

Population Growth and Urban Expansion: Implications for Urban Planning

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Abstract

As the world population continues to gravitate towards urban centres, challenges associated with an increase in urban population, such as increasing demand for urban infrastructure, social amenities, and living space, are beginning to overwhelm urban planners and managers. This has led to uncontrolled and unsustainable urban growth, especially on the urban fringes. The research is aimed at assessing the degree of expansion and development plans for Birnin Kebbi town for sustainable development. Landsat images from 1991 and 2018 were classified to determine urban expansion. In order to illustrate the trends in urban expansion, the official Master Development Plans between 1980 and 2017 of the study region were also scanned, georeferenced, processed, and digitalized. The study revealed that with a population of 44,600 in 1980 and an expected increase of approximately 87,000 inhabitants by 2000, 1450 ha were budgeted for the residential area. As of 1991, the population of Birnin-Kebbi had increased to 119,000, and according to Landsat image classification, there are currently 1,687 ha of built-up areas. In 2018, with an estimated population of 339,000 inhabitants, the urban/built-up area covered 7,725 ha. The results show that the rise in urban/built-up areas was caused by population growth and the conversion of other authorised or classified land uses into built-up/residential areas. This study recommended that urban planners adopt a compact city planning model that encourages vertical urban growth and ensures sustainable development.

Keywords: Built-up area; urban growth; land use; urbanization

1. Introduction

The ambitious goal of man in the twenty-first century is evidently "to meet the needs of the people within the means of this extraordinary, unique living planet so that humanity and the rest of nature can thrive" (Raworth, 2018). The increasing world population is the underlying factor behind most of the world's challenges. The world population reached 8 billion in 2022 and is projected to grow to 8.5 billion in 2030. By 2050, the world population is expected to reach 9.7 billion and 10.4 billion by 2100 (WPP, 2022). A large percentage of this population will live in cities, towns, and urban centres, and a majority will be centred in just eight countries: The Democratic Republic of the Congo, Egypt, Ethiopia, India, Nigeria, Pakistan, the Philippines, and the United Republic of Tanzania (UN-Habitat WCR, 2022). The world will continue to urbanise throughout the next 3 decades, increasing from 56 percent in 2021 to 68 percent in 2050. Cities and urban settlements will continue to grow at a fast rate over the next three decades, especially in Asia and Africa. An estimated 2.2 billion urban dwellers will live mostly in African and Asian cities (UN-Habitat WCR, 2022), while the urban growth rate is expected to slow in Latin America and other continents (Van den Berg, Otto, and Fikresilassie, 2021; as cited in IPCC 2022). Similarly, between 2015 and 2020, the global urban population increased by over 397 million inhabitants, with over 90% occurring in less developed regions (UNDESA, 2018). The 2018 UNDESA revised global urban population projection reaffirms the global population trend to increase from 5.167 million in 2030 to 6.680 million in 2050. Nigeria alone is projected to add 212 million urban dwellers between 2014 and 2050 (Grafakos, 2017). This unprecedented increase in the

global urban population has necessitated the concept of sustainability as the world enters uncharted territory with unknown consequences.

Urbanisation is defined as a transformational change in land use and land cover in a particular area leading to the territorial extent and development of non-developed areas (Pham and Vamaguchi 2011, cited in Khan et al., 2014). Urbanisation usually occurs in both spatial and temporal contexts, and it is mainly influenced by three factors: natural growth, rural-urban migration, and reclassification of areas from rural to urban (Buhang & Urdal, 2013, cited in Khan et al., 2014). The world population distribution witnessed a significant shift towards urban centres after the industrial revolution. New job opportunities and an improved standard of living in urban centres made the 20th century experience an extreme and unprecedented increase in global urbanisation. In Nigeria, the urban population trend has generally increased with the world urban population projection. In 2021, the country's urban population was 112,560,662, a 3.99% increase from 2020 (MacroTrends, 2023). Industrialization is the catalyst for urbanisation. Most developed urban centres have been connected with industrialization to varying degrees (Breese, 1966; cited in Oriye, 2016). However, some large urban centres experience urban growth independent of any industrial development. This growth is mainly stimulated by either administrative status or marketing centres (Oriye, 2016). Birnin Kebbi falls within the category of an urban centre whose growth is largely influenced by its administrative status, as urbanisation started in 1991 when Kebbi State was created from Sokoto State and Birnin-Kebbi was made the capital.

Although cities are economic engines that create wealth, provide employment opportunities, and drive human progress by harnessing the forces of agglomeration and industrialization (UN-Habitat, 2016), numerous towns and cities around the globe are largely not prepared for the complex and multifaceted challenges affiliated with urbanisation and urban growth. This is due to the fact that urbanisation and urban growth have typically relied on a prototype that is not sustainable in many ways. In terms of the environment, the most common urbanisation model promotes low-density urban development, that is primarily motivated by personal or individual requirements rather than societal needs. This model is made relatively easier by the overreliance on individual cars and their energy demands, thereby contributing dangerously to climate change (Sadiq, 2020). An objective or target-based method for urban development is referred to as urban planning. It involves analysing and predicting the urban environment, both quantitatively and qualitatively, to identify and evaluate alternative policy options leading to a beautiful life (Akhilendra, 2013).

The master plan approach to urban planning is one of the earliest in the history of planning; it is aimed at guiding and managing urban development (Mishra, 2012). A spatial planning model that is mainly based on in-depth land use maps, zoning systems, and planning criteria is often referred to as a "master plan." This system of planning has been abandoned in many industrialised countries around the world because of its convoluted and strict structure, which has failed to alleviate several socioeconomic difficulties caused by expanding urbanisation. This model of planning is usually based on zoning, which encourages the centralization of the various components of society in a different location and ultimately ends up creating urban sprawl (Sadiq, 2020). Planning for sustainable urban development involves experts from a variety of fields, including management, engineering, architecture, economics, accounts, history, sociology, geography, environment, policy formulation, public administration, statistics, demography, law, psychology, computer sciences, and information and communication technology. This is because if we are going to survive the 21st century, we have to work together to create functional, liveable, and resilient cities (Sadiq, 2020). Sustainable development is a common and contemporary goal of many urban development policies in various countries (Berke & Conroy, 2002; Chan & Lee, 2006; cited in Abu Bakar and Cheen, 2013).

The 1992 United Nations Convention in Rio de Janeiro (Agenda 21) provides a guide for sustainable growth in the twenty-first century, and the document was adopted by 179 countries, including Nigeria. One of the most important objectives is to provide adequate and environmentally friendly housing, and obviously, it has prospects of ensuring and supporting the sustainability agenda. Similarly, Goal 11 of the Sustainable Development Goals also emphasises making cities and human settlements inclusive, safe, resilient, and sustainable by 2030, thereby necessitating the need for sustainable urban planning (Sadiq, 2020). Even though the urban transition is a universal event that is witnessed in all countries, the causes or determinants, patterns, and outcomes do not necessarily follow a uniform process (Farrell, 2017). Africa's rapid urbanisation is driven mainly by natural increases, rural-urban migration, spatial expansion of urban settlements through annexation, reclassification of rural areas, and, in some countries, negative events such as conflicts and disasters (Bloch, Fox, Monroy, and Ojo, 2015). As a result, poor implementation issues plague urban planning and master plans at the local or ground level, fueling the expansion of slums and squatter colonies in a number of cities in Africa, notably Makoko in Lagos and Kibera in Nairobi, among others.

Cities in Africa are among the poorest in the world in terms of economic growth and therefore have limited resources to construct and maintain public infrastructure and services for their rising population. Over the past 50 years, Nigeria's urban population has grown incredibly quickly, and it is predicted that this trend will continue. The most dominant factor responsible for this rapid urban population growth and urban expansion is declining mortality and persistently high fertility (Bloch et al., 2015). Even though rural-urban migration has a role in urbanisation, it has a far smaller impact than the spontaneous urban growth and reclassification brought about by rural densification, particularly in the northern part of Nigeria. In Nigeria, the creation of elaborate, well-written papers like the master plan or development plan is fairly prevalent; the main issue is typically putting such documents into practise. In spite of the fact that almost all significant cities and towns in the country have a written development plan or master plan, the majority of them are expanding with little to no oversight. This research aimed to assess population growth, urban expansion, and their implications for urban planning.

2. Study Area

The administrative headquarters of Kebbi State is in Birnin-Kebbi (Figure 1). The total population of the city in 2006 was 268,620 (NPC, 2006), with an estimated population of 366,200 in the 2016 demographic statistics released by the National Bureau of Statistics (NBS, 2016). The fast-growing population has largely influenced the rate of urbanisation in the state. Despite the fact that there has been a master plan in place since 1980, unmanaged and unregulated urbanisation has resulted in slums and squatter communities, as well as the destruction of vegetal cover and top soil by replacing them with impermeable urban materials.

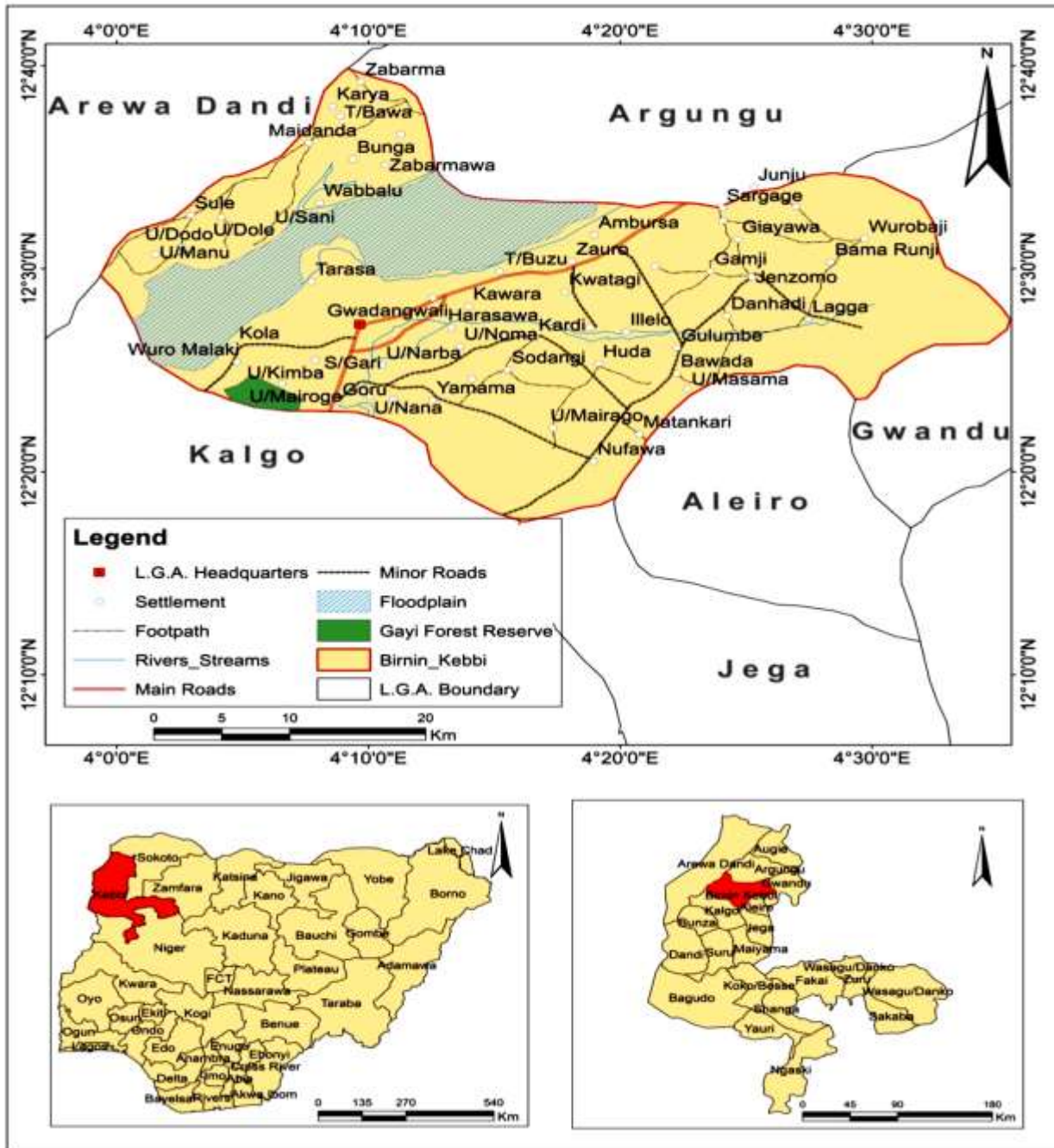


Figure 1: Map of Birnin Kebbi, Kebbi State, Nigeria
Adopted from Abubakar (2012)

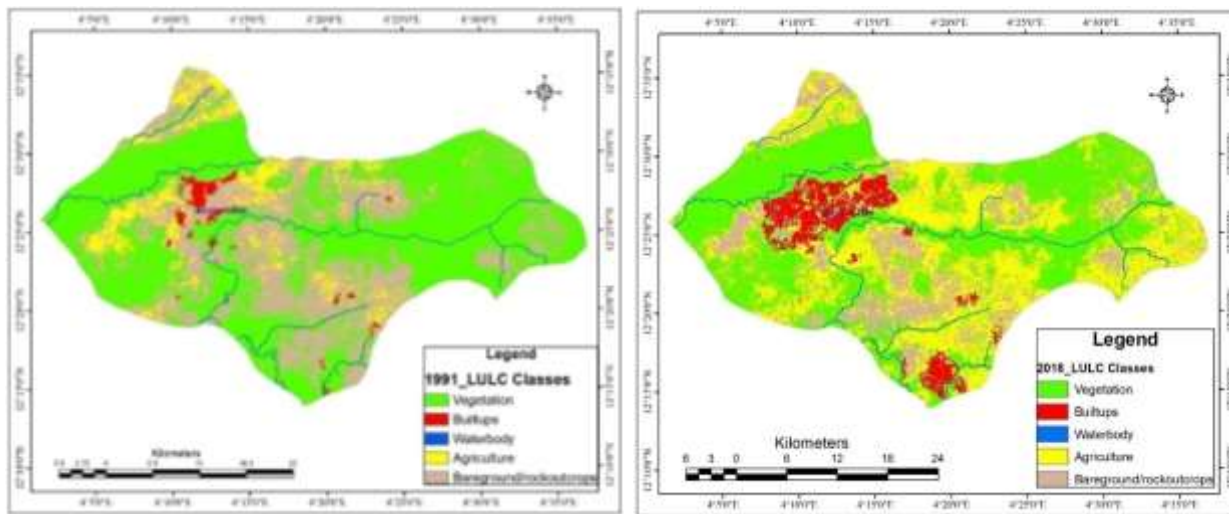
3. Methodology

A supervised classification method was adopted in the ArcGIS software to detect the changes that occurred from 1991 to 2018, using Landsat satellite imagery. Comparing and contrasting the 1980 Master Plan with the actual urban land cover enhanced our understanding of the expansion that has occurred on the ground surface. The 1980 Master Plan and the 2017 land use plan of the study area, which were obtained from the Ministry of Land and Housing, were georeferenced, scanned, and digitalized to achieve this. Furthermore, the non-urban development areas lost to urbanisation in 2018

were quantified, which included land use allocated for animal husbandry, nature conservation, and intensive agriculture. Along with on-the-ground field observations made during the fieldwork, the digitised Google Earth image of 2018 (GEI 2018), the Master Plan of 1980 (MP 1980), and the land-use plan of 2017 (LUP 2017) were used to assess the physical change in the 1980 land-use plan (Master Plan). A set of conditions was made to appraise the changes as modified by Tian and Shen (2007). These indices are: if a piece of land's usage is continuous over the MP 1980, LUP 2017, and GEI 2018, it is deemed to be in accordance with the plan and remains unchanged. A piece of land has departed from the plan and changed if its usage in the 1980 LUP differs from its use in the 2017 LUP and 2018 GEI.

4. Results and Discussion

The geographical pattern of land cover types and changes related to population growth were visualised and quantified using the supervised classification of Landsat data from 1991 to 2018. The findings (Figure 2(a) and Table 1) reveal that in 1991, when there were 119,000 people living there, the urban/built-up areas (which made up barely 1.40% of the entire land area) were mostly concentrated in the local government's northwest, with a few isolated settlements in other areas; development was also generally sparse. Additionally, 58.5% of the area was covered by flora, 0.4% by water bodies, 7.4% by agriculture, and 32.7% by bare terrain.



(a)

(b)

Figure 2: Land Use and Land Cover Classification Map of 1991 & 2018 Satellite Imagery.

Source: Field survey, 2019

The built-up areas in the south and the north-western part of the study area have significantly expanded as of 2018, when the population was 339,000, and some new towns can be seen strewn about the study area. These villages are remote, adjacent to the river channels, and encircled by farmland and/or agriculture. The built-up area presently makes up 6.2% of the total land area, up around 6,038 ha from 1991 to 2018, according to Figure 2(b) and Table 1. The area occupied by a water body shrank by 10 hectares, and the vegetation shrank by 18,038 hectares. Similar to how bare ground declined by 22,641 ha between 1991 and 2018, agricultural land increased by 34,651 hectares to now account for 35.2% of the total land surface.

Table 1. Land cover types of the different years and their percentage

Land cover type	1991(Ha)	%	2018(Ha)	%	Differences (Ha)
Built-up	1,687	1.40	7,725	6.20	6,038
Vegetation	73,030	58.50	54,992	44.10	-18,038
Water body	51	0.04	41	0.03	-10
Agriculture	9,270	7.40	43,921	35.20	34,651
Bare ground	40,773	32.70	18,132	14.50	22,641
Total	124,811	100	124,811	100	

Source: Field survey.

The land cover analysis shows the general spatial change in the surface area of Birnin Kebbi over time, and the Master Plan of 1980 specifies the various land use types with the budget. The impacts of implementing a suggested plan on urban development and growth in any city are both immediate and long-term. Although the magnitude of the population increase was overestimated, it was foreseen in the design of the Birnin Kebbi Master Plan. According to the 1983 Birnin Kebbi Master Plan, there were around 44,600 people residing in Birnin Kebbi in 1980. The number is expected to climb to between 107,600 and 133,300 by the year 2000. This population is expected to drive urbanisation and create competing demands for varied land uses. The proposed Master Plan in 1980 aimed to address these problems, allot spaces for different land uses, and also develop Birnin Kebbi LGA into an economic hub for Sokoto State.

Following the planning technique and design standard, the future land demand for Birnin Kebbi was assessed with careful account of the predicted population (3.1% annual population growth rate). Residential land use, which was predicted to handle an increase in population of about 87,000 at a density of 60 people per hectare, was determined to require the most land use (BKMP, 1983). According to the findings (Table 2 and Figure 2), 1450 hectares, or around 38.6% of the entire planned area, were designated for residential use. Additionally, 104 hectares were allocated for business (light industry), while 74 hectares were set aside for the town centre and central market. Additionally, the government allocated around 75 hectares for a public community project, while 289 and 60 hectares, respectively, were given to institutions and town parks. Similar to this, 298, 16, and 1391 hectares were allotted to urban agriculture, water bodies, and green spaces, respectively.

Table 2. Land use budget for the 1980 master plan

Land Use Type	Area (Ha)	Percentage (%)
Residential	1450	38.60
Business – light industry	104	2.80
Town centre and central market	74	1.90
Government public community project	75	2.00
Institutions	289	7.80
Town park	60	1.60
Urban agriculture	298	7.90
Water bodies	16	0.40
Green area	1391	37.00
TOTAL	3757	100

Authors work

Similarly, the land-use plan of the 2017 outcome, as displayed in Table 3 and Figure 3, is a more thorough plan that takes into account numerous other facets of society. In contrast to the 1980 Master Plan, which merely planned for 3757 hectares of land area for an estimated population of 133,300 inhabitants, the 2017 land-use plan attempted to include more classes and allocated 56,162 hectares of land.

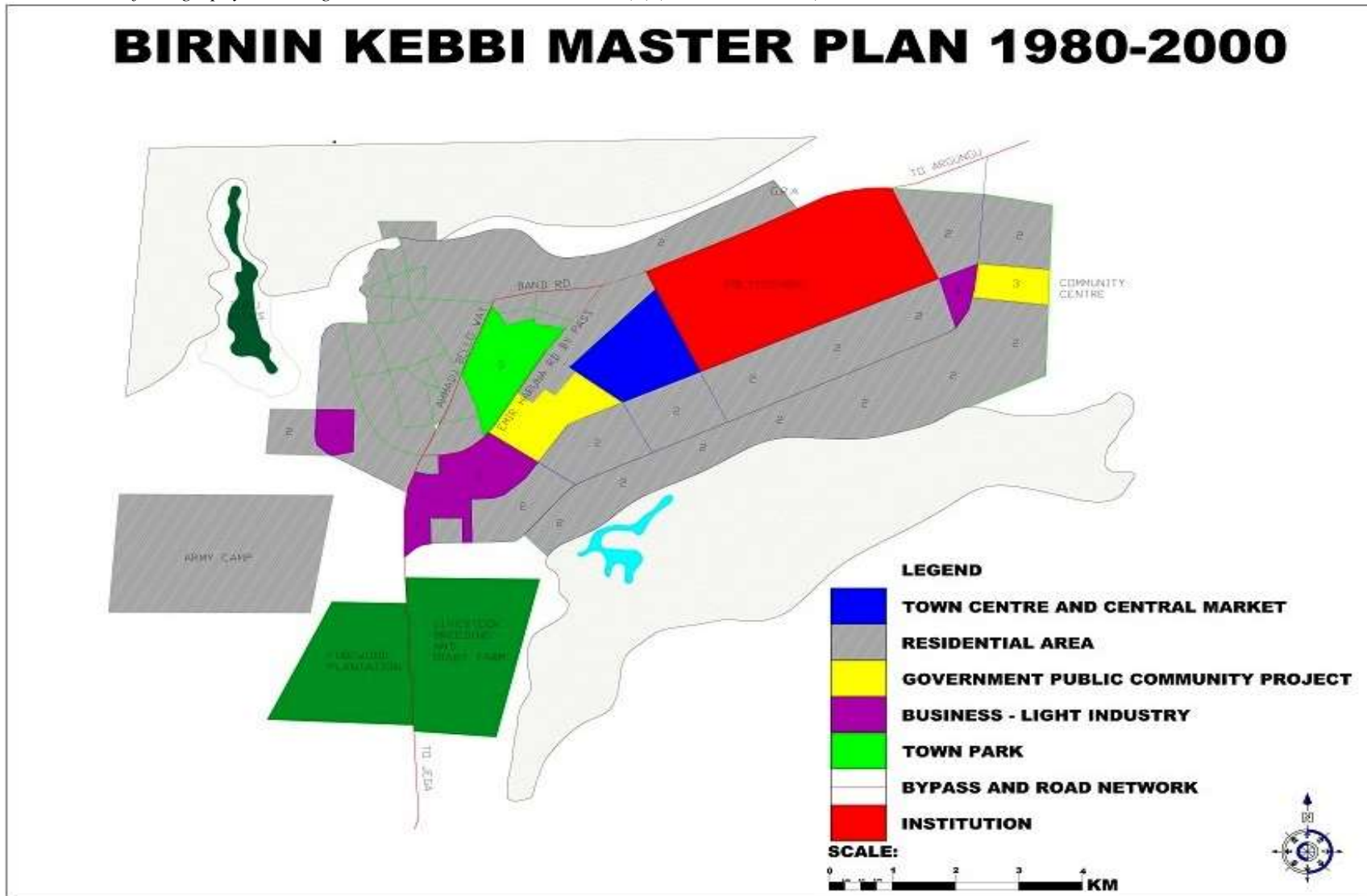


Figure 2: Master Plan of Birnin-Kebbi from 1980-2000.
Source: Ministry of Land and Housing, Kebbi State.

Table 3. Land use budget for the current land use map (2017)

Land Use Type	Area (Ha)	Percentage (%)
Residential	7798	13.90
Settlements	2659	4.70
Industrial and employment area	189	0.30
Public and semi-public	1911	3.40
Institutions (Education)	1931	3.40
Recreational	52	0.09
Farmlands	111	0.20
Water bodies	1834	3.30
Green open space	21547	38.40
Hills	237	0.40
Cemetery	8	0.01
Area reserved for future development	17885	31.80
Total	56162	100

Authors work, 2019.

The plan provided 2659 hectares for the existing rural communities while allocating a total of 7789 hectares for the residential area. Public and semi-public spaces, together with industrial and employment zones, received 0.3% and 3.4% of the total land area, respectively. Moreover, whereas the cemetery and areas set aside for future development made up 0.09% and 31.8% of the total area, respectively, water bodies, green open space, and hills covered 1834, 21,547, and 237 hectares, respectively.

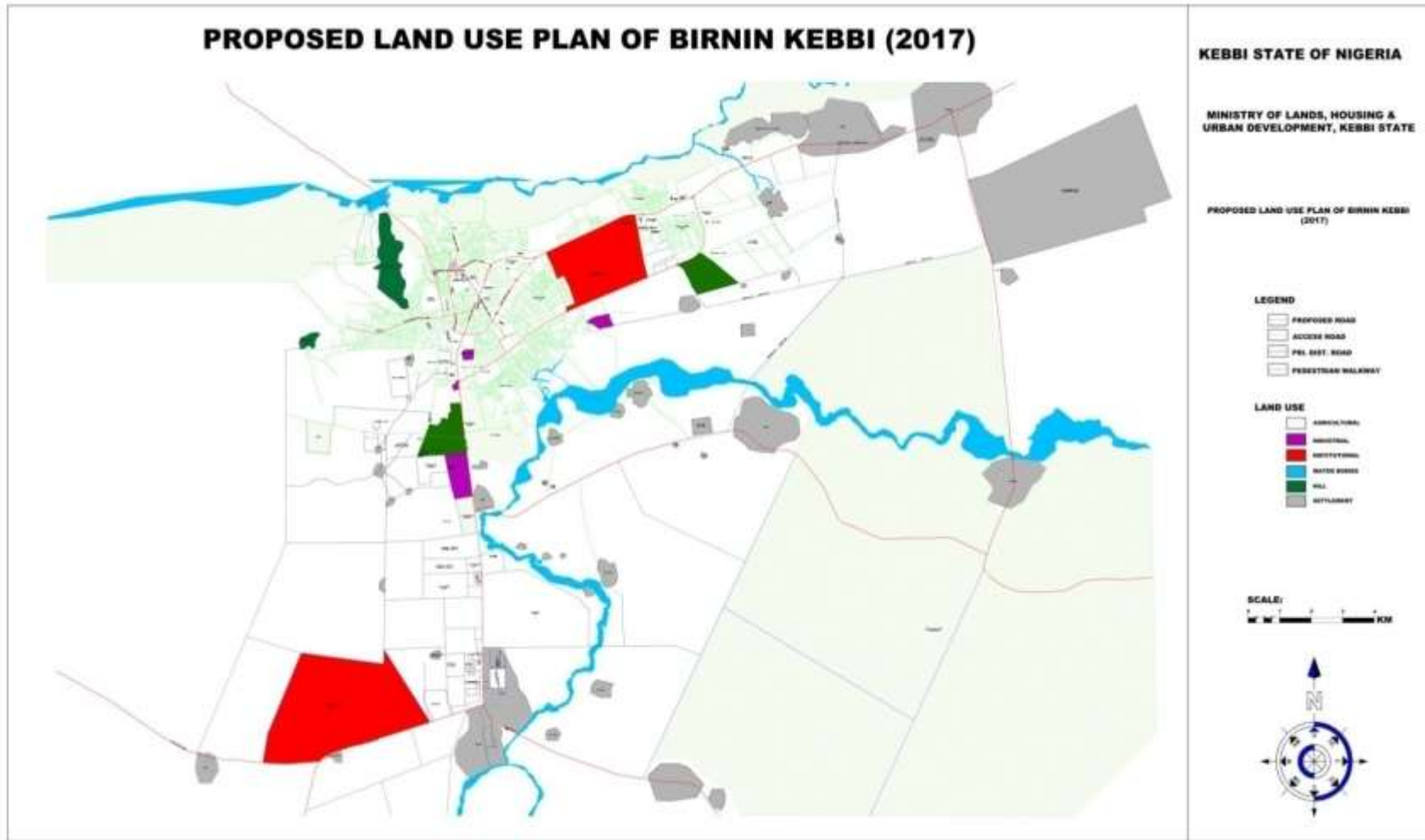


Figure 3: Current (2017) land-use plan of Birnin Kebbi
Source: Kebbi State Ministry of Land and Housing, 2019.

4.1 Implementation of the 1980 Land Use Plan

In 1980, the Sokoto state government produced a master plan for Birnin-Kebbi local government area as part of its developmental plans. As unique as the concept was, it was never anticipated that Birnin-Kebbi would become the capital of the newly created Kebbi state, and the plan design never considered such a status. Nonetheless, infrastructure and urban development progressed as planned, and residential buildings were built along the Argungu-Birnin-Kebbi highway prior to 1991.

The population had expanded from 44,600 in 1980 to 160,000 by 1991, when the local government became the capital of the newly formed state (UN-WPP, 2019). As a result, the Master Plan, which was designed with a population forecast of 133,300 by 2000 (using the average yearly population growth rate), proved to be completely unsuccessful. However, Birnin-Kebbi developed in accordance with the 1980 plan, and population growth necessitated the conversion of previously budgeted property for other reasons into urban districts. In an instant, 60 hectares designated for Town Park were changed to residential buildings, while a firewood plantation, cattle rearing, and dairy farm, totalling 1600 hectares, were turned into institutional and residential areas. According to the findings (Table 4), residential area has grown by 6348 hectares, industrial/employment area by 85 hectares, and institutional area by 1650 hectares.

Table 4. Land use change between the 1980 plan and the existing situation

Land uses	1980 (Ha)	2017 (Ha)	Deficit (Ha)
Residential	1450	7798	6348
Industrial/ employment area	104	189	85
Institutions	281	1931	1650
Public and semi-public	75	1911	1836
Water bodies	16	1834	1802
Urban Agricultural	298	111	-187
Green area	1391	21547	20156
Town park and recreational land	60	52	-8

Source: Authors work, 2019.

In contrast, a portion of the land set aside for urban agriculture has shrunk by 187 hectares, while the new locations for Town Park and recreation are about 52 hectares. According to the Director of Town Planning in Birnin Kebbi, "the urban growth in Birnin Kebbi has largely been managed sustainably, as the government has put in place some mechanisms, such as holding periodic meetings with the local chiefs (Mai-Angwa), to check the activities of the natives and prevent them from just selling a piece of land without proper layout and documentation." He went on to say that, while the land was vested in the governor's hands to hold in trust, the indigenous owned the right to utilise it and that they needed to properly engage the ministry for the design of the layout and other essential formalities before they could sell any slice of land.

5. Conclusion and Recommendation

Heilbroner & Milberg (2011) said, "Things take longer to happen than you think they will, and then they happen much faster than you thought they could." The rate of population explosion, urban expansion, and their effects on the environment have made the conversation on sustainable development unavoidable. Land cover change is a constant but gradual process that occurs in any geographical location on the Earth's surface over time and space. The land cover change of Birnin Kebbi demonstrates how urban growth can start very slowly and develop into a megacity, covering a large expanse of land. The urban growth from the land cover analysis shows consistency with the 2017 land use plan of the study area, therefore indicating steady urban growth. Because Birnin Kebbi is in its early phase of urban development, this research is imperative for how the city will plan and design future urban expansion. It was discovered that the Master Plan was largely

implemented between 1983 and 1991, but it was unable to be fully realised once the city's position changed from local government headquarters to state capital due to population growth, the need for additional infrastructure, and the requirement for residential buildings. So, a variety of land that had been officially allotted for other development reasons was changed to make way for residential areas.

Urban planners must recognise the fact that the world will continue to be urbanised, and subsequent master plans, strategic urban plans, or infrastructure plans should not only consider the estimated local urban growth rate but also incorporate the world urban trend projection. Urban planners must adopt more flexible methods of urban planning, such as compact city planning that promotes the construction of high-rise (residential density) buildings to accommodate the growing population with mixed land use. As the population grows, so does the need for housing, but the traditional method of developing estates with bungalow-style single-family homes is unsustainable. This is due to the fact that land is a limited resource and that population growth makes it inevitable that other environmental elements will be damaged if we continue to build in this way. The relevant government agency tasked with the enforcement of the development plan should be adequately trained to be able to adapt to different government policies and be able to re-modify the master plan to cope with the new responsibilities.

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