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Full Length Research Article

CHANGING URBAN STRUCTURE AND PHYSICAL EXPANSION TRENDS OF KAFANCHAN METROPOLIS, KADUNA STATE, NIGERIA

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ABSTRACT
This study examines the changes in the urban growth of the city using empirical methods. First, the population growth was analysed to track changes between 1978, 1991, and 2016. Secondly, the city's physical, structural expansion was assessed from 1990 to 2016 using earth observation satellite images over the two epochs on supervised classification and the maximum likelihood criterion. The study generated digital maps of land use/land cover changes of the two epochs. Results showed that the developed area had increased from 8.93 % in 1990 to 22.1 % in 2016. Most expansion took place at the periphery of the town. Considering population indices, from 1978 to 1991, there was 9.6% growth and a tremendous growth between 1991 and 2016 of 227.6%. Considering population growth and spatial land cover change increase, there is over 200% growth of both indices. The study recommends the need for the Kaduna State Urban Planning and Development Agency (KASUPDA to continuously monitor urban growth and compliance with the Master plan using similar empirical methods developed in this study.

Keywords: Urban Growth, Urban expansion, Kafanchan, Population, Trends, GIS.

INTRODUCTION
Today, the world in no doubt is increasingly becoming urbanised with a tendency exerting an increasing impact on society; specifically, the 20th-century undergone unprecedented and rapid urbanisation of the global population compared with previous world reports. However, the global urban population rose from 13% as recorded in 1900 to 29% recorded in 1950, 49% recorded in 2005(Aliyu and Amadu, 2017). 2018 Revision of World Urbanization Prospects projected that this number is expected to grow by 68% as of 2050. This trend represents the rise of the urban population, from 220 million people in 1900 to 732 million people in 1950). An estimated 55% (3.8 billion average population) resided as urban dwellers in 2014 (UNDESA, 2019), and populations of 4.9 billion are estimated to reside as urban dwellers by 2030 (at the rate of 1.8% urban increase annually) (Aliyu and Amadu, 2017). Nearly all of this growth is found in low-income Asian and African regions where the urban population is speedily apprehended. In these countries, urbanization is rising and is expected to become urban by 54% and 68% by 2050. By the early 20th century, only 16 urban cities worldwide (mostly in developing countries) found to contain one million or perhaps more people. Over 400 urban cities today have a population of one million or even more, and around 70% of them are found in underdeveloped nations (Aliyu and Amadu, 2017). According to the African report of the United Nations 2017 on urbanisation and drivers of migrations, over half of the world's populations currently live-in cities considered urban. However, in 2007, most people lived in towns and cities than those in rural areas for the first time in historical records; however, by 2017, even developing countries are expected to become even more urban than rural.

The Nigerian society is increasingly turning urban as a combination of a multitude of pull and push factors. This has produced urban public health issues within urban residents, especially the urban poor. Many other studies have also shown that insufficient urban spatial planning in Nigeria has also worsened city issues such as heat stress, air and water pollution, and congestion (Avis, 2019). These have generated public health crises of insufficient clean water supply, squalor and shanty settlements, sanitation, severe waste management crises, unprecedented stress on infrastructure systems, disease prevalence stress, air pollution, congestion, more unemployment rate, hazardous transportation system, and significant land-use land cover alterations (Aliyu and Amadu,2017). With growing numbers live in urban areas, the current urban infrastructure is striving to cope with urban dwellers' rising expectations in several ways. Rapid continuous growth and expansion have resulted in urban growth and suburban population sprawling, i.e., unregulated housing expansion, commercial construction, and road development (Avis, 2019). The Nigerian society is experiencing both demographic transformation (individuals live much longer) and epidemiological transition (transformation in health status due to lifestyle changes) primarily as a result of civilisation and urbanization (He *et al.*, 2018). The region is experiencing urban expansion with a fast-increasing population at the current growth rate averagely 2.8 % -3% a year in the past five decades (Aliyu and Amadu, 2017). This can be estimated Nigeria's city population will steadily grow in the foreseeable future. UNDESA (2019) estimates indicate the population of urban areas in Nigeria can be double in 30 years to come.

The process, phenomenon, and manifestations of Nigeria's urbanisation have been extremely pertinent (Aliyu and Amadu, 2017). The Nigeria cities/towns have expanded tremendously, with urban growth rates steadily over 2% a year (UNDESA, 2019). As a result, Nigerian cities were rapidly expanding, mostly without planning and unregulated approach (Ofem, 2012). Nigeria currently has limited planning frameworks that could have strategically address spatial expansion. Also, the country lacks sufficient demographic estimates to predict urban expansion demands accurately. Many other studies have also shown insufficient urban spatial planning in Nigeria, and even its severity has intensified urban issues, for example, both air and water pollution, heat stress, and congestion (Avis, 2019). Nigeria's urban centers are growing

at varying rates, depending on the urbanisation dimension considered, and developments appear to concentrates on the fringes (Lwasa *et al.*, 2014). Urban areas in Nigeria are experiencing unprecedented population rising, followed by unplanned and uncontrolled expansion, which has created many issues and difficulties for government and urban residents. Urban areas are just the critical main engine rooms for an overall economy to build up; hence, they must be well designed (Charles, 2015).

Although there is no standardised definition of the term urban settlement, the urban settlement concept differs with frequent reclassification, even country by country. Over time, this could also vary within a single country, (Avis, 2019). Any of those as mentioned below sometimes describes the conditions for categorising a town as an urban setting: political boundaries or administrative criteria, population density and population threshold size. These settlements are generally presumed to provide non-agricultural services to their residents and surrounding communities, such as trade, education, health, religion, recreation, administration and transportation, in addition urban infrastructures such as electric lighting, paved streets and sewerage, therefore have a dragging effect on neighboring settlement populations in order to meet their needs (Ofem, B. 2012) (Avis, 2019). Nigeria is adopting a population lower limit of 20,000 as the benchmark for identifying an urban area. Additionally, administrative/legal criteria comprise all states, and local government headquarters are also considered urban centers (Ofem, B. 2012; Burak *et al.*, 2017). Towns are seen as compacted areas associated with large growth rates, steadily expanding with physically significant characteristics of cities (Farrell, 2018). Urban expansion usually undergone on the outskirts as land cover increases, and thus the urban fringe goes through a continuous redefinition cycle, often redefining municipal boundaries. Both actual and quantitative population increase has also been followed by the developing domestic built-up areas and the creating of new and recognizable urban centers (Bloch *et al.*, 2015).

Urban increase- the actual or quantitative growth in the percentage of people residing in urban areas; a lot of factors are viewed driving urban growth and expansion are global (Seto *et al.*, (2012). The population and economic increase might add a little percentage to urban centers' transformation in many developed and emerging countries. The root reason for swift growth in urban areas and rapid urbanisation in Nigeria, Bloch *et al.* (2015), is population increase fueled by decreasing mortality and continuous high fertility. Urban natural growth, as such, plays an essential (likely dominant) role in affecting the rate of growth in population (Avis, 2019). Farrel (2018) published similar results. He states that drivers or components of urban population increase include many factors. The urban natural population increasing, responsible for an average of 50% of the urban rise, remains a significant increase in rural-urban migration balances that contribute to the dominant factor. Population growth and urban increase are estimated to increase steadily in Nigeria in the coming decades. In Nigeria, the urban population's growth pace relies on factors as natural city's population increase, population influx by rural-urban migration to urban areas, and rural settlements reclassify as cities and towns. Responsible causes or drivers, which make up the urban increase, may be extracted from three sources. First, Urban Natural Increase describes the discrepancy between the birth rate and death rate, indicating more births than deaths due to a high health facility standard. Secondly, rural-urban migration; people who come to the city from rural areas in search of scarce amenities around the rural settlements. Thirdly, reclassification of some rural settlement as town/city seen as some rural communities has expanded by its population to be categorised as urban (Farrel, 2018; Saghir *et al.*, 2018). Besides, the belief that cities provide more excellent opportunities in terms of health services, employment, and research are also practical pull factors. Many other factors that affected urbanisation in Nigeria include creating states, leading to the creation of new Local Government Areas (LGAs) with the consequent establishment of more state and LGA capitals. And virtually every created state, new colleges, and universities are established, and the current federal capital subsequently moved to Abuja (Charles,2015).

A Short Account of Nigeria Urban System in History

Looking at Urbanisation formation in Nigeria, it can be seen and link to three phases reflected in Nigeria's history. First, the pre-colonial era (before 1854), the majority of the population of Nigeria was spread all over its territory, with animal grazing by nomadic tribes and agricultural production. Early settlers started to emerge in some regions of the Northern part, including the Kanem-Bornu Empire and the Kingdoms of Hausa (Farrel, 2018). Those settlers were founded all along the Trans-Saharan trade route that linked West Africa and North Africa and gradually developed into central trading posts. Examples of essential trading posts that remain today are Zaria, Katsina, and Kano. The then trading settlements in the west dominated by the Yoruba's include Ibadan, Ijebu-Ode, and Ife (Bloch *et al.* 2015). Second, the colonial era (1854-1960), Nigeria's current population system was disrupted by the colonial period and mark the beginning of the new revolution.

Colonial masters continued to conquer the area with resource exploitation as their fundamental goal, leading to the discovery of animal skin in the North, including groundnuts. In the East, it was also coal. Following this, new settlements were established throughout the country, to serve as colonial administrative centers and colonial outposts (Farrel, 2018). These same British colonial masters established a vast road network and railroad to promote the exploitation and carriage of goods, linking these outposts to the vital major ports of Lagos and Port Harcourt. Settlements favorably sited along these transport routes emerged as major administrative, ports, and industrial cities (Fox *et al.*, 2018). Many of these settlements become central cities in the twenty-first century. The private firm, both industrial and agricultural production courses, the growth of towns in the south mostly relying more on government investment. Most examples of these cities are Kaduna, Enugu, Lagos, Jos, Kafanchan, and Port Harcourt. And lastly, the post-colonial era (1960 to date). But it wasn't until the post-colonial era that the urban transformation in Nigeria started to take off. Urban expansion can be linked to constant government reform, leading to the extensive creation of new major cities as administrative towns or cities and government investment across the country (Farrel, 2018). The emergence of new banking enterprises, the establishment of more educational institutions, including tourism and construction industries in the 1970s, 1980s, and 1990s, also speeding urban population growth. (Aliyu and Amadu 2017).

Objectives

The integration of remote sensing and GIS does provide spatially consistent and accurate knowledge about the structure of urban

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changes, allowing urban changes processes to be more accurately represented and understood. They have also been known as powerful and efficient instruments for detecting the spatio-temporal dynamics of different scale landscape changes. Remote sensing and GIS techniques will thus be used to analyze the urban changes of Kafanchan and its effect on land-use and land cover

i. Analyze population changes using population data during the period.
ii. Analyzing the consequences of the population changes on spatially build-up environment.
iii. Examine the magnitude, nature and trend of land-use and land cover changes that has occurred within the period of 1990 to 2016 in the study area.

The Study Area

Kafanchan is located in Jama'a Local Government Area of Kaduna State; it is a town in southern Kaduna, North-Central Nigeria, and among the oldest Local Government headquarters since Kaduna state creation in 1967. It has a geographical coordinate between latitude 9° 33' 30" to 9° 36' 30" North and longitude 8° 16' 0" to 8° 20' 0" East with an elevation of 739m (Abaje *et al*., 2009). It is bounded to the North by River Wonderful (Rafin Sarki), having a natural waterfall known as Tityong (in the dialect of Fantswam Tyap) and Matsirga (in Hausa). River Wonderful went further bounded to the west but had its name change to river Malaika. It has distinguished steep banks of the river or gully like characteristics, thereby providing substantial construction obstacles in this direction. Garaji Fadama to the East, and Ungwan Fari to the south (Musa, *et al*., 2016).

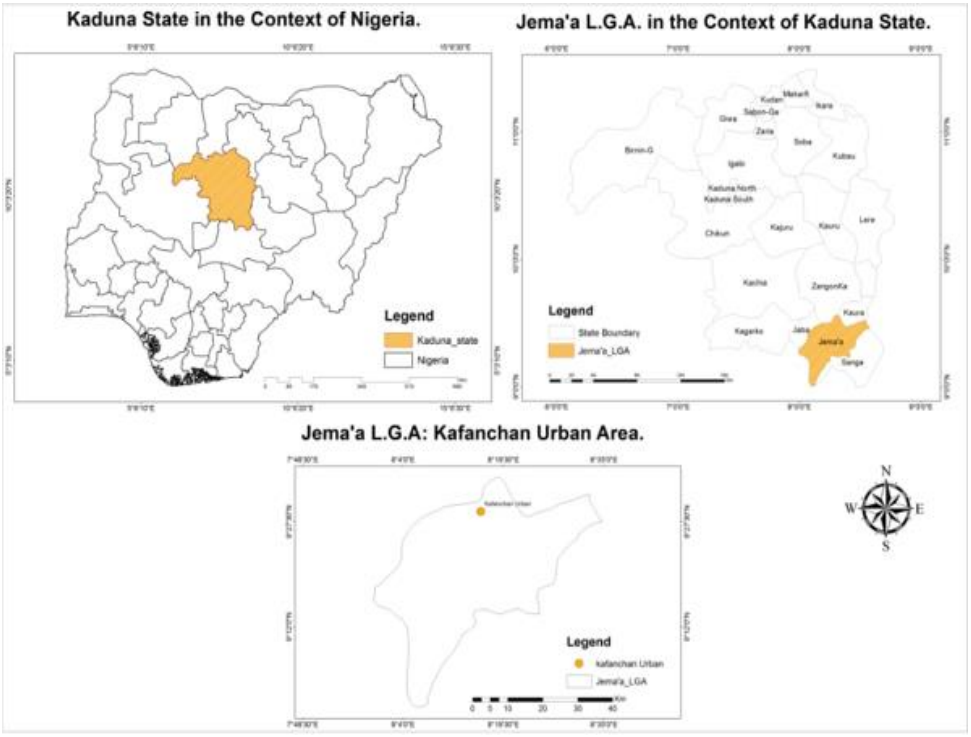

Fig 1: Location Map

Factors Influencing Migration to Kafanchan in History Time

Fantswam tribe were known to be the Initial settlers in where it is today as Kafanchan. The fight against Fulani Jihad and search for fertile land against famine, other neighboring tribes of Kaninkon, Bajju, and Atyap communities were caused to migrate and settle in between initial settlers Fanstswam people. In the early 1810s, the Hausa-Fulanis settlement in kajuru was forced away by the chief of Kajuru led by Usman Yabo, and a preacher settles a few kilometres from Fantswam at a location called Jama'a Dororo. The Hausa-Fulani established an emirate amongst the citizens at this site. In 1933 the ruler of the Hausa-Fulani community, Muhammadu, shifted his capital to the heart of Fantswam territory. These were achieved with British colonialist support (Britannica).

The colonial government had brought into being the system of railway building in Nigeria. It was one of the first transport infrastructures in place by the colonial government to facilitate colonial administration by maintaining a link between the central seats of government in Lagos and other parts of Nigeria. Besides, colonial railways were meant to facilitate the exploitation of agriculture and mineral resources for export to Europe (Ishaya *et al*., 2008). The coming of railway line 1926 in Kafanchan catalyzed development in the area contrary to the idea behind introducing the railway system in Nigeria, which was for maximum exploitation of resources. As the railways began to take shape, a new administration and commercial centers were being developed at strategic points on the lines (Uif, 1982). One of these was the emergence of modern urban centres on the railways, which Kafanchan is not an exception. If the colonial regime has brought about some economic change in Kafanchan and, by implication, Nigeria, it was by constructing railways (Britannica)

(Charles, 2009) observed that Kafanchan district headquarters was

the largest railway junction in the country. It was the only station operating colour light signal, and it served as a vital nerve center for traffic operation from the Western, Northern, and Eastern Districts. The emergence of Kafanchan as a significant urban center on the railway marked a radical departure from a traditional village settlement to an urban settlement. The coming of the railway in Kafanchan increased the immigration of different groups to the town (Ishaya *et al.*, 2008). The opening of the Easter railway from Port-Harcourt to Kaduna in 1927 marked a turning point in the population's movement from southern Nigeria to Kaduna. The Igbo were rich in palm oil, brought their goods, and bought other products such as yams and groundnut, which they do not produce. These attracted traders from Igbo land and other parts of Nigeria; Kafanchan experienced a massive influx of the Igbo people from the southeast and the Yorubas from the southwest. Hence it became the real point, were other new market centre emerged (Abaje *et al.*, 2009).

In Kafanchan, the increase in colonial activities increases and facilitated by the railway, hastened the integration process, especially the introduction of wage labour. It attracted many people who migrated and settled permanently. Wage labour featured prominently in Kafanchan town as rail line construction was going on (Charles B.A. 2009). The mobilisation and the recruitment of labour force cut across the different ethnic groups in northern and southern parts of Nigeria, (Uif, 1982). The post office and telegraph system came into existence because of the activities of the railway station. This shows that postal services were discharged punctually. The telephone lines used by the post office and town were direct from the railways since more than one-third of the workers in Kafanchan then were railway staff. The station had a transceiver and a radio system which was used to relay information to different places (Ishaya *et al.*, 2008). All these contributed to transmitting information to different areas. All these contributed to the process of advancement and modernisation of Kafanchan town. Hundreds of immigrants from southern Nigeria and neighbouring places move to Kafanchan in search of employment opportunities in the railway. Railway systems also culminated in intense commercial activities and the steady rise in the population in the urban centre's that subsequently became railway terminus or towns, (Abaje *et al.*, 2009).

As Kafanchan is sprawling with population influx, it also attracts missions, and schools were established. Commercial college and also an apprentice school established by Anglicans. Later, the Igbo community in Kafanchan also establish a school and name it Igbo Community Grammer School. On creation of Kaduna state in 1967(Uif, 1982), Kafanchan became a Local Government Area headquarters, the establishment of Post office, the establishment of a branch of bank of the North in 1971, and the General hospital that started as a railway clinic in 1929 and later in 1942 it was taken over by government were all pulled factors. The conversion of Igbo Community Grammer School to Government Secondary School, Kafanchan, and Commercial Collage to Teachers college all in 1971, and apprentice school to College of Education in 1977, all create population migration Kafanchan. As Kafanchan expands, other smaller villages around were merged to increase its size (Abaje *et al.*, 2009).

MATERIALS AND METHODS

The most recent innovation in monitoring urban and geospatial changes consists of geospatial databases composed of satellite imagery and data from censuses. Experts argue that satellite imagery of a developed extent is indeed more precise, reliable, clear, and comparable in town and city centers definition than ideas hold of demographic size or emphasis on territorial limits (Mohapatara *et al.*, 2014). This research utilises an advanced GIS and Remote Sensing urban mapping method. The concept behind this interactive analyst method is the dynamism it adds to the quantification of the study of Urban Growth indexes, the trend of urban increase, and the simulation of Urban Growth, using data obtained on varying temporal and spatial scales ramifications of one cohesive network. The capability of manipulating different spatial data just in one medium is the second principle in nature in the tool design. Four Landsat TM and ETM epoch resolution images of 1990, 2000, 2010, and 2016 were used to identify urban spatial growth trends in the study field.

All imagery was obtained from the Web site of the United States Geological Survey (USGS). As used, these research data sets were geometrically referenced to the WGS 1984, UTM Zone 32N projection system. Landsat images were used to analyse the spatial changes patterns of Kafanchan for 26 years. All images were geometrically corrected and geo-referenced. The supervised classification algorithm for maximum likelihoods was used in ArcMap 10.2. This study's shift identification was the post-classification comparison technique in which GIS overlay of two or more produced independent classified images in ArcGIS 10.2. The generated classified maps are then measured visually, compared, and the differences in the level of build-up area mark the extent changes in urban growth.

Table 1: Satellite Imagery Used

	Satellite	Path	Row	Year	Date
1	Landsat Tm	188	053	1990	22-12-1990
2	Landsat Etm+	188	053	2000	17-12-2000
3	Landsat Oli	188	053	2016	03-11-2016

RESULTS AND DISCUSSION

Discussion is presented in two parts, tables and figures. The tables explain urban extent (Population size) in the 1990s and 2016, while the maps show the graphic urban extend and expansions (geo-spatial; built-up areas) in 1990 and 2016 urban expansion.

Table 2: Population Sizes of Kafanchan.

YEAR	POPULATION	PERCENT RISE %	SOURCE
1978	79,891	6.4	www.Worldometers.infor
1991	87,563	7.0	1991 POP. Census
2016	286,857	23.0	citypopulation.com

Source: Research Survey, 2020

The growth of the world's urban population can be measured by comparing the dates on which important landmark milestones are reached (Ojo and Barau, 2017). Table ii shows the development and changes in the population of the urban areas of Kafanchan; i.e., 1978, 1991 and 2016. These indices show a rise from 79,891 in 1978 to 286,857 in 2016; dramatic increases in population

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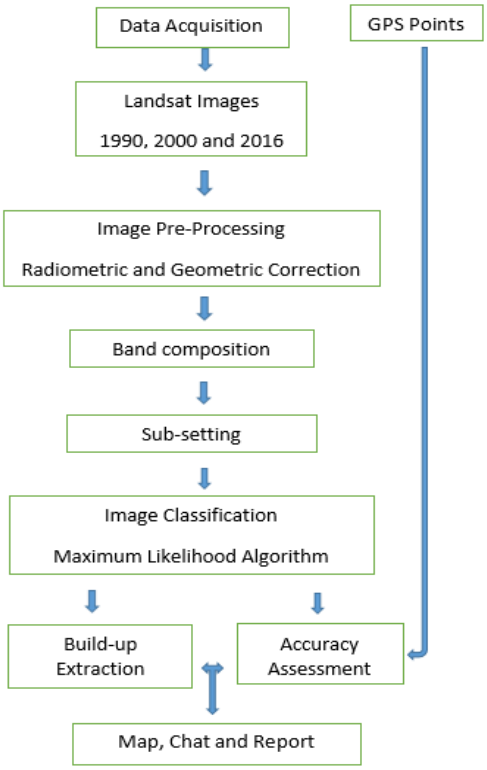
statistics clearly indicate an improvement in the trend and growth rate. Between 1991 and 2016, there was a significant rise of 327.60% compared to 113.88% between 1978 and 1991. This implies that the migration factors to Kafanchan urban are still very successful, suggesting an expected double increase over the next decades. Factors connection to this huge growth could be drown from natural increase factor; more of health care facilities. The reclassification element of the surrounding villages also merges with the urban Kafanchan (Musa *et al.*, 2016). This is seen in villages like Garaji to the north-east, Kastit to the west, and Takau to the south, all of which merge into Kafankan urban. Another consideration factor is migration from rural areas to Kafanchan urban areas, Kafanchan being the seat of the Local Government Headquarters and other job opportunities. The influx and urban growth areas is not compatible with the existing urban infrastructure to meet the anticipated demand. People are seen searching for drinking water from bore holes (Abaje *et al.*, 2009).

ANALYSIS FLOW CHAT



Source: Researcher's design analysis flow chat

The 1990 Epoch of Kafanchan Urban: The year 1990 epoch is used in this study as a basis for comparison with subsequent years for analysis. At this stage, the size and extent of urban development was minimal, as graphically produced from the 1990 image. The total land area set out for this analysis is 29.17km^2 constituted by five features land use/ land cover classes; built-up, vegetation, waterbody, rock outcrop, and bare surface were classified from the Landsat satellite images with Kafanchan urban in its central area. It is apparent from the land cover map that changes occurred in the proportion of the area covered especially for built up area which is the major focus for this study.

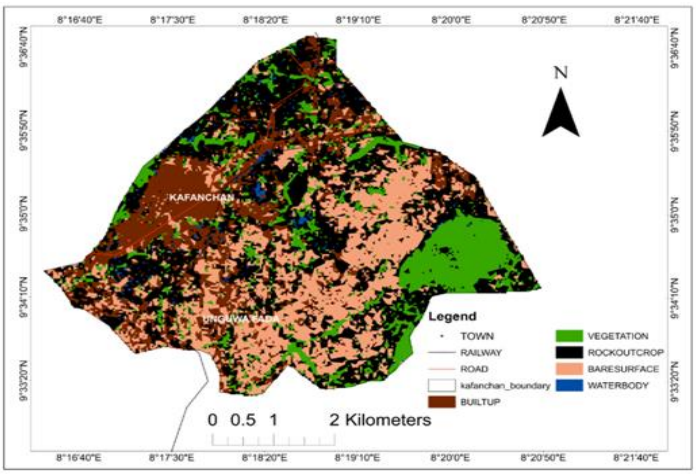


Figure 2: 1990 Kafanchan Urban Area Extent (Source: GIS Analysis, 2020)

Accuracy Assessment

The accuracy assessment reflects the difference between the target dataset and the reference data set. Table 2-4 presents the confusion matrix reference data obtained from the signature editor in Erdas imagine which was evaluated to achieve the overall accuracy assessment, user accuracy and producer accuracy. The overall accuracy assessments obtained from the classified imageries were 98.2%, 99.3% and 98.3% for 1990, 2000 and 2016 respectively.

Table 3: Error Matrix for Kafanchan 1990

	REFERENCE DATA						
CLASSIFIED DATA	Built-up	Vegetation	Rock outcrop	Bare surface	Waterbody	Row Total	User Accuracy
Built-up	103	0	0	0	0	103	100%
Vegetation	0	101	2	0	0	103	98.1%
Rock outcrop	0	0	123	0	1	124	99.2%
Bare surface	2	0	0	48	0	50	96%
Waterbody	0	0	2	0	13	15	86.7%
Column Total	105	101	127	48	14	395	

General Accuracy Assessment for Kafanchan (1990) = 103 + 101 +123 + 48 + 13/ 395= 98.2%

The 2020 Epoch of Kafanchan Urban

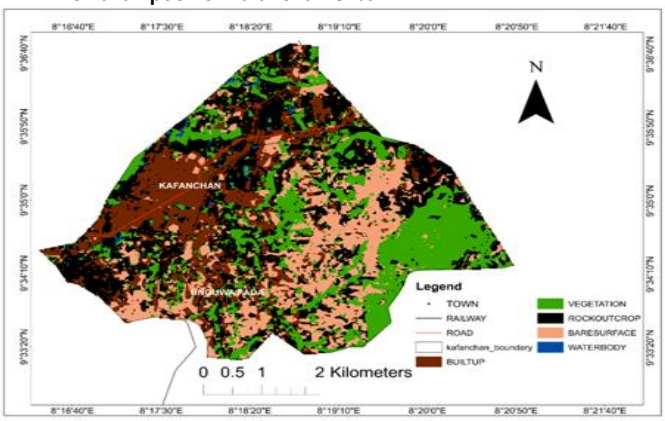


Figure 3: 2020 Kafanchan Urban Area Extent (Source: GIS Analysis, 2020.)

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Table 4: Error Matrix for Kafanchan 2000

	REFERENCE DATA						
CLASSIFIED DATA	Built up	Vegetation	Rock outcrop	Bare surface	Waterbody	Row Total	User Accuracy
Built-up	95	0	1	0	0	96	98.9%
Vegetation	0	166	0	0	0	166	100%
Rock outcrop	0	0	80	0	0	80	100%
Bare surface	0	0	0	60	0	60	100%
Waterbody	0	0	2	0	12	14	85.7%
Column Total	95	166	83	60	12	416	
Producer Accuracy	100%	100%	96.4%	100%	100%		

General Accuracy Assessment for Kafanchan (2000) = 95+166+80+60+12/ 416 = 99.3%

The 2016 Epoch of Kafanchan Urban: The 2016 epoch was used to evaluate and assess the gap of increase between 1990 and 2016, which will show the extent of Kafanchan 's urban growth and expansion in the 26 years covered by this analysis.

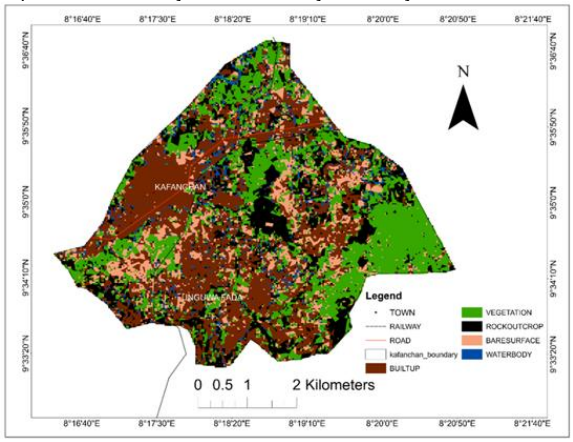

Figure 4: 2016 Kafanchan Urban Area Extent

Table 5: Error Matrix for Kafanchan 2016

	REFERENCE DATA						
CLASSIFIED DATA	Built up	Vegetation	Rock outcrop	Bare surface	Waterbody	Row Total	User Accuracy
Built-up	391	0	3	0	0	394	99.2%
Vegetation	0	237	1	0	0	238	99.6%
Rock outcrop	2	0	112	0	0	114	98.2%
Bare surface	3	2	0	48	0	53	90.6%
Waterbody	2	0	1	0	17	20	85%
Column Total	398	239	117	48	17	819	
Producer Accuracy	98.2%	99.2%	95.7%	100%	100%		

General Accuracy Assessment for Kafanchan 2016 = 391+237+112+48+17/819 = 98.3

Table6 shows the different land use/cover coverage; built-up, vegetation, waterbody, rock outcrop, and bare surface classes respectively, constituting 29.7km^2 set out for this analysis. All the imagery were acquired either in November or December. The feature class of patches of water body exist, this could be as a result of the time imagery were acquired, the study area experience rain in November and at times very scanty in December (Ishaya *et al.*, 2008). The class Bare surfaces reduces from 7.97Km^2 in 1990 to 3.98Km^2 2016. Also, Rock outcrop reduces from 10.26Km^2 to 5.17Km^2 in 2016. Vegetation increases from 4.82Km^2 to 8.47Km^2.

This also could be as a result of the time the imagery were acquired. November / December are months of much vegetation just before bush burning. Other features classes of bare surfaces and Rock outcrop were converted to vegetation due to little rain in those months. Our focus is the built-up class. Built-up area shows 5.87Km^2 in 1990 increases to 6.21Km^2 in 2000 and also an increase to 10.27Km^2 in 2016. It is evident that spatial growth has taken a high dimension in urban area of Kafanchan. A significant change in urban scale, both from the point of view of physical invasion and transition in 2016, has occurred and is occurring in an unregulated and uncontrolled manner, with no coherence to authority's approval. Prevalence of vegetation is noticeable due to the imagery were acquired during the little rainy months of November/December.

The population indices shown in Table 2 indicate a rise of 327.60 per cent from 1991 to 2016. From the state of geo-spatial extent in 1990 and 2016, from the image analysis in Table 6 showed a rise of 6.21Km2 to 10.27Km in the region between 1990 and 2016 respectively. Comparing population growth indices and built-up area growth for the period, it indicates there has been an increase in population with corresponding increase in built-up area.

Table 6: Area Covered by Feature Classes

FEATURE CLASSES	1990 (KM^2)	2000(KM^2)	2016(KM^2)
WATERBODY	0.25	0.17	1.28
BARE SURFACE	7.97	6.20	3.98
ROCK OUTCROP	10.26	9.18	5.17
VEGETATION	4.82	7.41	8.47
BUILT-UP	5.87	6.21	10.27
TOTAL	29.17	29.17	29.17

Source: GIS Analysis, 2020

Urban Growth Overlay

Built-Up Extraction and Trend of Urban Growth 1990-2016

From the classified imageries, the built up were extracted from each of the years and overlaid to show the extent of growth within the study area (figure 4). Table 5 shows area covered by built-up between 1990, 2000 and 2016. It presents that built up covers 5.87KM^2, 6.21KM^2 and 10.27KM^2 in 1990, 2000 and 2016 respectively. This relatively shows significant changes in built up areas.

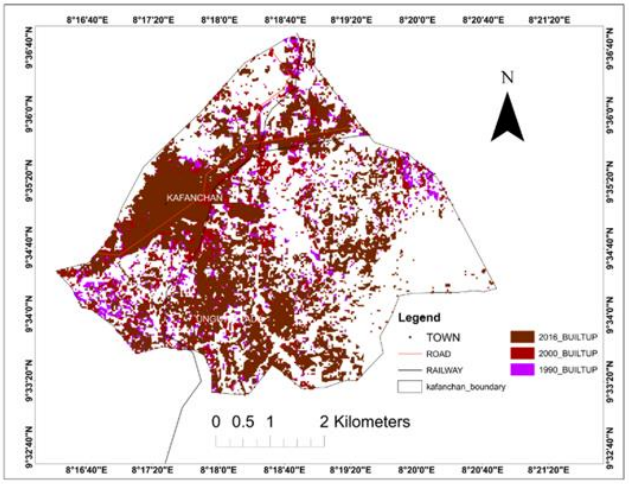

Figure 5: Built-Up Extent for 1990, 2000 and 2016

Change Detection Analysis between 1990, 2000 and 2016

The change detection analysis between 1990 and 2016 (26years period) shows a significant change in built up while bare surface and rock outcrop experiences drastic reduction possibly to vegetation. It was accomplished by superimposing the land use map of 1990, 2020 on the land use map of 2016 to create a composite map of multiple layers. The difference is seen in contrasting colors, which indicate changes in the degree of land use and changes in the area's land cover.

Urban Growth Direction

Careful observation reveals that most spatial growth occurs around existing built-up areas. The spatial growths over the years have generally followed a leap-frog pattern with also patches of edge-expansion. Most of the urban growth and expansion in the Kafanchan urban area tend to grow outwardly, majorly occurring or growing towards the South-East, South-West, and North-East fringes, respectively. It can be seen that only a few proportions of this growth occurring towards the town's extreme North due to the significant barrier that river Malaika presents to this axis of its gully or river bank steepness. In contrast, the excessive cost of land and lack of space within the core areas has affected the growth rate and expansion in the town's heart.

Conclusion

Urban growth and expansion in Kafanchan have occurred mostly in the town's fringes, thereby significantly modifying the urban landscape compared to what existed in 1990. The significant surge in population from 79,891 in 1978 to 286,857 in 2016 over 26 years is a clear indication of population growth with consequences in spatial growth. Although rural-urban migration has contributed significantly, the internal mechanisms of fertility, reduced mortality, and improved living standards have played significant roles. At the same time, there has indeed been unprecedented urban growth in Kafanchan urban area. The process of land use or growth is mostly informal since about 70% is carried out this way, which implies that the authorities do not approve the changes. From close observation, it was apparent that urban growth patterns have been altered over the years as development continues. The study recommends a comprehensive data generation of urban indices of Kafanchan that will provide a basis for constant monitoring and supervision, as unplanned urban growth is associated with social challenges that can be overwhelming the authorities. When implemented, urbanisation will lead to Kafanchan's social and economic growth. That being said, with the unprecedented speed and size of the urban growth presently surpassing the ability of local government to provide the accommodation, utilities, and services required to cope with an increasingly urban population, those results are not assured.

Recommendation

There are currently minimal planning frameworks for coping systematically with spatial development. Also, Kafanchan lacks proper demographic estimates to predict urban land needs reliably. A thorough analysis should inform such planning of how urban expansion occurs in some particular urban areas of the town. Given Nigeria's government system's qualities, Federal and states have more functions and powers than LGAs, and the state governments observed assimilated spatial extension. The study recommends closer and up-to-date monitoring of environmental changes, employing satellite imagery taken consistently at an interval set timeframe. To appease the growing need for planning, land use mapping should regularly be carried out. In addition, the Kaduna State Urban Planning and Development Agency (KASUPDA) to continuously monitor urban growth as well as compliance with the Master plan using similar empirical methods developed in this study.

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