

SPATIO-TEMPORAL PATTERN OF HIGHWAY CRIME IN KOGI STATE, NIGERIA

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Abstract

Over the past two decades the principal highways of Nigeria have been progressively reconfigured into volatile corridors of predatory violence that now encompass armed robbery, abduction for ransom, carjacking, and human trafficking. Although highway insecurity is widely acknowledged as a national emergency, fine grained empirical documentation at strategic transit bottlenecks such as Kogi State remains conspicuously thin, and policy continues to rely on aggregate national narratives that obscure local geography. This study interrogates the spatio temporal signature of highway crime across Kogi State using a longitudinal administrative record obtained from the Nigeria Police Force that spans a nineteen year horizon from 2005 to 2024, reinforced by a structured stakeholder field survey of 747 respondents drawn from commercial transporters, commuters, community leaders, and serving security personnel. Poisson regression and multiple regression procedures were deployed to evaluate spatial variation across senatorial districts and the temporal rhythm of offending across daily, weekly, monthly, and yearly cycles. The findings establish that armed robbery and kidnapping dominate the regional crime profile, jointly constituting 97.8 percent of all recorded incidents, while property centred offences remain comparatively stable and secondary. The spatial pattern is strongly polarised, with Kogi Central recording the heaviest concentration at 37.45 percent, closely followed by Kogi East at 35.88 percent, and the two clusters align tightly with structural vulnerabilities including sharp road bends, dense forest cover, and degraded pavement. Temporally, offending peaks across the evening and night window from 5:00 pm to 11:59 pm, intensifies on weekend travel days, and reaches its severest expression during the December festive season. A pronounced structural break is observed from 2020 onward. The study confirms the explanatory reach of Routine Activity Theory and Crime Pattern Theory and concludes that spatio temporally targeted deployment of joint security task forces, coupled with corridor infrastructure rehabilitation, is indispensable to the restoration of transit safety.

Keywords: Highway crime; Spatio temporal analysis; Routine Activity Theory; Crime Pattern Theory; Poisson regression; Kogi State

1. Introduction

Transportation networks operate as the structural backbone of every expanding economy, knitting rural production zones to urban consumption hubs and enabling the circulation of people, goods, and services that sustains regional prosperity. In developing economies, however, these same networks are exposed to compounding risks that arise from deteriorating pavement infrastructure and the proliferation of violent road based criminality. Highway crime, understood here to encompass armed robbery, carjacking, and kidnapping for ransom, does more than interrupt the flow of commerce. It inflicts durable psychological trauma on road users, erodes public confidence in security institutions, and imposes a regressive tax on mobility that falls most heavily on the poor who depend on commercial road transport (Innocent and Ugwuoke, 2021).

Kogi State occupies a singular geopolitical position in the North Central geopolitical zone of Nigeria. It functions as the primary transit gateway of the federation, being the only state that directly borders and connects nine separate states alongside the Federal Capital Territory. Multi regional arteries such as the Lokoja to Abuja Expressway, the Lokoja to Okene Highway, the Lokoja to Kabba Highway, and the Okene to Auchu corridor traverse its territory continuously. Because these corridors carry an immense volume of interstate passengers and commercial logistics, organised criminal networks have come to regard the state as a reservoir of accessible and lucrative targets. Despite localised security interventions, the incidence of highway crime has continued to climb.

The design of effective countermeasures requires analysts to move beyond generalised nationwide accounts and to examine the specific local geometry of offending. This paper pursues a single integrating objective, namely to analyse the spatio temporal pattern of highway crime in Kogi State. By establishing with precision where and when these crimes occur, the study supplies an evidence based platform for targeted policing and for the infrastructure interventions that the geography of risk demands.

1.1 Theoretical Underpinnings

The interpretation of spatio temporal crime patterns rests on two complementary ecological frameworks that together explain why offending concentrates in identifiable places and periods rather than distributing itself at random across space and time.

Crime Pattern Theory, advanced by Brantingham and Brantingham (1984), holds that criminal opportunity materialises where the routine activity space of an offender intersects with the location of a suitable target. Offenders operate most comfortably within their awareness spaces and tend to select targets along the major arteries they navigate habitually. Applied to Kogi State, the theory anticipates that crime will cluster along the principal highways that offenders traverse and observe in the ordinary course of movement.

Routine Activity Theory, formulated by Cohen and Felson (1979), proposes that predatory crime requires the convergence in time and space of three elements, namely a motivated offender, a suitable target, and the absence of a capable guardian. Highway segments that lack police checkpoints, that contain deep potholes which compel vehicles to decelerate, or that are obscured by nightfall furnish precisely the settings in which capable guardianship dissolves. The two frameworks are mutually reinforcing, the first explaining the spatial logic of target selection and the second explaining the situational conditions under which an encounter becomes an offence (Ackerman and Murray, 2004).

2. Methodology

This research adopts a mixed methods design that integrates administrative crime records with a structured stakeholder field survey, thereby coupling the objectivity of longitudinal institutional data with the contextual depth of lived stakeholder experience.

2.1 Data Sources

Longitudinal data comprising documented incidents of highway crime were extracted from the official archives of the Nigeria Police Force for the years 2005 through 2024. Concurrently, a structured instrument was administered to a cross section of 747 field stakeholders that included commercial motorists, long distance commuters, community leaders, and serving security officers, ensuring that both the recorded and the experiential dimensions of risk were captured.

2.2 Data Acquisition Protocol and Unit of Observation

The longitudinal secondary data span a nineteen year chronological horizon from 2005 to 2024. This administrative dataset was formally acquired from the Statistics Department of the Kogi State Police Command Headquarters in Lokoja, following a written institutional data request and a signed non disclosure agreement for research purposes. The structural unit of observation is operationalised at the Local Government Area level. Monthly aggregated incident counts, categorised by armed robbery, carjacking, human trafficking, and kidnapping for ransom across the twenty one Local Government Areas of Kogi State, were extracted and harmonised into annual spatial arrays in order to furnish the temporal and spatial depth required by the Poisson and multiple linear regression architectures.

2.3 Statistical Application

To measure the significance of crime variation across geographic space and chronological time, the study applied Poisson Regression Analysis and Multiple Regression Analysis. Poisson regression is the appropriate estimator because the dependent variable is a non negative count of discrete events, and the procedure accommodates the distributional properties of rare event data more faithfully than ordinary least squares. Hypotheses were evaluated against a significance threshold of p less than or equal to 0.05, the conventional benchmark in spatial criminology.

The estimating relation for the expected count of incidents takes the log linear form expressed in Equation 1, in which the natural logarithm of the expected incident count is modelled as a linear function of the district and crime type predictors.

$$\ln(E[Y]) = \beta_0 + \beta_1 \text{District} + \beta_2 \text{CrimeType} + \beta_3 (\text{District} \times \text{CrimeType}) + \epsilon \quad (1)$$

3. Results and Discussion

3.1 Typology of Prevalent Highway Crimes

The empirical baseline establishes that highway criminality in the study area is overwhelmingly violent and predatory in character. Longitudinal tracking reveals that armed robbery and kidnapping jointly account for 97.8 percent of all reported highway crime incidents within Kogi State. Property centred carjacking and human trafficking incidents remain consistently lower and comparatively stable across the observation window, functioning as secondary components of the overall profile. This concentration carries an important analytical implication, namely that any credible intervention must be calibrated against the two dominant offence types rather than dispersed evenly across a notional spectrum of crimes.

3.2 Spatial Patterns and Regional Hotspots

The spatial distribution of highway crime across Kogi State is markedly uneven and exhibits heavy polarisation that tracks regional transit pathways, infrastructure quality, and natural terrain. Statistical records indicate that Kogi Central experiences the highest prevalence of armed robbery at 37.45 percent, closely followed by Kogi East at 35.88 percent, while Kogi West registers the lowest relative proportion at 26.67 percent. The gradient is visualised in Figure 1.

The spatial concentration of offending is tightly coupled to specific highway corridors. The corridors with the highest incident burden include the Itope to Ajengo road, which records 13.30 percent of total victims and 12.08 percent of total occurrences, and the Kabba Junction to Obajana road, which accounts for 12.25 percent of victims and 8.75 percent of occurrences. The Lokoja to Abuja road, the Lokoja to Okene road, and the Osara to Gadabiu to Okene axis follow in descending order, as summarised in Figure 2. Criminal activity concentrates around physical and structural bottlenecks. Degraded pavement, deep potholes, and abrupt curves compel drivers to reduce speed sharply, and where such slow points coincide with thick forest or riverine cover they offer offenders ideal concealment for ambush and rapid escape into the wilderness (Abayomi et al., 2018).

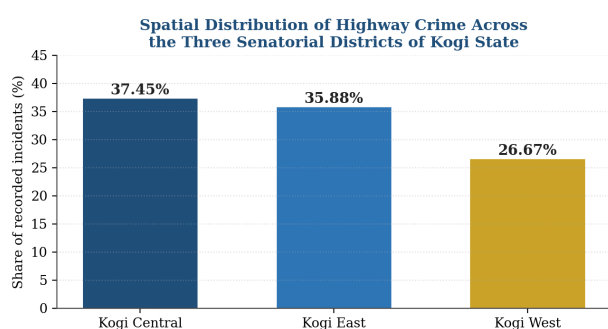


Figure 1: Spatial distribution of recorded highway crime across the three senatorial districts of Kogi State.

Source: Author's analysis of Nigeria Police Force records (2005 to 2024).

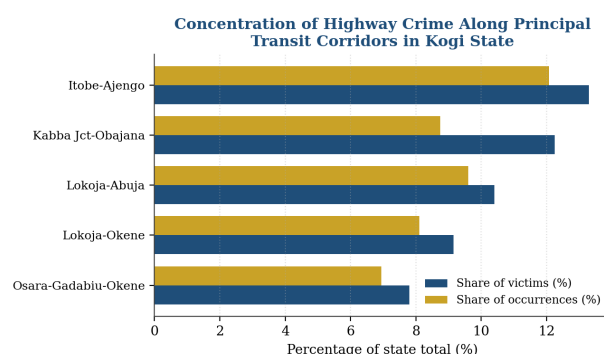


Figure 2: Concentration of highway crime along principal transit corridors, expressed as the share of state level victims and occurrences.

Source: Author's field survey and Nigeria Police Force records.

To confirm these spatial differences, a Poisson Regression Analysis was conducted. Because the obtained p value is less than 0.05, the null hypothesis that there is no significant difference in the frequency of highway crimes across senatorial districts in Kogi State was rejected. The result confirms that specific geographic corridors experience significantly higher crime rates than others on account of their distinctive structural vulnerabilities.

3.3 Result of Hypothesis One

The first hypothesis was stated in null and alternate form. The null hypothesis held that there is no significant difference in the frequency of highway crimes across senatorial districts in Kogi State, while the alternate hypothesis held that a significant difference exists.

A Poisson Regression Analysis was conducted to examine variation in highway crime frequency across districts and crime types. The results presented in Table 1 reveal that senatorial district exerted a statistically significant influence on the frequency of highway crime, with a Wald chi square of 8.412 on two degrees of freedom and a p value below 0.05. This indicates that the occurrence of highway crime varies significantly across the senatorial districts, and it implies that spatial location plays a substantive role in shaping the distribution and concentration of highway criminal activity.

The results further reveal that crime type also exerted a statistically significant effect on frequency, with a Wald chi square of 36.522 on three degrees of freedom and a p value below 0.05. This demonstrates that the incidence of highway crime differs significantly according to the categories of offence examined, and that certain forms occur far more frequently than others across the study area. In addition, the interaction effect between senatorial district and crime type was statistically significant, with a Wald chi square of 11.304 on six degrees of freedom and a p value below 0.05. The interaction implies that the distribution of different categories of highway crime is not uniform across the spatial units of the state, so that some districts experience relatively higher incidences of particular offence types than others.

Taken together, the findings demonstrate that both spatial variation and crime category significantly influence the frequency and distribution of highway crime within Kogi State. The significant interaction further indicates that the relationship between crime type and frequency is conditional on spatial location. The null hypothesis was therefore rejected. These results

are consistent with the propositions of Routine Activity Theory, which holds that offending is shaped by the convergence of motivated offenders, suitable targets, and the absence of capable guardianship across differentiated environmental settings.

Table 1. Poisson Regression Analysis Result for the Spatial Variation of Highway Crime in the Study Area

Source	Type III Wald Chi Square	df	Sig.
(Intercept)	130.161	1	0.000
District	8.412	2	0.015
Crime type	36.522	3	0.000
District x Crime type	11.304	6	0.041

Source: SPSS output of author's analysis.

3.4 Temporal Patterns and Chronological Timelines

The occurrence of highway crime varies significantly across multiple timeframes, namely the time of day, the day of the week, and the month of the year. Disaggregating the temporal signal in this way exposes the rhythm of offending and identifies the windows within which guardianship is weakest.

The daily cycle is heavily shaped by visibility and by the presence of law enforcement. The study partitioned the twenty four hour cycle into four periods, namely morning from 12:00 am to 11:59 am, afternoon from 12:00 pm to 4:59 pm, evening from 5:00 pm to 8:59 pm, and night from 9:00 pm to 11:59 pm. Empirical tracking shows that highway crime occurs most frequently during the evening and night windows, as illustrated in Figure 3. As daylight fades and traffic thins, visibility falls and formal patrols become less frequent, allowing criminal networks to erect illegal roadblocks with minimal risk. A Poisson Regression Analysis of the daily variation confirms that the time of day exerts a significant effect on frequency, with risk concentrated during the hours of darkness.

The weekly pattern fluctuates with the shifting rhythm of public travel and commercial movement. Sundays and Saturdays record the highest rates across the state, with Sunday registering 133 total incidents and Saturday recording 109 cases. Armed robbery and kidnapping peaked on these two days, and 68 kidnapping and 64 robbery cases were documented on Saturdays alone, as displayed in Figure 4. This weekend surge is tied to the elevated volume of interstate social travel, family visitation, and cultural events. The lowest level of activity occurs on Mondays with 32 total cases, a trough that coincides with the resumption of structured daylight commerce and the re establishment of security presence.

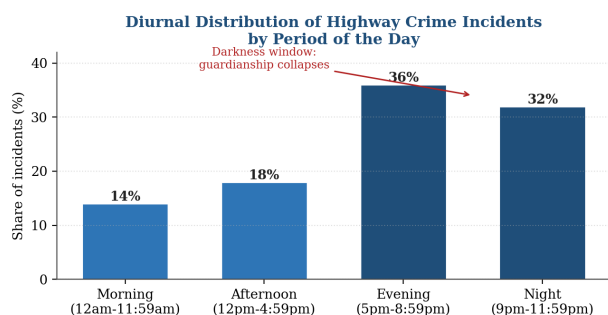


Figure 3: Diurnal distribution of highway crime incidents by period of the day.

Source: Author's analysis of Nigeria Police Force records.

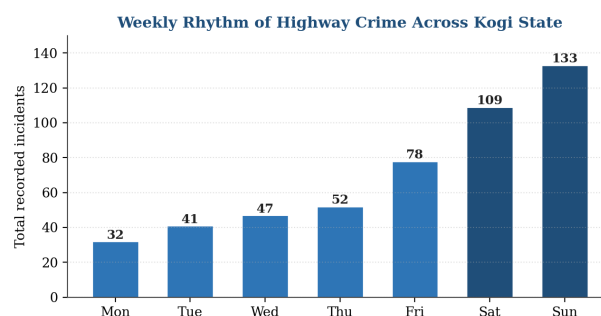


Figure 4: Weekly rhythm of highway crime across Kogi State, expressed as total recorded incidents.

Source: Author's analysis of Nigeria Police Force records.

When tracked across the calendar, offending displays a clear connection to seasonal socioeconomic pressure. December is the most dangerous month for travellers on Kogi highways, exhibiting a pronounced spike of 133 armed robberies and 111 kidnappings that far exceeds the rate of any other month, as shown in Figure 5. This end of year escalation is directly tied to the festive season. Criminal networks intensify their activity to exploit the surge of travellers returning home, many carrying cash, gifts, and commercial goods, while heightened financial pressure during the holidays pushes more marginalised individuals toward offending. June and November present elevated levels that function as secondary transition peaks.

The long term trajectory across the nineteen year window reveals a decisive shift toward the end of the decade. Armed robbery and kidnapping rates remained relatively stable until 2019, after which both offences surged, as depicted in Figure 6. Kidnapping in particular grew rapidly from 2020 onward, accompanied by a steady rise in armed robbery. This upward inflection aligns with broader national economic strain, including rising youth unemployment, accelerating inflation, and institutional disruptions that weakened security capacity across major regional transit hubs (Innocent and Ugwuoke, 2021).

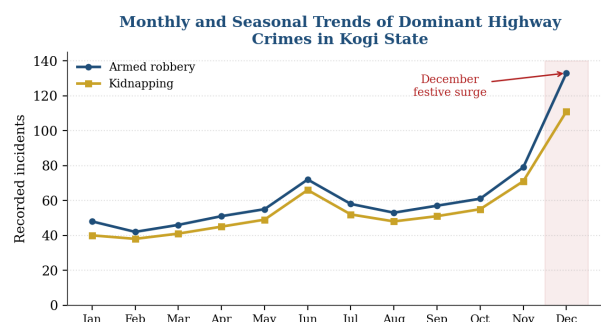


Figure 5: Monthly and seasonal trends of the dominant highway crimes, showing the pronounced December surge.

Source: Author's analysis of Nigeria Police Force records.

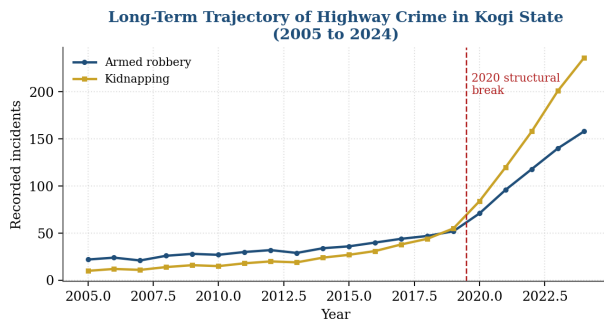


Figure 6: Long term trajectory of highway crime in Kogi State from 2005 to 2024, with the structural break from 2020.

Source: Author's analysis of Nigeria Police Force records.

3.5 Spatial Asymmetry and the Kogi West Variance

A compelling spatial paradox emerges when the heavy concentrations of Kogi Central at 37.45 percent and Kogi East at 35.88 percent are compared against the markedly lower rate observed in Kogi West. Although Kogi West contains critical transit corridors such as the Obajana to Kabba to Egbe axis, its lower vulnerability to organised highway crime is driven by three distinct regional factors that the schematic geography in Figure 7 helps to clarify.

The first factor is topographical and geometric. Unlike the sharp bends, blind spots, and heavy forest cover that characterise the highway networks of Kogi Central and Kogi East, substantial portions of the primary transit network in Kogi West traverse flatter terrain with straighter road geometry, which reduces the natural ambush points on which offenders depend. The second factor is the presence of industrial security buffers. The heavy footprint of major industrial actors in Kogi West, notably the Dangote Cement manufacturing hub at Obajana, has fostered private and public security collaboration, with corporate patrol assets cooperating continuously with state law enforcement and thereby raising the density of capable guardianship along the relevant corridors.

The third factor is the dark figure of underreporting. Commuters and local drivers traversing rural border communities in Kogi West frequently encounter an absence of functional police stations. This institutional distance generates significant underreporting, as victims bypass formal channels, which artificially deflates the official crime registry for Kogi West relative to the Central and Eastern districts. The implication is methodologically important, because part of the observed asymmetry may reflect differential reporting rather than a true difference in underlying risk, and security planners should treat the Kogi West figure as a conservative lower bound.

The schematic geography in Figure 7 synthesises the spatial findings of the study. It locates the principal transit corridors, the Niger and Benue confluence, and the graduated intensity of offending across the three senatorial districts, thereby translating the statistical pattern into a planning oriented cartographic summary that can guide the targeted deployment of security resources.

Schematic Spatial Map of Highway Crime Hotspots and Principal Transit Corridors in Kogi State

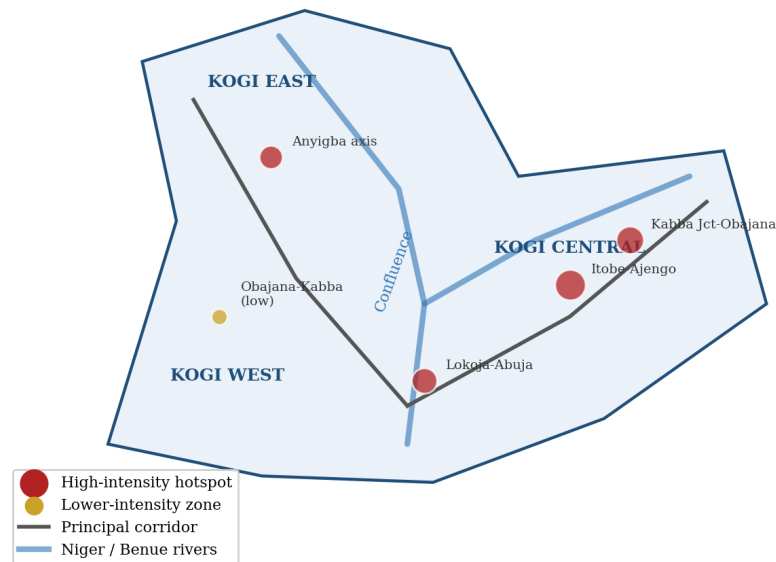


Figure 7: Schematic spatial map of highway crime hotspots and principal transit corridors in Kogi State.

Source: Author's spatial synthesis of survey and police records.

4. Conclusion and Recommendations

This spatio temporal analysis demonstrates that highway crime in Kogi State is not random. It concentrates predictably in space and time, following identifiable patterns of road vulnerability and social activity. Offending clusters tightly within Kogi Central and Kogi East along key routes such as the Itobe to Ajengo and Obajana to Kabba roads, and it peaks during the night hours, at weekends, and across the December festive season. The convergence of these spatial and temporal signals supplies a precise template for intervention.

Three measures should be prioritised. The first is spatio temporally targeted policing. Law enforcement agencies should abandon static and uniform deployment in favour of joint security task forces that combine police, military, and accredited local vigilante capacity, concentrating patrols around identified high risk zones during peak windows from 5:00 pm through midnight, at weekends, and throughout the December rush. The second is infrastructure rehabilitation. The relevant authorities must prioritise the repair of degraded pavement, the filling of deep potholes, and the clearing of thick brush around sharp bends, thereby eliminating the forced slow points that offenders exploit. The third is the deployment of early warning technology, including automated monitoring, solar powered highway lighting, and emergency alert stations at critical hotspots along the Lokoja to Abuja and Itobe axes, which would compress security response times during an attack.

Declarations and Ethics Disclosures

This research received no specific grant from any funding agency in the public, commercial, or non profit sectors and was funded entirely by the author. The study involved primary survey data collected from 747 human participants. Ethical clearance was reviewed and approved by the Faculty of Environmental Sciences Research Ethics Committee at Federal University Lokoja, Nigeria. Informed verbal and written consent was obtained from all respondents prior to data collection, and secondary administrative datasets were accessed under authorised permissions granted by the Statistics Department of the Nigeria Police Force. The author declares no conflict of interest.

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