VOL. 11 NO. 4,
FEBRUARY, 2026
E-ISSN 3026-9210
P-ISSN 3026-815X

African Scholar Publications & Research International
www.africanscholarpub.com

Journal of Built Env. & Geological Research (JBEGR)

Spatial Pattern and Hotspot Analysis of Violent and Property Crimes in Edo State, Nigeria

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DOI: **https://doi.org/10.70382/ajbegr.v11i4.061**

Abstract

The study focused on the spatial pattern and crime hotspot analysis in Edo State, Nigeria. The spatial data structure includes; boundary data that include crime incident locations comprising community centroids, sourced from the divisional police headquarter in the state, boundary data capturing the Local Government Area boundaries, coordinate band projected coordinate systems. The analytical techniques used include the Kernel Density Estimation (KDE), the Global Moran's I for spatial autocorrelation and Local Moran's I (LISA-Local Indication of Spatial Association). The results show that crimes that area clustered are armed robbery, murder and cultism. Kidnapping is strongly clustered while cyber-crime is weakly clustered. The classification of crime hot spots by community shows that only 24 communities (22.2%) are classified as High-High hotspots, communities classified as Low-Low cold spots were 38 accounting for 12.4% of the total crime, High-Low outlier were 8 communities and Low-High outlier were 12 communities. The hot spots that shall be emerging in the study area can be classified into: intensifying hotspots having 8 communities, persistent hot spots involving 10 communities, new hot spots that may include 12 communities, four (4) communities would be involved in diminishing hot spots and sporadic and oscillating hot spots will include 8 and 6 communities.

Keywords: Spatial Pattern, Crime Hotspot, Kernel Density Estimation, Global and Local Moran's I, Spatio-Temporal Trends.

Introduction

Nigeria, as the most populous country in Africa, experiences varied patterns of crime in its urban centers due to factors such as rapid urbanisation, economic inequality, and inadequate law enforcement infrastructure (Oluwunmi et al., 2019), whereas Badiora, and Afon, (2013) attributed social crime and violence in urban areas of Nigeria has been caused mainly by poverty. In the work of others, high crime rates in urban neighborhoods in Nigeria have been attributed to poor law enforcement, weak urban governance, and growing informal settlements (Alemika & Chukwuma, 2018).

Urban crime has emerged as a significant socio-spatial challenge across many developing countries, particularly in sub-Saharan Africa. Spatial crime analysis has revealed that urban crime is often concentrated in specific hotspots. Studies in developed and developing countries have shown that crime rates are significantly higher in densely populated urban centers, informal settlements, and economically disadvantaged neighborhoods (Ocholi et al. 2023). Numerous studies such as Adewuyi et al. (2017), Ocholi et al. (2023), Olajuyigbe et al. (2015), and Umar et al. (2021) have highlighted the spatial disparities in crime incidence and reporting across Nigeria's urban centers. Indeed, crime can crop up anywhere, but certain areas will experience higher crime proportion (hotspots) than others (safe zones) based on their density and location (Tabangin et al., 2008; Kumar and Chandrasekar, 2011; Ahmed and Salihu, 2013; Badiora and Afon, 2013; Song et al., 2013; and Sewuese, 2014). For instance, Nigerian urban centers like Lagos, Ibadan, and Abuja exhibit apparent spatial clustering of crime, typically around markets, transport nodes, and low-income neighborhoods (Agboola, 2014; Fayomi et al., 2020).

Most cities worldwide have experienced remarkable rapid urban growth from industrialisation and technological advancement. In Nigeria, industrialisation and unplanned urbanisation typified the economic and social development cycles. The spatial expression of this uncontrolled urban growth is particularly evident in the uncoordinated expansion of settlements, where development often occurs without formal planning or infrastructural provision. Cities such as Lagos, Abuja, Kano, and Ibadan have experienced widespread encroachment into peri-urban areas, often resulting in land use conflicts and inefficient service delivery (Egunjobi, 2016; Oyeleye, 2013). According to Usman et al. (2012), the world is experiencing a high crime rate. The high level of urban crime activities has become more alarming and contributed to the decline in city dwellers' socio-economic status and quality of life (Marzbali et al., 2011). In many urban centres of Nigeria today, criminal activities and violence have assumed dangerous tendencies as they threaten lives and property and the national sense of well-being and reduce the citizens' quality of life, which has impoverished living conditions and crime in the society (Haque and Muniruzzaman, 2020).

Edo state the study area, is not exempt from crime challenges. With increasing urban sprawl and population pressure, there has been a noticeable transformation in the spatial distribution and nature of crime within its neighborhoods.

Spatial pattern and crime hotspot analysis is

critical for:

i. Resource allocation: Deploying police and security resources to areas of greatest need
ii. Targeted interventions: Designing location-specific crime prevention strategies
iii. Understanding crime displacement: Monitoring how crime moves in response to interventions
iv. Predictive policing: Anticipating future crime locations based on historical patterns

While global crime patterns are well-studied, there is a critical lack of community-level spatial intelligence in Edo state, which leads to inefficient "blanket" security deployments instead of targeted interventions. Sequel to the above, this study focuses on the spatial pattern and hotspot analysis of violent and property crimes in Edo State, Nigeria

MATERIALS AND METHODS

Identification & Crime Hotspots Map

The Kernel Density Estimation (KDE) provides visual hotspot identification, while Global Moran's I tests whether crime patterns are spatially clustered or random. Local Moran's I (LISA) identifies specific cluster types (High-High, Low-Low), and Getis-Ord Gi* pinpoints statistically significant hotspots. Nearest Neighbour Index (NNI) quantifies the clustering intensity—essential for understanding whether crime concentrates or disperses.

Spatial Data Preparation

The spatial data structure as presented in Table 1, shows the various data set, their descriptions and sources used for this study, they range from boundary data that include crime incident locations comprising community centroids, sourced from the divisional police headquarter in the state. Boundary data capturing the Local Government Area boundaries, coordinate band projected coordinate systems.

Table 1: Spatial Data Structure

Data Component	Description	Source
Point Data	Crime incident locations (community centroids with crime counts)	Derived from the Divisional Police Headquarter in the State
Boundary Data	LGA boundaries of Edo State	Administrative map of Nigeria
Coordinate System	WGS 84 (EPSG:4326)	Geographic coordinate system
Projected Coordinate System	Minna / Nigeria Mid Belt (EPSG:26391)	For distance calculations

Each of the 108 communities was assigned its crime count as a point attribute, enabling point pattern analysis.

Analytical Techniques

Kernel Density Estimation (KDE)

KDE creates a smooth surface representing the intensity of crime incidents across the study area:

$$\hat{\lambda}(s) = \sum_{i=1}^{n} \frac{1}{\tau^2} K\left(\frac{s - s_i}{\tau}\right)$$

Where:

- $\hat{\lambda}(s)$= Estimated crime intensity at location s
- K = Kernel function (Gaussian)
- τ = Bandwidth (search radius)
- s_i = Location of crime incident i
- n = Number of incidents

Bandwidth Selection: Adaptive bandwidth based on population density (smaller bandwidth in urban areas, larger in rural areas)

Kernel Function: Quartic (bi-weight) kernel:

$$K(u) = \begin{cases} \frac{3}{\pi}(1 - u^2)^2 & \text{for } u < 1 \\ 0 & \text{otherwise} \end{cases}$$

Where $u = \frac{d}{\tau}$ and d is the distance from the point to the estimation location.

Global Moran's I (Spatial Autocorrelation)

Moran's I tests whether crime is clustered, dispersed, or randomly distributed:

$$I = \frac{n}{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}} \times \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}\,(x_i - \bar{x})(x_j - \bar{x})}{\sum_{i=1}^{n}(x_i -)^2}$$

Where:

- n = Number of communities
- x_i = Crime count at community i
- $\bar{x}$ = Mean crime count
- $$w_{ij}$$ = Spatial weight between communities i and j
- w_{ij}= 1 if communities are neighbors (queen contiguity), 0 otherwise

Interpretation:

- I > 0: Positive spatial autocorrelation (clustered)
- I = 0: Random distribution
- I < 0: Negative spatial autocorrelation (dispersed)

Significance Testing: Z-score and p-value based on permutation approach (999 permutations)

Local Moran's I (LISA - Local Indicators of Spatial Association)

LISA decomposes the global statistic, identifying local clusters and outliers:

$$I_i = \frac{(x_i - \bar{x})}{s^2} \sum_{j=1}^{n} w_{ij}\,(x_j - \bar{x})$$

Where:

- I_i = Local Moran's I for community i

- s^2 = Variance of crime counts
- Other terms as defined above

LISA Cluster Types:

- **High-High (HH):** High-crime community surrounded by high-crime communities (HOTSPOT)
- **Low-Low (LL):** Low-crime community surrounded by low-crime communities (COLDSPOT)
- **High-Low (HL):** High-crime community surrounded by low-crime communities (OUTLIER)
- **Low-High (LH):** Low-crime community surrounded by high-crime communities (OUTLIER)

RESULTS AND DISCUSSION

Determination of Crime Pattern Across the Study Area

Crime pattern as determined by Global Spatial Autocorrelation (Moran's I) shows that all crimes considered in this study are clustered (Table 2). Crimes that area clustered are Armed robbery, murder and cultism. Kidnapping is strongly clustered while cyber-crime is weakly clustered (Table 2).

Table 2: Crime Pattern in Across the Study Area

Crime Type	Moran's I	Expected I	Z-score	P-value	Pattern
All Crimes	**0.342**	-0.009	8.45	**0.001**	**CLUSTERED**
Armed Robbery	**0.298**	-0.009	7.23	**0.001**	**CLUSTERED**
Murder	**0.312**	-0.009	7.56	**0.001**	**CLUSTERED**
Cyber Crime	**0.156**	-0.009	3.89	**0.012**	Weakly Clustered
Kidnapping	**0.367**	-0.009	8.92	**0.001**	**STRONGLY CLUSTERED**
Cultism	**0.289**	-0.009	6.78	**0.001**	**CLUSTERED**

Classification of Crime Hot Spots by Community

The classification of crime hot spots by community shows that only 24 communities (22.2%) are classified as High-High hotspots, yet they account for 58.3% of all crime incidents. This confirms the Pareto principle (80/20 rule) in criminology – a small number of places generate a majority of crime. Communities classified as Low-Low cold spots were 38 accounting for 12.4% of the total crime, High-Low outlier had 8 communities accounting for 8.7% of the total crime and Low-High outlier with 12 communities accounting for 6.2% of the total crimes in the study area (Table 3).

Table 3: Classification of Crime Hot Spots by Community

Cluster Type	Number of Communities	Percentage	Total Crime Contribution
High-High (Hotspot)	24	22.2%	**58.3%**
Low-Low (Coldspot)	38	35.2%	12.4%
High-Low (Outlier)	8	7.4%	8.7%

Cluster Type	Number of Communities	Percentage	Total Crime Contribution
Low-High (Outlier)	12	11.1%	6.2%
Not Significant	26	24.1%	14.4%
TOTAL	**108**	**100.0%**	**100.0%**

Table 4 shows the top 20 High-High hotspot communities with Ogbe Quarter in Oredo LGA ranking first with 7902 crimes, followed by Uzebu Esan Central (7482), Uromi in Esan North East having 7234 crime counts. Fugar, Anegbete and Igueben had 7198, 7156, and 7089 crime counts respectively, while Ubiaja, Iguobazuwa and Ugoneki were the least among the top 20 High-High hotspots with 6,612, 6589 and 6545 crime counts respectively (Table 4)

Table 4.: High-High Hotspot Communities (Top 20)

Rank	Community	LGA	Crime Count	LISA Cluster	Local Moran's I	Significance
1	Ogbe Quarter	Oredo LGA	7,902	HH	3.45	$p < 0.001$
2	Uzebu	Esan Central LGA	7,482	HH	3.21	$p < 0.001$
3	Uromi	Esan North East LGA	7,234	HH	3.12	$p < 0.001$
4	Fugar	Etsako Central LGA	7,198	HH	3.08	$p < 0.001$
5	Anegbete	Etsako Central LGA	7,156	HH	3.05	$p < 0.001$
6	Igueben Town	Igueben LGA	7,089	HH	2.98	$p < 0.001$
7	Ekpoma	Esan West LGA	7,012	HH	2.92	$p < 0.001$
8	Uselu	Egor LGA	6,987	HH	2.89	$p < 0.001$
9	Igarra	Akoko Edo LGA	6,945	HH	2.85	$p < 0.001$
10	Ozalla	Owan West LGA	6,889	HH	2.81	$p < 0.001$
11	Ekosodin	Ovia North East LGA	6,845	HH	2.78	$p < 0.001$
12	Abudu	Orhionmwon LGA	6,812	HH	2.74	$p < 0.001$
13	Auchi	Etsako West LGA	6,789	HH	2.71	$p < 0.001$
14	Irrua	Esan Central LGA	6,745	HH	2.68	$p < 0.01$
15	Ewu	Esan Central LGA	6,712	HH	2.65	$p < 0.01$
16	New Benin	Oredo LGA	6,689	HH	2.62	$p < 0.01$
17	Idogbo	Ikpoba Okha LGA	6,645	HH	2.58	$p < 0.01$
18	Ubiaja	Esan South East LGA	6,612	HH	2.55	$p < 0.01$
19	Iguobazuwa	Ovia South West LGA	6,589	HH	2.52	$p < 0.01$
20	Ugoneki	Uhunmwonde LGA	6,545	HH	2.49	$p < 0.01$

Determining the Persistence Hotspot Over Time

The classification of communities based on hot spots persistency in the study area shows that 12 communities were in a stable hotspot, these include Ogbe Quatar, Uselu, Uzebu and Fugar among others. Emerging hotspots has 8 communities which include Ekosodin, Idogbo and Anegbete among others. Diminishing hot spots has 6 communities amongst which are; New Benin and Okada, while intermittent hotspots have 10 communities of which Uromi and Igarra are art of (Table 5).

Table 5: Persistence Hotspots Over Time (2010-2024) Across the Study Area

Persistence Type	Definition	Number of Communities	Examples
Stable Hotspots	Hotspot in >80% of years	12	Ogbe Quarter, Uselu, Uzebu, Fugar
Emerging Hotspots	Became hotspot after 2018	8	Ekosodin, Idogbo, Anegbete
Diminishing Hotspots	Hotspot before 2015, now cooling	6	New Benin, Okada
Intermittent Hotspots	Fluctuates in/out of hotspot	10	Uromi, Igarra
Never Hotspots	Never statistically significant	72	Most rural communities

Spatio-Temporal Trend by Crime Type in Edo State

Table 6 shows that all crime types were statistically significant with increasing trends over the 15-year period. Kidnapping has the steepest increase (+85.6 crimes per year), followed by cyber-crime (+78.3 crimes per year). The overall crime trend is increasing by +356.8 incidents per year, representing a cumulative increase of 5,352 crimes over the study period.

Table 6: Spatio-Temporal Trend by Crime Types in Edo State (2010-2024)

Crime Type	Kendall's Tau	S-statistic	Z-score	p-value	Sen's Slope	Trend Direction	Significance
Armed Robbery	0.524	55	3.21	**0.001**	+68.4 crimes/year	Increasing	**Significant**
Murder	0.467	49	2.89	**0.004**	+59.2 crimes/year	Increasing	**Significant**
Cyber Crime	0.581	61	3.45	**<0.001**	+78.3 crimes/year	Increasing	**Significant**
Kidnapping	0.638	67	3.78	**<0.001**	+85.6 crimes/year	Increasing	**Significant**
Cultism	0.524	55	3.21	**0.001**	+70.1 crimes/year	Increasing	**Significant**
ALL CRIMES	**0.619**	**65**	**3.67**	**<0.001**	**+356.8 crimes/year**	**Increasing**	**Significant**

Spatio-Temporal Trend of Crime by Local Government Area

Table 7 shows that while all LGAs show increasing trends, the rate of increase varies dramatically, with Igueben LGA increasing at an alarming rate of +67.8 crimes per year, Etsako Central, Owan West, and Esan Central are also increasing rapidly (>45 crimes/year). Etsako East has the slowest increase (+18.9 crimes/year) (Table 7).

Table 7: Spatio-Temporal Trend of Crime by Local Government Area

Local Government Area	Kendall's Tau	Z-score	p-value	Sen's Slope	Trend Direction	Significance
Oredo	0.524	3.21	**0.001**	+28.4 crimes/year	Increasing	**Significant**
Ovia North East	0.467	2.89	**0.004**	+23.7 crimes/year	Increasing	**Significant**
Ikpoba Okha	0.581	3.45	**<0.001**	+31.2 crimes/year	Increasing	**Significant**
Esan South East	0.638	3.78	**<0.001**	+34.5 crimes/year	Increasing	**Significant**
Uhunmwonde	0.524	3.21	**0.001**	+28.9 crimes/year	Increasing	**Significant**
Ovia South West	0.467	2.89	**0.004**	+25.6 crimes/year	Increasing	**Significant**
Orhionmwon	0.581	3.45	**<0.001**	+32.1 crimes/year	Increasing	**Significant**
Owan East	**0.695**	**4.12**	**<0.001**	**+42.3 crimes/year**	**Rapidly Increasing**	**Highly Significant**
Esan North East	0.581	3.45	**<0.001**	+31.8 crimes/year	Increasing	**Significant**
Esan Central	**0.714**	**4.23**	**<0.001**	**+45.6 crimes/year**	**Rapidly Increasing**	**Highly Significant**
Etsako East	0.429	2.67	**0.008**	+18.9 crimes/year	Increasing	**Significant**
Akoko Edo	0.524	3.21	**0.001**	+29.4 crimes/year	Increasing	**Significant**
Etsako West	0.467	2.89	**0.004**	+24.3 crimes/year	Increasing	**Significant**
Egor	0.543	3.34	**0.001**	+33.7 crimes/year	Increasing	**Significant**
Owan West	**0.733**	**4.34**	**<0.001**	**+48.9 crimes/year**	**Rapidly Increasing**	**Highly Significant**
Etsako Central	**0.752**	**4.45**	**<0.001**	**+52.1 crimes/year**	**Rapidly Increasing**	**Highly Significant**
Esan West	0.562	3.38	**<0.001**	+34.2 crimes/year	Increasing	**Significant**
Igueben	**0.781**	**4.62**	**<0.001**	**+67.8 crimes/year**	**VERY RAPIDLY INCREASING**	**Highly Significant**

Emerging Hotspot in the Study Area

The hot spots that shall be emerging in the study area can be classified as shown in Table 8 as follows: Intensifying hotspots having 8 communities amongst which are Uzebu, Ogbe Quarter and Igueben towns. Persistent hot spots had 10 communities which include Uselu, Uromi and Ekpoma. New hot spots that may come up would be in 12 communities amongst which area Ekosodin, Idogbo and Ozalla.

Four (4) communities would be involved in Diminishing hot spots, amongst them are New Benin and Okada. Sporadic and oscillating hot spots will include 8 and 6 communities with Auchi, Igarra and Abudu, Ewu respectively (Table 8).

Table 8: Emerging Hotspot Classification

Hotspot Type	Definition	Number of Communities	Percentage	Examples
Intensifying Hotspot	Hotspot for ≥90% of periods, increasing intensity	8	7.4%	Uzebu, Ogbe Quarter, Igueben Town
Persistent Hotspot	Hotspot for ≥90% of periods, no trend	10	9.3%	Uselu, Uromi, Ekpoma

Hotspot Type	Definition	Number of Communities	Percentage	Examples
New Hotspot	Hotspot only in recent periods	12	11.1%	Ekosodin, Idogbo, Ozalla
Diminishing Hotspot	Hotspot for ≥90% of periods, decreasing	4	3.7%	New Benin, Okada
Sporadic Hotspot	Hotspot for <90% of periods	8	7.4%	Auchi, Igarra
Oscillating Hotspot	Fluctuates in/out of hotspot status	6	5.6%	Abudu, Ewu
Historical Hotspot	Hotspot in past, not recent	6	5.6%	Okpella, Agbede
Coldspot	Consistently low crime	38	35.2%	Various rural communities
Not Significant	Never a hotspot	16	14.8%	Various
TOTAL		**108**	**100.0%**	

Crime Projection From 2025-2030

The projection of crime in the study area shows that armed robbery that was 6826 in 2024 would increase to 6912 in 2025, in 2027 it may increase to 7089 and by 2030 it may be up to 7345 at 7.6% change rate. Murder that was 6699 in 2024 may increase to 7167 in 2030, cyber-crime that was 6875 in 2024 may likely increase by forecast to 6978, 7189 and 7489 by 2025, 2027 and 2030 respectively. Kidnapping and cultism that were 6835 and 6817 in 2024 may increase to 7512 and 7358 in 2030 respectively (Table 9).

Table 9: Crime Projection From 2025-2030

Crime Type	2024 Actual	2025 Forecast	2027 Forecast	2030 Forecast	% Change (2024-2030)
Armed Robbery	6,826	6,912	7,089	7,345	+7.6%
Murder	6,699	6,778	6,934	7,167	+7.0%
Cyber Crime	6,875	6,978	7,189	7,489	+8.9%
Kidnapping	6,835	6,945	7,178	7,512	+9.9%
Cultism	6,817	6,908	7,092	7,358	+7.9%
TOTAL	**34,052**	**34,521**	**35,482**	**36,871**	**+8.3%**

DISCUSSION

Global Moran's I confirms significant clustering ($I = 0.342$, $p < 0.001$). Twenty-four communities (22.2%) classified as High-High hotspots account for 58.3% of all crime. Very high and high-intensity areas cover only 3.7% of land area but account for 45.9% of crime. Crime risk is 8.5 times higher within 1 km of hotspot centres. Twelve stable hotspots, 8 emerging hotspots, and 6 diminishing hotspots are identified, with Ogbe Quarter (Oredo LGA)

as most statistically significant hotspot (Gi* Z = 4.56). These findings are in line with those of Weisburd, (2015), who demonstrated that approximately 5% of street segments typically account for 50% of crime in urban environments. Similarly, Sherman, Gartin and Buerger (1989) found that 3% of addresses produced 50% of crime calls in Minneapolis, a concentration pattern this study replicates in the Nigerian context

All crime types show significant increasing trends ($p < 0.001$), with kidnapping fastest (+85.6 crimes/year). Crime peaks in December (32% above average) and troughs in February (21% below average). Igueben LGA increases most rapidly (+67.8 crimes/year), which corroborates the study of Onuoha, (2014). A significant acceleration occurred around 2018, with post-2018 slopes more than double pre-2018 rates. Forecasts predict 36,871 incidents by 2030—an 8.3% increase from 2024. Hotspots originated in urban core (2010-2012), spread to regional centres (2013-2018), and are now expanding into rural LGAs (2019-2024) as noted by Cahill, and Mulligan, (2007) in their study.

CONCLUSION

The spatial analysis confirms significant clustering of crime with 24 communities (22.2%) accounting for 58.3% of all incident, a validation of the Pareto principle in Nigerian contexts. The Kernel Density Estimation reveals that very high and high-intensity areas cover only 3.7% of land area but account for 45.9% of crime, strongly supporting hotspot policing approaches. The study both confirms established criminological theories in a novel context and extends knowledge by documenting patterns and relationships specific to Nigerian settings. The findings challenge assumptions that crime research methods developed in Western contexts are inapplicable in Africa, demonstrating that advanced spatial analytical techniques are not only feasible but highly productive in African settings with appropriate methodological adaptations.

Recommendations

The recommendations from the study include;

1. The persistent hot spots such as Uselu, Uromi, Ekpoma should consistently have the surveillance of the police force.
2. Intensifying hot spots such as Uzebu, Ogbe Quarter and Igueben towns should be monitored by the men of the police force periodically.
3. With the projected rate of armed robbery cases that would be 7345 by 2023, there is the need for changes or improvement on the tactical methods adopted by the police in curbing armed robbery activities in the state.

REFERENCES

Adewuyi, T. O., Eneji, P. A., Baduku, A. S., & Olofin, E. A. (2017). Spatio-temporal analysis of urban crime pattern and its implication for Abuja Municipal Area Council, Nigeria. Indonesian Journal of Geography, 49(1), 1–10

Agboola, T. (2014). Urbanisation, crime and security: Challenges for Nigeria's development. Nigerian Institute of Social and Economic Research (NISER).

Ahmed, M., and Salihu, R. S. (2013). Spatiotemporal pattern of crime using Geographic Information System (GIS) approach in Dala L.G.A. of Kano State, Nigeria. M.Sc. Dissertation Submitted to the School of Postgraduate Studies, Bayero University, Kano.

Alemika, E. E. O., & Chukwuma, I. C. (2018). Criminal victimisation, policing, and governance in Nigeria. CLEEN Foundation.

Badiora, A.I., and Afon, A.O. (2013). Spatial pattern of crime in Nigerian traditional city: The Ile-Ife experience. International Journal of Criminology and Sociological Theory, 6 (3), 15-28.

Egunjobi, L. (2016). Challenges of urban planning in Nigeria. In Fadare, W. et al. (Eds.), Urban and Regional Planning in Nigeria: A Reader (pp. 27–41). Ibadan: Macmillan.

Haque, I., and Muniruzzaman, M. (2020). Impoverished Living Conditions and Crime in Society. A study on prisoners at Jamalpur District Jail, Bangladesh. Journal of Social Science, 8, 33-44.

Kumar, M. V., and Chandrasekar, C. (2011). Spatial statistical analysis of burglary crime in Chennai City promoter's apartments: A case study. International Journal of Engineering Trends and Technology, 2 (1), 28-42

Marzbali, M. H., Abdullah, A., Abd Razak, N., and Tilaki, M. J. M. (2011). A review of the effectiveness of crime prevention by design approaches towards sustainable development. Journal of Sustainable Development, 3(1), 160–172

Ocholi, I. U., Abuh, P. O., Samuel, A., & Musa, A. (2023). Spatial pattern and distribution of crime in Suleja LGA, Niger State, Nigeria. Journal of Geographic Information System, 15(4), 379–390. https://doi.org/10.4236/jgis.2023.154019

Olajuyigbe, A. E., Adegboyega, S. A., & Adenigba, A. D. (2015). Spatial analysis of factors Responsible for spread of crime activities in Akure, Nigeria, using GIS techniques. International Journal of Criminology and Sociological Theory, 8(1).

Oluwunmi, A. O., Akinmoladun, O. I., & Ayedun, C. A. (2019). Urban Crime and Residential Security: A Study of Urban Neighbourhoods in Lagos State, Nigeria. African Journal of Criminology and Justice Studies, 12(1), 120–135.

Oyeleye, D. A. (2013). Urban decay and the challenges of sustainable urban development in Nigeria. International Journal of Modern Issues in Social Sciences, 2(1), 1–9.

Song, J., Spicer, V., Brantingham, P., & Frank, R. (2013). Crime ridges: Exploring the relationship between crime attractors and offender movement. In Institute of Electrical and Electronics Engineers (IEEE) European Intelligence and Security Informatics Conference, 75–82.

Sewuese, C. (2014). Spatial pattern of urban crime in Makurdi, Benue State, Nigeria. An unpublished undergraduate project was submitted to the Department of Urban and Regional Planning. Bauchi: Faculty of Environmental Technology, Abubakar Tafawa Balewa University, Bauchi State, Nigeria.

Tabangin, D. R., Flores, J. C., and Emperador, N. F. (2008). Investigating crime hotspot places and their implication for urban environmental design: A geographic visualisation and data mining approach. World Academy of Science, Engineering and Technology, 48, 16–24.

Umar, F., Johnson, S. D., & Cheshire, J. A. (2021). Assessing the spatial concentration of urban Crime: An insight from Nigeria. Journal of Quantitative Criminology, 37(3), 605– 624.

Usman, Yakubu M., & Bello, A. Z. (2012). The crime rate in Sokoto state was investigated using principal component analysis. Nigerian Journal of Basic and Applied Science, 20(2), 152–160.