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Research Article

Mineralized Urbanization and Socio-Spatial Dynamics in Extractive Hubs: Empirical Evidence from Oworo District, Kogi State, Nigeria

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ABSTRACT

Mining activities in rural landscapes of developing countries often catalyse profound socio-spatial transformations, yet the subjective dimensions of these changes, particularly residents' livability perceptions, remain inadequately understood. This study assesses rural transformation in Oworo District, Lokoja Local Government Area, Kogi State, Nigeria, examining the drivers of rural-urban transition and residents' perceptions of the benefits and challenges associated with mining activities. A mixed-methods approach was employed, integrating Geographic Information Systems (GIS) analysis of Landsat imagery, structured questionnaires administered to 381 respondents across eight communities, and Focus Group Discussions with community leaders. Results reveal significant rural-urban transition driven primarily by mining-induced economic opportunities (50%), population growth and migration (25%), and infrastructure development. The transition is characterised by built-up area expansion (48.1% increase from 2012-2022) and vegetation loss (−23.7%). While mining generated substantial employment (40% of respondents reported job creation) and income improvements (20%), it also precipitated loss of farmland and livelihoods (30%), environmental degradation (20%), and health problems (16%). Corporate Social Responsibility initiatives were perceived as limited and unevenly distributed. Overall, 75.0% of residents perceived an improvement in community livability, although perceptions were less favourable in Oworo West, the ward closest to the quarry and cement factory. The study contributes to the discourse on extractive-led development, demonstrating that mining-induced transformation creates a paradoxical landscape of economic opportunity and socio-environmental vulnerability. Policy recommendations emphasise integrated land-use planning, strengthened regulatory enforcement, equitable benefit-sharing mechanisms, and livelihood diversification to foster sustainable development that preserves livelihoods and environmental integrity.

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1 Introduction

Rural communities in developing nations, particularly in sub-Saharan Africa, are undergoing profound transformations driven by industrialisation, infrastructure development, and resource extraction activities (Bryceson et al., 2022; Bebbington et al., 2018). Mining, as a cornerstone of economic development in many mineral-rich countries, has emerged as a critical catalyst for these transformations. While mining contributes substantially to national revenues and local employment, it simultaneously generates intricate socio-spatial changes in land-use patterns, settlement structures, and environmental quality (Hilson et al., 2020; Sonter et al., 2020). These transformations fundamentally reshape community perceptions and residents' livability experiences, including their relationships with their environments (Masterson et al., 2017; Adams & Shriver, 2024).

Oworo District in Kogi State, Nigeria, exemplifies these dynamics. Historically agrarian with low population density and strong communal bonds, the district has experienced escalating mining activities, particularly limestone quarrying for cement production over recent decades. This has precipitated a gradual transformation from a predominantly rural environment to an increasingly urbanised landscape characterised by infrastructural development, commercial growth, and demographic diversification (Ogunleye et al., 2023; Esheya & Awolumate, 2025). These changes necessitate critical evaluation of their implications for residents' livability perceptions, community identity, and well-being.

The analysis of rural-urban transformation in mining host communities requires understanding multiple interconnected dimensions: land-use change, occupational restructuring, population dynamics, and access to social amenities (Tacoli et al., 2015; United Nations, 2019). Mining operations typically catalyse this transition through infrastructure development- roads, housing, and supporting services- that simultaneously improve economic opportunities while potentially disrupting traditional land uses like agriculture and fishing (Salami, 2021; Sonter et al., 2017). The scale of this

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transition fundamentally shapes community identity and residents' relationships with their environment.

Understanding the factors driving rural-urban transition is equally critical. Mining activities stimulate in-migration of people seeking employment and business opportunities, resulting in population growth, cultural diversification, and pressure on existing facilities (Udelsmann Rodrigues et al., 2021; Pretorius & Blaauw, 2023). Government policies, private sector investments, and improved accessibility further accelerate these changes. Environmental alterations, land degradation, deforestation, and modification of water bodies also influence settlement patterns and livelihoods, reinforcing the transition process (Eze et al., 2024; UNEP, 2019). Identifying these drivers is essential for understanding the forces behind change and formulating measures for sustainable development in mining areas.

However, mining activities generate complex challenges that can significantly erode residents' connection with their environment (Egan et al., 2024; Gidado et al., 2023). Environmental degradation, air and water pollution, soil erosion, and vegetation loss diminish the aesthetic and ecological value of landscapes (Bamigboye et al., 2020; UNEP, 2019). Social disruptions, displacement, loss of farmland, and conflicts between indigenous populations and migrant workers undermine community cohesion and cultural identity (Adonteng-Kissi et al., 2016). These adverse effects frequently lower residents' satisfaction with their living environment, as residents perceive their surroundings as impoverished or devalued, a concern closely related to the broader concept of sense of place (Chigbu, 2013; Masterson et al., 2017).

In the study area, mining activities have generated both environmental and social challenges- abandoned quarries, landform degradation, and loss of agricultural productivity- alongside opportunities for economic development and urbanisation (Mensah & Amoah, 2024; Jethro et al., 2018). The arrival of people and enterprises has stimulated economic growth and urbanisation, necessitating comprehensive evaluation that considers residents' experiences and perceptions of livability (Rajala et al., 2020; Zwiers et al., 2018). Livability is understood here as residents' perceived quality of everyday life in their community, shaped by economic opportunity, environmental conditions and access to services (Ruth & Franklin, 2014). This research addresses this imperative by assessing livability perceptions among rural mining communities, filling a critical gap in understanding the socio-spatial effects of mining and informing policy, planning, and stakeholders in rural development and environmental management.

Therefore, the transformation of rural communities under mining activities constitutes both an opportunity and a challenge, significantly affecting residents' livability perceptions (Okolo-Obasi & Uduji, 2023; Oladipo, 2023). Understanding these dynamics in the study area is essential for promoting sustainable development that maintains the socio-cultural and environmental integrity of host communities. This study provides a critical foundation for investigating mining-induced changes that transform human-environment relations and suggesting strategies that maximise positive impacts while minimising negative consequences. This paper addresses three linked research questions: (1) What are the principal drivers of rural–urban transformation associated with mining in Oworo District? (2) How do residents perceive the benefits and challenges of mining activities in their communities? (3) How do residents perceive the overall impact of mining on community livability? By combining household survey data, focus group discussions, and land-cover analysis, the study provides an integrated assessment of extractive urbanization in a West African cement-mining district and derives implications for planning and corporate–community relations.

2 Materials and Methods

2.1 Study Area

Oworo District is located in Lokoja Local Government Area, Kogi State, Nigeria, situated between latitudes 7.95°N and 8.40°N and longitudes 6.16°E and 6.54°E (Figure 1). The district is bounded to the north by Kogi LGA, to the south by Okehi, Adavi, and Ajaokuta LGAs, to the west by Kabba/Bunu LGA, and to the east by Koton-Karfe LGA. The district hosts several mining companies, most notably the Dangote Cement Industry, located at Obajana, one of the district's communities that has experienced significant transformation from a rural settlement to an industrial hub (Kogi State Government, 2020).

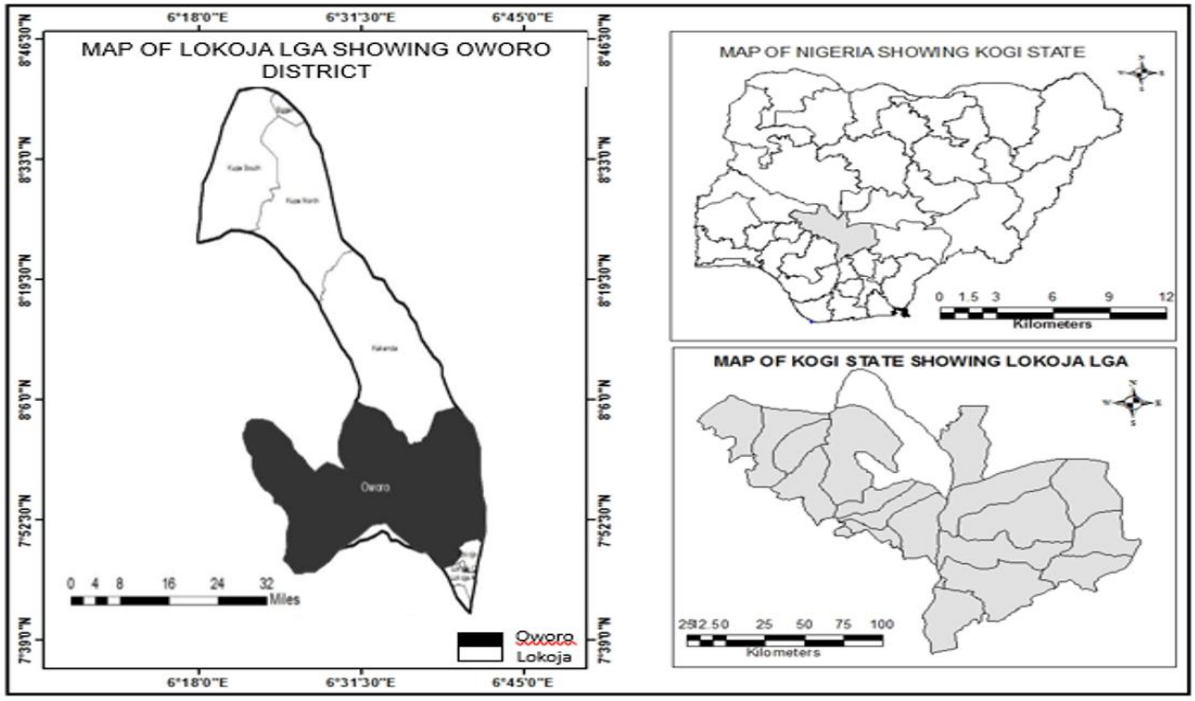


Figure 1: Map of Lokoja Local Government Area showing Oworo District, Kogi State, Nigeria
Source: GIS Laboratory, Department of Environmental Sciences, Fed. Uni. Dutse, 2025

The district experiences a tropical savanna climate with distinct wet and dry seasons, averaging approximately 1200 mm of rainfall annually (Agbo et al., 2023). The underlying geology comprises basement complex rocks, predominantly folded gneisses and metasediments, with significant limestone deposits that form the basis for quarrying activities (Afeni et al., 2008). The terrain is characterised by rugged quartzite ridges rising to approximately 100 metres above lowlands, drained primarily by Rivers Mimi and Oinyi.

2.2 Research Design

This study adopted a mixed-methods research design, combining quantitative and qualitative approaches to achieve a comprehensive understanding of mining-induced rural transformation (Creswell & Creswell, 2017). The design integrated three complementary data collection strategies: Geographic Information Systems (GIS) analysis of land-use/land-cover change, structured questionnaire administration, and Focus Group Discussions (FGDs). The analytical procedure for each strand is presented separately under Data Analysis.

2.3 Population and Sampling

The study population comprised residents of the forty-eight (48) existing communities in Oworo District. A multi-stage sampling procedure was employed to ensure representativeness: The three political wards of Oworo District are Oworo East, Oworo Central, and Oworo West; all were treated as strata following principles of stratified sampling to ensure proportional representation (Taherdoost, 2016; Etikan & Bala, 2017). Six communities were randomly selected from the sampling frame using the lottery method of simple random sampling, ensuring equal probability of selection (Elfil & Negida, 2017; Nwana, 2012). Two additional communities, such as Oyoo (hosting the limestone quarry) and Obajana (hosting the cement factory) were purposively selected due to their special relevance to the research objectives (Patton, 2015; Tongco, 2007), bringing the total sampled communities to eight (Table **1**). Sample size per community was determined using proportional allocation (Cochran, 1977; Singh & Masuku, 2014), calculated as:

$$Sample\ Size = \left(\frac{Community\ Population}{Total\ Population\ of\ Sampled\ Communities}\right) \times Total\ Questionnaire\ Sample$$

Table 1: Questionnaire Administration by Community

S/N	Community	Ward	Population	Sample Size
1	Agbaja	Oworo Central	4,744	36
2	Felele	Oworo Central	21,780	164
3	Oyoo	Oworo West	3,227	24
4	Obajana	Oworo West	14,350	108
5	Jakura	Oworo West	1,083	8
6	Oshokoshoko	Oworo West	2,363	18
7	Akpayan	Oworo East	1,448	11
8	Owara	Oworo East	1,600	12
Total			**50,595**	**381**

2.4 Data Collection Methods

Structured questionnaires were administered to 381 respondents across the eight sampled communities using the KoBoCollect mobile application for efficient data collection. Questionnaires captured demographic characteristics, perceptions of rural-urban transition, identification of drivers of change, and assessment of benefits and challenges. Focus Group Discussions were conducted with community leaders and the council of chiefs (eight groups, 6–10 participants each) to gather qualitative insights into historical changes and community experiences (Krueger & Casey, 2015). Landsat satellite imagery for 1992, 2002, 2012, and 2022 (USGS archives) was acquired for land-use/land-cover analysis. Secondary data on cultural heritage were obtained from the Lokoja Local Government Area Department of Arts and Culture.

2.5 Data Analysis

2.5.1 Land-Use/Land-Cover Analysis

A multi-temporal Landsat satellite time series (1992, 2002, 2012, and 2022) was analysed for land-use/land-cover (LULC) change using supervised classification (maximum likelihood algorithm) in ArcGIS 10.8. The five land cover classes identified and mapped were: (1) Built-up Area, (2) Vegetation, (3) Agricultural Land, (4) Water Bodies, and (5) Quarry/Mining Sites. The training samples were selected using visual interpretation of high-resolution imagery and local knowledge of the study area. The magnitude of spatial transformation over the 30-year study period was quantified using change detection analysis. The study's methodological limitations include the lack of formal accuracy assessment (error matrix, overall accuracy, and Kappa coefficient) of the classified images.

2.5.2 Quantitative Analysis

Descriptive statistics (frequencies, percentages) and inferential statistics (Chi-square tests) were used to analyse perceived drivers and their association with community characteristics. Frequency distribution and percentages were used to analyze perceived benefits and challenges and then presented using pie charts and bar charts for visualization. The CSR performance assessment was carried out using Vintró's (2010) framework, which includes sustainability, ethics, and human resources aspects of CSR (Table 2). The Analytic Hierarchy Process matrix (AHP), consistency ratios, and expert weighting bases were not produced; therefore, simple ranking of frequencies was used to conduct ranked analysis of the socioeconomic benefits.

Table 2: Corporate Social Responsibility Assessment Framework

S/N	Sustainability	Ethics	Human Resources
1	Rational Exploitation of Natural Resources	Promotion of Local Community Economy	Secure Working Methods
2	Clean Extraction Technologies	Fair Funds Administration	Training and Capacity Development
3	Mine Closure and Recovery Program	Job Security and Dignity	Employee-Manager Relations
4	Emergency Management	Quality of Production	Respect for People

Source: Adapted from Vintró (2010)

2.5.3 Qualitative Analysis

Qualitative data were analysed using thematic analysis (TA) in NVivo 14 software, as guided by Braun and Clarke (2006), using six phases of analysis. The six phases were as follows: (1) familiarisation with the data; (2) generating initial codes across the entire data; (3) searching for themes by collating codes into themes; (4) reviewing themes against coded extracts and against full data; (5) defining and naming themes to define the specifics of each theme; and (6) producing the report by selecting vivid extract examples and relating analysis back to research questions and literature.

2.5.4 Statistical Analysis

All data were analyzed by SPSS 27.0 software and R software 4.3.1. The respondent characteristics were summarised using descriptive statistics. Chi-square tests

at α = 0.05 were used to assess relationships among demographic variables and perceptions of transformation. Wilcoxon signed-rank tests were used to compare the perceived benefits and challenges. Data were presented in frequency tables, charts, and inferential statistics.

2.6 Ethical Considerations

The study was approved by the Federal University Dutse Research Ethics Committee. All participants gave informed consent; anonymity and confidentiality were ensured (Resnik, 2020). The involvement was voluntary, and respondents were advised that they could opt out at any time.

3 Results

3.1 Demographic and Socio-Economic Characteristics of Respondents

A total of 381 valid questionnaires were analysed. Table 3 presents the demographic and socio-economic characteristics of respondents. The demographic profile reveals a predominantly male sample (56.8%), reflecting both the male-dominated nature of mining employment and greater accessibility of male respondents for research purposes (Onwuka et al., 2018). However, substantial female representation (43.2%) affirms women's growing presence in mining-related economic activities (Seamon, 2015). The majority of respondents (71.9%) were within the economically active age bracket (31–55 years), indicating that mining's socioeconomic impacts predominantly affect the productive population (Cattaneo et al., 2019).

Table 3: Demographic and Socio-Economic Characteristics of Respondents

Variable	Category	Frequency	Percent
Gender	Male	216	56.8
	Female	165	43.2
	Total	**381**	**100.0**
Age Group	18–30 years	30	7.9
	31–40 years	152	39.9
	41–55 years	122	32.0
	Above 55 years	77	20.2
	Total	**381**	**100.0**
Education Level	No Formal Education	53	13.9
	Primary	84	22.0
	Secondary	122	32.0
	Tertiary	122	32.0
	Total	**381**	**100.0**
Occupation	Trading	145	38.1
	Mining	122	32.0
	Civil Service	84	22.0
	Farming	19	5.0
	Others	11	2.9
	Total	**381**	**100.0**
Length of Residency	<10 Years	84	22.0
	10–20 Years	145	38.0
	21–30 Years	99	26.0
	>30 Years	53	13.9
	Total	**381**	**100.0**

Educational attainment was distributed across all levels, with respondents aged 26 - 35 years recording the highest tertiary education attainment, reflecting increased educational opportunities linked to urban expansion. This generational disparity is characteristic of rapidly urbanising regions where educational infrastructure expands unevenly over time (UNESCO, 2021; NBS, 2022). Occupational distribution reveals a significant departure

from traditional agrarian livelihoods. Trading (38.1%) and mining (32.0%) emerged as dominant occupations, while farming, historically the primary rural livelihood, constituted only 5.0% of respondents. This represents a fundamental restructuring of the local economy, consistent with extractive-led transformation observed in other mineral-rich regions (Hilson et al., 2020; Bryceson et al., 2022).

3.2 Spatial and Land-Use Transformation

The land-use/land-cover changes in Oworo District from 1992 to 2022 reveal significant spatial transformation associated with mining activities (Table 4, Figure 2). The analysis reveals a dramatic expansion of built-up areas (238.5%; 1,245 ha in 1992 to 4,213 ha in 2022) over the three-decade period, of which 48.1% (2,845 ha to 4,213 ha) occurred between 2012 and 2022. Decadal growth was similar across the study period: 52.3% (1992–2002), 50.1% (2002–2012) and 48.1% (2012–2022). This expansion was accompanied by substantial declines in vegetation (−23.7%), agricultural land (−30.0%), and water bodies (−21.9%). Quarry and mining sites exhibited the most pronounced growth (+954.1%), reflecting intensification of mining activities, particularly limestone extraction for the Dangote Cement factory.

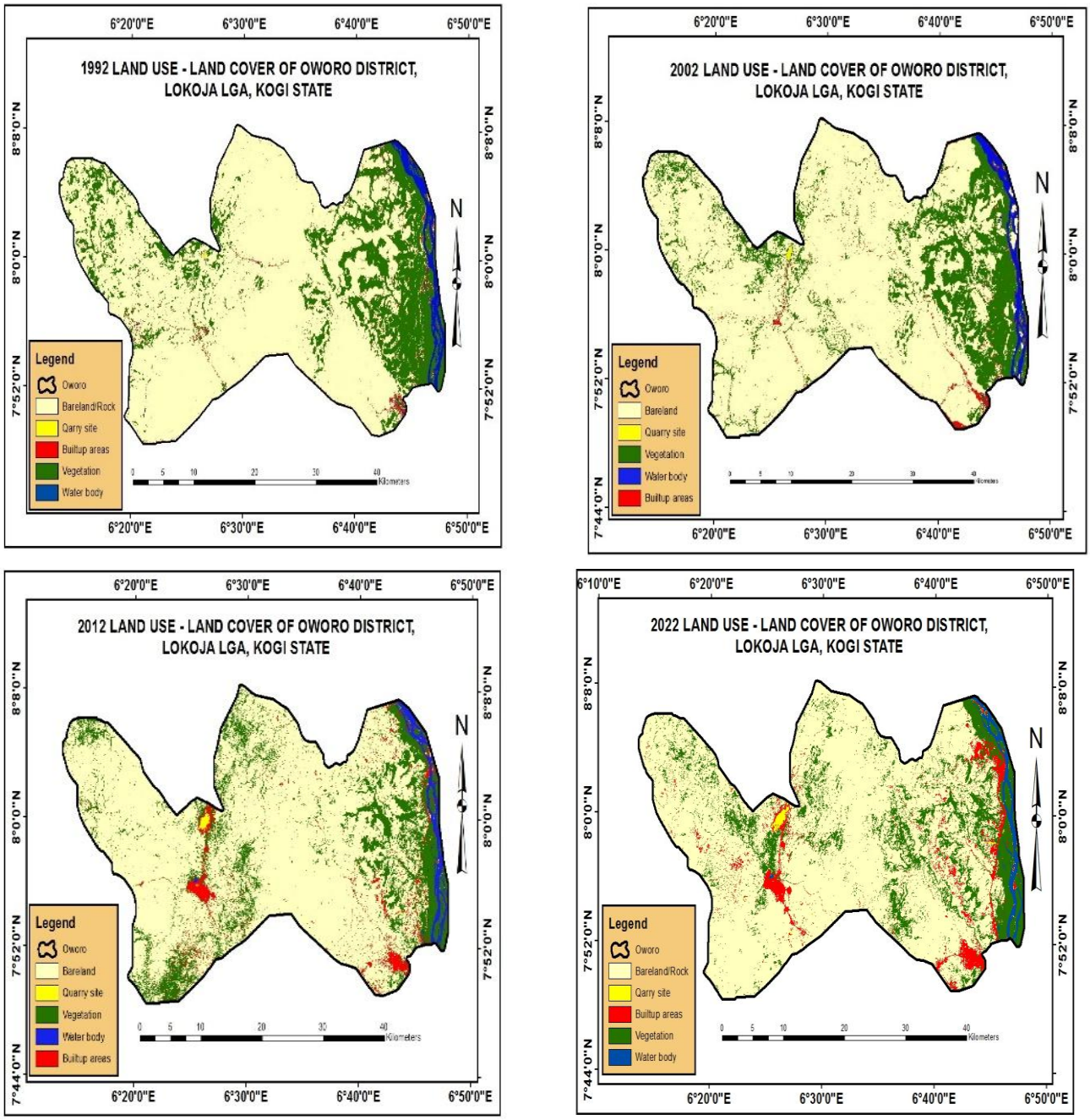


Figure 2: Land-Use/Land-Cover Change in Oworo District (1992–2022)

Table 4: Land-Use/Land-Cover Change Dynamics in Oworo District (1992–2022)

Land Cover Class	1992 (ha)	2002 (ha)	2012 (ha)	2022 (ha)	Change (1992–2022)
Built-up Area	1,245	1,896	2,845	4,213	+238.5%
Vegetation	8,942	8,234	7,456	6,824	−23.7%
Agricultural Land	6,523	6,012	5,234	4,567	−30.0%
Water Bodies	342	318	289	267	−21.9%
Quarry/Mining Sites	85	234	512	896	+954.1%

Spatial analysis revealed a linear development pattern following major transport corridors, interspersed with nodal development around mining sites and processing facilities. This pattern indicates unplanned, market-driven urbanisation characteristic of mineralized urbanisation documented in other African contexts (Bryceson et al., 2022; Hilson & McQuilken, 2018). The expansion of built-up areas has been most pronounced in communities proximate to mining activities, including Obajana and Oyoo (Oworo West ward), while more distant communities (e.g., Akpayan, Owara in Oworo East) exhibited slower transformation.

The pace of built-up expansion in Oworo District is comparable to that reported for other Nigerian urban centres. In Jos Metropolis, built-up land increased from about 3,494 ha in 1999 to about 16,995 ha in 2022, an increase of roughly 386% (Shehu et al., 2023), while in Lokoja Metropolis urban land cover expanded from 6,668 ha in 2000 to 15,985 ha in 2024, about 140% (John-Nwagwu et al., 2025). Earlier work in Lokoja likewise documented tremendous built-up expansion at the expense of vegetation, wetlands and water bodies between 1986 and 2007 (Adeoye, 2012). Expressed as compound annual growth calculated from the reported areas, Oworo District's built-up area grew by about 4.1% per year, compared with about 7.1% in Jos and 3.7% in Lokoja. Oworo's growth is therefore faster than that of the state capital but slower than that of Jos, even though Oworo is a rural district whose growth is anchored on a single industrial node rather than on a large administrative or commercial centre. Its distinguishing feature is the mining signature, with quarry sites expanding almost tenfold alongside built-up land. A similar mining-linked conversion of land cover has been reported in the gold-mining enclaves of Zamfara State, where bare ground, built-up and rock-outcrop classes expanded as mining intensified (Ado et al., 2022).

3.3 Drivers of Rural-Urban Transition

3.3.1 Observed Population Change

The overwhelming majority (87.9%) of respondents, as presented in Figure 3, perceived population increase, indicating active rural-urban transition driven by migration in search of economic opportunities (United Nations, 2019; Tacoli et al., 2015). This pattern aligns with the push-pull migration framework, where limited rural livelihoods push residents outward while urban economic prospects pull migrants inward (Todaro & Smith, 2020).

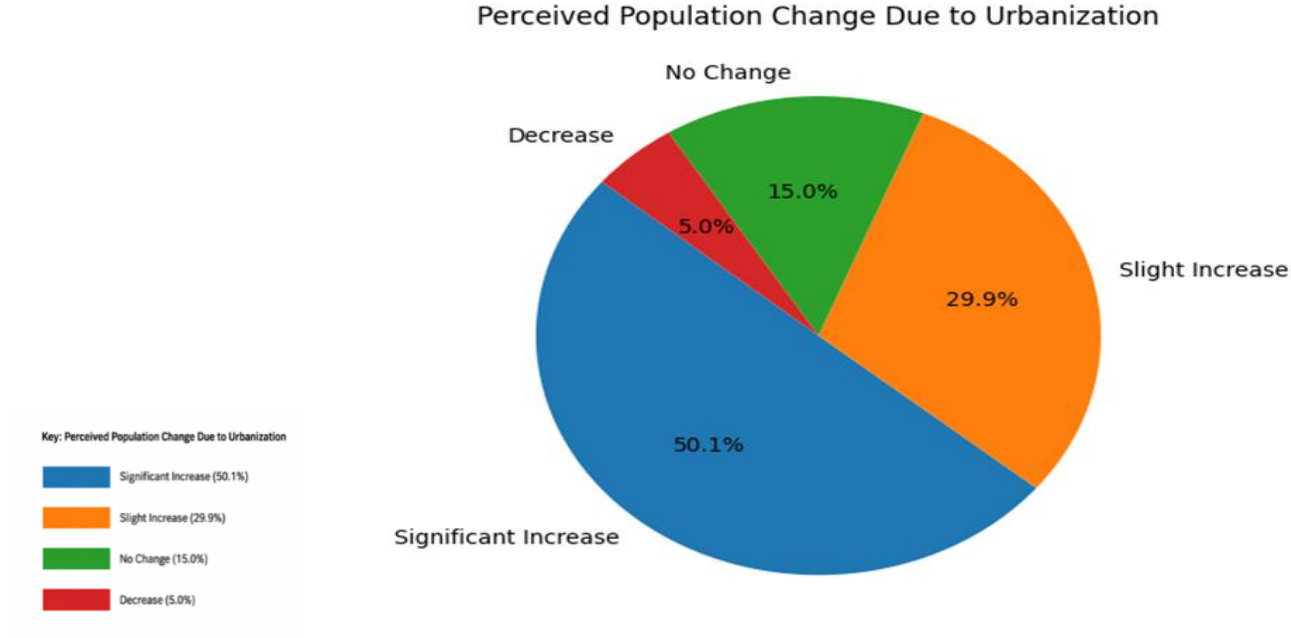


Figure 3: Perceived Population Change in Oworo District Mining Communities

The findings demonstrate that Oworo District has undergone significant rural-urban transition driven primarily by mining and associated economic opportunities. This transformation reflects a pattern of "mineralised urbanisation" documented across sub-Saharan Africa, where extraction leads to migration, service diversification, and semi-urban spaces in rural administrative contexts (Bryceson et al., 2022; Lahiri-Dutt, 2018). The 238.5% expansion of built-up areas over three decades, alongside 954.1% growth in quarry sites, confirms the intensity of this transformation.

This extractive-led urbanisation, however, raises important concerns about sustainability and governance. The linear and nodal development pattern following transport corridors and concentrating around mining sites indicates unplanned growth without adequate infrastructure or service provision (UN-Habitat, 2020; Haikola & Anshelm, 2018). The imbalance between economic and social infrastructure development suggests that urbanisation in Oworo District is primarily market-oriented rather than state-mediated, with limited regulatory oversight (Kinyondo & Huggins, 2019; Udelsmann Rodrigues et al., 2021). These findings corroborate global evidence that mining-induced urbanisation often creates "boomtown" dynamics: rapid population growth, housing shortages, rising costs of living, and strained social services that can undermine long-term community well-being (Pretorius & Blaauw, 2023; Tacoli et al., 2015). The demographic pressure from in-migration (87.9% reporting population increase) has intensified these challenges, particularly in communities proximate to mining operations.

3.3.2 Mining Activities and In-Migration

Employment and business opportunities (64.1%) emerged (Table 5) as the primary drivers of in-migration, confirming mining's role as a demographic catalyst (Collier, 2017; Bryceson et al., 2022). Respondents highlighted the multiplier effect of mining operations, where direct employment in mining and quarrying generates secondary opportunities in trade, housing, transportation, and services (World Bank, 2018; Bartrem et al., 2022).

Table 5: Reasons for In-Migration to Mining Communities

Reason for Migration	Frequency	Percent
Employment/Jobs	145	38.1
Business/Trading Opportunities	99	26.0
Access to Services/Infrastructure	61	16.0
Education	38	10.0
Family/Other Reasons	38	10.0
Total	**381**	**100.0**

3.3.3 Infrastructural Development

Roads and transportation infrastructure constituted the most reported development (34.9%), as presented in Figure 4, which highlights the extractive industries' emphasis on transport corridors that facilitate mineral extraction and market access (Haikola & Anshelm, 2018; Hilson et al., 2020).

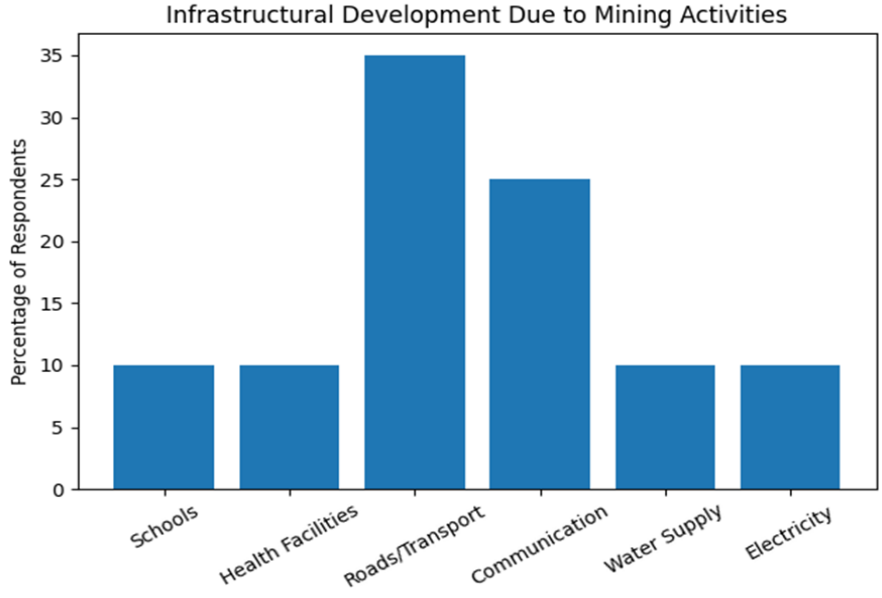


Figure 4: Infrastructure Development Attributed to Mining Activities

Communication networks (24.9%) were the second most cited, reflecting the importance of connectivity in mining operations. However, the relatively low percentages for social infrastructure- schools (10%), healthcare (10%), and water supply (10%) indicate uneven development, where economic infrastructure advances more rapidly than social services. This imbalance can intensify urban vulnerability and strain community resilience if population growth is not matched with adequate service provision (UN-Habitat, 2020; World Bank, 2021).

3.3.4 Key Drivers of Rural-Urban Transition

Mining and economic opportunities emerged as the dominant driver of urbanisation (50.1%), confirming that urban growth (Figure 5) in the study area is largely resource-driven (Collier, 2017; World Bank, 2018). This extractive-led development model creates direct employment while stimulating secondary economic activities, thereby reinforcing urban growth dynamics (Bryceson et al., 2022). The comparatively smaller contribution of government policies/investment (10%) and private sector investment (5%) indicates that urbanisation is shaped more by market-driven forces than by planned urban development, raising concerns about informal settlement growth and weak urban governance (UN-Habitat, 2020; Kinyondo & Huggins, 2019).

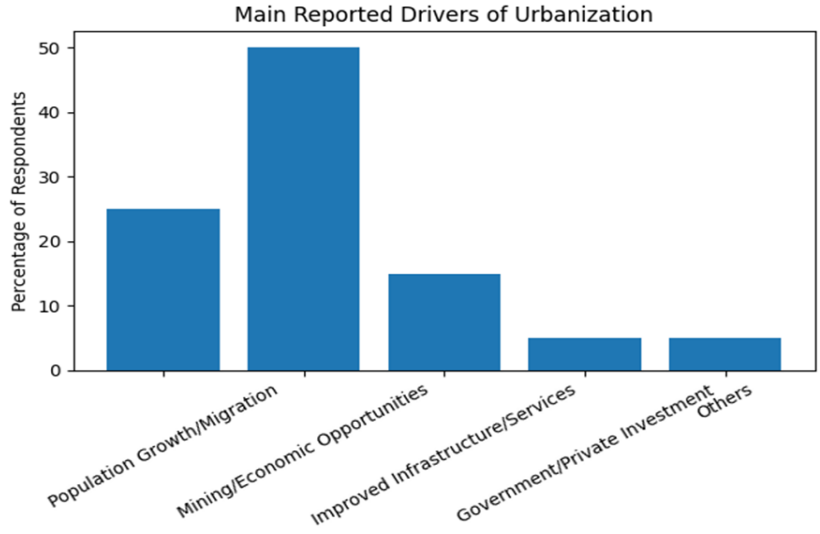


Figure 5: Drivers of Rural-Urban Transition in Mining Communities

A Chi-square test revealed a significant association between respondents' occupational status and their perception of urban transformation drivers ($\chi^2 = 28.45$, df = 8, $p < 0.001$). Mining workers were more likely to attribute transformation to mining and economic opportunities (OR = 2.34, 95% CI: 1.62–3.38), while farmers were more likely to identify negative impacts such as loss of farmland and environmental degradation.

3.4 Benefits and Challenges of Mining Activities

3.4.1 Perceived Socio-Economic Benefits

Job creation and employment (39.9%) emerged as the most frequently reported benefit (Figure 6), highlighting mining's labour-absorptive nature, particularly in rural regions with limited employment alternatives (Hilson et al., 2020; World Bank, 2018). Income improvement (19.9%) and growth of local businesses (19.9%) were also prominently identified, indicating that mining generates multiplier effects extending beyond direct employment (Hilson & McQuilken, 2018; Lahiri-Dutt, 2018).

The study confirms that mining generates substantial economic benefits, particularly through employment, income improvement, and business growth. Job creation (39.9%) and income enhancement (19.9%) support the labour-absorptive and multiplier effects documented in extractive economies globally (Hilson et al., 2020; World Bank, 2018). These benefits have attracted migrants and stimulated local commercial activity, contributing to urban growth and economic diversification.

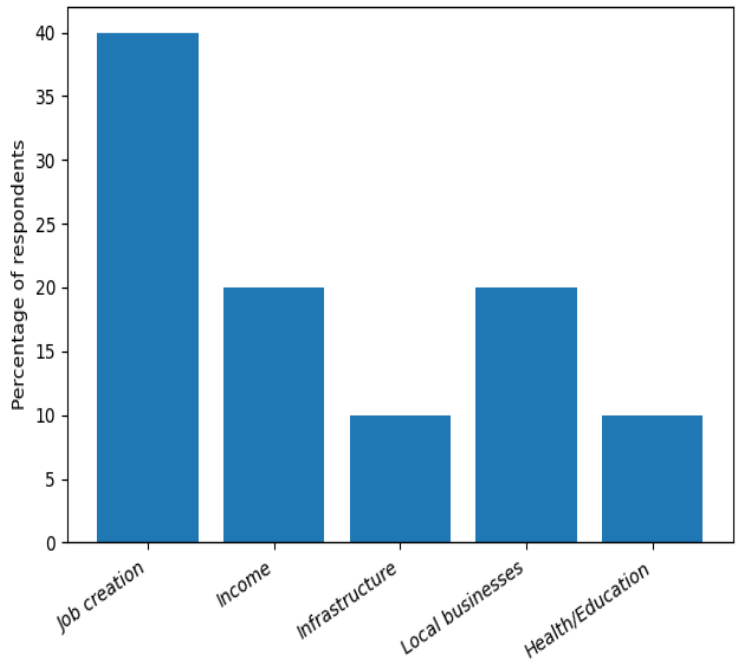


Figure 6: Socio-Economic Benefits of Mining Activities

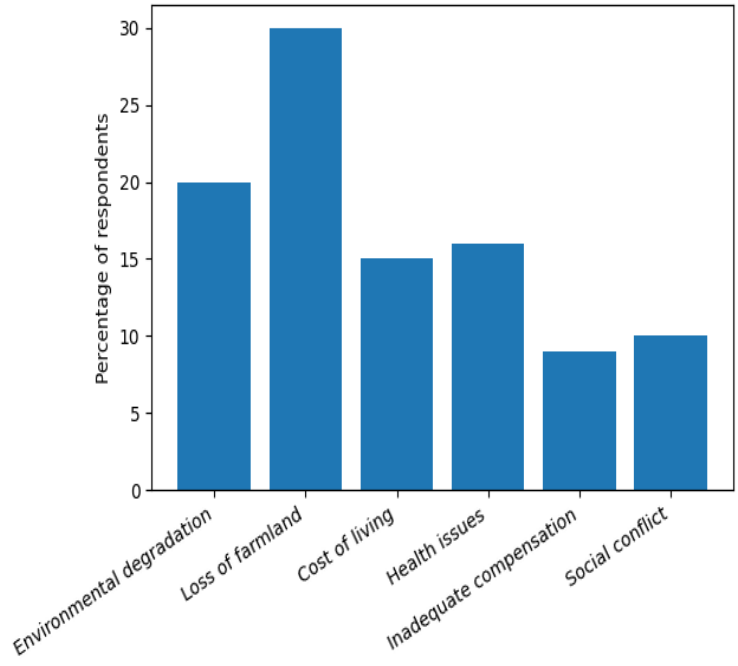


Figure 7: Challenges Associated with Mining Activities

However, CSR investments in social infrastructure, healthcare, and educational improvements (10.2%) and infrastructure development (10.0%) were comparatively limited. This imbalance suggests that while mining contributes substantially to private economic gains, its contribution to public goods and human development is relatively weak (Idemudia, 2014; UNEP, 2019). The result negates the World Bank's (2021) expectation that mining companies should contribute to sustainable community development and ensure equitable benefit-sharing with host communities (Habib et al., 2024).

Based on a simple ranking of the percentage of respondents citing each benefit, the benefits ranked as follows: job creation and employment (39.9%, 1st); improved personal income and growth of local businesses (19.9% each, joint 2nd); healthcare and educational improvements (10.2%, 4th); and infrastructure development (10.0%, 5th). This ranking reveals a strong emphasis on direct economic benefits, while CSR-related social investments occupy lower positions, suggesting insufficient or inadequately aligned CSR initiatives (UNDP, 2021; Vintró, 2010).

However, the distribution of these benefits is highly unequal. The statistical analysis reveals that mining employees perceive benefits outweighing challenges, while non-employees perceive the opposite, confirming the "enclave" nature of extractive development (Bebbington et al., 2018; Idemudia, 2014). Those directly employed in the sector capture the majority of economic benefits, while broader community members bear the environmental and social costs. This pattern is characteristic of resource-dependent regions where extractive industries operate as economic enclaves with limited linkages to the broader local economy (Collier, 2017; Hilson et al., 2020).

The limited CSR implementation (Vintró, 2010) further compounds these inequalities. The weak provision of social infrastructure (healthcare, education, water supply) and inadequate environmental rehabilitation indicate that CSR initiatives remain insufficiently aligned with community needs (UNDP, 2021; NEITI, 2021). This aligns with critiques of CSR in extractive industries, which often emphasise philanthropy rather than transformative, participatory development (Idemudia, 2014; Habib et al., 2024).

3.4.2 Major Challenges Experienced by Communities

Loss of farmland and livelihoods (29.9%) emerged as the greatest challenge (Figure 7), highlighting the conflict between extractive land use and traditional agrarian livelihoods that form the economic foundation of rural populations (Adonteng-Kissi et al., 2016; Bebbington et al., 2018). Environmental degradation (19.9%) and health problems (16.0%) ranked next, with respiratory and skin conditions associated with pollution exposure. The high correlation between environmental degradation and health problems ($r = 0.74$, $p < 0.001$) confirms the interconnected nature of environmental and health impacts (UNEP, 2019; UN-Habitat, 2020).

Higher cost of living (15%) emerged due to in-migration and inflation from mining economies, while inadequate compensation (9.2%) reflects weak governance and accountability in benefit-sharing systems (NEITI, 2021; Kogi State Government, 2020). Social conflict and insecurity (10%) were particularly pronounced in communities with recent in-migration, aligning with studies of migrant-host tensions in resource frontiers (Adebayo & Okafor, 2022; Yusuf et al., 2021). A Wilcoxon signed-rank test revealed that perceived challenges (Mean Rank = 4.72) significantly outweighed perceived benefits (Mean Rank = 3.15) among respondents not directly employed in mining ($Z = -5.23$, $p < 0.001$). Conversely, mining employees perceived benefits as outweighing challenges ($Z = -3.41$, $p = 0.001$), confirming the unequal distribution of mining's costs and benefits (Bebbington et al., 2018; Mbachu, 2025).

The challenges documented in this study loss of farmland (29.9%), environmental degradation (19.9%), and health problems (16.0%) highlight the high socio-environmental costs of mining. The loss of agricultural land and livelihoods is particularly consequential, as it undermines the traditional economic foundation of rural communities and creates dependence on an inherently volatile sector (Adonteng-Kissi et al., 2016; Sonter et al., 2020).

Environmental degradation- air and water pollution, soil erosion, and vegetation loss has far-reaching implications for both ecological integrity and human well-being (UNEP, 2019; Bamigboye et al., 2020). The strong correlation between environmental degradation and health problems ($r = 0.74$) underscores the direct health consequences of environmental pollution, including respiratory and skin conditions. This observation aligns with literature on mining-related pollution and population health vulnerability (UNEP, 2019; Egan et al., 2024).

Social challenges- higher cost of living, social conflict, and inadequate compensation- reflect the governance deficits characteristic of resource extraction in weak regulatory environments (NEITI, 2021; World Bank, 2022). The influx of migrants, displacement of traditional livelihoods, and uneven distribution of benefits have contributed to social tensions and community fragmentation (Udelsmann Rodrigues et al., 2021; Yusuf et al., 2021). These social disruptions, combined with environmental degradation, fundamentally reshape residents' relationships with their environment and are likely to lower their perceived livability (Masterson et al., 2017; Adams & Shriver, 2024).

3.4.3 Corporate Social Responsibility Assessment

Assessment of CSR implementation revealed limited and uneven application. Based on the Vintró (2010) framework, rational exploitation of natural resources was not observed due to significant environmental degradation. Clean extraction technologies were inadequately implemented, evidenced by pollution and land degradation. Promotion of the local community economy and creation of jobs recorded fairly encouraging scores, but fair funds administration and job security were limited. Training and capacity development received fair scores, but employee-manager relations and respect for people were variable. This limited CSR implementation may have weakened residents' perceived livability, as environmental quality degradation, livelihood insecurity, and inadequate social investments reduce satisfaction with the living environment. This link is inferential, because livability and place-related attachment were not measured with a dedicated scale (see Limitations of the Study) (Masterson et al., 2017; Chigbu, 2013; Adams &

Shriver, 2024).

3.4.4 Overall Impact on Community Livability

Mixed perceptions emerged, with 75.0% (Figure 8) reporting improvement (greatly improved: 29.9%; slightly improved: 45.1%) while 25.0% indicated no change or deterioration. This dualistic perception reflects the unequal distribution of mining's benefits and costs: economic opportunities for some, environmental degradation and livelihood loss for others (Bebbington et al., 2018; Ernstson & Swyngedouw, 2019). The comparatively large proportion reporting only slight improvement suggests that perceived benefits remain fragile rather than transformative.

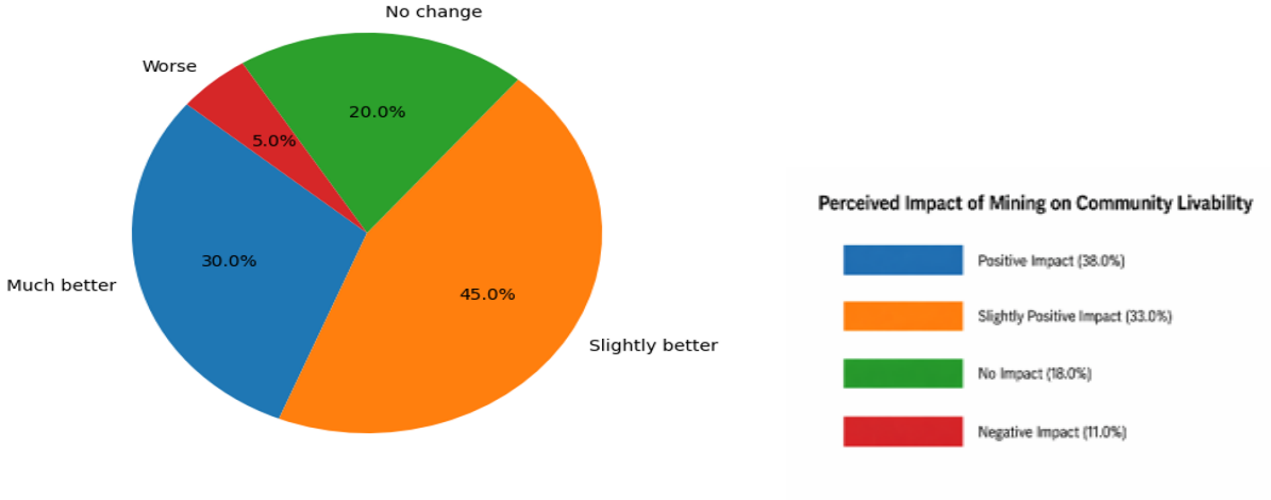


Figure 8: Perceived Impact of Mining on Community Livability

Community location significantly influenced livability perceptions. Respondents in Oworo West (proximal to the quarry and factory) were more likely to report negative impacts (χ^2 = 12.34, df = 2, $p < 0.01$), while residents in Oworo East and Oworo Central (more distant) reported either positive or neutral perceptions. This spatial gradient confirms that mining's impacts are concentrated in proximate communities, while benefits (particularly employment) are more widely distributed (Bartrem et al., 2022; Pretorius & Blaauw, 2023).

4 Implications for Livability and Sustainable Development

The findings have important implications for livability, understood here as residents' perceived quality of everyday life (Ruth & Franklin, 2014). The mixed perceptions of community livability (45.1% slight improvement, 29.9% great improvement, 25.0% no change or deterioration) reflect the contradictory nature of mining's impacts: economic benefits for some, environmental losses and social disruption for others. The erosion of agricultural livelihoods, environmental degradation, and social conflict are likely to lower residents' satisfaction with their living environment and may weaken their attachment to their communities (Rajala et al., 2020; Zwiers et al., 2018). Because attachment and identity were not directly measured in this study, this interpretation remains tentative and should be tested in future work using validated sense-of-place scales. Where residents perceive their communities as environmentally degraded and socially fragmented, their satisfaction with local conditions is likely to decline (Adams & Shriver, 2024; Gidado et al., 2023).

Conversely, the economic improvements reported by some residents, particularly those employed in mining, may enhance perceived livability, such as satisfaction with income and material well-being (Seamon, 2015; Oladipo, 2023). This dualistic dynamic highlights the complexity of assessing livability in contexts of rapid transformation, where communities simultaneously experience gains and losses (Masterson et al., 2017; Egan et al., 2024). Achieving sustainable development in this context requires addressing the structural imbalances identified in this study: integrating economic development with environmental restoration, ensuring equitable benefit-sharing, strengthening regulatory enforcement, and promoting livelihood diversification (World Bank, 2022; UNDP, 2021). Without such integration, mining-induced transformation risks creating vulnerable urban structures and livelihoods vulnerable to economic and environmental shocks (UN-Habitat, 2020; Sonter et al., 2020).

4.1 Limitations of the Study

First, the LULC maps were not subjected to a formal accuracy assessment (error matrix, overall accuracy and kappa coefficient), so the area estimates in Table 4 should be interpreted with caution (Congalton, 1991; Foody, 2002). Second, livability was assessed through residents' self-reported perceptions rather than a composite

livability index or a validated sense-of-place scale, so links between mining, livability and place attachment are inferential. Third, perceived benefits were ranked by response frequency and were not weighted by respondent or expert judgement. Future studies should include accuracy assessment, validated multi-item livability and place-attachment scales, and multi-criteria ranking methods with documented consistency checks.

5 Conclusion

Based on the findings from the study, the research demonstrates that mining has become the dominant process shaping the physical, socio-economic, and environmental landscape of the district. The key drivers of rural-urban transition identified include mining and economic opportunities (50.1%), population growth and migration (24.9%), and infrastructure development, particularly roads and transportation (34.9%). These drivers have catalysed significant spatial transformation, including a 238.5% expansion of built-up areas (48.1% between 2012 and 2022) and 954.1% growth of quarry sites over three decades, alongside substantial losses in vegetation (−23.7%) and agricultural land (−30.0%). This transformation exemplifies "mineralised urbanisation" — extractive-led development that generates semi-urban spaces without commensurate infrastructure and governance capacity. The benefits of mining are primarily economic: employment generation (39.9%), income improvement (19.9%), and business growth (19.9%). However, the distribution of benefits is highly unequal, with direct mining employees capturing the majority of advantages while broader community members bear the environmental and social costs. Challenges include loss of farmland and livelihoods (29.9%), environmental degradation (19.9%), and health problems (16.0%). Corporate Social Responsibility initiatives remain limited and unevenly implemented, falling short of sustainable development expectations.

The study contributes to the discourse on extractive-led development by demonstrating that mining-induced transformation creates a paradoxical landscape of economic opportunity and socio-environmental vulnerability. This paradox is reflected in residents' livability perceptions: 75.0% reported some improvement, but perceptions were less favourable in Oworo West, the ward closest to the quarry and cement factory, and the erosion of environmental quality, livelihood security, and social cohesion may weaken perceived livability over time. The pattern of uneven development highlights the limitations of extractive-led growth when unsupported by strong regulatory oversight, inclusive governance, and equitable benefit-sharing mechanisms.

5.1 Recommendations

Based on the findings, the Kogi State Ministry of Lands and Housing, along with the Lokoja Local Government, should make a plan to control the built-up expansion along the road corridors and the mining sites, considering the results of a 238.5% increase in built-up area. Regular environmental audits by the Ministry of Solid Minerals Development and enforcement of compliance by the Mines Inspectorate are required, due to the increase in quarry area of 954.1% and a reduction in vegetation of 23.7%. The companies involved in the mining of the area should rehabilitate the mined-out lands by replanting, preventing erosion, and rehabilitating water bodies, and allocate the corporate social responsibility of the companies to health, education, and water supply. Just some of the many things that land-compensation funds should be used for are youth skills training and small businesses. Farmland loss will benefit from agricultural extension services that decreased by 30.0%. It is recommended to set up health surveillance in mining communities, and involve traditional institutions and civil-society organisations in development agreements and environmental monitoring.

Declarations

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Conflict of Interest

The authors declare no conflict of interest.

Data Availability

The data supporting this study are available from the corresponding author upon reasonable request.

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