocation of the FCC from Lagos to Abuja and the relocation scheme of the FCDA have been changing the urban area of the Suleja local government area. The proximity of Suleja L.G.A. to the proposed new Federal Capital Territory made both the Federal Government and the Niger State Government consider the development of Suleja LGA (International Planning Association, 1979; Maxlock, 1979). Since the Federal Government envisaged that Suleja LGA would be a dormitory town and a commercial city with rapid investment opportunities to be derived from the new capital city (Maxlock, 1979). To this effect, the Abuja master plan recommends that immediate and tight development control measures be implemented and that the Federal Capital Development Authority (FCDA) locate its administrative and planning offices in Suleja (Maxlock, 1979).

The construction of phase one of the new capital was momentous to the resettlement of all persons residing in the proposed capital city and settlements within a 5 km radius of the proposed Federal Capital City by the FCDA (IPA 1979; Maxlock, 1979; The Center on Housing Rights and Evictions Social and Economic Right Action Center, 2008). The resettlement scheme by the FCDA influenced the population growth of Suleja; in 1981, the FCDA resettled 11,000 persons in two newly built villages (Wuse and Jiwa) in Suleja Local Government Area (Maxlock, 1979; CHRESERAC, 2008). The FCDA further drew a plan to resettle eight more villages with an estimated population of 18,000 out of the proposed Federal Capital City (FCC) in the Suleja local government area. The final relocation of the Federal Capital City from Lagos to Abuja in 1991 led to an influx of people from other parts of the country to settle at Suleja L.G.A. due to the

envisaged business opportunities and the high cost of accommodation within the new Federal Capital Territory (Buba et al., 2016).

In a bid to keep the sanctity of the master plan for the new Federal Capital Territory, 49 more settlements were relocated out of Abuja between 2003 and 2007 (CHRESERAC, 2008), and some of the inhabitants of these settlements relocated to Suleja L.G.A. To address the rapid urbanization in Suleja due to the increase in population, the Niger State Government prepared an Integrated Development Plan in 2012 to make Suleja L.G.A. a smart city (NSUSP, 2012). The initiative of the Integrated Development Plan is yet to be achieved by the State government as of 2021.

The planning and development of Suleja were enhanced with the initiation of the Niger State Development Blue Print (2019 – 2023). The Development Blue Print proposed that major roads in Suleja should be landscaped and beautified with drainage systems. Other features of the Development Blueprint include installing solar streetlights, implementing social housing, developing new towns along Suleja, and reviewing the Suleja Masterplan of 1987. As a result of the obsolete policy documents (Niger State Regional Development Plan 1979 – 2000, Suleja Masterplan 1987 - 2007), Suleja Local Government Area continues to grow unguided. The chronological urban development policies of Suleja are presented in Figure 8.

Before the 1976 relocation policy of the Federal Government of Nigeria moving the Federal Capital City from Lagos to Abuja, the only industry and commercial establishment found in Suleja was the Ladi Kwali pottery center (or Abuja pottery center), which was established in 1951. When the relocation policy was made, the Ladi Kwali pottery center was the only establishment in Suleja L.G.A. that could employ at least 57 workers (Maxlock, 1979). The initiation of the Abuja masterplan (1979), the Regional Development Plan of Niger State (1979), and the masterplan of Suleja L.G.A (1987) prompted an increase in the rate of investment, speculation, and in-migration into Suleja L.G.A.

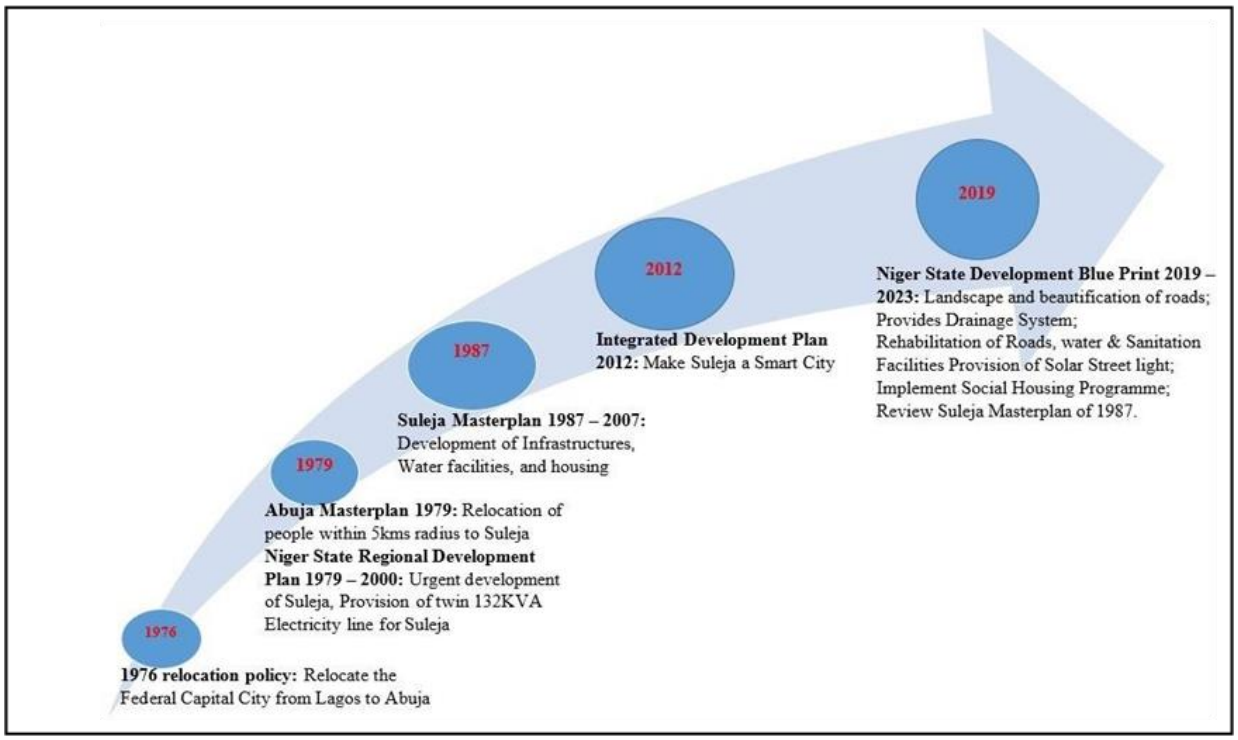

Figure 8 Urban policies in Suleja from 1976 – 2019

Table 6 explains the changes in small, medium, and large enterprises in Suleja L.G.A. due to the influence of the Federal Government of Nigeria and the Niger State urban development policies/plans. The eventual relocation of the Federal Capital City from Lagos to Abuja in 1991 by the Federal Government had a positive effect on the socio-economic development of Suleja L.G.A as small, medium, and large enterprises agglomerated in the region. The table further explains that between 1987 and 2019, the agglomeration of small, medium, and large enterprises increased significantly. An increase of 333.73% was recorded in the growth of the small, medium, and large enterprises in the Suleja Local Government Area.

In response to the 1979 relocation policy of the Federal Government of Nigeria (shifting of the new Federal Capital City to Abuja from Lagos), the Niger State Government proposed a twin 132KVA line in the Niger State Regional Development Plan of 1979 to boost the electricity Supply in Suleja L.GA. The twin 132KVA was offered to run from the Shiroro hydropower lines proposed in the Niger State Regional Development Plan of 1979.

To meet the increased electricity demand, the capacity of the sub-station was upgraded in 2016 with additional new transformers of 2X60MVA, 132/33KV. The two new transformers have a load capacity of 48Mw each, which increased the Suleja L.G.A. sub-stations capacity from 66MW to 162MW (Emenike, 2019). Considering the proximity of Suleja L.G.A. to the new Federal Capital City (Abuja), the Suleja L.G.A. masterplan of 1987 envisaged that Suleja L.G.A. would be a dormitory town for many civil servants who would be working in Abuja. The Suleja L.G.A. master plan (1987) proposed housing estates closer to the new Capital City.

Table 6 Agglomeration of Small, Medium, and Large Enterprise in Suleja Local Government Area between 1987 and 2019

Small, medium, and large enterprises	**Suleja 1979**	**Suleja 1987**	**Suleja 2019**
Transport Company	-	-	10
Information Technology	-	-	36
Agricultural Mills	17	17	24
Major Argo Processing Industries	-	-	3
Hotels and Restaurants	-	-	33
Health/Pharmacies	18	18	124
General Hospital	1	1	1
Educational	178	186	490
Building Construction/Block Industries	2	2	33
Bakery and Confectioneries	1	1	35
Manufacturing	20	21	40
Wholesale and Retail Trade	-	2	224
Repair of Home Gadgets	-	2	11
Repair of Vehicles	-	1	10
Micro Finance Banks	-	-	3
Real Estate firms	-	-	3
Commercial Banks	-	1	13
Total	237	252	1093

(Source: Niger State Regional Development Plan, 1979; Suleja Masterplan, 1987; Niger State Bureau of Statistics, 2011; Niger State Bureau of Statistics, 2012; Niger State Ministry of Education, 2021; Niger State Small and Medium Business Enterprises, 2021; Author's compilation, 2021.)

Due to the rising urban population and housing deficit in Suleja L.G.A. (Ojo, 2021), the Niger State Government initiated the first housing estate (Zuma Housing Estate) in 2001, 10 years after the relocation of the new Federal Capital City. Though the Zuma housing estate was meant to

have been completed in 2002 (Yashim, 2001), findings reveal that only 80 percent of the houses were completed in 2019.

In the same vein, the Federal Government of Nigeria and the Niger State, in collaboration with the private sector, initiated the Zariawa housing estate (1000 housing units) in Suleja L.G.A. This project was to ease the housing burden faced by civil servants who resides in Suleja (Ganagana et al., 2016; Mosadomi, 2014). The finding reveals that only 10% of the housing units in Zariawa Estate were completed before the project was abandoned

This study further reveals that in the bid for the Niger State Government to transform Suleja L.G.A. into a modern urban city with smart homes following the Masterplan and the Niger State Development Blue Print. The Niger State government, in collaboration with private sectors, embarked on 279 and 1,220 units of housing estate at Rafin-Sayin and Dikko, respectively.

The study reveals that before the 1987 Masterplan of the Suleja local government area, only 10.97 km^2 of tarred roads were found in the urban area, while other roads were graded tracks. In preparation for the new Federal Capital City (Abuja) relocation, the Niger State government improved the road infrastructure in Suleja L.G.A. by constructing an additional 41.19 km^2 roads in the study area. As a result of the increasing urban population and urban change in Suleja L.G.A., an additional 20.23 km^2 roads were constructed in 1997. To ease traffic challenges due to the rising urban population in the Study area in 2013, the Niger State Government, in collaboration with the World Bank through the Rural Access Mobility Project II (RAMP II), constructed an additional 10.56 km^2 roads in Suleja L.G.A (Niger State Ministry of Works, 2014). Though large percentages (84.94%) of the roads in Suleja LGA are still graded tracks, this study further reveals that Suleja L.G.A. has significantly increased road construction from 10.97 km^2 (1987) road within the urban area to 82.95 km^2 (2019). The increasing number of tarred roads has influenced the pattern of urban change in Suleja L.G.A. between 1987 and 2019.

4.2.3. Proximity to the Federal Capital City

The location and proximity of Suleja LGA prompted the Niger State government to prioritize the physical development of Suleja, among other local government areas in the State (Maxlock, 1979). The location of Suleja also encouraged the Federal Government of Nigeria to designate the local government as a satellite town to the new FCC (Benna & Benna, 2017; International Planning Association, 1979). Obiadi et al. (2019) also believed that the proximity of Suleja to the Federal Capital City brought stability to the town in socio-economic activities and physical development. The proximity of Suleja to the FCC influenced land speculators, developers, and investors to start planning on maximizing the benefits accompanying the new Federal Capital (Maxlock, 1987). The investors' approach encouraged the establishment of various industries in Suleja, which in turn provided economic opportunities for the residents of the LGA and other neighboring states. The proximity of Suleja has also encouraged the Niger State Government to develop various low-cost housing. The development of housing by both State government and Private investors eases the housing burden of the public servant who works in Abuja (Alfred et al., 2016).

4.2.4. Neighborhood Quality as a Factor of Urban Change in Suleja LGA

The mean weighted index was used to analyze the neighbor quality of the study area. Five sets of indexes were created, ranging from 1.00 – 5.00, to represent each scale. Indexes 1.00 – 1.80 was used to describe the "Very Poor" opinion, 1.81 – 2.60 was used to denote "Poor" opinion, 2.61 – 3.40 means "Average" opinion. While the indexes of 3.4 - 4.20 and 4.21 – 5.00 represent "Good" and "Excellent" opinions, respectively. The analysis reveals that commercial activities

in Suleja L.G.A. had a "Good" response. While accessibility, social amenities, recreational facilities, aesthetic qualities, and green spaces (organized open spaces) responded poorly.

Table 7 further reveals that perceived safety, quietness, and healthcare centers recorded an average perception due to the influx of people in the study area. The "Good" response received in commercial activities on a Likert scale explains that commercial activities in the study area thrive due to its proximity to the Federal Capital City (Ejaro & Abdullahi, 2013).

Table 8 explains the factors the residents of Suleja L.G.A. perceived to have influenced urban change within the study period. The study reveals that 53.02% of the respondents, which constitutes the highest percentage, thought that economic opportunities are a strong factor that influences urban change in Suleja L.G.A. Proximity to the Federal Capital City, Abuja, was also noted as a strong factor influencing urban change in Suleja L.G.A., as this option is ranked second in the order of response. Table 8 also reveals that 36.24% (3rd rank) of the respondents perceived that the social status of some residents had influenced urban change in the study area.

Table 7 Neighborhood Quality/Characteristics of Suleja L.G.A

Neighborhood Quality / Characteristics	Very Poor	Poor	Average	Good	Excellent	Total	Mean	Decision
Recreational Facilities	48	92	126	52	0	318	2.13	Poor
Aesthetic Quality	37	102	141	56	0	336	2.26	Poor
Accessibility	21	92	165	108	0	386	2.59	Poor
Perceived Safety	15	108	159	108	0	390	2.62	Average
Green Spaces	47	118	96	44	0	305	2.05	Poor
Quietness	27	68	162	132	5	394	2.64	Average
Market/Shopping Centers	1	20	150	348	5	524	3.52	Good
Social Amenities	19	104	156	104	0	383	2.57	Poor
Health Care Center	5	30	174	276	10	495	3.32	Average

(Source: Author's Field Survey, 2021)

Low rent was argued to be a factor influencing urban change in Suleja L.G.A. by 24.16% of the sample respondents who believed that more civil servant in Abuja resides in the urban area of Suleja. Religious belief, early marriage, and institutions of learning were other factors that were believed to have influenced urban change in Suleja L.G.A within the study period. These factors were ranked 7th, 8th, and 4th, respectively.

Table 8 Perceived Factors Responsible for Urban Change

Options	Frequency	Percentage	Rank
Low rent	36	24.16	6
Economic Opportunities	79	53.02	1
Early marriage	19	12.75	8
Large Household size	43	28.86	5
Religious Belief (Polygamy)	29	19.46	7
Social Status	54	36.24	3
Institutions of Learning	45	30.20	4
Proximity to the Federal Capital Territory	71	47.65	2

(Source: Author's Field Survey 2021)

5. DISCUSSION

The rapid magnitude of changes recorded in Suleja between 1987 and 1999 is attributed to the relocation of the Federal Capital City (FCC) to Abuja in 1991, which was instrumental to the commencement of various physical development activities in Suleja. The rapid urban change of Suleja LGA can also be ascribed to the influx of people who have come to Abuja in search of economic opportunities and 'public servants' who commute daily from Suleja to Abuja due to affordable house rent (Auta, 2019; Buba et al., 2016). Studies (Abubakar et al., 2021; Buba et al., 2016) have confirmed this affirmation that due to the proximity of Suleja L.G.A. to the New Federal Capital City (Abuja), a momentous urban change has been witnessed in the study area.

Those farmlands formed the highest proportion of land use land covers transformed into built-up areas (urban land) between 1987 and 2019 indicates that as the population increases, needed for physical development. Thus, farmlands are most accessible to the residents for physical development. This result was similar to Shifaw et al.'s (2018) findings, which reveal that farmlands were the major contributor to urban lands amidst an urban change in the province of Pingtan in China. Between 1987 and 2019, a total of 30.15 km^2 of farmlands were converted into built-up areas.

The pattern/forms of urban changes in Suleja LGA reveal that edge and outlying expansions encourage a more dispersed pattern of urban change. These findings affirm He et al. (2018) assertion that edge and outlying changes are the main contributors to dispersed growth in an urban area. Since edge expansion is more dominant than the urban infill change in Suleja LGA, the implication is that the urban change of Suleja LGA is characterized by urban sprawl. Studies by Gong et al. (2018), Jiao et al. (2018), and Yu & Zhou (2017) affirm this result. The dispersed growth of Suleja is also evident in its Outlying (leapfrogging) urban form of urban change. The sprawling nature of Suleja from these two epochs (1999 – 2007, 2007- 2019) was also affirmed in the analysis of the forms of urban change in Suleja (See Figure 5 – 6).

This analysis also asserts the conclusion of Al-Sharif (2017) that when the expansion rate of built-up areas/ urban lands is constantly higher than the population growth rate, then high dispersion emerges, which is an indicator of higher urban sprawl. On the other hand, the urban pattern of 1999 – 2007 and 2007 – 2019 also indicates chaotic urban planning. According to Soffianian et al. (2010), chaotic urban planning occurs when the percentage of urban areas exceeds the rate of population growth.

The low urban density index recorded in Suleja between 1987 and 2019 reveals that the urban area of Suleja is not growing in a coordinated manner. This result asserts the findings of Abdullahi et al. (2017); Abdullahi & Pradhan (2017); Norzailawati et al. (2014), who opined that a high urban density index indicates urban sustainability and Smart growth, which encourages walking and cycling while low urban density areas indicate a scattered and a decentralized urban form which is not a sustainable form of urban growth. The urban density indexes recorded in Suleja ranged from 0.030 to 0.165.

Between the study epochs (1987 to 2019), Suleja LGA has had three different development policy documents (Suleja Masterplan, Integrated Development Plan, and Niger State Development Blue Print). Though the Integrated Development Plan was never implemented, the outdated Masterplan and Niger State Development Blue Print still enhanced the development of the study area. In the perceived factors responsible for urban change in Suleja, economic opportunities ranked 1st, meaning economic opportunities are a strong factor influencing urban change in Suleja L.G.A. This perception affirms the findings of Liang et al., 2018; Lu et al., 2013 that

economic activities affect growth and changes in an urban area. In a study conducted by Mawoli (2021) on the analysis of Niger State's business environment for investment attraction opportunities, Suleja was noted to have 40% of the functional industries in the State. It implies that economic opportunities actually progress in Suleja Local Government Area.

6. CONCLUSION

This study adopted remote sensing and GIS tools to quantitatively analyze the processes of urban change in Suleja from 1987 to 2019. During the 32 years of the study period, a rapid category of urban change was witnessed in Suleja, and this led to an outlying urban form characterized by a dispersed pattern of physical development. The urban change in Suleja within the 32 years study period was driven by population growth, urban density, and the government's urban policies. Further studies can be done in urban change and simulation of future urban forms. This study, therefore, recommends that the Niger State Government should review the obsolete Niger State Regional Plan and the Suleja Master Plan to achieve the anticipated Suleja smart city project envisaged. Amidst the rapid urbanization experienced in Suleja, the Niger State Urban Development Board should enforce articulated urban planning to check the problems of uncoordinated urban planning arising from the dispersed nature of physical development. Abandoned housing estates and other ongoing housing estates in the LGA should be encouraged to be completed in the proposed Integrated Development Plan of Suleja, as this will help solve the problems associated with housing and low urban density.

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REFERENCES

Abdullahi, S. & Pradhan, B. (2017). Sustainable Urban Development. In Pradhan, B. (ed) Spatial Modeling and Assessment of Urban Form, Analysis of Urban Growth: From Sprawl to Compact Using Geospatial Data: *Springer* Pp 17-34.

Abdullahi, S., Pradhan, B., & Al-sharif, A. A. A. (2017). Sprawl Versus Compact Development. In Pradhan, B. (ed) Spatial Modeling and Assessment of Urban Form, Analysis of Urban Growth: From Sprawl to Compact Using Geospatial Data: *Springer* Pp 32 – 58.

Abubakar, A., Bala, A., David, S. S., Abdullahi, H., & Kodan, Y. M. (2021). The Impact of Urbanization on Educational Landuse in Suleja, Niger State, NigeriA.U. *AU eJournal of Interdisciplinary Research* (ISSN: 2408-1906), 6(1), 45 -51.

Alfred, B. Y., Gillian, M. U., Mike, O., Ofonedum, O. L., & Audu-Moses, J. (2016). Urban Growth and Landuse Cover Change in Nigeria using GIS and Remote Sensing Applications. Case Study of Suleja LGA, Niger State. *International Journal of Engineering Research & Technology, 5*(8), 124-138.

Al-sharif, A. A. A., Pradhan, B., & Abdullahi, S. (2017). Urban Sprawl Assessment. In Pradhan, B. (ed) Spatial Modeling and Assessment of Urban Form, Analysis of Urban Growth: From Sprawl to Compact Using Geospatial Data: *Springer* Pp 61 -92

Auta, J., (2019). Accommodation in Abuja: Low income earners' headache. Punch, 22 January 2019 [www document]. URL https://punchng.com/accommodation-in-abuja- low- income-earners-headache/ (retrieved October 12, 2021).

Benna, U., & Benna, I. (Eds.). (2017). *Urbanization and its impact on socio-economic growth in developing regions.* IGI Global.

Bhatta, B. (2010). *Analysis of urban growth and sprawl from remote sensing data.* Springer Science & Business Media.

Buba, Y. A., Makwin, U. G., Ogalla, M., Okoro, L. O., and Audu, M. J. (2016). Urban Growth and Landuse Cover Change in Nigeria Using GIS and Remote Sensing Applications. Case Study of Suleja L.G.A., Niger State. *International Journal of Engineering Research and Technology, Vol. 5(08):* 124 -138.

Dempsey, N. Brown, C. Raman, S. Porta, S., Jenks, M., Jones, C., and Bramley, G. (2010). Elements of Urban Form in M.Jenks, C. Jones (eds), Dimensions of the Sustainable City, Future City". *Springer science+Business Media* Pp 21-51.

Deng, J.S.; Wang, K.; Hong, Y. & Qi, J.G. (2009). Spatio-temporal dynamics and evolution of land use change and landscape pattern in response to rapid urbanization. *Landsc. Urban Plan. 92:* 187–198.

Ehlers, E., & Floor, W. (1993). Urban change in Iran, 1920–1941. *Iranian studies, 26(3-4),* 251-275.

Ejaro, S. P.& Abdullah, U. (2013). Spatiotemporal Analyzes of Land Use and Land Cover Changes in Suleja Local Government Area, Niger State, Nigeria. *Journal of Environment and Earth Science Vol 3 (9):* 72 -83.

Emenike, O. (2019). *TCN Inaugurates 2 transformers in Suleja Sub-Station* Available at https://plustvafrica.com/tcn-inaugurates-2-transformers-in-suleja-sub-station/ Accessed 3/04/2022.

Fabeku, B. B., Balogun, I. A., Adegboyega, S. A., & Faleyimu, O. I. (2018). Spatio-Temporal Variability in Land Surface Temperature and Its Relationship with Vegetation Types over Ibadan, South-Western Nigeria. *Atmospheric and Climate Sciences, (8):* 318-336.

Fabiyi, O. O. (2006). Urban Land Use Change Analysis of a Traditional City from Remote Sensing Data: The Case of Ibadan Metropolitan Area, Nigeria. *Humanity & Social Sciences Journal 1 (1):* 42-64.

Force, U. T., & Rogers, R. G. (1999). *Towards an urban renaissance.* Spon London.

Forman, R.T., (1995). *Land Mosaics: the Ecology of Landscapes and Regions*. Cambridge University Press.

Ganagana, M., Adams, J., Ejembi, R., Oota, L., Adeyemi, E., Olanrewaju, L. & Bere, G. (2016). *Abandoned Housing Estate Projects Litter States.* Available at https://www.sunnewsonline.com/ (Accessed 16/02/2022).

Gong, J., Hu, Z., Chen, W., Liu, Y., & Wang, J. (2018). Urban expansion dynamics and modes in metropolitan Guangzhou, China. *Land Use Policy*, 72, 100-109.

He, Q., He, W., Song, Y., Wu, J., Yin, C., & Mou Y. (2018). The impact of urban growth patterns on urban vitality in newly built-up areas based on an association rules analysis using geographical 'big data'. *Land Use Policy* 78: 726–738.

International Planning Association (1979) *The Master Plan for Abuja the New Federal Capital of Nigeria*

Jiao, L., Liu, J., Xu, G., Dong, T., Gu, Y., Zhang, B., ... & Liu, X. (2018). Proximity Expansion Index: An improved approach to characterize evolution process of urban expansion. *Computers, Environment and Urban Systems*, 70, 102-112.

Lambin, E. F., Geist, H., & Lepers, E. (2003). Dynamics of land use and cover change in tropical regions. *Annual Review of Environment and Resources*, 28, 205–241.

Li, X., Gong, P., & Liang, L. (2015). A 30-year (1984–2013) record of annual urban dynamics of Beijing City derived from Landsat data. *Remote Sensing of Environment* 166: 78– 90.

Liang, X., Liu, X., Li, X., Chen, Y., Tian, H., & Yao, Y. (2018). Delineating multi-scenario urban growth boundaries with a CA-based FLUS model and morphological method. *Landscape and Urban Planning*, 177, 47-63.

Liu, X., Li, X., Chen, Y., Tan, Z., Li, S., & Ai, B., (2010). A new landscape index for quantifying urban expansion using multi-temporal remotely sensed data. *Landscape Ecology*. 25 (5): 671–682.

Lu, C., Wu, Y., Shen, Q., & Wang, H. (2013). Driving force of urban growth and regional planning: A case study of China's Guangdong Province. *Habitat international*, 40, 35- 41.

Mawoli, M. A. (2021). *Analysing Niger State Business Environment for Investment Attraction Opportunities: The Role of Government and Private Investors.* FMSS-IBBUL, Seminar Series.

MaxLock. (1979). Niger State Regional Development Plan

MaxLock. (1987). *Suleja Master Plan.*

Miller, R. L., & Brewer, J. D. (2003). A-Z of Social Research. London: Longman.

Mosadomi, W. (2014). *The Story of Niger Housing without Tears*. Available at https://www.vanguardngr.com/ (Accessed 16/02/2022).

Mukwaya, P. I., Sengendo, H., & Lwasa, S. (2010). *Urban development transitions and their implications for poverty reduction and policy planning in Uganda*. In Urban Forum 21(3), 267-281.

Nas, P. J., & Theuns, K. (2005). Semarang: Was HF Tillema a director of urban change? 1. In *Directors of Urban Change in Asia* (167-182). Routledge.

National Population Census (NPC) (2006). *Details of the breakdown of the National and State Provisional Population Totals.* Official Gazette 96 (2): 1–42. Abuja: Federal Republic of Nigeria.

National Population Commission, Nigeria (1991). *Census Report.*

Niger State Urban Support Programme (NSUSP), (2012). *Final Niger State Brochure.* Available at www.nigerstate.gov.ng accessed 20/09//2021.

Nkambwe, M. (1982). Change in Urban Areas in Nigeria. *Urban Studies*, 19(3), 321-327.

Norzailawati, M. N., Alias, A., and Nuraulia, R. (2014). Density Indexes in Determining an Urban Sprawl Using Remote Sensing and GIS Techniques. *Proceedings of the International Conference on Urban and Regional Planning.*

Obiadi, B. N.,Ezezue, A. M., & Uduak, P. U. (2019). Ab-uja: Nigeria's Spatial Economic Turmoiland Urban Development Disarray. CurrentUrban Studies, 7, 371-398.https://doi.org/10.4236/cus.2019.73019

Ojo, A. (2021). Niger Partners Private Sector on 279 *Suleja Housing Estate*. Available at https://www.blueprint.ng Accessed on 04/02/2022.

Olujimi, J. (2009). Evolving a Planning Strategy for Managing Urban Sprawl in Nigeria . *Journal of Human Ecology*, 25(3): 201-208.

Phadke, A. (2014). Mumbai Metropolitan Region: impact of recent urban change on the peri- urban areas of Mumbai. *Urban Studies,* 51(11), 2466-2483.

Qiuying, L., Chuanglin, F., Guangdong, L.,and Zhoupeng, R. (2015). Quantitative measurement of urban expansion and its driving factors in Qingdao: An empirical analysis based on county unit data. *Journal of Resources and Ecology*, (6): 172–179.

Rawding, C. (2012). Teaching urban change using the local area. *Teaching Geography*, 37(3), 99.

Senanayake, I.P., Welivitiya, W.D.D.P., Nadeeka, P.M. (2013). Remote sensing based analysis of urban heat islands with vegetation cover in Colombo City, Sri Lanka using Landsat- 7 ETM+ data. *Urban Climate* (5):19–35.

Shifaw, E., Sha, J.,Li, X., Jiali, S., & Bao, Z.(2018). *Remote sensing and GIS-based analysis of urban dynamics and modeling of its drivers, the Case of Pingtan, China. Environment, Development and Sustainability.* Available at: https://doi.org/10.1007/s10668-018-0283-z [Accessed 23/06/2019].

Soffianian, A., Nadoushan, M. A., Yaghmaei, L., & Falahatkar, S. (2010). Mapping and analysing urban expansion using remotely sensed imagery in Isfahan, Iran. *World Applied Sciences Journal*, 9 (12): 1370–1378.

The Center on Housing Rights and Evictions Social and Economic Rigth Actions Center / CHRESERAC (2008). The Myth of the Abuja Master Plan: Forced evictions as urban planning in Abuja, Nigeria. *The Center on Housing Rights and Evictions (COHRE),* Geneva, Switzerland, U.N.

UN (2018). *World Urbanization Prospects.* Department of Economic and Social Affairs Population Division.

Weng, Y. C. (2007). Spatiotemporal changes of landscape pattern in response to urbanization. *Landscape and Urban Planning*, 81, 341–354.

Wilson, E.H., Hurd, J.D., Civco, D.L., Prisloe, S. & Arnold, C. (2003). Development of a geospatial model to quantify, describe and map urban growth. *Remote Sensing of Environment,* 86(3), 275–285.

Xiao, J. Y., Shen, Y. J., Ge, J. F., Tateishi, R., Tang, C. Y., Liang, Y. Q., et al. (2006). Evaluating urban expansion and land use change in Shijiazhuang, China, by using GIS and remote sensing. *Landscape and Urban Planning*, 75, 69–80.

Xu, C.; Liu, M.S.; Zhang, C.; An, S.Q.; Yu, W. &Chen, J.M. (2007). The Spatiotempora l dynamics of rapid urban growth in the Nanjing metropolitan region of china. *Landsc. Ecol*. 22: 925–937.

Yashim, E. (2001). *Nigeria: Procon Group to Complete Zuma Rock Estate* in 2002. Available at http://www.allafrica.com/stories/200110190442.html [Accessed on 04/02/2022].

Yin, J., Yin, Z. Zhong, H., Xu, S., Hu, X., Wang, J., & Wu, J. (2010). monitoring urban expansion and land use/land cover changes of Shanghai metropolitan area during the transitional economy (1979–2009) in *China. Environment Monitoring Assessment* 177:609–621.

Yu, W., and Zhou, W. (2017). The spatiotemporal pattern of urban expansion in China: A comparison study of three urban megaregions. *Remote Sensing*, 9(45): 1-18.