Migration-Driven Urban Growth and Land Use Dynamics in Jos Metropolis, Nigeria: A Geospatial Analysis of Environmental and Socio-Economic Consequences (2015–2024)

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ABSTRACT

This study examined the environmental and socio-economic consequences of migration-driven urban growth in Jos Metropolis, Plateau State, Nigeria, between 2015 and 2024. Using a mixed-methods approach integrating remote sensing (Sentinel-2 imagery), GIS analysis, and household surveys (n=193), the research analysed land use and land cover (LULC) changes, urban expansion patterns, and residents' perceptions of environmental and socio-economic impacts.

The findings revealed that built-up areas expanded from 32.37 km² (12.54%) in 2015 to 46.02 km² (17.82%) in 2024, representing a 42% increase. Notably, vegetation cover recovered from 18.60% to 26.88% during the same period, suggesting environmental regeneration. The survey data indicated that migration was primarily economic-driven (75%), with 45% of migrants being seasonal. Environmental challenges reported included deforestation (70%), water scarcity (65%), and land competition (80%). Socio-economic benefits included economic prosperity (60%) and increased agricultural production (55%), while challenges included job competition (60%) and environmental pressure (65%).

The study recommends strengthened urban planning, environmental management, and migration governance to promote sustainable urban development in Jos.

Keywords: Urban growth, migration, land use/land cover, environmental degradation, socio-economic impacts, Jos Metropolis, Nigeria

INTRODUCTION

Rapid urbanisation has emerged as one of the most significant demographic transformations of the modern era, particularly in Sub-Saharan Africa where urban growth rates are among the highest globally (Farrell, 2018). Nigeria, the most populous country in Africa, exemplifies this trend with its cities experiencing sustained expansion driven by rural-urban migration and natural population increase. According to the United Nations (2019), Nigeria's urban population is projected to continue growing rapidly, placing increasing pressure on urban infrastructure, environmental resources, and social services.

Jos Metropolis, the capital of Plateau State in North-Central Nigeria, has experienced considerable urban expansion due to sustained migration flows. The city's favourable climatic conditions, historical mining activities, and presence of major educational institutions have attracted migrants from various parts of the country. However, this growth has occurred against a backdrop of inadequate urban planning frameworks and weak governance mechanisms, resulting in environmental degradation, pressure on housing and infrastructure, and socio-economic challenges (Wapwera, 2011; Adzandeh et al., 2015).

Understanding the dynamics of migration-driven urban growth and its consequences is essential for sustainable urban planning and management. While several studies have examined urbanisation in Nigerian cities, relatively

few have focused on medium-sized cities like Jos. Furthermore, studies integrating geospatial analysis with socio-economic survey data to examine both environmental and socio-economic impacts remain limited (Aweda et al., 2024; Olise et al., 2024). This study addresses these gaps by employing a mixed-methods approach combining remote sensing, GIS, and household surveys to analyse migration-driven urban growth in Jos Metropolis between 2015 and 2024.

The specific objectives of this study were to:

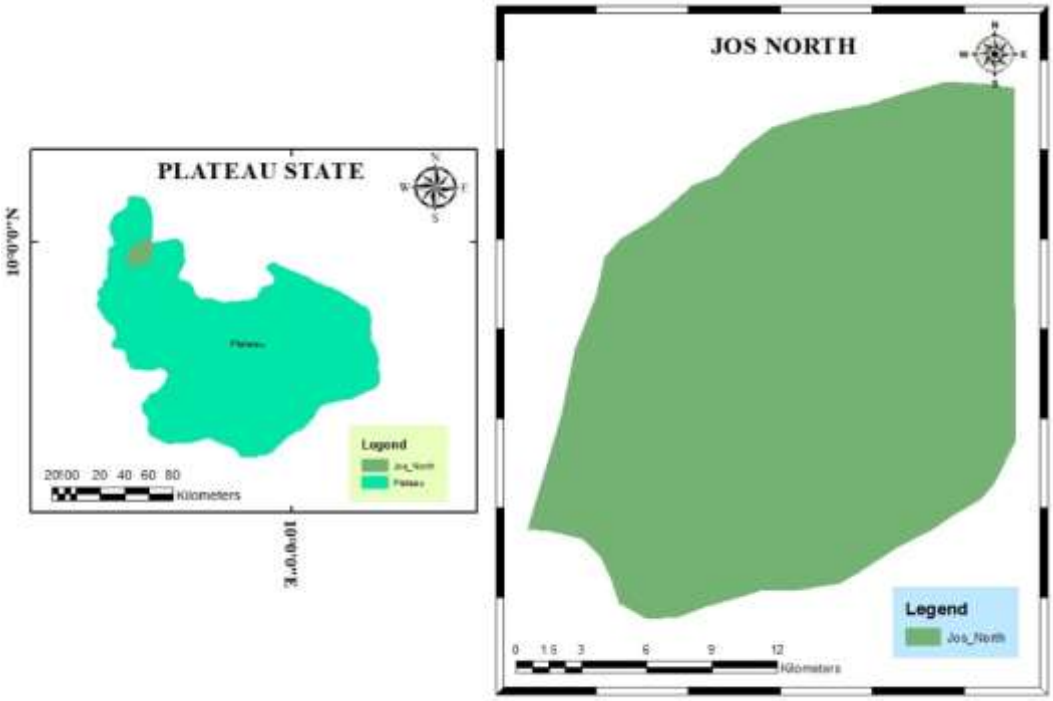
1. Analyse the spatial extent and patterns of urban growth in Jos between 2015 and 2024
2. Examine changes in land use and land cover associated with urban expansion
3. Assess the environmental consequences of migration-driven urban growth
4. Evaluate the socio-economic impacts of migration on host communities

MATERIALS AND METHODS

2.1 Study Area

Jos North Local Government Area is situated within the Jos Plateau in Plateau State, Nigeria, lying between latitudes 9°39′N and 9°50′N and longitudes 8°54′E and 9°50′E, with an average elevation of approximately 1,500 metres above sea level. The study area covers approximately 258.18 km² and had a population of 3,954,581 according to the 2006 national census. Jos has a semi-temperate climate with temperatures ranging from 18°C to 25°C and average annual precipitation of approximately 1,074.8 mm.

Figure 1: Map of the Study Area



2.2 Data Sources and Methods

2.2.1 Satellite Imagery Acquisition and Processing

Sentinel-2 images were sourced from the Copernicus Open Access Hub (https://scihub.copernicus.eu) for the years 2015 and 2024. Data were collected during the dry season to ensure cloud-free imagery and achieve

seasonal consistency. Radiometric and geometric corrections were applied to adjust for surface reflectance fluctuations caused by sensor calibration, air absorption, scattering, and illumination geometry.

2.2.2 Image Classification Methodology

Land use and land cover classification was conducted using a **supervised maximum likelihood classification** method based on the Level 1 classification system of Anderson et al. (1976). The following steps were followed:

Step 1: Image Preprocessing

Layer stacking was performed to combine spectral bands. Resampling was conducted to ensure consistent spatial resolution. Image enhancement was applied to improve visual interpretation.

Step 2: Training Site Selection

Training sites were generated by on-screen digitising for each land cover class. Six land cover classes were identified: Built-up Area, Agricultural Land, Water Bodies, Vegetation, Bare Surface, and Rock Outcrops. Training sites were selected based on field observations and spectral signatures.

Step 3: Supervised Classification

A supervised (full Gaussian) maximum likelihood classification was implemented. This method was chosen because the researcher had familiarised himself with the study area through dedicated field observation, enabling accurate identification of spectral characteristics for each class.

Step 4: Accuracy Assessment

Ground truth information was collected using GPS coordinates during field visits. An error matrix was generated to calculate overall accuracy, producer's accuracy (omission error), user's accuracy (commission error), and the Kappa coefficient.

Table 1: Accuracy Assessment Results (2024)

Class	**Producer's Accuracy (%)**	**User's Accuracy (%)**
Waterbody	92	90
Bare Surface	88	92
Vegetation	90	94
Agricultural Land	91	86
Built-up	90	85
Overall Accuracy	**89.2%**	
Kappa Coefficient	**0.86**	

Source: Author's Analysis, 2024

2.2.3 Land Use and Land Cover Classification Scheme

Six land use and land cover classes were identified for this study:

S/N	Class	Description
1	Built-up Area	Residential areas, roads, markets, schools, and other infrastructure
2	Agricultural Land	Plantations and small farmlands devoted to crop production and livestock rearing
3	Water Bodies	Rivers, streams, and reservoirs
4	Vegetation	Forests, grasslands, and shrubs
5	Bare Surface	Exposed soil and rock surfaces not permanently covered by vegetation or water
6	Rock Outcrops	Geological formations with exposed rock surfaces

Source: Adapted from Anderson et al., 1976

2.2.4 Household Survey Methodology

Sample Size Determination

The sample size for this study was determined using the SurveyMonkey sample size calculator. The following parameters were applied: a projected 2024 population of Jos North (approximately 900,000), a 95% confidence level, and a 5% margin of error. The calculator yielded a required sample size of approximately 384 respondents. For practical reasons, 193 respondents were sampled, representing 40% of the target. This sample size is consistent with similar urban socio-economic studies in Nigeria and is considered adequate for meaningful statistical analysis (Krejcie & Morgan, 1970).

Sampling Procedure

A multi-stage sampling technique was employed. In the first stage, four communities – Angwan Rukuba, Rikkos, Ali-Kazaure, and Farin Gada – were purposively selected based on high urban growth and migrant concentration. In the second stage, systematic random sampling was used to select households within each community. In the third stage, stratified sampling ensured proportional representation of migrants (40%) and non-migrants (60%).

Questionnaire Design and Reliability

The structured questionnaire was divided into five parts covering personal information, migration status, current income status, factors behind migration, and impacts of migration. Questionnaire items were derived from established migration and urban studies literature.

A pilot survey was conducted with 10-20 households outside the study area to test clarity, consistency, and appropriateness of questionnaire items. Feedback from the pilot was used to refine the instrument before full-scale administration (Creswell & Creswell, 2018). Content validity was ensured through expert review by the supervisor and peers prior to field administration.

RESULTS

3.1 Land Use and Land Cover Dynamics

Table 2: Land Use and Land Cover in Jos (2015–2024)

Classification	2015 (Km²)	2015 (%)	2024 (Km²)	2024 (%)	Change (Km²)	Change (%)
Rock Outcrops	38.47	14.89	51.20	19.83	+12.73	+33.09%
Farm Land	81.89	31.72	68.96	26.71	-12.93	-15.79%
Vegetation	48.01	18.60	69.41	26.88	+21.40	+44.58%
Built Up	32.37	12.54	46.02	17.82	+13.65	+42.17%
Bare Ground	56.39	21.85	21.36	8.27	-35.03	-62.12%
Water Body	1.37	0.53	1.56	0.60	+0.19	+13.87%
Total	**258.18**	**100**	**258.18**	**100**		

Source: Author's Analysis, 2024

Key Finding: Built-up areas increased by 42.17% between 2015 and 2024, while vegetation cover surprisingly recovered by 44.58% during the same period.

Figure 2: Land Use and Land Cover Distribution Map (2015)

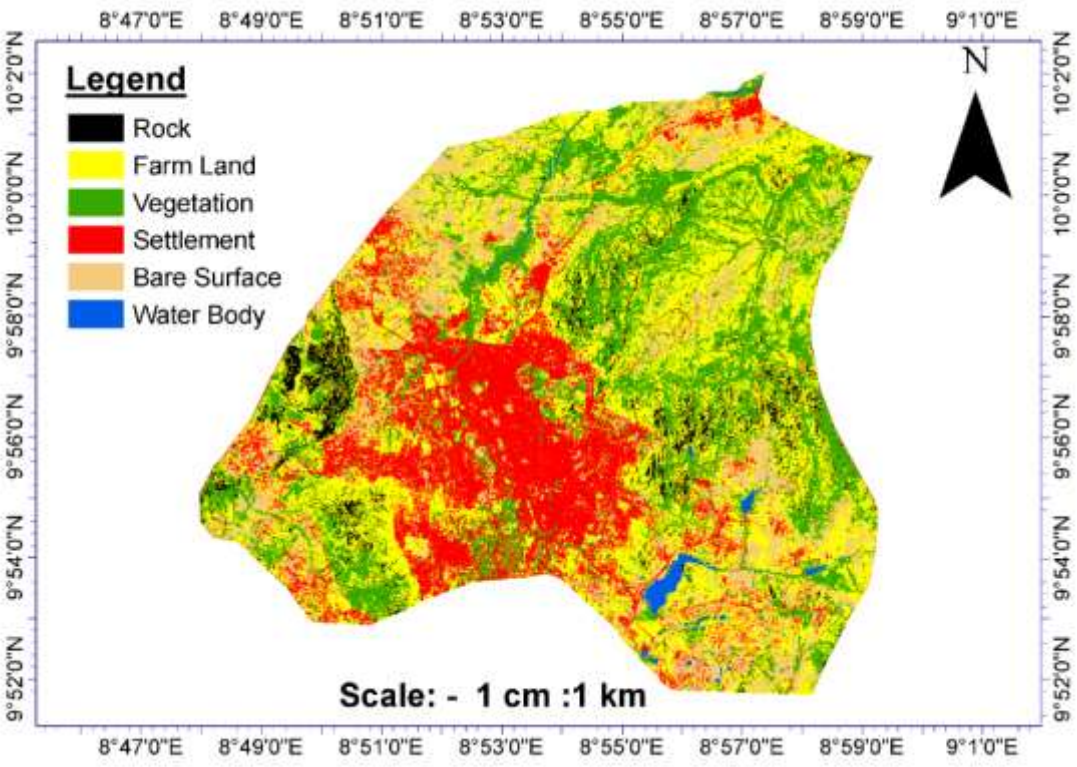
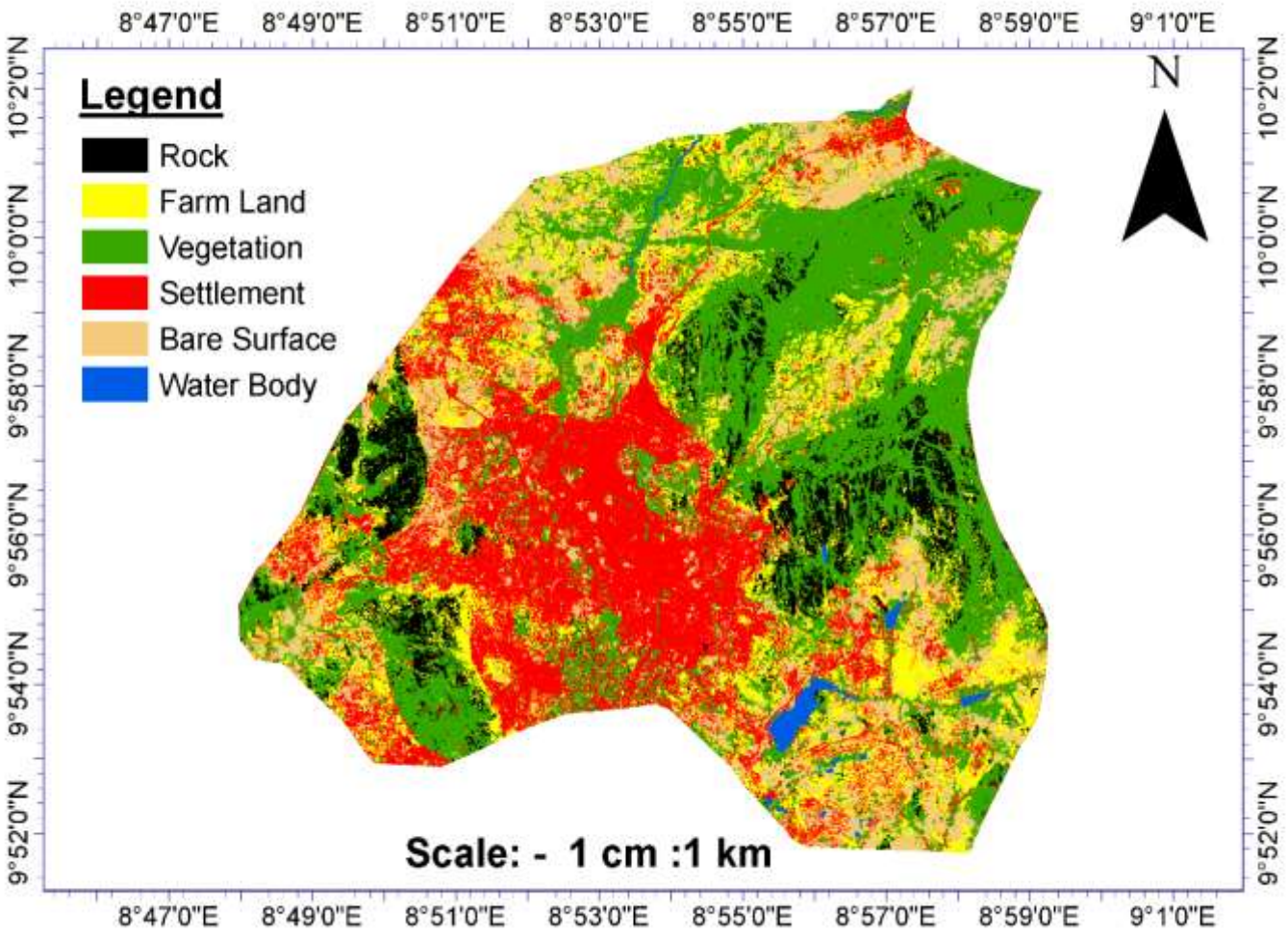


Figure 3: Land Use and Land Cover Distribution Map (2024)



3.2 Demographic Characteristics of Respondents

Table 3: Sample Composition

Community	Migrants	Non-Migrants	Total
Angwan Rukuba	50	34	84
Rikkos	36	43	79
Ali-Kazaure	15	15	30
Farin Gada	21	24	45
Total	**77 (40%)**	**116 (60%)**	**193**

Source: Author's Fieldwork, 2024

3.3 Migration Characteristics

Table 4: Duration of Stay and Reasons for Migration

Characteristic	Percentage
Duration of Stay	
Seasonal	45%
Temporary	40%
Permanent	15%
Reasons for Migration	
Inadequate job opportunities	75%
Insecurity	45%
Unavailability of land	35%
Opportunities for trading	30%
Socio-cultural ties	30%
Environmental/Climate factors	15%

Source: Author's Fieldwork, 2024

3.4 Environmental Consequences

Table 5: Environmental Challenges Reported

Environmental Challenge	Percentage
Deforestation	70%
Water scarcity	65%
Sanitation & Health depletion	55%
Soil erosion	50%
Flooding	45%
Pollution	35%

Source: Author's Fieldwork, 2024

Table 6: Land Competition and Degradation Perception

Perception	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Land Competition	45%	35%	15%	5%	0%
Land Degradation	40%	35%	15%	8%	2%

Source: Author's Fieldwork, 2024

3.5 Socio-Economic Outcomes

Table 7: Benefits of Migration (Migrants Only)

Benefit	Percentage
Financial enhancement	70%
More opportunities	65%
New jobs	55%
Skills development	50%
New social network	45%
Peace of mind/security	40%

Source: Author's Fieldwork, 2024

Table 8: Community Benefits and Challenges

Community Benefit	Percentage	Community Challenge	Percentage
Economic prosperity	60%	Environmental pressure	65%
Increased agricultural production	55%	Competition for jobs	60%
Market availability	50%	Land competition	55%
Menial job provision	45%	Land pressure for development	50%
Social network	40%	Insecurity	40%

Source: Author's Fieldwork, 2024

DISCUSSION

4.1 Migration as a Driver of Urban Growth

The findings confirm that migration is a primary driver of urban growth in Jos Metropolis, with 40% of respondents being current migrants. The dominance of economic factors (75% citing inadequate job opportunities) aligns with the push-pull model of migration (Lee, 1966) and earlier studies on Nigerian urbanisation (Akinyemi et al., 2014; Adepoju, 2018). The high proportion of seasonal migrants (45%) reflects Jos's historical role as a seasonal labour destination for migrants from northern states (Kano, Kaduna, Bauchi), consistent with patterns observed in other Sub-Saharan African secondary cities (Ginsburg et al., 2021; Anane & Anaafo, 2026).

The built-up area expansion (42.17% increase) is consistent with findings from other rapidly urbanising Nigerian cities. Studies in Abuja (Momoh et al., 2018) and Suleja (Buba et al., 2016) documented similar rates of urban expansion driven by migration and administrative functions. However, the built-up growth rate in Jos (42% over 9 years) is slightly lower than the 300% increase documented in Suleja between 1990-2015 (Buba et al., 2016), which may reflect Jos's more rugged terrain and historical constraints on urban expansion.

4.2 Environmental Consequences

The finding that deforestation is the most significant environmental challenge (70%) reflects the pressure that urban expansion and migrant populations place on forest resources through fuelwood demand, agricultural expansion, and urban development. This aligns with observations by Olagunju et al. (2021) in northern Nigeria and Agbonifo (2022) in the Niger Delta, where urban expansion has been linked to deforestation and habitat fragmentation.

Water scarcity (65%) indicates the strain on water resources from population growth. This pattern has been documented across Nigerian cities, with Kazeem (2020) noting groundwater depletion around growing urban centres in northern Nigeria. The high agreement on land competition (80%) and land degradation (75%) corroborates studies on urban expansion pressures in Nigerian cities (Adebimpe & Peters, 2018; Agbonifo, 2022).

4.3 The Paradox of Vegetation Recovery

One of the most notable and counterintuitive findings of this study is the vegetation recovery from 18.60% to 26.88% between 2015 and 2024. This finding requires careful interpretation and may be explained by several factors.

Land abandonment and regeneration – Economic decline in the mining sector may have led to land abandonment in some areas, allowing natural vegetation to regenerate. This pattern has been documented in post-industrial cities globally (Seto et al., 2012).

Reforestation and afforestation programs – State and local government initiatives may have contributed to vegetation recovery. Plateau State has implemented various environmental regeneration programs, including tree planting campaigns and watershed management initiatives.

Changes in agricultural practices – Shifts from extensive to more intensive agricultural practices may have reduced the land area under cultivation, allowing vegetation to recover on abandoned farmlands.

Urban greening initiatives – City greening programs, including park development and roadside planting, may have contributed to increased vegetation cover within the urban area.

Improved land management – Strengthened environmental governance and community-based natural resource management may have improved vegetation outcomes (Agbonifo, 2022).

Methodological considerations – The apparent vegetation recovery could partly reflect improved image resolution between 2015 (Landsat) and 2024 (Sentinel-2), with Sentinel-2's higher resolution capturing more vegetated patches.

This pattern suggests that environmental outcomes are not predetermined and can be influenced by governance interventions. Similar patterns have been observed in some Latin American and Asian cities where urban greening policies have reversed environmental degradation (Seto et al., 2012).

4.4 Socio-Economic Outcomes

Migration provides significant economic benefits to both migrants and host communities. Financial enhancement (70%) and economic prosperity (60%) confirm the positive economic contributions of migrants. This aligns with findings by Adedokun and Karzanova (2019) who demonstrated that migrants' remittances reduce household poverty and positively impact the national economy.

However, these benefits are accompanied by challenges including job competition (60%) and environmental pressure (65%). The higher unemployment rate among migrants (31%) reflects the difficulty of absorbing a growing labour force into Jos's formal economy. This is consistent with the Harris-Todaro model of urban unemployment (Harris & Todaro, 1970), which predicts that rural-urban migration can result in urban unemployment when formal sector job creation lags behind labour supply.

The socio-economic outcomes observed in Jos are comparable to findings from other Nigerian cities. Adekola et al. (2017) documented mixed outcomes in Ogun State, where urban renewal produced both economic benefits and social disruption. Roberts and Okanya (2022) found similar patterns in Lagos, where forced evictions exacerbated poverty and slum proliferation.

4.5 Comparative Analysis with Other African Cities

The findings of this study are consistent with broader patterns of migration-driven urban growth in Sub-Saharan Africa.

In Ghana, Anane and Anaafo (2026) documented "secondaryfication" and land use transitions in Ghana's secondary cities, observing similar patterns of peri-urban agricultural land conversion and environmental pressure. Studies on Nairobi's peri-urban areas (Ginsburg et al., 2021) have documented similar patterns of migration-driven expansion and the emergence of informal settlements, with migrants attracted to employment opportunities in the service sector. Research on Addis Ababa and its satellite towns has documented rapid urban expansion driven by migration, with similar environmental and socio-economic consequences (Aweda et al., 2024).

The Jos case demonstrates that while migration-driven urban growth is a continent-wide phenomenon, its consequences are shaped by local governance, economic structure, and historical context. The unexpected vegetation recovery in Jos is a departure from the generally negative environmental outcomes documented in many other African cities, suggesting that governance interventions can make a difference.

4.6 Policy Implications

The findings highlight the need for:

1. **Strengthened urban planning** to manage spatial expansion and land use conflicts
2. **Environmental management** addressing deforestation, water scarcity, and land degradation
3. **Labour market interventions** including skills development and job creation programs
4. **Migration governance** that addresses root causes of migration while managing its consequences
5. **Community participation** in planning and environmental management
6. **Green infrastructure investment** to sustain and enhance vegetation recovery

CONCLUSION

This study demonstrates that migration-driven urban growth in Jos Metropolis has produced significant environmental and socio-economic consequences between 2015 and 2024. Built-up areas expanded by 42.17%, while environmental challenges including deforestation (70%), water scarcity (65%), and land competition (80%) were widely reported by respondents.

However, the unexpected vegetation recovery (from 18.60% to 26.88%) suggests that environmental outcomes are not predetermined and can be influenced by governance interventions. This finding represents a departure from the generally negative environmental outcomes documented in many other African cities and underscores the potential for positive environmental outcomes through appropriate policy interventions.

The study contributes to the growing body of literature on African urbanisation by providing empirical evidence from a medium-sized Nigerian city. The mixed-methods approach integrating geospatial analysis with socio-economic surveys offers a comprehensive understanding of migration-urbanisation dynamics.

The findings underscore the need for integrated urban planning that addresses both environmental sustainability and socio-economic development. Specific recommendations include strengthened urban planning, environmental management addressing deforestation and water scarcity, labour market interventions including skills development and job creation, migration governance that addresses root causes while managing consequences, community participation in planning, and green infrastructure investment to sustain vegetation recovery.

Future research should investigate the drivers of vegetation recovery in Jos, conduct longitudinal studies to track ongoing changes, compare Jos with other Nigerian cities using similar methodologies, and examine the social dimensions of migration including implications for gender, education, and health.

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