KADUNA JOURNAL OF GEOGRAPHY
2026, VOL. 8, No. 1, 635-642
https://doi.org/10.47514/kjg.2026.08.01.061

Research Article

Spatiotemporal Analysis of Land-Use/Land-Cover Change and Environmental Impacts of Urbanization in Minna Metropolis (2000–2020)

Hassan Suleiman [a], Isah Jibril Masha [a], Alfa Mohammed Alhaji [a], Hassan Alhaji Ibrahim [b], Mohammed Abdulkadir [c]

[a] Department of Geography, Dr. Umaru Sanda Ahmadu College of Education, Minna, Nigeria. [b] Department of Urban and Regional Planning, Niger State Polytechnic Zungeru, Nigeria. [c] Department of Geography, Ibrahim Badamasi Babangida University, Lapai, Nigeria

ABSTRACT

Rapid population growth and urbanization are transforming Minna Metropolis, the capital of Niger State, Nigeria, with significant consequences for land use, environmental quality, and public health. This study examined the effects of these processes between 1990 and 2020 using a mixed-methods approach. Multi-temporal Landsat imagery (1990, 2005, and 2020) was classified via Maximum Likelihood Classification in ArcGIS 10.8 into five land-use/land-cover classes, and change statistics were derived; 500 structured household questionnaires were also administered across five principal wards, of which 479 valid responses were analysed. Built-up area expanded from 1,904.4 ha (7.76%) in 1990 to 5,088.78 ha (20.75%) in 2020, while vegetation cover fell from 32.79% to 4.47% and agricultural land contracted from 51.81% to 38.38% over the same period. Expansion was spatially concentrated around institutional growth poles, notably the relocation of the Federal University of Technology to Gidan Kwano and the establishment of the NECO headquarters, indicating that institutional siting decisions, not just demographic pressure, are shaping the city's sprawl pattern. Survey findings revealed inadequate drainage infrastructure, widespread indiscriminate solid-waste disposal, and a high prevalence of malaria (82.9%), pointing to deteriorating sanitary conditions linked to unplanned expansion. The study recommends strict enforcement of the existing master plan around institutional growth nodes, routine satellite-based monitoring of land-cover change, targeted investment in drainage and waste-management systems, and mandatory environmental impact assessment for new peri-urban development.

ARTICLE HISTORY
Submitted 30 April 2026
Accepted 21 August 2026
Published 28 August 2026

GUEST EDITOR
A. M. Ahmed

KEYWORDS
Population Growth; Urbanization; Land Use/Land Cover Change; Remote Sensing; Environmental Health; Minna Metropolis

1 Introduction

Urbanization is a global phenomenon that continues to reshape the spatial organization of cities, particularly in developing countries. In Nigeria, the rapid growth of urban centers has driven significant transformation in land use and land cover (LULC), frequently producing urban sprawl, the largely unplanned expansion of cities into peripheral rural and agricultural land (Oyesiji, 2023). Urbanization, broadly understood as the process by which cities grow through industrialization and economic development, brings with it specialization of labor, diversification of human activity, and structural change in how land is allocated and used (Chaolin, 2020). Across Nigeria, rural-to-urban migration driven by the search for employment and services has intensified pressure on urban housing stock, a pattern consistent with global trends identified by UN-Habitat (2010). In much of the country, this pressure has translated into urban decay: inadequate land-use planning, insecure land tenure, poverty, substandard construction, and weak development control have combined to produce overcrowded, poorly serviced, and often flood-prone slum settlements (George, 2010).

The scale and composition of urban population growth are themselves significant drivers of slum proliferation (Muhammad, 2013), and there is growing scholarly and policy concern over how best to manage this expansion while still achieving sustainable urban development. Minna, the capital of Niger State, illustrates these dynamics clearly. Unregulated population growth has been accompanied by a visible proliferation of new buildings and the informal expansion of the built environment, often outpacing the provision of basic infrastructure such as roads, water, electricity, and market facilities (Bashir et al., 2022). Agricultural land on the city's periphery is increasingly sold to prospective developers, converting farmland into residential and commercial use with little regard for planning frameworks (Muhammad & Musa, 2024). It is against this backdrop that the present study examines the extent to which urbanization has reshaped the environment of Minna.

The environmental and infrastructural consequences of urban growth in Nigerian cities, such as loss of agricultural land, deforestation, traffic congestion, and the spread of informal settlements, mirror challenges documented across much of the developing world (Jamali et al., 2024). As cities expand outward, the conversion of open space, vegetation, and agricultural land into built environments follows a broadly similar trajectory (Kassouri & Okunlola, 2021), even where the specific drivers differ from one city to another. Lazarus (2012)

Corresponding Author: Suleiman, H. hsuleiman457@gmail.com Department of Geog., Dr. Umaru Sanda Ahmadu College of Education, Nigeria
© 2026 The Author(s)

found that rapid population growth and rural-urban migration place enormous strain on housing and public service delivery across African cities, manifesting as high rents, overcrowding, and slum formation. In Minna, this pressure has produced erosion, flooding, inadequate service provision, poor sanitation, and elevated urban environmental health risks. The pace of the city's physical growth has consistently outstripped the capacity of local planning institutions: the Urban Development Board has struggled to manage the demands of rapid, largely unplanned expansion (Omole, 2010). More broadly, unchecked urbanization intensifies land-use pressures such as agriculture, mining, deforestation, and recreation, to the point where their cumulative effects appear as uncontrolled development, deteriorating environmental quality, loss of prime agricultural land, and destruction of wetland and wildlife habitat. Migrants who cannot afford urban housing costs are frequently pushed into informal settlements, compounding poverty that is often more acute in cities than in the rural areas migrants left behind (World Bank, 2022).

Minna's role as a regional hub, anchored by its motor parks, schools, hospitals, government offices, religious centers, and commercial districts, has made it a persistent pull factor for in-migration, since these facilities also generate employment. The resulting population growth has made land use increasingly complex and has driven a corresponding rise in the volume and variety of solid waste generated within the city. Remote sensing offers a practical entry point for characterizing these changes systematically, providing baseline evidence that can inform planning responses and raise public awareness of the pressures urban growth places on residents. This study accordingly maps LULC change in Minna between 1990 and 2020, with a view to identifying the effects that population growth and unplanned expansion have had on the city's environment.

Comparable LULC studies from other parts of Nigeria help situate Minna's experience within a broader national pattern, while also showing that the specific drivers of change vary considerably by location. In Kaduna Millennium City, a Support Vector Machine classification of Landsat imagery from 2004 to 2024 found substantial urban expansion, with built-up area and bare land increasing while grassland and vegetation cover declined sharply, a shift accompanied by rising landscape fragmentation and a measurable decline in habitat quality across the two-decade period (Ahmad et al., 2026). This pattern, built-up growth displacing vegetated and grassland cover, closely parallels the trajectory expected in Minna, where residential and commercial expansion has similarly encroached on farmland and open space. By contrast, in the savannah agroecological zone of Yamaltu-Deba LGA in northeastern Nigeria, decadal Landsat analysis from 1990 to 2020 found a different pattern: low forest and grassland cover declined markedly, but this was accompanied by an expansion of savannah cover rather than built-up land, with implications for regional carbon storage capacity (Afolayan et al., 2026). This case underscores that vegetation loss in Nigerian cities and their surrounding zones is not always synonymous with urban expansion; ecological degradation can proceed through land-cover conversion pathways that have little to do with settlement growth. A third case, from Du in Jos South, Plateau State, illustrates yet another driver: a random forest classification of Landsat and Sentinel-2 imagery from 2010 to 2025 found that active artisanal and small-scale mining expanded by nearly 350 percent, displacing irrigated cropland and even contracting built-up area, while abandoned mining pits filled with water became a persistent public health hazard (Tsenkus & Musa, 2026). These three cases demonstrate that while built-up expansion, vegetation loss, and land degradation are common threads running through Nigerian LULC change, the underlying drivers, specifically demographic pressure and planning failure in Kaduna and Minna, agroecological transition in Yamaltu-Deba, and extractive activity in Du, differ enough to warrant city- and region-specific analysis rather than a single generalized narrative of urban sprawl. Situating Minna within this comparative context strengthens the case for a dedicated, empirically grounded assessment of how population growth and unplanned development have specifically reshaped its land use and environment over the past two decades.

This paper is therefore centered on the effects of population growth and urbanization on Minna Metropolis, drawing on remote sensing evidence and comparison with recent Nigerian LULC studies, and offers possible solutions toward enhancing a more sustainable and well-planned urban environment in Minna.

2 Materials and Methods

2.1 Study Area

Minna Metropolis, the capital of Niger State, Nigeria, lies approximately between latitudes 9.33°N and 9.40°N and longitudes 6.29°E and 6.35°E (Figures 1 and 2). The city functions as a major administrative, educational, commercial, and transportation hub within the state. It contains motor parks, tertiary institutions (including the Federal University of Technology, Minna), government offices, hospitals, markets, and religious centres that collectively act as strong pull factors for rural–urban migration. The study area encompasses the continuously built-up and peri-urban zones of Minna that have experienced rapid physical expansion between 1990 and 2020 (Sani et al., 2026).

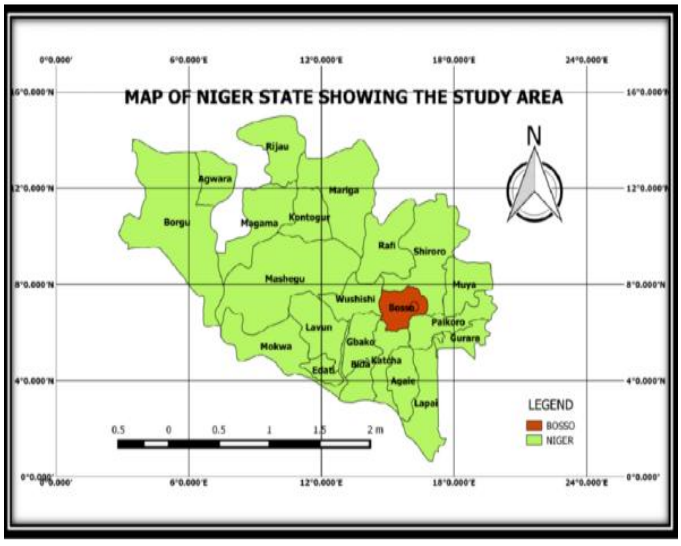


Figure 1: Niger State showing Bosso LGA

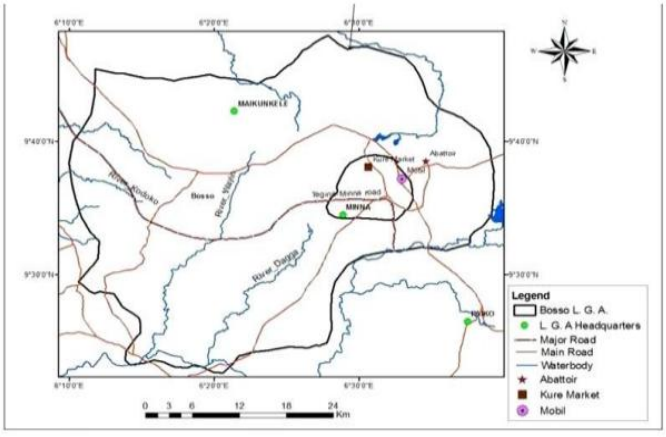


Figure 2: Map of Minna metropolis

2.2 Data Sources

Multi-temporal Landsat imagery for the years 1990, 2005, and 2020 was acquired from the United States Geological Survey. The images were selected for minimal cloud cover and comparable seasonal conditions to reduce phenological differences. Also, socio-economic data were obtained through a structured household questionnaire administered in five principal wards that constitute the core of Minna Metropolis. Other data included the Niger State Urban Development Board documents, National Population Commission (NPC, 2006) reports, and relevant published literature.

2.3 Household Survey Design and Sampling

A structured questionnaire was designed to capture information on socio-demographic characteristics, availability of drainage facilities, solid-waste disposal practices, perceived environmental problems, and prevalence of common diseases. The instrument was pre-tested in a neighbouring ward and revised for clarity and relevance.

Five principal wards that together represent the spatial and socio-economic diversity of Minna Metropolis were purposively selected. Within each ward, households were selected using systematic sampling. Because house numbering is incomplete in several parts of the city, a fixed interval (every kth dwelling) was applied after a random starting point in each selected street or cluster.

A total of 500 questionnaires were administered. After data cleaning, 479 valid responses (95.8 % response rate) were retained for analysis. The sample size was distributed proportionally according to the approximate population size of each ward.

2.4 Remote Sensing and GIS Workflow

All image processing and classification were performed in ArcGIS 10.8. The workflow comprised the following sequential stages:

2.4.1 Image acquisition and pre-processing

Geometric correction and geo-referencing to a common coordinate system (UTM Zone 32N, WGS 84). Radiometric and atmospheric correction to minimise sensor and atmospheric effects. Image subsetting to the defined boundary of Minna Metropolis. Layer stacking of relevant spectral bands.

2.4.2 Training sample selection

Training samples for five land-use/land-cover (LULC) classes were collected through visual interpretation of the imagery supported by local knowledge of the study area. The five classes adopted were: Built-up area, Agricultural land, Vegetation, Bare surface, and Water body

2.4.3 Image classification

Supervised classification was carried out using the Maximum Likelihood Classification (MLC) algorithm.

2.4.4 Post-classification processing

Majority filtering was applied to reduce isolated pixels. Classified maps for 1990, 2005, and 2020 were produced.

2.4.5 Change detection

Area statistics (hectares and percentages) for each LULC class were extracted for the three dates. Net change and percentage change between 1990–2005, 2005–2020 and 1990–2020 were calculated.

2.5 Quantitative Data Analysis

Quantitative survey data were coded and analysed using descriptive statistics (frequencies and percentages). Cross-tabulations were used to examine relationships between selected variables.

2.6 Ethical Consideration

Ethical considerations included informed consent from respondents and assurance of anonymity. No personal identifiers were retained in the final dataset.

3 Results

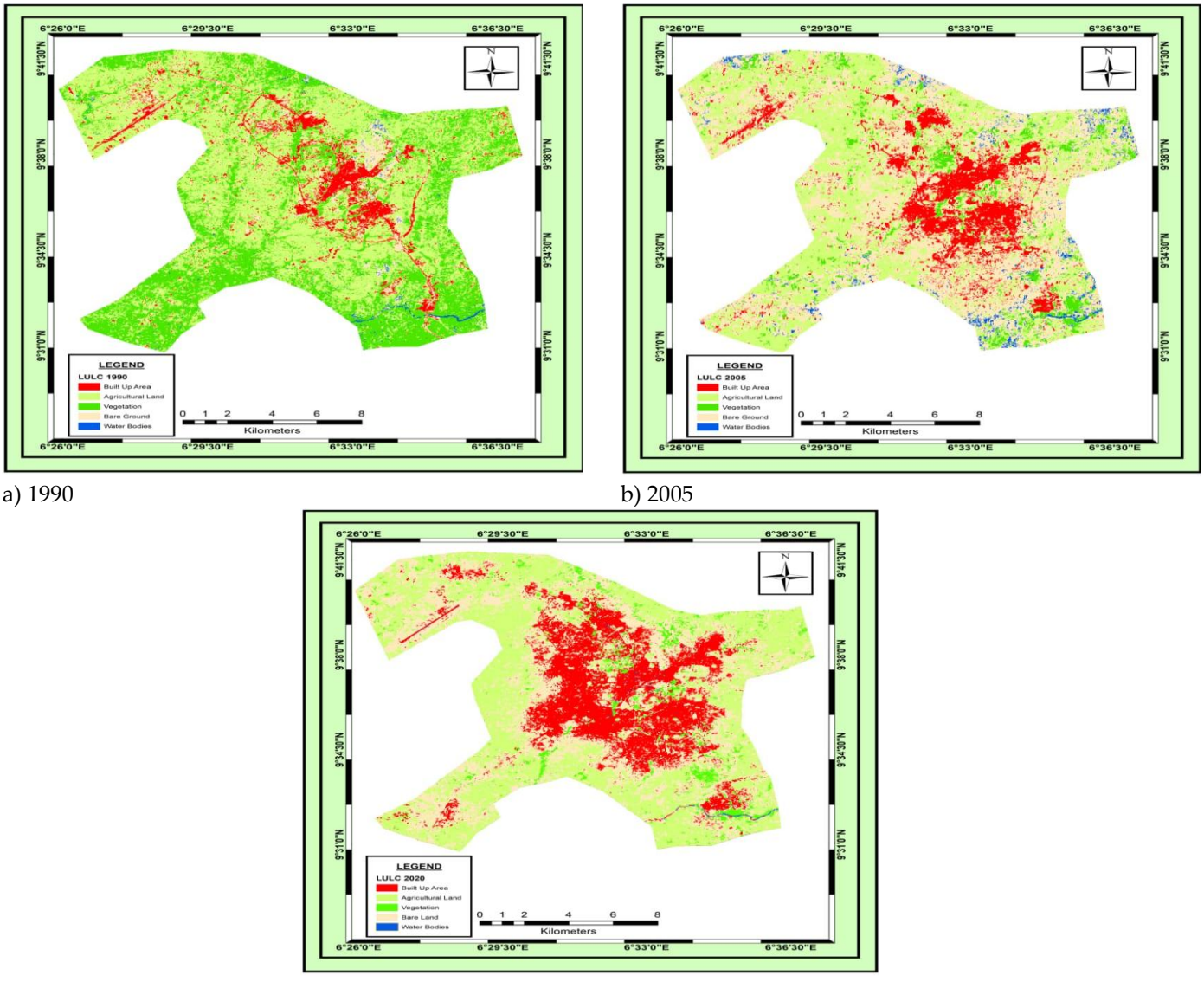
3.1 Land Use and Land Cover Changes (1990–2020)

Multi-temporal Landsat images for 1990, 2005 and 2020 were classified into five land-use/land-cover (LULC) classes using the maximum-likelihood classifier in ArcGIS 10.8. The resulting areal statistics are summarised in Table 1.

Table 1: Land Use and Land Cover Distribution in Minna Metropolis (1990–2020)

LULC Class	1990 (ha)	1990 (%)	2005 (ha)	2005 (%)	2020 (ha)	2020 (%)
Agricultural land	12,706.74	51.81	8,446.86	34.44	9,413.19	38.38
Vegetation	8,043.84	32.79	1,505.61	6.13	1,096.47	4.47
Built-up area	1,904.40	7.76	3,092.58	12.61	5,088.78	20.75
Bare ground	1,687.59	6.88	–	–	–	–
Water bodies	181.89	0.74*	460.17	1.87	53.10	0.21

Between 1990 and 2020, the built-up area expanded by 3,184.38 ha, rising from 7.76 % to 20.75 % of the study area. This represents a net gain of 12.99 percentage points over two decades. The increase was most pronounced between 2005 and 2020. Spatial expansion was predominantly linear and directed toward the northern and southern fringes of the metropolis (Figure 3). Field observation and local knowledge indicate that this pattern coincides with the relocation of the Federal University of Technology, Minna to Gidan Kwano and the establishment of the NECO headquarters at Gidan Mongoro, both of which stimulated residential and commercial development.



a) 1990

b) 2005

c) 2020

Figure 3: Land use and land cover distribution of Minna in a) 1990, b) 2005, and c) 2020

Vegetation cover declined sharply from 8,043.84 ha (32.79 %) in 1990 to 1,096.47 ha (4.47 %) in 2020. Agricultural land also contracted substantially between 1990 and 2005 (from 12,706.74 ha to 8,446.86 ha) before a modest recovery to 9,413.19 ha in 2020. Water bodies fluctuated, decreasing overall from 181.89 ha in 1990 to 53.10 ha in 2020. The progressive conversion of vegetated and agricultural land into built-up surfaces is consistent with the observed urban sprawl and indicates increasing pressure on natural and productive land resources.

3.2 Household Perceptions of Environmental Conditions

A structured questionnaire was administered to 500 households across five selected wards; 479 valid responses were retrieved and analysed.

Table 2 revealed that the majority of respondents (76.2 %) disagreed or strongly disagreed that adequate drainage facilities exist. Respondents linked blocked or absent drains to frequent flooding, erosion, and occasional contamination of shallow wells by pit latrines.

Table 2: Availability of Drainage Facilities

Response	Frequency	Percent
Strongly agree	40	8.4
Agree	74	15.4
Disagree	167	34.9
Strongly disagree	198	41.3
Total	**479**	**100.0**

Table 3 revealed that although 41.3 % of households reported using designated dumpsites, a combined 58.7 % disposed of waste by indiscriminate dumping, burning, or burying. These practices contribute to surface-water pollution, groundwater contamination, and the proliferation of disease vectors.

Table 3: Methods of Solid-Waste Disposal

Method	Frequency	Percent
Designated dumpsite	198	41.3
Indiscriminate dumping	167	34.9
Burning	74	15.4
Burying	40	8.4
Total	**479**	**100.0**

Table 4 revealed that Malaria was by far the most frequently reported illness (82.9 %), followed by typhoid (10.0 %). The high prevalence of malaria and the presence of water-borne diseases (cholera, dysentery, typhoid) are consistent with poor drainage, indiscriminate waste disposal and inadequate sanitation infrastructure.

Table 4: Common Diseases Reported by Respondents

Disease	Frequency	Percent
Malaria	386	82.9
Typhoid	59	10.0
Cholera	17	3.5
Dysentery	17	3.5
Total	**479**	**100.0**

3.3 Synthesis

The remote-sensing results demonstrate a clear trajectory of urban expansion at the expense of vegetation and, to a lesser extent, agricultural land. Concurrently, household survey data reveal that the expanding built environment is not matched by corresponding improvements in drainage and solid-waste management. The combination of rapid land-cover conversion and deficient environmental services has produced observable declines in environmental quality, manifested as flooding, pollution and elevated incidence of sanitation-related

diseases. These findings underscore the need for integrated land-use planning and infrastructure provision to mitigate the environmental consequences of continued population growth and urbanisation in Minna.

4 Discussion

The land-use and land-cover results confirm that Minna Metropolis has undergone rapid and largely unplanned physical expansion over the 1990–2020 period. The near threefold increase in built-up area, from 1,904.40 ha to 5,088.78 ha, occurred predominantly at the expense of vegetation cover, which fell by more than 85 percent over the same period. This pattern is consistent with the trajectory described by Oyesiji (2023) and Kassouri and Okunlola (2021) for rapidly growing Nigerian and African cities, where outward expansion converts open space and vegetated land into built surfaces in a broadly similar sequence regardless of location. The spatial concentration of new development along the northern and southern fringes of the metropolis, coinciding with the relocation of the Federal University of Technology to Gidan Kwano and the establishment of the NECO headquarters at Gidan Mongoro, supports the observation that institutional relocation and infrastructure investment act as strong localized pull factors for residential and commercial development, reinforcing the regional-hub dynamic described in the introduction (Morrison, 2022).

The trajectory of vegetation loss accompanying built-up expansion in Minna is similar to the findings from Kaduna Millennium City, where Ahmad et al. (2026) documented a comparable pattern of built-up and bare-land growth displacing grassland and vegetation cover between 2004 and 2024, alongside rising landscape fragmentation and declining habitat quality. The convergence of these two cases, although having different scales and specific institutional drivers, strengthens the inference that demographic pressure and weak development control, rather than location-specific factors alone, are the primary engines of vegetation loss in Nigeria's fast-growing secondary cities. However, the results contrast with the findings of Afolayan et al. (2026) in Yamaltu-Deba, where vegetation and low-forest decline proceeded largely independently of settlement growth, and with the findings of Tsenkus and Musa (2026) in Du, where mining rather than urban expansion drove land-cover conversion and even contracted built-up area. Read together, these comparisons suggest that Minna's LULC trajectory is best classified within the "demographic-pressure and planning-failure" category of Nigerian urban change rather than the agroecological or extractive categories, a distinction that has direct implications for the kinds of interventions likely to be effective.

The behaviour of agricultural land is worth examining separately from vegetation. Its sharp decline between 1990 and 2005, followed by a partial recovery by 2020, is not immediately intuitive given the sustained growth of the built-up class over the same second decade. Plausible explanations include a slowdown in the conversion rate of peripheral farmland relative to the 1990–2005 period, possible reclassification of fallow or regenerating land as agricultural in the later imagery, or a genuine re-expansion of cultivation into land vacated by the sharper collapse in vegetation cover. Because the classification scheme also lost the bare-ground class after 1990, some of the apparent recovery in agricultural land may reflect spectral confusion between bare and cultivated surfaces rather than an actual land-use reversal; this is a limitation of the maximum-likelihood approach that later work could address with a denser time series or a fixed class scheme across all three dates. The marked decline in water bodies, from 181.89 ha to 53.10 ha, is similarly worth treating cautiously, since seasonal timing differences between the acquisition dates can produce large apparent changes in surface water extent independent of any genuine hydrological trend.

The household survey results extend the remote-sensing findings by showing that Minna's physical growth has not been accompanied by commensurate investment in basic environmental infrastructure. That more than three-quarters of respondents reported inadequate drainage, and that a majority disposed of solid waste through indiscriminate dumping, burning, or burying rather than designated collection, indicates that service provision has lagged well behind the pace of built-up expansion documented in the LULC analysis. This gap between physical growth and infrastructural capacity is precisely the dynamic described by Lazarus (2012) and Omole (2010) for other Nigerian and African urban centres, where rural-urban migration outpaces the ability of local planning institutions to deliver services, and it echoes the pattern of urban decay described by George (2010) in the Lagos context. The very high prevalence of malaria (82.9 percent) and the presence of typhoid, cholera, and dysentery among respondents provide a public-health corollary to the land-cover findings: poor drainage and uncollected waste create standing water and unsanitary conditions that favour disease-vector breeding, linking environmental degradation directly to household welfare outcomes rather than leaving it as an abstract planning concern.

Taken together, the GIS and household survey results reinforce one another. Where the LULC analysis shows that Minna's natural and agricultural land base is being steadily converted to built-up use, the survey data show that this conversion is occurring without the parallel expansion of drainage and waste-management

infrastructure that would be needed to keep environmental and health outcomes stable. This is consistent with the World Bank's (2022) characterization of unmanaged low-income urban growth, and it suggests that the environmental consequences documented here are not an inevitable by-product of urbanization itself but a product of the specific way growth has been allowed to proceed in Minna, largely outside the framework of the existing master plan and with limited enforcement capacity on the part of the Niger State Urban Development Board.

5 Conclusion

This study has shown that Minna Metropolis experienced substantial and largely unplanned land-use transformation between 1990 and 2020, with built-up area more than doubling in percentage share of the study area while vegetation cover collapsed by over 85 percent and agricultural land underwent net contraction despite a partial late-period recovery. These changes were concentrated around institutional growth poles, particularly the relocation of the Federal University of Technology to Gidan Kwano and the establishment of the NECO headquarters, underscoring how institutional decisions can act as powerful, spatially concentrated drivers of urban sprawl even in the absence of formal planning guidance. The household survey component demonstrated that this physical expansion has outpaced the provision of basic environmental services: most residents lack adequate drainage, a majority of households dispose of solid waste through informal or unsafe methods, and malaria and other sanitation-related diseases are widespread.

Based on these findings, it is recommended that the Niger State Urban Development Board strictly enforce the existing master plan, particularly around institutional growth nodes such as Gidan Kwano and Gidan Mongoro; institutionalize routine satellite-based land-cover monitoring to detect unauthorized land conversion; prioritize drainage and formal solid-waste management investment in the most deficient wards; and mandate environmental impact assessment for new peri-urban developments. Future research should extend the LULC time series with denser, seasonally matched imagery to clarify the agricultural-land and water-body trends, and integrate household-level health data more directly with spatial change analysis to strengthen the link between urbanization and public-health outcomes in Minna.

References

Afolayan, O., Yero, A. B., & Umar, H. (2026). Land Use Land Cover Dynamics and Implications for Carbon Stock in the Savannah Agroecological Zone: A Case Study of Yamaltu-Deba LGA, Northeast Nigeria. Kaduna Journal of Geography, 8(1), 291-296. https://doi.org/10.47514/kjg.2026.08.01.031

Ahmad, M., Aliyu, A., & Ahmed, A. M. (2026). Spatiotemporal Dynamics of Land Use/Land Cover Change and Their Impacts on Ecosystem Fragmentation and Habitat Quality in Kaduna Millennium City, Nigeria. Kaduna Journal of Geography, 8(1), 11-22. https://doi.org/10.47514/kjg.2026.08.01.002

Bashir, I. Y., Osesienemo, S. R., Aliyu, H., Sheikh, A., Danjuma, A. Z., Muhammed, A., & Jiya, S. N. (2022). Detection and delineation of agricultural land losses in Minna, Niger State, Nigeria. Remote Sensing of Land, 6(1), 28-39. https://doi.org/10.21523/gcj1.2022060103

Chaolin, G. (2020). Urbanization. International Encyclopedia of Human Geography, 14, 141-153. https://doi.org/10.1016/B978-0-08-102295-5.10355-5

George, C. K. (2010). Nigeria; Challenges of Lagos as a mega-city (2). Daily Independent, October 18, 20 12, Standard Newspaper, Lagos.

Jamali, A. A., Behnam, A., Almodaresi, S. A., He, S., & Jaafari, A. (2024). Exploring factors influencing urban sprawl and land-use changes analysis using systematic points and random forest classification. Environment, Development and Sustainability, 26(5), 13557-13576. https://doi.org/10.1007/s10668-023-03633-y

Kassouri, Y., & Okunlola, O. A. (2021). Analysis of spatio-temporal drivers and convergence characteristics of urban development in Africa. Land Use Policy, 112, 105868. https://doi.org/10.1016/j.landusepol.2021.105868

Lazarus, M.O. (2012). An Evaluation of the Efficiency of the Land Use Act 1998 of the Federal Republic of Nigeria and its Implication in Minna and Environs. International Federation of Surveyors Abuja.

Morrison, N. (2022). Impact of Universities on Urban and Regional Economies. In: Brears, R.C. (eds) The Palgrave Encyclopedia of Urban and Regional Futures. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-030-87745-3_165

Muhammad, M. (2013). Assessment of Drinking Water Quality and its impact on Residents' Health in Bahawalpur City. International Journal of Humanities and Social Science, 3(15), 114-128.

Muhammad, H., & Musa, H. D. (2024). Impact of Urban Expansion on Agricultural Land in Minna, Niger State, Nigeria. Proceedings of School of Environmental Technology International Conference 2024 (SETIC 2024) 22nd – 24th October, 2024, Federal University of Technology, Minna, Niger State, Nigeria.

National Population Commission, Minna, Nigeria (NPC, 2006). Census of Nigeria Provisional population totals.

Omole, K. F. (2010). An Assessment of Housing Condition and Socio-Economic Life Styles of Slum Dwellers in Akure, Nigeria. Contemporary Management Research, 6(4). https://doi.org/10.7903/cmr.2980

Oyesiji, O. A. (2023). Spatio-temporal measurements of urban sprawl dynamics in Oyo Town, Nigeria. African Journal on Land Policy and Geospatial Sciences, 6(1), 094-106. https://doi.org/10.48346/IMIST.PRSM/ajlp-gs.v6i1.34547

Sani, I. A., Muhammed, M., & Ibrahim, I. (2026). Impact of Road Construction Delays on Public Well-Being in Minna, Niger State, Nigeria. Kaduna Journal of Geography, 8(1), 275-282. https://doi.org/10.47514/kjg.2026.08.01.029

The World Bank (2022). Upgrading of low-income settlements. World Bank: New York.

Tsenkus, E., & Musa, H. D. (2026). Spatiotemporal Impact of Artisanal and Small-Scale Mining Activity on Land Use/Land Cover Dynamics in Du, Jos South, Nigeria. Kaduna Journal of Geography, 8(1), 321-330. https://doi.org/10.47514/kjg.2026.08.01.034

UN-Habitat (2010). The state of African cities governance, inequality and urban land markets/ United Nations Human Settlement Programme: International Conference on Human Settlement. Held on March 18, 2010, Nairobi.