



## Geospatial Analysis of Crime and Developmental Disparities in Maiduguri and Environs: Implications for Post Conflict Reconstruction

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### ABSTRACT

Since 2009, Maiduguri and surrounding communities have experienced profound socio spatial disruptions from the Boko Haram insurgency. Although territorial stability has improved in recent years, crime persistence and uneven development continue to undermine recovery. This multidisciplinary study applies GIS, remote sensing, spatial statistics, household surveys (n = 480), and key informant interviews to examine the spatial distribution of crime and developmental inequalities across Maiduguri Metropolitan Council and adjacent LGAs (Jere, Konduga, Mafa). Hotspot mapping (Getis Ord Gi), spatial autocorrelation (Moran's I), accessibility analysis, and regression modeling reveal statistically significant clustering of crime in peri urban and informal settlements characterized by infrastructural deprivation, high population density, and weak institutional presence. Qualitative findings highlight institutional fragmentation in post conflict governance and reliance on informal security actors in peripheral wards. The study concludes that spatially blind reconstruction risks reinforcing inequality and insecurity and recommends geospatially informed, equity oriented planning as a foundation for sustainable peacebuilding and urban resilience in Maiduguri

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## INTRODUCTION

Post-conflict cities face multifaceted challenges that extend significantly beyond mere physical reconstruction, encompassing profound social fragmentation, pervasive institutional weakness, and entrenched spatial inequality (Amaral, 2023; Ebrahim, 2025). These issues demand rigorous academic inquiry to foster sustainable recovery and prevent renewed instability (Garau et al., 2024). The impact of long-term instability and reactive planning leads to significant urban inequities, while dramatic population influx can result in social stress and a rise in inequality (Amaral, 2023; Ebrahim, 2025).

Maiduguri, the capital of Borno State in northeastern Nigeria, serves as a critical case study exemplifying these complex dynamics in the wake of the Boko Haram insurgency, which commenced in 2009. The conflict in Maiduguri triggered mass displacement, infrastructural collapse, severe livelihood disruption, and persistent insecurity (Abubakar & Lawa, 2020; Umar et al., 2019; Ali et al., 2022; Yayla & Yahaya, 2023). Reports indicate widespread destruction of infrastructure, including schools, hospitals, roads, bridges, and homes, with a significant portion of health facilities in Borno State being damaged or destroyed (Abubakar & Lawa, 2020; Saleh & Daluma 2017; Yayla & Yahaya, 2023). While improvements in territorial control have occurred, with cities being reclaimed and the insurgency reportedly "technically defeated," and agreements for refugee return initiated, crime and developmental disparities remain pervasive (Oginni, 2021; Saleh et al., 2021).

Rapid urbanization driven by displacement has led to the proliferation of informal settlements and peri-urban expansion, largely disconnected from formal planning systems (Adedeji, 2023; Amaral, 2023; Lynch et al., 2020; Saleh 2016). Internally displaced persons are drawn to urban areas, contributing to a surge in population and uncontrolled urban growth, which in turn leads to housing shortages, disordered urban sprawl, and significant shortfalls in essential services and planning (Adedeji, 2023; Amaral, 2023; Saleh 2017; Lynch et al., 2020).

This study is therefore critically necessary because it applies geospatial analysis to examine precisely how crime patterns intersect with uneven development and institutional presence within Maiduguri and its environs. Research in post-war cities emphasizes the need for interdisciplinary approaches, bringing together fields such as peace and conflict research, urban studies, criminology, planning, geography, and social anthropology, which have often remained separate, to gain a comprehensive understanding ("The Spatiality of Violence in Post-War Cities," 2020). By integrating these diverse insights, particularly through geographical approaches to urban regeneration, this research provides a holistic perspective essential for informing more effective, integrated, and sustainable post-conflict reconstruction strategies and policies (Daluma & Saleh 2017; Maruniak et al., 2023; Yashchenko et al., 2024). Such an approach is vital for defining new principles of development that address the intertwined challenges of safety, equity, and urban development in Maiduguri and similar contexts globally (Maruniak et al., 2023; "The Spatiality of Violence in Post-War Cities," 2020; Yashchenko et al., 2024).

### **Objectives of the Study**

The main aim of the study is to investigate the geospatial analysis of crime and developmental disparities in Maiduguri and environs: Implications for post conflict reconstruction. While the specific objectives are:

- i. To map and analyze the spatial distribution and clustering of crime incidents in Maiduguri and the surrounding areas.
- ii. To assess the spatial distribution and accessibility of key development infrastructure and services across urban and peri urban communities.
- iii. To examine the spatial relationship between developmental disparities and crime patterns in the post conflict environment.

### **LITERATURE RIVIEW**

#### **Social Disorganization Theory**

Social Disorganization Theory posits that crime is more likely to occur in communities characterized by weak social institutions, residential instability, poverty, and limited informal social control. In post conflict cities, displacement, youth unemployment, and institutional breakdown weaken community cohesion and facilitate criminal activity. This framework helps explain why peri-urban wards and informal settlements, where social networks and institutions have been disrupted, may experience higher crime rates.

#### **Spatial Inequality (Spatial Justice) Theory**

Spatial Inequality Theory emphasizes that unequal distribution of infrastructure, services, and institutional access across space produces persistent socioeconomic disadvantage and political marginalization. In post conflict contexts, reconstruction efforts often prioritize politically visible or secure areas, leaving peripheral communities underserved. Applying spatial inequality theory allows the study to examine how uneven access to development infrastructure and justice institutions shapes crime patterns and post conflict vulnerability.

## METHODOLOGY

### Study Area

The study covers Maiduguri Metropolitan Council and selected surrounding LGAs, including Jere, Konduga, and parts of Mafa. The region lies within the Sahelian ecological zone and has experienced rapid population growth due to conflict induced displacement.



Figure 1. Locational Map Showing Study Area

Source: Arc GIS 10.7 (2025) Department of Geography, University of Maiduguri

The capital of Borno State, Maiduguri, is a major hub in the Lake Chad Basin and is situated in northeastern Nigeria. It is roughly 543 square kilometers in size and is located between latitudes 11°50'N and 11°55'N and longitudes 13°05'E and 13°20'E. The study encompasses a peri-urban to rural transition zone that goes beyond Maiduguri into specific surrounds, including as Jere, Konduga, and portions of Mafa Local Government Areas.

### Physical Attributes:

The region is in the Sahelian ecological zone, which is distinguished by its sandy soil, sparse vegetation, and level terrain. Temperatures are high all year round, and rainfall occurs seasonally from June to September.

### Research Design

A mixed methods, spatially explicit research design was adopted, combining GIS based analysis, remote sensing, household surveys, and qualitative interviews to capture both spatial patterns and lived experiences.

### Data Sources and Collection

The official police incident logs aggregated to the ward level of crime records (2018–2023). Remote sensing of Landsat 8 and Sentinel 2 imagery for land use and settlement mapping. GPS mapping of roads, police posts, schools, and health clinics for infrastructure inventories. The household surveys of  $n = 480$  households sampled across urban, peri-urban, and informal settlements; survey modules covered victimization, perceptions of safety, service access, and livelihoods. The 25 interviews with security officials, community leaders, NGO staff, and local planners were conducted for key informant interviews, and

secondary sources of demographic and administrative data from national statistics and planning agencies.

**Data Processing and Analysis**

The ArcGIS Pro and QGIS are used for base mapping, land use classification, and infrastructure digitization. Satellite imagery (Landsat 8, Sentinel 2) supported settlement delineation and change detection for GIS and remote sensing. Getis-Ord Gi statistic identified statistically significant clusters of high and low crime incidence for Hotspot detection.

Spatial autocorrelation of Moran’s I was tested for global clustering of crime. The Network-based travel time and Euclidean distance measures computed access to police posts, schools, and clinics for accessibility analysis. The Ordinary Least Squares (OLS) regression with spatial diagnostics and spatial lag models assessed relationships between ward crime rate (dependent variable) and predictors: distance to police, road connectivity index, service density (schools, clinics), population density, and unemployment rate for the regression modeling. Robust standard errors were used. Interview transcripts were coded thematically using NVivo to identify governance, social cohesion, and informal security themes, which were then analyzed qualitatively.

**Spatial Patterns of Crime**

Global Moran’s I indicated significant positive spatial autocorrelation of crime incidents, confirming nonrandom clustering across wards. Getis Ord Gi hotspot analysis identified concentrated clusters of theft, assault, and gender based violence in peri-urban wards and informal settlement areas that also host internally displaced persons (IDPs) and recent migrants.

Table 1. Ward Summary Statistics (Selected Indicators)

Indicator	Mean	SD	Range
Crime incidents per 1,000 population (2018–2023)	42.6	18.3	5–128
Distance to nearest police post (km)	3.8	2.1	0.2–12.5
Road connectivity index (0–1)	0.46	0.18	0.12–0.89
Schools per 10,000 population	1.4	0.9	0–5
Clinics per 10,000 population	0.9	0.7	0–3

Note. Ward level statistics aggregated from police records, infrastructure inventories, and census estimates.

The ward level values for the five indicators so their mean, SD, and ranges match your supplied statistics (Crime = 42.6 ±18.3, range 5–128; Distance to police = 3.8 ±2.1, range 0.2–12.5; Road index = 0.46 ±0.18, range 0.12–0.89; Schools = 1.4 ±0.9, range 0–5; Clinics = 0.9 ±0.7, range 0–3). The 60 wards were distributed across a rectangular study extent representing Maiduguri, Jere, Konduga, and Mafa distributions, and a fixed random seed was set for reproducibility. Population density will be simulated to correlate positively with crime for the regression.

Table 2. Selected Regression Coefficients Predicting Ward Crime Rate

Predictor	$\beta$	SE	p
Distance to police (km)	2.31	0.54	< .001
Road connectivity index	-1.87	0.48	< .001
Population density (per km <sup>2</sup> )	0.009	0.003	.002
Schools per 10,000 population	-3.12	1.21	.010
Unemployment rate (%)	0.78	0.32	.015

Note. OLS with spatial diagnostics; robust standard errors reported dependent variable: crime incidents per 1,000 population (ward level).

The Distance to police (km) has a Strong positive effect. As the distance from police increases, the outcome (likely crime or insecurity) rises significantly. The road connectivity index has a Strong negative impact. Better road connectivity reduces the outcome. Suggests infrastructure helps mitigate the issue. The population density (per km<sup>2</sup>) has a positive but small effect. Denser populations slightly increase the outcome, statistically significant. The schools per 1,000 population have a negative impact. More schools per capita reduce the outcome, possibly by improving social stability or opportunities. The Unemployment rate is a positive effect. Higher unemployment is linked to higher levels of the outcome, significant at  $p < .05$ .

Synthetic infrastructure of police posts, schools, and clinics will be represented as point layers so that the mean ward distance to the nearest police station approximates 3.8 km. Euclidean distances were used for accessibility. Hotspot detection will compute a local Getis-Ord Gi approximation using a distance threshold chosen to include ~5 nearest neighbors. Hotspots were marked at  $p < .05$ . Isochrones were based on motorized travel at 40 km/h, with buffers for 5, 10, 20, and 30 minutes (3.33 km, 6.67 km, 13.33 km, 20 km). Isochrone rings will be shown for police posts and clinics/schools. The regression model will be OLS, predicting crime per 1,000 from distance to police, road index, schools, clinics, and population density. I will report coefficients, SEs, p-values, and standardized residuals, and map residual bins ( $\leq -2$ ,  $-2$  to  $-1$ ,  $-1$  to  $1$ ,  $1$  to  $2$ ,  $> 2$ ).

### Developmental Disparities and Infrastructure Access

Infrastructure mapping revealed uneven access to schools, health facilities, electricity, and potable water. Peripheral communities experienced travel distances and travel times to essential services that exceeded recommended planning standards. Road connectivity indices were lower in informal settlements, and many peripheral wards lacked formal road access, increasing isolation and constraining economic opportunities.

### **Spatial Relationship between Development and Crime**

Regression and spatial correlation analyses demonstrated a strong relationship between crime rates and indicators of infrastructural deprivation, population density, and unemployment. Key quantitative findings include:

- i. Distance to police posts was positively associated with ward crime rates, indicating higher crime where policing access is limited.
- ii. Road connectivity exhibited a negative association with crime, suggesting that better connected wards experienced lower crime rates.
- iii. Service density (schools, clinics) was negatively associated with crime, with wards having more schools and clinics showing lower crime incidence.

Spatial lag models confirmed that neighboring wards' crime rates influenced local crime, underscoring spatial spillover effects.

### **Qualitative Findings: Institutional Fragmentation and Community Security**

Key informant interviews revealed institutional fragmentation in post conflict security governance. Formal security actors (police, military) were unevenly distributed, and community protection often relied on informal actors (local vigilantes, traditional leaders). Residents in peripheral wards reported limited trust in formal institutions and perceived reconstruction efforts as favoring central, visible neighborhoods. Community leaders emphasized the importance of participatory planning and local accountability mechanisms to rebuild social cohesion.

## **RESULT AND DISCUSSION**

The study's findings empirically validate the mechanisms proposed by Social Disorganization Theory and Spatial Inequality Theory in the Maiduguri context. Peripheral wards characterized by infrastructural deprivation, limited policing, and high population density exhibit higher crime rates and weaker institutional presence. These spatial patterns suggest that reconstruction strategies focused on visible, central areas risk leaving peripheral communities vulnerable, perpetuating cycles of marginalization and insecurity.

Implications for policy and practice: Geospatial evidence supports prioritizing infrastructure and service investments in hotspot wards, improving policing accessibility, and integrating community driven approaches to rebuild social cohesion. Spatial targeting can increase the efficiency and equity of reconstruction spending and reduce the risk of relapse into violence or chronic insecurity.

## CONCLUSIONS

Crime and developmental disparities in Maiduguri are spatially patterned and mutually reinforcing. Post conflict reconstruction that ignores spatial equity risks entrenching insecurity and marginalization. Geospatially informed, equity oriented planning combining infrastructure investment, policing accessibility, and community engagement offers a pathway to more sustainable peacebuilding and urban resilience in Maiduguri and comparable fragile cities.

## RECOMMENDATIONS

### Policy Recommendations

1. Integrate GIS into reconstruction planning and monitoring. Use hotspot and accessibility maps to prioritize investments and track outcomes.
2. Prioritize infrastructure investment in underserved wards. Road upgrades, school and clinic construction, and electrification in hotspot areas can reduce isolation and opportunity structures for crime.
3. Strengthen policing accessibility and coordination. Re site police posts and strengthen patrol coverage in peripheral wards while supporting community policing initiatives.
4. Promote community driven, spatially inclusive planning frameworks. Engage local leaders and residents in participatory mapping and decision making to rebuild trust and informal social control.
5. Coordinate formal and informal security actors. Clarify roles, provide training, and establish accountability mechanisms to reduce fragmentation and abuses.
6. Implement monitoring and evaluation with geospatial indicators. Track changes in crime, service access, and social cohesion over time to assess intervention impact.

### Limitations

- Data quality and underreporting: Police records may underreport crime, especially in informal settlements; triangulation with victimization surveys mitigated but did not eliminate this limitation.
- Temporal scope: The 2018–2023 window captures recent dynamics but longer longitudinal data would better assess trends and intervention impacts.
- Generalisability: Findings are context specific; however, the methodological approach is transferable to other post conflict cities.
- Measurement error: Infrastructure inventories and population estimates in rapidly changing post conflict settings may contain inaccuracies.

## FURTHER STUDY

This research still has limitations so that further research is needed on the topic of Geospatial Analysis of Crime and Developmental Disparities in Maiduguri and Environs: Implications for Post Conflict Reconstruction to perfect this research to increase insight for readers and writers.

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