

SPATIAL ANALYSIS OF CRIME VULNERABILITY IN KADUNA STATE SENATORIAL ZONES

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ABSTRACT

This study examines the spatial patterns of crime vulnerability across the three senatorial zones of Kaduna State, Nigeria, using a mixed-methods approach. Data were obtained from a survey of 774 respondents, selected through a multistage sampling procedure; Focus Group Discussions (FGDs); police crime records; and geocoded crime incidents, analyzed using ArcGIS (2025). Descriptive statistics, Nearest Neighbour Index (NNI), and Geographically Weighted Regression (GWR) were employed to investigate the distribution and determinants of crime vulnerability. The results indicate that kidnapping/banditry (24.7%) and property theft (19.8%) are the most prevalent crimes, while 67.1% of respondents confirmed the presence of organized criminal gangs. Marked spatial variations were observed across the senatorial zones. The Central Senatorial Zone recorded the highest rates of violent and organized crimes, particularly in Birnin Gwari and Giwa LGAs. Higher rates of theft, cultism, and student-related offences characterized the Northern Zone. At the same time, communal clashes, ethnic tensions, and land-related conflicts were more prevalent in the Southern Zone. NNI analysis revealed a clustered distribution of crime incidents across the state. At the same time, GWR revealed spatial heterogeneity in the influence of socioeconomic and environmental factors on crime vulnerability. This signifies that crime drivers vary significantly across locations. The findings highlight the limitations of uniform security strategies and stress the need for zone-specific, evidence-based interventions that address both structural socioeconomic conditions and local environmental factors. In conclusion, the study provides a geospatial evidence base for targeted crime prevention, resource allocation, and security planning in Kaduna State.

Keywords: Crime, senatorial, zones, GWR, NNI.

INTRODUCTION

Crime, particularly violent forms such as kidnapping, armed banditry, and cattle rustling, remains a pressing global challenge that undermines human security, economic growth, and sustainable development. Globally, kidnapping incidents have increased in several regions, driven by economic desperation, organized criminal networks, and governance deficits (Enemuwe *et al.*, 2025). In Latin America and parts of Asia, kidnapping for ransom has become a lucrative criminal enterprise, while in Africa, banditry often intersects with resource conflicts and insurgency (Ejiofor, 2025).

In sub-Saharan Africa, violent crime and organized banditry have escalated significantly in fragile border regions, fueled by youth unemployment, poverty, climate-induced resource scarcity, and weak state presence (European Union Agency for Asylum-EUAA, 2025). West Africa has witnessed the transformation of bandit groups into sophisticated criminal syndicates operating across

national borders.

Nigeria exemplifies these regional dynamics, recording one of the highest incidences of kidnapping and banditry in the world since the late 2010s. The North-West geopolitical zone has been the epicenter, with banditry causing thousands of deaths, mass displacements, school abductions, and substantial economic losses (ACLEDA, 2023; Karfe *et al.*, 2025; Thompson, 2025). These crimes have evolved from opportunistic attacks to structured criminal economies involving ransom demands and livestock rustling.

Kaduna State, situated in North-Western Nigeria, ranks among the most severely affected states. Between 2020 and 2025, the state recorded thousands of kidnapping cases, with Birnin Gwari, Giwa, Chikun, Kajuru, and Zangon Kataf LGAs repeatedly targeted. High-profile incidents, including the 2024 Kuriga school abduction and subsequent attacks in 2025-2026, have intensified national concern. The persistence of these crimes has severely disrupted agriculture, education, commerce, and inter-community relations (Karfe *et al.*, 2025; Okorie *et al.*, 2025).

While previous studies have examined crime in Kaduna Metropolis using GIS (Ayuba, 2016; Balogun *et al.*, 2014) or analyzed secondary data on banditry (Mohammed, 2021; Adeola *et al.*, 2025; Oluyemi, 2025), there remains a paucity of research that integrates primary resident perceptions with advanced spatial techniques across senatorial zones. This study addresses this gap by analyzing demographic and socioeconomic profiles, crime prevalence and types, and spatial patterns of vulnerability across the Northern, Central, and Southern Senatorial Zones. It is grounded in the modified Routine Activity Theory (Cohen & Felson, 1979) as described by Stones and Tilley (2022). It employs a State-Based Crime Analysis (SBICA) framework that incorporates Ordinary Least Squares (OLS) regression, GWR, and the Nearest Neighbour Index (NNI).

MATERIALS AND METHODS

Study Area

Kaduna lies largely within the Northern Guinea Savannah and is geographically part of the High Plains of Northern Nigeria between latitude 09°02' and 11°32' North of the equator and longitude 06°15' and 08°38' east of the Greenwich meridian, at an average altitude of about 643m above sea level (Abaje *et al.*, 2015). Administratively, it comprises twenty-three Local Government Areas (LGAs), which includes Chikun, Giwa, Gwari, Igabi, Ikara, Jaba, Jema'a, Kachia, Kaduna North, Kaduna South, Kagarko, Kajuru, Kaura, Kauru, Kubau, Kudan, Lere, Makarfi, Sabon Gari, Sanga, Soba, Zaria and Zangon Kataf with headquarters respectively in Birnin Gwari, Kujama, Giwa, Turunku, Kwoi, Kafanchan, Kachia, Doka, Makera, Kagarko, Kajuru, Kaura, Kauru, Anchau, Hunkuyi, Saminaka, Makarfi, Sabongari, Gwantu, Maigana, Zaria and Zonkwa. Kaduna State is one of the most

strategically situated States in Nigeria, owing to its contiguous borders with seven other northern states and the Federal Capital Territory (FCT). Nasarawa State and the FCT border it to the South; Katsina, Kano, and Zamfara States to the North; Bauchi and Plateau States to the East, and Niger State to the West (Ekpo & Izge, 2023). The State occupies an estimated landmass of 46,026 km², and its metropolitan area is surrounded by scattered farmland settlements (Tini & Light, 2020). See Figures 1 and 2.

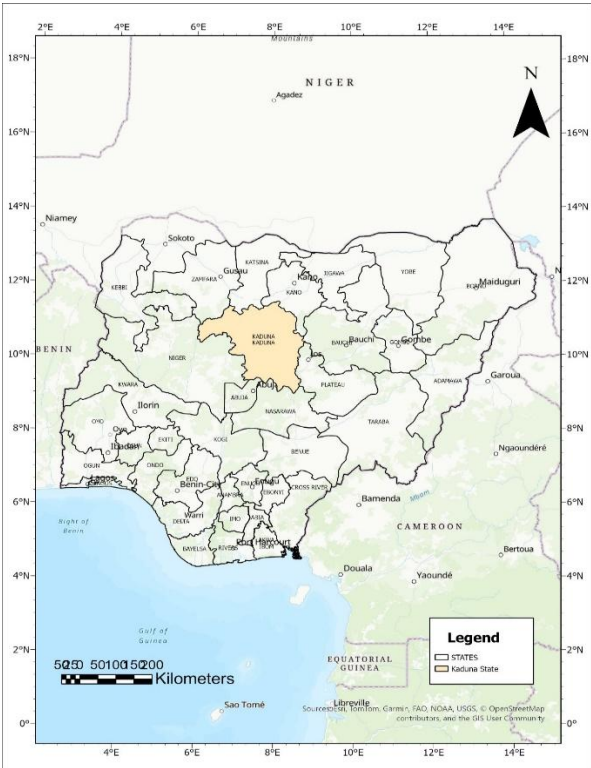


Figure 1: Kaduna State in Nigeria
Source: NDA, Kaduna (2025)

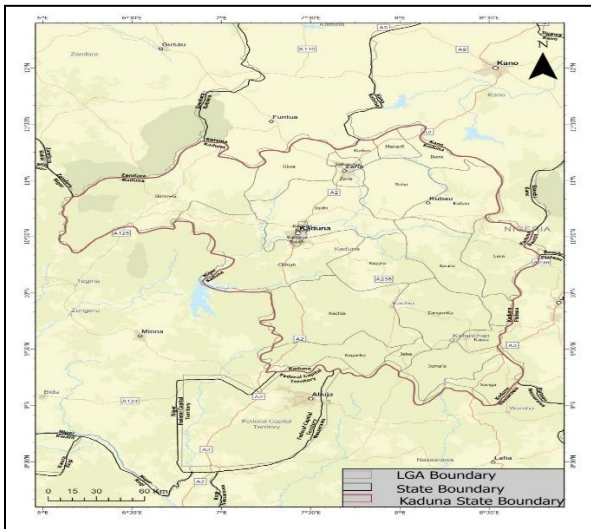


Figure 2: Kaduna State showing Local Government Areas
Source: NDA, Kaduna (2025)

The study adopted a descriptive, mixed-methods survey design. Multi-stage sampling selected 774 respondents across LGAs in the three senatorial zones. Data sources included structured questionnaires, FGDs, secondary police records, and 463 ground-truthed GPS crime locations. These data were analyzed in ArcGIS using Kernel Density, Hot Spot, Inverse Distance Weighted (IDW), and Nearest Neighbour Index (NNI) tools. OLS regression and Geographically Weighted Regression (GWR) were used to examine socioeconomic predictors and spatial heterogeneity. Qualitative data were thematically analyzed. Ethical approval and informed consent were obtained.

RESULTS AND DISCUSSION

Demographic and Socioeconomic Characteristics of Respondents

The sample (N = 774) was predominantly male (73.4%), aged 36–50 years (53.5%), married (72.1%), and had attained secondary or tertiary education. Employment was mixed, with 46.7% full-time, 26.3% casual, and most respondents earning between ₦30,000 and ₦70,000 monthly (Table 1). These characteristics reflect higher mobility and exposure risks among economically active populations, consistent with Okafor (2021) and the United Nations Office on Drugs and Crime (UNODC, 2023). The findings align with those of Igbiniedion and Ebomoyi (2017), who linked low- to middle-income and irregular employment to elevated vulnerability to crime in Nigeria.

Table 1: Demographic and Socioeconomic Characteristics of Respondents

Gender	Frequency	Percentage
Male	568	73.4
Female	206	26.6
Total	774	100
Age Group		
18-35	205	26.5
36-50	414	53.5
>50	155	20.0
Total	774	100
Marital Status		
Married	558	72.1
Single	216	27.9
Total	774	100
Employment Status		
Full-time	362	46.7
Casual	203	26.3
Self-employed	150	19.4
Unemployed	59	7.6
Total	774	100
Monthly Income		
< 30,000	77	9.9
30,000-70,000	481	62.1
70,000-<100,000	216	27.9
Total	774	100

Source: Fieldwork (2025)

Prevalence and Types of Crimes

Respondents reported 993 crime mentions. Kidnapping/banditry was the most prevalent (24.7%), followed by property theft (19.8%), assault (11.3%), and armed robbery (9.9%). Organized criminal

gangs were reported by 67.1% of respondents (Table 2). These patterns corroborate recent studies on the dominance of violent crimes in North-West Nigeria (Enemuwe *et al.*, 2025; Karfe *et al.*, 2025; Thompson, 2025). FGDs highlighted the severe psychological toll, especially in Birnin Gwari, consistent with global findings on the emotional impact of chronic insecurity (Riek, Böhme and Moore, 2015).

Table 2: Types and Frequency of Crime Occurrences

Types of Crime	Frequency	Percentage
Armed Robbery	98	9.9
Burglary	85	8.6
Property Theft	197	19.8
Assault	112	11.3
Cattle Rustling	93	9.4
Kidnapping/Banditry	245	24.7
Cybercrime	63	6.3
Thuggery	48	4.8
Others	52	5.2
Total	993	100
Presence of Organized Criminal Gangs		
Yes	519	67.1
No	255	32.9
Total	774	100

Source: Fieldwork (2025)

Spatial Patterns of Crime Vulnerability across Senatorial Zones

Northern Senatorial Zone

This zone exhibited a relatively lower violent crime rate but higher concentrations of theft, cultism, cybercrime, and student-related offences, influenced by the presence of major tertiary institutions and agricultural cycles (Figure 3). The pattern reflects opportunity structures around educational and market centers (Ayuba, 2016).

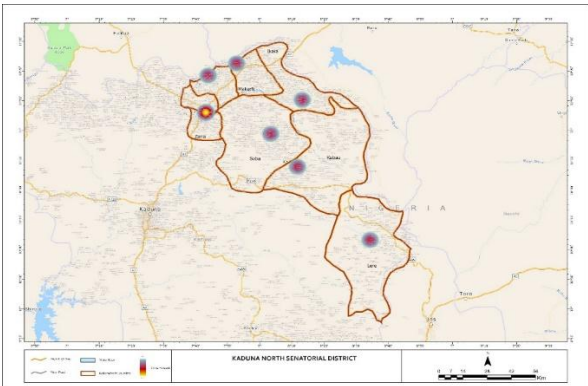


Figure 3: Spatial Footprints of Crimes in Kaduna North Senatorial Zone

Source: Fieldwork (2025)

Central Senatorial Zone

The Central Zone recorded the highest crime density, driven by urban population pressure, unemployment, and rural banditry in forest fringes and on highways. Birnin Gwari and Giwa local government areas emerged as major hotspots for kidnapping and armed robbery in the zone (Figure 4). This aligns with findings on the role of transport corridors and ungoverned spaces in facilitating

organized crime (Okorie *et al.*, 2025; Zumve & Okoru, 2025).

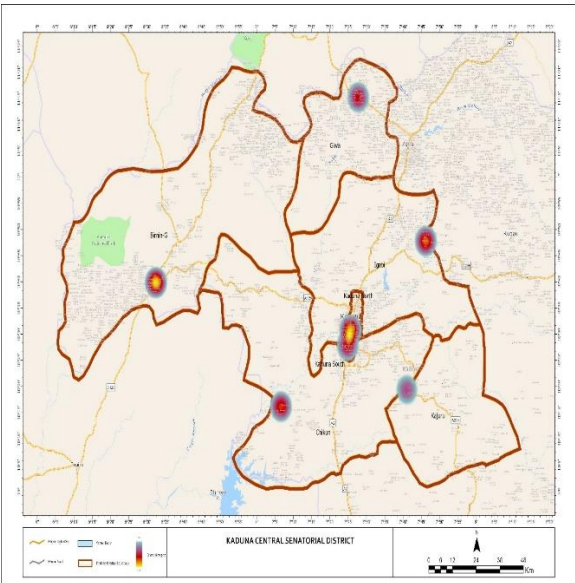


Figure 4: Spatial Footprints of Crimes in Kaduna Central Senatorial Zone

Source: Fieldwork (2025)

Southern Senatorial Zone

Communal clashes, ethnic tensions, land disputes, and some vigilante activities characterized the Southern Zone. FGD participants, particularly women, expressed concerns over domestic violence and underreporting of gender-based crimes (Figure 5). This reflects the interaction between crime and historical socio-political grievances (Karfe *et al.*, 2025).

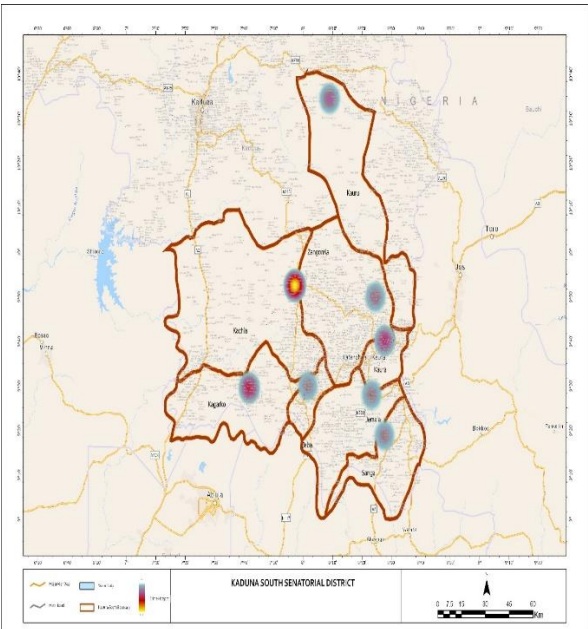


Figure 5: Spatial Footprints of Crimes in Kaduna South Senatorial Zone

Source: Fieldwork (2025)

State-Wide Crime Density and Clustering

The Nearest Neighbour Index (NNI) analysis confirmed a significantly clustered pattern of crime distribution, with pronounced hotspots in Kaduna North, Sabon Gari, Kaduna South, Zaria, and Birnin Gwari LGAs. Urban crimes concentrated around commercial and transit hubs, while rural banditry clustered in the peripheral areas (Figure 6).

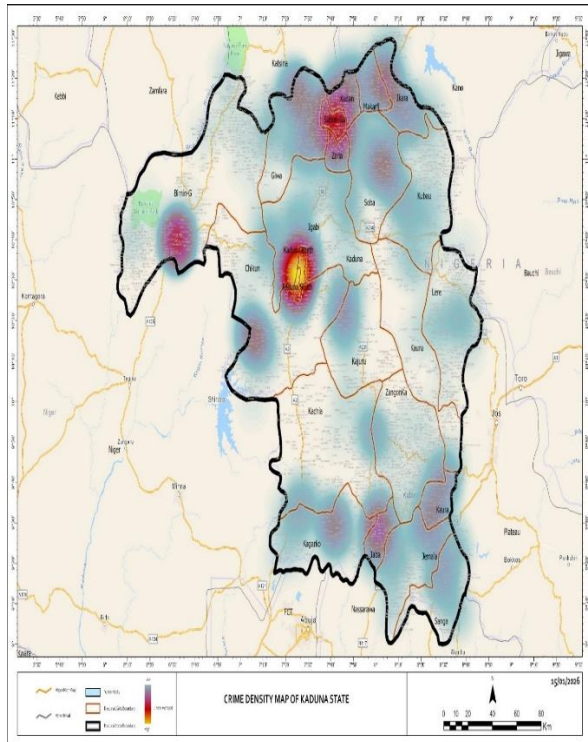


Figure 6: Crime Density Map of Kaduna State

Source: NDA, Kaduna (2025)

The observed urban–rural and zonal variations strongly support Routine Activity Theory, as criminals exploit areas with suitable targets and weak guardianship (Cohen & Felson, 1979; Faisal, 2017). Strain Theory further explains how few or completely blocked economic opportunities due to unemployment and inequality drive criminal behaviour (Merton, 1938). These findings extend earlier GIS-based studies in Kaduna (Ayuba, 2016; Balogun *et al.*, 2014) and recent spatial analyses of banditry in North-West Nigeria (Yahaya *et al.*, 2025).

The results demonstrate the inadequacy of one-size-fits-all security strategies. Zone-specific interventions are essential: enhanced youth and educational programs in the North, intensified rural policing and highway surveillance in the Central Zone, and community mediation mechanisms in the South. Socioeconomic programs addressing poverty, unemployment, and inequality remain fundamental. Improved geospatial crime data management and community trust-building are also critical to reducing underreporting.

Conclusion and Recommendations

This study provides empirical evidence of significant spatial heterogeneity in crime vulnerability across Kaduna State's senatorial zones. Kidnapping/banditry and property crimes

dominate, with distinct patterns shaped by land use, population density, economic activities, and environmental factors. The application of NNI, OLS, and GWR highlights the value of spatially explicit approaches in understanding and addressing insecurity in complex environments such as Kaduna State (Yahaya *et al.*, 2025; Andresen, 2022). The persistence of organized crime amid socioeconomic vulnerabilities underscores the limitations of purely militarized responses. Sustainable crime reduction requires integrated strategies that address both immediate security needs and the underlying structural drivers. Addressing the spatial and socioeconomic dimensions of crime in Kaduna State is essential for restoring peace, security, and sustainable development in Nigeria's North-West region.

Recommendations

- I. Develop and implement zone-specific crime prevention plans tailored to the unique crime profiles of each senatorial district.
- II. Prioritize socioeconomic interventions, including youth employment schemes, skill acquisition programs, and agricultural support, particularly in high-vulnerability LGAs.
- III. Strengthen community-oriented policing, vigilante coordination, and intelligence sharing between residents and security agencies.
- IV. Address underreporting through gender-sensitive mechanisms, awareness campaigns, and improved access to justice, especially for domestic and sexual violence.
- V. Enhance geospatial crime intelligence systems by incorporating real-time data collection and predictive hotspot mapping using GWR and machine learning techniques.
- VI. Invest in infrastructure development (roads, lighting, and surveillance) in high-risk corridors and rural fringes to enhance guardianship and reduce opportunities for crime.
- VII. Foster multi-stakeholder collaboration among government, traditional institutions, civil society, and international partners for holistic and sustainable interventions.

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