AMERICAN JOURNALS
Open Access, Peer Reviewed Journals

American Journal of Research in Humanities and Social Sciences
ISSN (E): 2832-8019 Volume 1, | June, 2022

THE TRAJECTORY OF URBAN GROWTH, LAND USE PATTERNS, AND MOBILITY IN KANO URBAN AREA, NIGERIA

Solomon Dyachia Zakka1 *, Amos Danladi2, Haruna Ahmadu3,
*1*Department of Urban and Regional Planning, Federal University Oye-Ekiti, Ekiti State Nigeria*
2,3Department of Urban and Regional Planning, Nuhu Bamalli Polytechnic Zaria, Kaduna State, Nigeria
**Corresponding author email: zakka.solomon@fuoye.edu.ng*

ABSTRACT

The trajectory of urban Growth, Land use patterns, and mobility in Kano Nigeria was motivated by the trend of rapid urbanization in third world countries of sub-Saharan Africa that is driven by demography and forces of push-pull factors. The study aimed to examine the trend of urban growth, Land use patterns, and urban mobility, in the sub-Saharan city of Kano, and to ascertain the implications and consequences of this trend on the city transitional process on the city sustainability index. Method of Remote Sensing and Geographic Information System (RS/GIS) was used to extract imageries maps for Kano Urban Area. Spatial analysis of data was carried out using the ArcGIS 10.2 software. Furthermore, a set of questionnaires were administered. Respondents were drawn from the sample of urban commuters with n=600. Collected data were analysed using frequency analysis. Findings from the research revealed the growth of the city is characterised by the following: steady expansion of the built-up area by 346.15% over the past thirty (30) years, the gradual fragmentation of the urban landscape is supported by a spatial metric indicator of an increase in urban landscape patches from 63 in the year 1990 to 115 patches in the year 2020. An average Fractal Dimension Index (FD) value of approximately = 1 was calculated. The research further confirmed the transformation of the city from mono-centric form to polycentric form by creating a sphere of influence and attraction for the City of Kano. A total of 81.83% of all commuter trips are attracted to the various poles of attraction located within the city sphere of influence and attraction. The research has revealed high dependence on tricycles as the common mode of transportation for the city. This has resulted in excessive traffic congestion and an increase in traffic time for urban commuters. The repositioning of the land

KEYWORDS

Urban Growth, Planning, Land use Pattern, Mobility.

administration system to guide urban growth and the land-use patterns toward the classical polycentric model, the provision of light rail transit to connect the various poles of attraction within the city sphere of influence, and the entrenchment of a mass transit road transport system to reduce traffic congestion were some of the policy approach measures suggested for the city.	

1.Introduction:

The large-scale urbanization in the sub-Saharan region of Africa, calls for urgent attention from major urban stakeholders. This is will help in the development of efficient and functional urban centres across the region. The variables of urban growth, land use pattern, and mobility remain the major components of the urbanization process for a long time. Therefore, effort must be geared toward understanding the intricacy associated with these variables for a better and more efficient urban environment that will guarantee a better quality for its inhabitants. Kano like many urban areas in the region has continued to witness a transitional transformation over the years. The colonial era of the city marks the advent of the colonial master. This period marks the transitional trend of the transformation stage from the ancient to modern Kano through the reconfiguration and the development of the city in the provision of basic urban infrastructure (Okopi, 2021; Gambo, 2014). The post-colonial era saw an effort from the native government in trying to boost and consolidate the gains of the colonial Master.

The general configuration of the contemporary Kano urban area may not be different from many urban centres in the region. In line with the assertion of Bloch et al., (2015) document which pointed out that contemporary urban settlement in Nigeria embraces multifaceted and dynamic variables that are characterised by a centrally placed traditional core city and its adjourning land use of residential, commercial, and industrial zones. This land use may continue to grow towards its fringes depending on the various factors of influences. Urban growth is said to be a spatial process and usually goes together with demographic increment over time (Bhatta *et al.*, 2010). On the other hand, urban growth is seen as part of the transitional trend that connects the process of urbanization. The growth of urban areas through expansion remains unabated considering the important roles they play in high productivity, economic growth, and the betterment of the living condition of its inhabitants (Otuoze *et al.*, 2020; Cobbinah *et al.*, 2015). However, urban growth in the sub-Saharan region has always been synonymous with sprawling. Karppi, (2020) defines urban sprawling in terms of a physical development pattern that is revealed through spatial discontinuous, scattered settlement and disconnected from the city hub and usually characterised by low density. The major bond of contention regarding urban growth is the ability to establish the pattern, direction, and scale of the transitional trend for effective intervention.

Kano like many urban settlements in Nigeria inherited a land-use pattern fashioned to the urban design concept of European cities which was rooted in the 1946 act linked to the 1932 town and country planning act of the United Kingdom (Aribigbola, 2008). This act was the bedrock on which many urban settlements derived their land use pattern. Many of the urban areas across the region developed a pattern that was classical incline toward the mono-centric model due to the fragile land use planning measure (Dowell and Ellis, 2009). The classical mono-centric model is usually identified with its high concentration of public jobs, commerce, services, and amenities at the central position of the urban

settlement. These single reasons make the city center to become more influential and attractive to the urban population.

The lack of coherence in the land use planning for any city may likely result in poor land use pattern. The poor land use pattern may directly impact negatively the mobility pattern of the city. Urban mobility is connected to the transportation system and remains one of the variables of urban dynamism. Urban mobility is a function of the transportation system and is also seen as basic indicator that makes a liveable city (Capello and Nijkamp, 2004). The land use connectivity in urban spatial space generates the mobility pattern along the lines of desire. Therefore, the mobility pattern may be considered as a function of many factors which play a key role in developing functional cities. The impact of land use pattern on urban settlement especially in third-world cities may greatly influence and limits the urban mobility pattern. The land use pattern is linked to the urban spatial arrangement of land use, transport system, variables of urban design that cover the physical urban spread, and the collective physical structure of urban settlement (Handy, 1996). Empirical research in recent times has shown that the urban land use pattern is a key path toward sustainability. Similarly, the Urban Land Institute saw a land-use pattern from compact development promoting a better pedestrian network that creates a short distance to urban land use activities within a trekking distance as very successful (Brandes et al., 2010) The overall urban land use remains as a guide to the land use pattern that determines the pattern of mobility to a place of daily activities (Bhada & Hoornweg, 2009) for urban commuters. The studies on land use patterns and mobility may vary between cities in developed and developing countries. For example, Snellen (2002) concluded his study for Southern California and reported no evidence that land-use variable influences travel behaviour in a spatial direction. Similarly, a study in Nine (9) Asian cities and some cities in the developed world Barter, (1999) show a strong relationship between the land use patterns as dictated by the urban structure and mobility pattern. Above all the application of the commuter origin-destination trip hypothesis is strongly debated that the urban structure may likely influence and dictate the urban mobility pattern.

Understanding the trajectory of growth, land use pattern, and mobility for the sub-Saharan city of Kano is very cardinal. A basic fact that Kano urban area with a current population of over 4 million and second in rank to Lagos is already on its path to becoming a mega city in an agreement with Beall et al., (2010) who pointed out that many cities in developed countries have attained a terminal level in their transition, the projected urban growth potential from the years 2030-2050 will be witness in Africa and Asia cities where world mega – Cities will emerge. Based on 2013 demographic indices of 58.3% urbanization level in Nigeria (Farrel, 2018), many cities including Kano will continue to expand undisputably.

This study aims to access how urban growth and land-use pattern influences the pattern of trip making in the city of Kano and to ascertain its consequences on the city. To accomplish this aim the following objectives were outlined: analyzed and identified the current trend and direction of city growth over the years, secondly to identified the spatial land use arrangement of the city of Kano from the recent land use map, and ascertain the forces responsible over this land use formation over the years, and thirdly ascertained how the variables of urban growth and land-use pattern influence urban mobility pattern for the city. Finally, to profound a policy guide for the city that will enhance and promote livable human settlement for all.

2.Study Area and Methodology

2.1Study Area

Kano city is the administrative headquarter of Kano state in the northwest geopolitical zone of Nigeria. The city is considered the commercial nerve Centre of Northern Nigeria. Kano city covers eight (8) Local Government Areas which include the following: Dala, Fagge, Gwale, Kano Municipal, Kumbotso Nassarawa, and Ungongo. The entire area has a landmass coverage of 499 square Kilometers (193 Squares Miles). Kano is the second-largest city in Nigeria next to Lagos. The projected population of the Kano Urban area covering the Eight (8) Local Government Councils in 2022 is 4,219,000 with a growth rate of 2.83. See figure 1. A focus on Kano is motivated by its demographic size, structural changes in the physical form, and its historical antecedent over the years. Figure 2 shows the administrative composition of the Kano urban area.

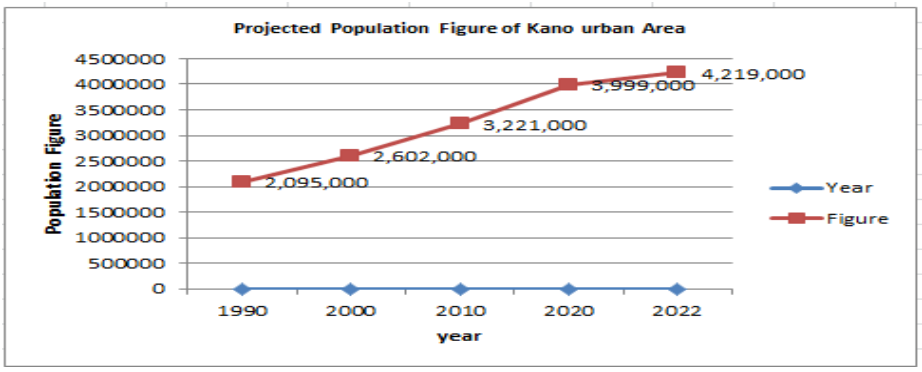

Figure 1. Projected population figure of Kano urban area
Source: Macrotrends.net

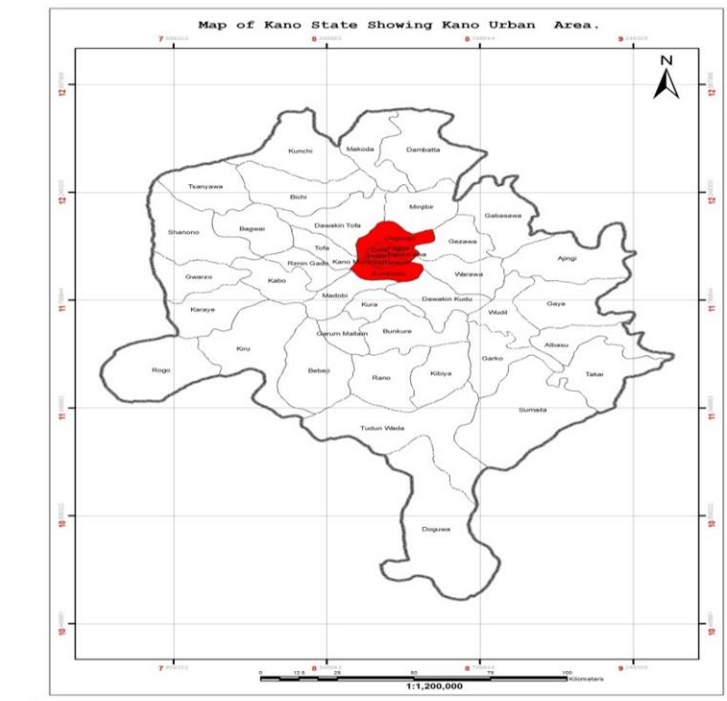

Figure 2 Administrative composition of Kano Urban Area.

2.2 Methodology

Following the outline objectives of this work, a systematic technique of Remote Sensing and Geographic Information System was used to extract all the spatial data. The land cover and the land use maps of the Kano urban area for the years 1990, 2000, 2010, and 2020 were subjected to analysis using ArcGIS 10.2 software. In addition, the generated spatial data were used to calculate the Fractal Dimension Index (FDI),. The application of the landscape spatial metric was used to measure the urban growth pattern for the city. The spatial metrics were used to show the level of urban patches, compactness, and fragmentation over the period under consideration, and the approach can also be used for monitoring and guiding the general growth of urban areas towards the path of sustainability and liveable human settlements. Similarly, the land use classification map was used to analyse the structural configuration of land use categorization for the city to ascertain the land use pattern of the city.

2.1 Fractal Dimension Index (FDI): The Fractal Dimension Index served as an indicator to show the level of aggregate or fragmentation in urban physical growth and development. The FDI is expressed as equal to two times the logarithm of patch perimeter (M) divided by the logarithm of patch area (M^2) (McGarigal, 2015).

$$FDI = \frac{2log(pi)}{log(si)}$$

- (Pi) = Perimeter of patch Pi in (M)
- (Si) = Area of patch Si in (M^2)
- FDI values Range between 1 and 2
- As FDI values skewed to 2 the urban area under consideration is considered more compact, while with a skew towards 1, development becomes fragmented indicating sprawling.

2.2 Mean Built-up Size Index (MBSI)

This is considered one of the area metrics that was used to identify the trend of urban Fragmentation over a period of time and then spread over a given time. (Ramachandra et al., 2015) stated that the MBSI of the urban class is inversely related to the level of fragmentation, while the higher the value of MBSI the more compactness of an area.

$$MBSI = \frac{Area\ (A)}{Number\ of\ Patches(N)} \div 10,000$$

A = Area (M^2) of all patches

N = Correspondent number of patches.

It can be interpreted as MBSI equals the sum of areas (M2) of all patches of the corresponding patches type divided by the number of patches of the same type, divided by 10,000. All the calculated values of the MBSI range: MBSI>0, without limit.

. This metric was used to look at the trend of area growth over the selected years and the trend for different parts of the city for the year 2016.

2.2 Questionnaires administration: To ascertain how the land use pattern has influenced the mobility pattern of the city, questionnaires were administered with a sample of n=600 for urban commuters, from the urban population of N>I, 000,000. The questionnaires were structured to include: commuter

place of residence and trip to place of work. Daily trips were considered across the city using commuters as a parameter for the number of trips generated by each residential neighborhood. The distribution of questionnaires covers the eight Local government Areas that constitute the Kano Urban areas which include the following: Dala, Fagge, Gwale, Kano Municipal, Kumbotso Nassarawa, and Ungongo. A simple frequency analysis was used to express the result in percentage.

3.The Trend and direction of urban Growth based on Research Results.

The time series analysis of Kano imageries for the years 1990, 2020, 2010, and 2020 as shown in table 2 revealed remarkable changes in the land use cover over time. The earmarked built-up area that formed Kano Urban Area covers an area of 4,395.61 hectares in 1990, 7848.17 hectares in 2000, 13026 hectares in 2010, and 19,611 hectares in 2020. The period of transition for the built-up area has experienced an increase with a positive value of 15,215 hectares. Therefore, the increase for the built-up area is translated to 346.1%. Similarly, the bare land surface and water bodies in the area have shown a steady increase over the years under consideration. The increase in the bare land surface and water bodies is proportional to the increase witnessed in the built-up area. On the contrary, the vegetation land covers for the area keep decreasing over the years. The decrease from 1990 to 2020 gives a negative value of −27.241 representing a decreasing value of −31.19% over the years under consideration. The transition in the land cover for the city is graphically represented in Figure 2. The physical evidence of expansion seen in table 2 and figure 2 are guided by transitional changes that favour the human settlement of the built-up areas to the detriment of the rich natural vegetation that is declining.

Table 1: Kano Urban Land Cover Trend from 1990 - 2020

Land Cover	Area in Hectares (1990)	% of Area (1990)	Area in Hectares (2000)	% of Area (2000)	Area in Hectares (2010)	% of Area (2010)	Area in Hectares (2020)	% of Area (2020)	Changes 1990-2020	% of Changes
Built-up area	4,395.61	4.3	7848.17	7.6	13028	12.6	19611	19.0	15,215.39	346.15
Vegetation	87340.04	84.6	78717.94	76.2	72556.16	70.3	60098.53	58.3	−27,241.51	−31.19
Bare land	10476.93	10.2	15586.33	15.1	16555.19	16	22356.84	21.6	11879.91	113.39
Water bodies	958.43	0.9	1018.61	1.1	1030.90	1.1	1104.15	1.1	145.72	15.20

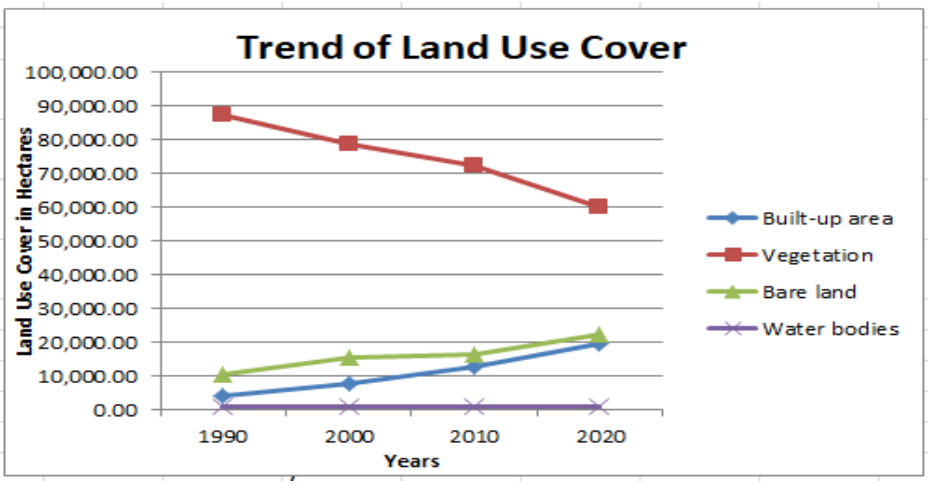

Figure 3: Trend of Land Use Cover for Kano Urban Area 1990-2020

Table 2: Spatial Landscape Metric Values for 1990, 2000, 2010 and 2020

Landscape metric	Total Number of Builtup Patches (TNBUP)	Total Builtup Patch Size(TBPS) in Ha	Total Builtup Edge (TBE)in m	Mean Builtup Patch Size (MBPS) in Ha	Mean Builtup Patch Edge (MBPE) in m	Mean Builtup Edge Density (MBED) in Ha	Mean Fractal Dimension (MFD)
year							
1990	63	4396	23507	69.78	373	2961	0.9863 =1
2000	83	7848	31406	92.33	378	2.08	0.9868 =1
2010	102	13028	40464	127.73	397	2.24	0.9866 =1
2020	115	20875	52221	181.52	454	2.51	0.9890 =1

The landscape metrics results in table 4.3 show a steady increase in urban patches from the years 1990, 2000, 2010, and 2020 we have 63, 83, 102, and 115 patches respectively. The increase in urban patches over the four decades of study is an indication of urban growth characterised by fragmentation. Fragmentation is defined in terms of the degree to which developments spread across a spatial space; it is measured by the number of urban land fabric fragments per square Kilometer of the demarcated built-up areas (Karppi, 2018; Frenkel and Ashkenazi, 2008). Fragmentation growth implies sprawling. The urban landscape was further analysed using the Mean Built-up patch size (MBPS). The MBPS serves as an indicator and is considered to be inversely related to the rate of fragmentation within the urban landscape under consideration. The values of MBPS may be very high depending on the level of compactness of the landscape under consideration. The values in table 3 are 69.78, 92.33, 127.73, and 181.52 for the years 1990, 2000, 2010, and 2020 respectively. The rise in the value over the years under consideration may be attributed to the merging of patches to form bigger patches of the infilling of spatial spaces in the existing landscape. The calculated values of Edge and mean density indicated the level of complexity of the landscape for the city translated into fragmentation from the urban periphery. There is an increase in all calculated values over the past four (4) decades, therefore indicating expansion of the urban landscape. The Fractal Dimension index (FD) is an indicator with values ranging from 1 to 2. All calculated values that are skewed to 1 shows a level of fragmentation of the landscape while calculated values skewed to two indicate the compactness of a landscape. All the calculated values in table 3 for the years under consideration are skewed to 1, therefore, corroborating the fragmentation of the City landscape.

4.The trend and direction of urban growth from land-use cover and landscape matric analysed values

A look at land use cover and Metrics analysis has revealed a steady growth of the Kano Urban area over the past four decades. The years 1990 to 2020 show that the built-up area has continued to expand significantly. The natural land use cover of the savannah vegetation, farmlands, and natural streams is gradually declining, giving way to physical human development at a very unprecedented rate. The general trend of growth can be described as leapfrogging considering the number of landscape patches

identified from the metrics values. On the other hand, as the built-up areas continue to expand through fragmentation, the smaller patches continue to merge into bigger patches as each of the patches continues to experience an infilling that may lead to densification.

The identified trend of growth in the Kano urban area is similar to the assertion of Amoako and Cobbinah (2011); Karen *et al.,(2012)* the pointed out that urbanization and urban growth in Africa usually surpass the urban Master plan, therefore, resulting in unguided physical development and encroachment into rich natural vegetation. The case of Kano is not far from this assertion, because the initial master plan for the city (Metropolitan Kano 1963 – 1983) has expired. All effort to review the Master plan to accommodate the current reality and challenges for the city is yet to see the light of the day. For closed to 40 years physical development in Kano Urban area has continued without any legal and comprehensive document to serve as a guide. Evidence has shown that the growth of the Kano urban area has exceeded the 1963 to 1983 master plan provision to a greater extent. The expansion of the city can be considered as very poor growth that is driven by uncoordinated plot layouts and a weak planning system in form of development control trailing from behind.

Physical development has been through segmented plot layout and informal growth. The decline in the rich savannah vegetation buttressed the high impact of Urbanization and urban growth on the conversion of fertile farmland into plots of land for housing construction (Abubakar *et al.*, 2018). The identified fragmentation of the Kano landscape is synonymous with urban sprawl. A look at the years 1990, 2000, 2010, and 2020 extracted imageries for the urban area has revealed sprawling along major exit routes from the city which include: Kano-Zaria-Abuja route, Kano-Katsina routes, Kano-Maiduguri route, and Kano-Hadeja-Gumel route. Urban sprawling negates the concept of sustainability and hurts urban growth because it is a major predator on land by creating uncontrolled development and its consequences at the urban fringes (Zakka, *et al.*,2017; Okopi, 2020) and increases automobile dependence on urban commuters resulting to the high footprint of Greenhouse emission (Habitat, 2014).

5.The land use pattern for Kano Urban Area

The general land use classification of residential, commercial, industrial, public/semi-public, circulation, and organised open space have shown a trend of increase over the years under review. The increase can be attributed to the increase in the urban population as projected in table1. The land-use categories have developed a pattern for the city. The residential land use has spread and dominated the entire landscape of the city as can be seen in figure 3. The residential housing accommodation for any city remains very important for its population. Therefore the residential land use category has continued to spread from the city center to the fringes. A total of 58 residential neighbourhoods are identified in the city see table 4.3. The growth of residential housing is driven by individuals, private developers, and the government.

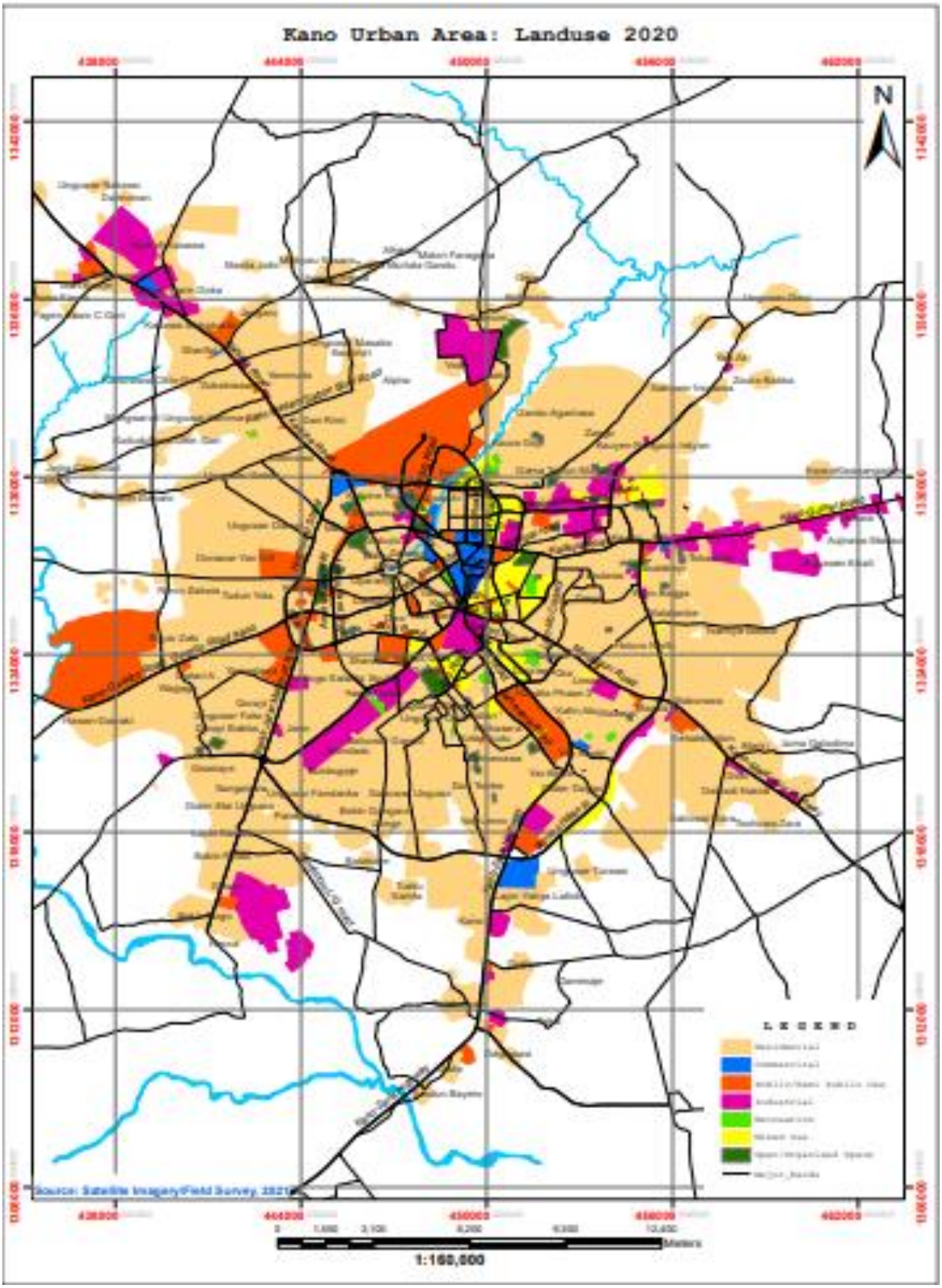

Figure 4. Kano urban Land use classification for the year 2020

The commercial land use category is also spread in patches across the city with a high concentration of commercial activities in the old Kano metropolitan area which is made of the current administrative areas of Nasarawa, Fagge, Dala, Gwale, Kano Municipal, and Tarauni. Major markets in this area include the following: Sabon Gari Market, Kanti Kwari market, Yan lemu Market, Kurmin Market, Rimi Market, Danwano Market, Galadima Market, Yankura Market, and Tarauni Market. The intensity of activities in these Markets is very high because international traders are attracted from other African Countries. Many products include local food products, local textile materials, local shoes and bags, livestock, and products from Arab and Europeans Countries.

Adjourning the commercial land use of high-intensity activities is a stretch of industrial land use covering a long strip of the land mass of intensive industrial activities. The major industrial areas in this axis include the following: The Sharada industrial layout, Bompai industrial layout, and the Gunduwara Hadeja road industrial area. Away from this axis is the Panshekara and Challawa industrial areas in the South-Eastern part of the metropolitan area. Major industries include the following: Agrochemical industries, textile industries, Foot ware industries, plastic industries, oil, and flour mills, and local fabrication.

The public/semi-public land use category for the city is woven from the former Kano metropolitan area spread across the city. This land-use covers both public and private institutional areas, public and private offices, military and paramilitary areas, and airports. This land use is adjourned to residential land use across the city. One notable fact about this land category is its ability to annex large hectares of undeveloped land for future development purposes. Examples of these institutions include Bayero University, Federal College of Education, Aminu Kano International Airport, Aminu Kano Teaching hospital, Brigade Barracks, Nigeria Air force base, and many others. In addition to this land-use category is mixed land use. This land-use type is mostly a mixture of commercial and residential activities or office activities and commercial activities within the same premises. As shown in the land use classification map in figure 3. It is concentrated around the old Kano metropolitan area which is sparsely spread towards the North-East and South-East of the city.

6. Implications of urban growth and land use pattern on urban mobility for Kano urban area.

The general configuration of land use categories in the City has developed a very strong sphere of urban activities covering an extensive landmass area with the Old Kano Metropolitan built-up area standing as a hub. The land use pattern has greatly developed to influence the mobility pattern of the city to a greater extent. The land-use activities have over the years interwoven to create what is called the Sphere of Influence and Attraction (SIA) in this study as shown in figure 4.7 The SIA covers the six (6) administrative areas of Fagge, Nasarawa, Gwale, Dala, Tarauni, and Kano Municipal. The SIA has the longest traveling distance of 14.5Km from Kano Municipal. This sphere has a greater influence on urban mobility for the city because of the different points of attraction within the sphere. The current land use classification for the city showed the high intensity of activities in the sphere. The intensity of activities cutting across all sectors of the socio-economic has become a major daily attraction for urban commuters.

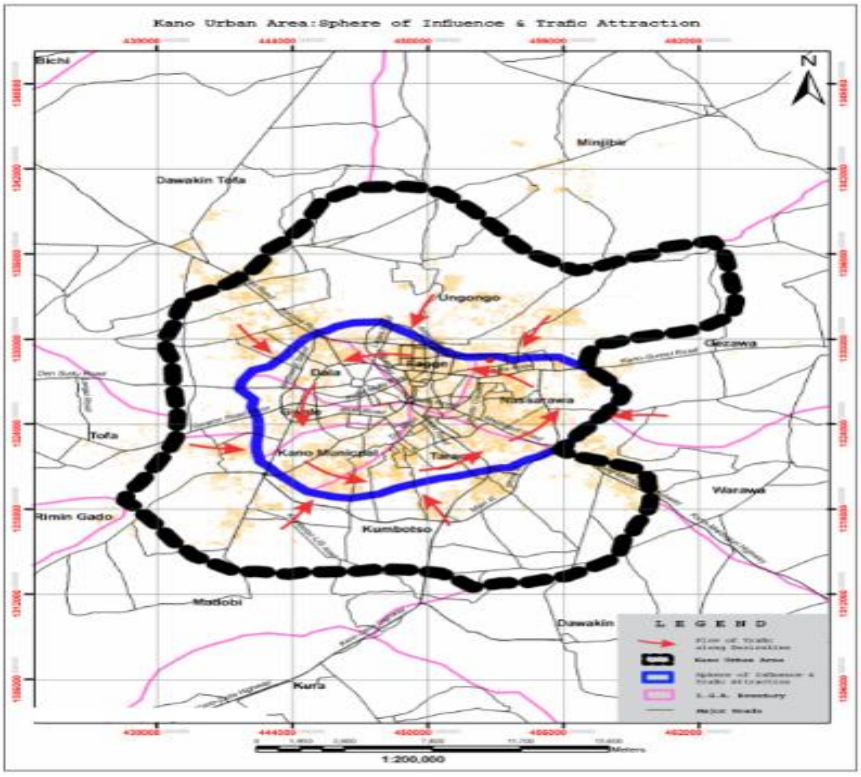

Figure 5. Sphere of Influence and Attraction in Kano urban area

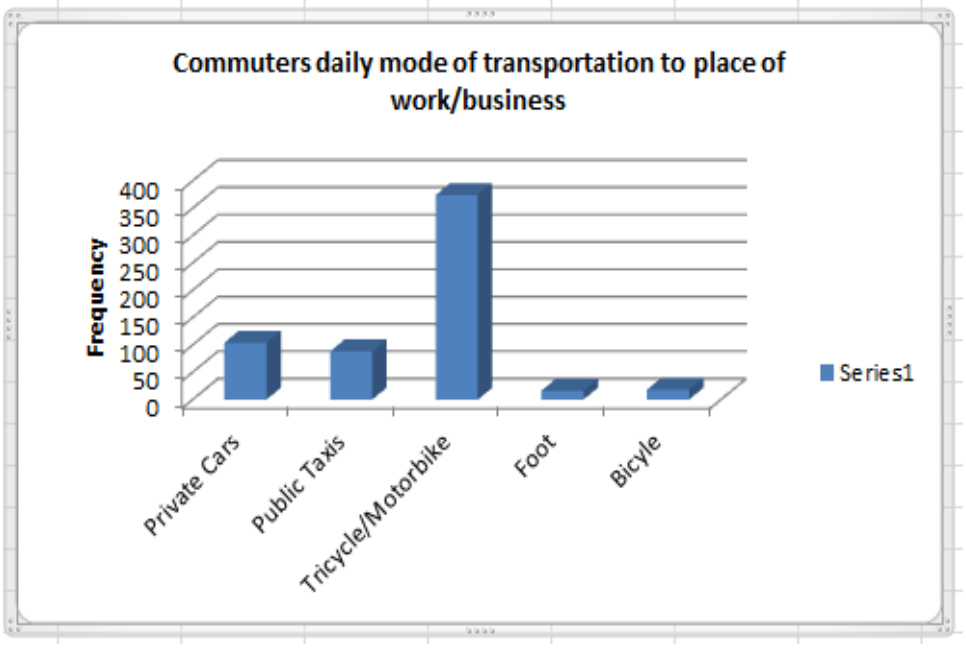

Figure 6: Mode of Transportation in the Kano urban area

The growth of the city through fragmentation has created the longest traveling distance of 24.6 Kilometres along the desired line as shown in table 3. The further analysis of commuter's trip into the Kano urban area shown in table 3 has revealed that 81.83% of the commuter trip is attracted to the SIA. The daily commuter trip-making along the desired line for the city originated from inside and outside the sphere. Furthermore, 18.17% of commuter trip making is outside the sphere of influence. The origin of commuter trips making along the desired line is from 58 residential settlements in the

city, while seven (7) of the settlements in table 3 marked with an asterisk are from outside Kano urban area. What are the implications of high commuter trip making into the sphere of influence and attraction for the City of Kano?

Table 3: Analysis of Commuters' trip making in Kano Urban Area.

No	Name of Residential Neighborhood	Distance of Neighborhood from Kano Manucipal (KM)	Frequency of Trips Generated by Commuters from Residential Neighborhoods	Commuter Trip outside the Sphere of Influence and Attraction	Commuter Trip within Sphere of Influence and attraction
1	Nassaarawa	7.7	31		31
2	Brigade	10.7	17		17
3	Badawa	11.8	2		2
4	Dakata	14.1	37	2	35
5	Giginyu	10.9	5		5
6	Hotoro	12.1	40	5	35
7	Tudun Wada	10.2	9		9
8	Gwagwarwa	9.5	1		1
9	Bompai	9.1	3		3
10	Yankaba	12.2	5		5
11	Badawa	5.3	5		5
12	Fagge	12	18		18
13	Jaba	14.6	12		12
14	Sabon Gari	9.4	14		14
15	Rijiyar Lemo	16.6	12	3	9
16	Gwale	3.8	9		9
17	Kabuga	6.2	16	2	14
18	Goron Dutshe	5.8	8		8
19	Dorayi	18.5	4		4
20	Kano Manucipal		4		4
21	Sharada	2.3	13	2	11
22	Zango	16.3	1		1
23	Dan,agundi	4.8	1		1
24	Jakara	7.1	2		2
25	Tarauni	8.9	18	6	12
26	Gyadi-Gyadi	12.3	3		3
27	Ungwan Uku	14.2	16	6	10
28	Danmanawa	12.8	4		4
29	Dala	6.1	23		23
30	Kofar Mazugal	9.8	4	1	3
31	Gobirawa	14.4	8	1	7
32	Dogon Nama	13.9	4	1	3
33	Yelwa	27.6	5	1	4
34	Kantudu	10.9	3		3
35	Bakin Ruwa	13.6	17	2	15
36	Kofar Ruwa	8.8	7	1	6
37	Adakawa	10.5	6		6
38	Ungogo	21.7	18	8	10
39	Rangaza	9.0	12		12
40	Rijiyar Zaki	14.3	30	7	23

41	Kumbotso	19.0	27	13	14
42	Challawa	13.6	1		1
43	Chiranchi	22.1	2		2
44	Gwammaja	11.8	1		1
45	Mariri	9.5	5	3	2
46	Naibawa	15.5	9	2	7
47	Panshekara	8.9	16	5	11
48	Danmaliki	15.5	10	8	2
49	Kofar Mata	6.2	5	2	3
50	Janguza	16.2	2		2
51	Dangi	7.0	5	2	3
52	Kundila	11.3	5	2	3
53	Zawaciki	24.6	17	11	6
54	Gaida	9.9	3	2	1
55	Yan Lemo	14.7	7	5	2
56	Gandu	4.3	3		3
57	Tamburawa	15.8	7	5	2
58	Rimin Gata	9.3	16		16
59	*Dawakin Kudu		1		1
60	*Konar Dwakin		2	1	1
61	*Dawaki Tofa		1		1
62	*Tofa		1		1
63	*Minjibir		2		2
64	*Danbatta		4		4
65	*Bichi		1		1
	Total		**600**	**109(18.17%)**	**491(81.83%)**

The high commuter trip making to the sphere of influence and attraction has resulted in constant traffic congestion and its multiplier effects on the city. A traffic count conducted in 2019 in some selected locations that fell within the sphere as revealed by Abdullahi *et al.*, (2020) shows a high volume of traffic in the following Locations: Tarauni (Dnagi Junction) 4199, Nasarawa (Kwana Nasarawa Junction) 7198, Fagge (Kanti Kwari Junction) 2386, Kano Municipal (Kwana Rimi Junction) 8904, Dala (Gidan Malam Junction) 3634, Gwale (Tal'udu Junction) 2983 and Kumbostso (Sharada Junction) the only location outside the sphere has a traffic volume of 6755. A breakdown of traffic based on model split shows a high number of Tricycles/ Motorbike which is the common means of intra-city transportation for commuters as shown in figure 6. The increase in the number of tricycles in the city over the years has become very unprecedented. Data from the office of Director Revenue, monitoring, and Evaluation, Kano Road Traffic Agency (KAROTA) Head office, in April 2022 showed that 49,089 tricycles were registered in the city in the year 2020/2021. Commuter mobility in the city is limited to, private cars, private taxis, tricycles/motorbikes, and few bicycle users. The city lacks a light rail transportation system and a robust and efficient mass transit service for intra-city transportation that goes with a modern approach to green growth and sustainable cities.

7.Conclusion and Recommendations

A look at "the trajectory of urban Growth, Land use pattern and mobility in Kano Nigeria" has identified a projected increase in the urban population which can be related to the physical growth of the city from the transitional changes in its land use cover that favoured the built-up area. Furthermore,

the increasing built-up area has over the years developed a structural pattern characterized by a dominant core with a high concentration of urban activities which has developed into an extensive sphere with different poles of socio-economic influence. This sphere of influence has become a pull of attraction for the majority of the urban commuters from adjourning residential land use. The study also identified the expansion of the city is marked by an outward growth that is characterized by fragmentation and sprawling at the fringes. The fragmentation pattern of the city has continued to create distance between the city center and commuter trips from adjourning residential areas which have culminated in traffic congestion and its likely consequences for the city.

Based on findings from the study the following policy approaches are put forward as recommendations to regulate urban growth and land-use pattern toward developing a sustainable mobility pattern for the city:

7.1 Land Use Planning Policy towards Compact Growth in Kano

A policy that will reposition the land use planning activities of the city towards compact growth is paramount. The old rigid system of a top-down approach that commonly entails the strict zoning of urban activities over a long period without due consideration for urban dynamism and participation should be overturned. The land-use planning system should be repositioned under the contemporary approach that is geared toward sustainability. The land-use planning system for the city has failed to curtail the excesses of urban dynamism, which has resulted in urban growth driven by fragmentation from the fringes.

The land-use planning should be repositioned to guide the city toward a functional polycentrism pattern, where more poles will be developed and connected with modern transportation infrastructure across the city as a way of diffusing the high commuter trips to the sphere of influence and attraction. Polycentric urban growth is commonly associated with sustainability and can only be achieved through an efficient land-use system. The transition of the Kano urban area from its current status of polycentrism should be properly guided because a properly planned and managed polycentrism pattern directed towards decentralization could help reduce trip distance and extension of time in the city.

7.2 Public Mass Transit for the on-road transport system in Kano

One of the major challenges with the current land use pattern for the city is high traffic flow along the major road leading into the Sphere of Influence and Attraction during peak hours of working days. The high dependence on the automobile for intra-city movement by commuters can be managed through the use of a good designed public mass transit system. As pointed out by IPCC (2014), high population densities at the point of origin and destination are very necessary for functional mass transit. Urban density is a basic criterion for operating mass transit. The Bus Rapid Transit (BRT) system will play a functional role in the global campaign toward urban sustainability and urban mobility futures (Cervero, 2013). In addition, the light rail system connecting the poles of attraction at the sphere of influence and attraction will ease mobility in the city.

REFERENCES

1. Abdullahi, H., Sinniah, G. K., Siong, H. C., & Wei, L. R. (2020, February). Air Pollution And Environmental Implications In Kano Metropolis Nigeria. In IOP Conference Series: Earth And Environmental Science (Vol. 450, No. 1, P. 012011). IOP Publishing.

2. Abubakar, A., Maigari, A. I., Danhassan, S. S., Umar, S. I., Usman, M. K., & Gambo, J. (2018).
3. Smallholder Farmer's Adaptation Strategies To Drought In The Sahelian
4. Zone Of Jigawa State, Nigeria. International Journal of Advanced Academic Research, 4(10).
5. Amoako, C. & Cobbinah, P. (2011). Slum Improvement In The Kumasi Metropolis, Ghana: A Review Of Approaches And Results. Journal Of Sustainable Development In Africa, 13**,** 150-170.
6. Aribigbola, A. (2008). Improving Urban Land Use Planning And Management In Nigeria: The Case Of Akure. Theoretical and empirical researches in urban management(9), 1.
7. Barter, P. (1999). An international comparative perspective on urban transport and urban form in Pacific Asia: the challenge of rapid motorisation in dense cities. Murdoch University.
8. Beall, J., Guha-Khasnobis, B., & Kanbur, R. (2010, August). Introduction: African development in an urban world: beyond the tipping point. In Urban Forum (Vol. 21, No. 3, pp. 187-204). Springer Netherlands.
9. Bloch, R., Monroy, J., Fox, S., & Ojo, A. (2015). Urbanisation and urban expansion in Nigeria.
10. Bhada, P., & Hoornweg, D. (2009). The global city indicators program: A more credible voice for cities. Bhatta, B., Saraswati, S., & Bandyopadhyay, D. (2010). Quantifying the degree-of-freedom, degree-of-sprawl, and degree-of-goodness of urban growth from remote sensing data. Applied Geography, 30(1), 96-111.
11. Bhatta, B., Saraswati, S., & Bandyopadhyay, D. (2010). Quantifying the degree-of-freedom, degree-of-sprawl, and degree-of-goodness of urban growth from remote sensing data. Applied Geography, 30(1), 96-111.
12. Brandes, U., MacCleery, R., Peterson, J., & Johnston, M. (2010). Land use and driving: The role compact development can play in reducing greenhouse gas emissions. Washington, DC: Urban Land Institute.
13. Capello, R., & Nijkamp, P. (2004). The theoretical and methodological toolbox of urban economics: from and towards where? Contributions to Economic Analysis, 266, 1-27.
14. Cobbinah, P. B., Erdiaw-Kwasie, M. O., & Amoateng, P. (2015). Africa's urbanisation: Implications for sustainable development. Cities, 47, 62-72.
15. Dowall, D. E., & Ellis, P. D. (2009). Urban land and housing markets in the Punjab, Pakistan. Urban Studies, 46(11), 2277-2300.
16. Ewing, Bartholomew, K., Winkelman, S., Walters, J., Chen, D., Mccann, B. & Goldberg, D. (2008a). Growing Cooler: The Evidence On Urban Development And Climate Change (Washington, Dc: Urban Land Institute).
17. Fagbohun, P. O. (2007). Population and Urbanization in Nigeria. Lagos-Nigeria: Bluesign Publication.
18. Frenkel, A., & Ashkenazi, M. (2008). Measuring urban sprawl: how can we deal with it?. Environment and Planning B: Planning and Design, 35(1), 56-79.
19. Gambo, B. (2014). Origin and growth of Urban Kano. Kano Environment, Society and Development, published by Adonis & Abbey publishers Ltd, 67-79.
20. Gitundu, B. H. (2020). Theme: Urban Environment, Sustainability And Climate Change.
21. HABITAT, U.(2010). The State Of African Cities 2010: Governance, Inequality And Urban Land Markets. United Nations Environment Programme, United Nations.
22. Habitat, U. (2011). Global report on human settlements 2011: Cities and Climate Change. United Nations Human Settlements Program, Earthscan.

23. HABITAT, U. (2014). Urban Patterns For A Green Economy: Leveraging Density. Nairobi: Unon Publishing Services.
24. Handy, S. (1996). Methodologies for exploring the link between urban form and travel behavior. Transportation Research Part D: Transport and Environment, 1(2), 151-165.
25. Karen, S., Güneralp, B. & Hutyra, L. R. (2012). Global Forecasts Of Urban Expansion To 2030 And Direct Impacts On Biodiversity And Carbon Pools. Proceedings Of The National Academy Of Sciences, 109**,** 16083-16088.
26. Karppi, I. (2020). Rethinking Urban Sprawl: Moving towards Sustainable Cities.
27. Macrotrends, Kano, Nigeria Metro Population 1950-2022;htt://www.macrotrends.net/cities/22005/kano/population
28. McGarigal, K. (2015). FRAGSTATS help. University of Massachusetts: Amherst, MA, USA, 182.
29. Okopi, M. (2021, March). Urbanization and Sustainable Growth of Urban Kano, Nigeria. In IOP Conference Series: Earth and Environmental Science (Vol. 665, No. 1, p. 012063). IOP Publishing.
30. Otuoze, S. H., Hunt, D. V., & Jefferson, I. (2020). Predictive Modeling of Transport Infrastructure Space for Urban Growth Phenomena in Developing Countries' Cities: A Case Study of Kano—Nigeria. Sustainability, 13(1), 308.
31. Ramachandra, T., Bharath, A. & Sowmyashree, M. (2015). Monitoring Urbanization And Its Implications In A Mega City From Space: Spatiotemporal Patterns And Its Indicators.
32. Journal Of Environmental Management, 148**,** 67-81.
33. Snellen, D. M. (2002). Urban form and activity-travel patterns: an activity-based approach to travel in a spatial context.
34. Zakka.S D., Permana, A. S., Ho, C. S., Baba, A. N., & Agboola, O. P. (2017). Implications of present land use plan on urban growth and environmental sustainability in a Sub Saharan
35. Africa City. International Journal of Built Environment and Sustainability, 4(2).