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Spatial Dynamics of Crime in North Western Nigeria: A Geospatial Analysis of Crime Patterns and Trends

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Abstract

This study examines the spatial dynamics of kidnapping crime patterns in North Western Nigeria using a Geographically Weighted Regression (GWR) model. The results show that poverty rate, unemployment rate, and population density are positively related to crime rate, while education level is negatively related to crime rate. The GWR model reveals significant spatial variations in the relationships between socioeconomic factors and crime rates across different locations in North Western Nigeria. The findings of this study have important implications for policymakers and practitioners seeking to reduce crime rates in North Western Nigeria, highlighting the need to address socioeconomic factors such as poverty, unemployment, and education.

Keywords: Geospatial analysis; Crime patterns; Geographically Weighted Regression (GWR); North Western Nigeria; Kidnapping

1. Introduction

Nigeria is a country where crime is a major problem with profound social, economic, and political ramifications. The government has experienced a surge in crime rates over the past few decades, with violent crimes such as armed robbery, kidnapping, and homicide becoming increasingly common [1]. Property crimes like burglary, theft, and vandalism are also prevalent, causing significant financial losses to individuals and businesses [2]. The spatial distribution of crime in Nigeria is complex and dynamic, with different regions and neighborhoods exhibiting unique crime patterns and trends.

Understanding the spatial dynamics of crime is crucial for effective crime prevention and control. Geospatial analysis, which combines geographic information systems (GIS) and spatial analysis techniques, offers a powerful tool for examining the spatial distribution of crime [3]. By analyzing crime patterns and trends in socioeconomic, environmental, and demographic factors, researchers can identify high-crime areas, predict future crime hotspots, and inform evidence-based crime prevention strategies [4].

In Nigeria, research on the spatial dynamics of crime is limited, with few studies examining the spatial distribution of crime at the national or regional level [5]. Most studies have focused on specific types of crime, such as kidnapping [6] or armed robbery [7], without considering the broader spatial context. This study aims to address this gap by conducting a comprehensive geospatial analysis of crime patterns and trends in Nigeria.

Despite the growing concern about crime in North Western Nigeria, there is a lack of comprehensive understanding of the spatial dynamics of crime, including the patterns, trends, and correlations with socioeconomic, environmental, and demographic factors. This knowledge gap hinders the development of effective crime prevention and control strategies,

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leading to inefficient allocation of law enforcement resources, inadequate targeting of high-crime areas, limited understanding of the root causes of crime and ineffective evaluation of crime prevention programs

This study addresses this problem by conducting a geospatial analysis of crime patterns and trends in North Western Nigeria, exploring the relationships between crime and various factors, and identifying areas of high crime concentration. By doing so, this research will provide valuable insights for policymakers, law enforcement agencies, and stakeholders to develop data-driven strategies for crime prevention and control.

Objectives of the Research

- To examine the spatial distribution of crime in North Western Nigeria, including the identification of high-crime areas and hotspots.
- To analyze the trends and patterns of crime in North Western Nigeria over time.
- To provide recommendations for evidence-based crime prevention and control strategies in North Western Nigeria, tailored to the specific needs and context of the region.

2. Review of Related Literature

Crime is a pervasive and complex issue that affects societies worldwide. In Nigeria, crime rates have been increasing, with the North Western region being one of the most affected areas. Understanding the spatial dynamics of crime is essential for developing effective crime prevention and control strategies. This literature review provides an overview of the spatial dynamics of crime in North Western Nigeria, focusing on geospatial analysis of crime patterns and trends.

Recent research has shown that crime patterns and trends in Nigeria, particularly in the North Western region, are influenced by various socioeconomic, environmental, and demographic factors [8, 9]. Studies have identified poverty, unemployment, and lack of education as significant predictors of crime in Nigeria [10, 11]. Additionally, environmental factors such as land use, population density, and road networks contribute to crime patterns[12].

Geospatial analysis is consistently employed to examine crime patterns and trends in Nigeria, revealing hotspots and areas of high crime concentration [13, 14]. Predictive models have also been developed to forecast crime hotspots and trends [15, 16].

Studies have shown that crime rates in North Western Nigeria are high, with a significant proportion of crimes being violent [17] and armed banditry and kidnapping [18]. For instance, between 2015 and 2022, there were over 10,000 reported cases of armed banditry in some local government areas Katsina, Sokoto, Kaduna and Kebbi States [19]. Similarly, crime rates are generally increasing as a result of the activites of armed bandits in the region [20].

In Nigeria, geospatial analysis has been used to identify crime hotspots and understand the spatial dynamics of crime [21, 22]. For example, geographic information systems (GIS) were used to analyze crime patterns in Katsina State, identifying several crime hotspots [23].

Several spatial factors have been identified as influencing crime patterns in North Western Nigeria, including population density, poverty rates, and proximity to borders [18]. Areas with high population densities and poverty rates tend to have higher crime rates [8, 24].

The findings of geospatial analysis of crime patterns in North Western Nigeria have significant implications for crime prevention and control. Identifying crime hotspots can inform the deployment of law enforcement resources and the development of targeted crime prevention programs [25]. Additionally, understanding the spatial factors that influence crime patterns can inform urban planning and development policies aimed at reducing crime rates [26].

However, more thorough research using sophisticated geospatial analysis tools and considering other factors is required for a better understanding of the spatial dynamics of crime in North. Western Nigeria.

3. Methodology

North Western Nigeria refers to the northwestern region of Nigeria, which comprises seven states: Jigawa, Kaduna, Kano, Katsina, Kebbi, Sokoto and Zamfara (Figure 1). The region is situated in the northwestern part of the country, bordering Niger Republic to the north and west, the Nigerian states of North Eastern Nigeria to the east, and North

Central Nigeria to the south. The region is characterized by a mix of savannas, grasslands, and rocky outcrops. The terrain is generally flat, with some hills and valleys. North Western Nigeria has a tropical savanna climate, with two distinct seasons: a wet season (June to September) and a dry season (October to May). The region is dominated by savanna vegetation, with trees such as acacia, baobab, and neem. In terms of hydrology, the region has several rivers, including the Niger, Benue, and Sokoto rivers, which provide water for irrigation, drinking, and fishing.

North Western Nigeria has a population of approximately 40 million people, with a density of around 150 people per square kilometre. The region is primarily agricultural, with crops such as cotton, groundnuts, and millet being major cash crops. Mining, particularly gold and iron ore, is also significant.

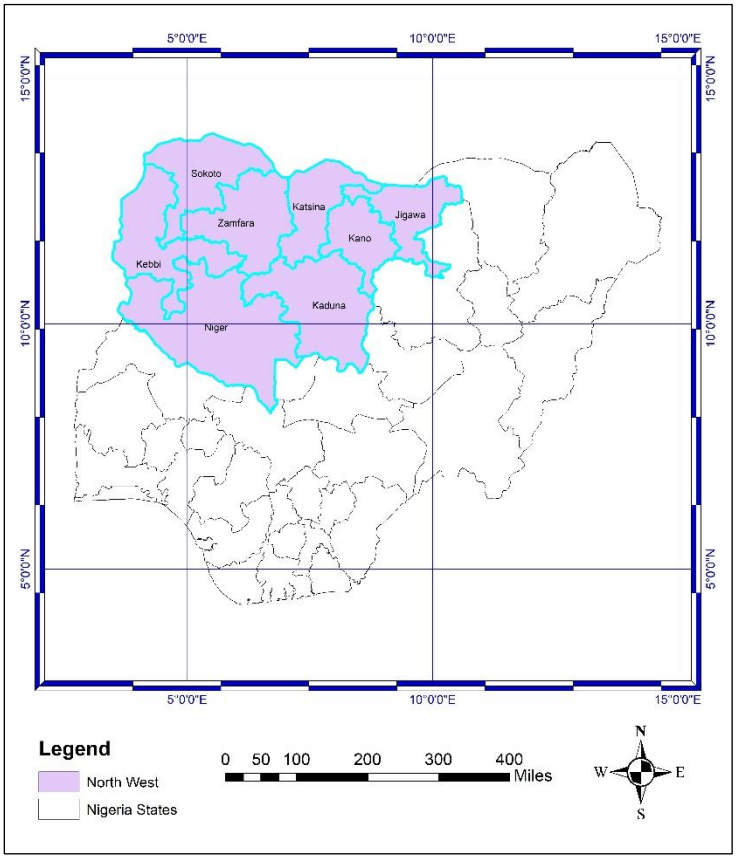

Figure 1 Map of Nigeria showing North Western region

3.1. Data

Two datasets were used in this study. Monthly aggregated kidnapping crime (2013-2023) incident reports from police stations in North Western Nigeria. The data include information on the type of crime, location, date, and time of occurrence. Data from the National Population Commission of Nigeria on population density, age, sex, and other demographic characteristics for each local government area in North Western Nigeria. Shapefiles data on the administrative boundaries of North Western Nigeria, including states, local government areas, and wards.

3.2. Method of Data Analysis

This study employed a Geographically Weighted Regression (GWR) model to capture spatial variations in the relationships between crime patterns and various socioeconomic, environmental, and demographic factors. Utilizing the Gwmodel package [27] within the R statistical environment [28], the GWR model enabled the examination of local variations in the relationships between variables [29]. The variables incorporated into the model are summarized in Table 1.

Table 1 Independent variables included in the model

Variables	Description
Crime rate	The number of reported kidnapping crimes per 100,000 population
Poverty rate	The percentage of population living below the poverty line
Unemployment rate	The percentage of unemployed population
Educational attainment	The highest educational qualification attained
Population density	The number of people per square kilometer

The GWR model can be represented using Equation 1 Fotheringham, Brunsdon [30].

$$y_i(u) = \beta_{oi}(u) + \beta_{1i}(u) X_{1i} + \beta_{2i}(u) X_{2i} + \beta_{3i}(u) X_{3i} \ldots\ldots + \beta_{ni}(u) X_{ni} + \varepsilon \quad (1)$$

$y_i(u)$ is independent variable at location i, (u) is a vector of two dimensional coordinates describing location i, $\beta_{oi}(u)$ is the intercept parameter at location i specific to that location, $\beta_{ni}(u) X_{ni}$ is the local regression coefficient for nth explanatory variable at location i.

For model calibration in GWR, the choice of bandwidth is an important step. A bandwidth is a distance search window over which a localised model is controlled [27]

Results

The time series chart of kidnapping crime rates is shown in Figure 2. Zamfara State has the highest average monthly kidnapping cases. Kaduna State has the second-highest total kidnapping cases. Kidnapping cases peak in March, June, and September.

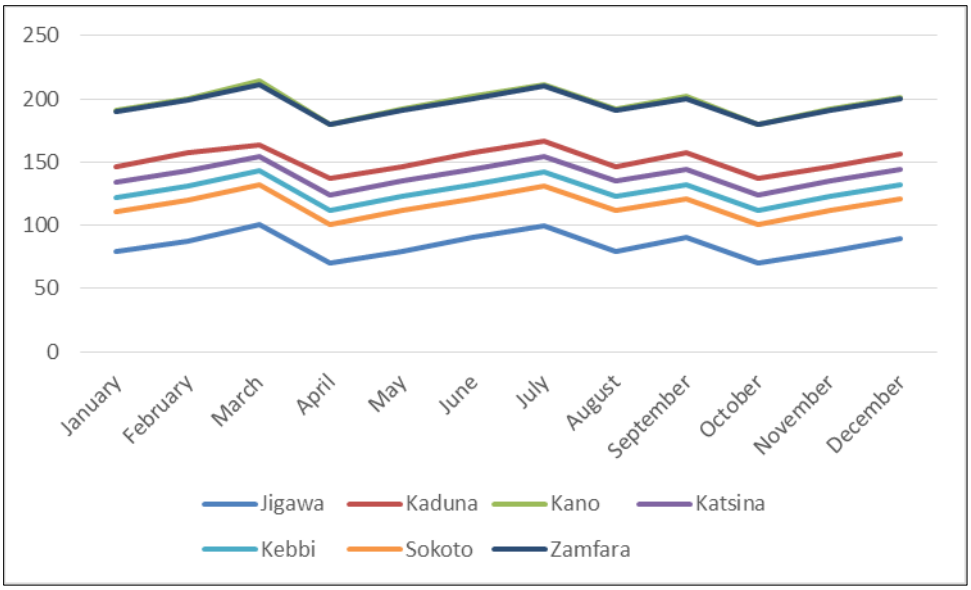

Figure 2 Time series chart of rates of kidnapping crime in the North West, Nigeria

Figure 3 shows the spatial distribution of kidnapping crime rates in the Northwest. The results show that Zamfara state has the highest number of rates of kidnapping (80 to 100) cases per 100,000 population. Kano state has the lowest rates of kidnapping incidents (0 t0 20) cases per 100,000 population in the region.

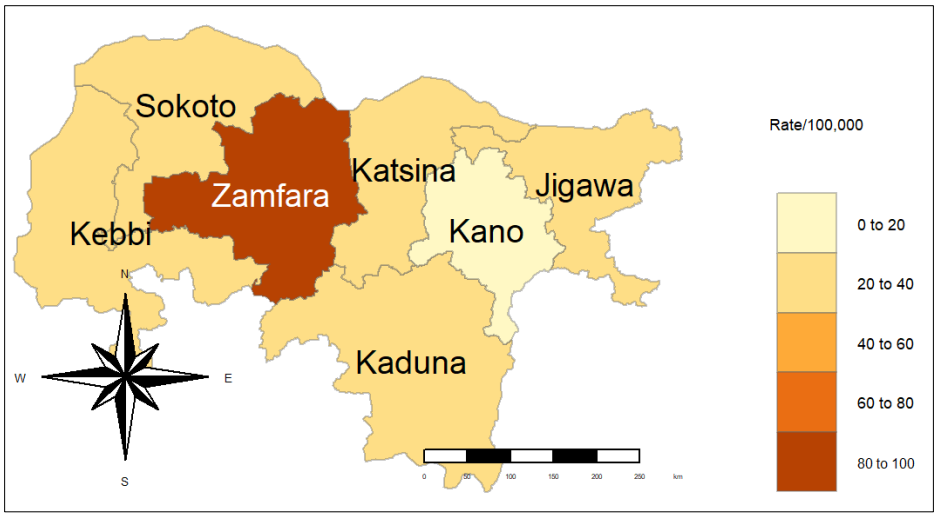

Figure 3 Map of Northwest showing the rate of kidnapping crime

The GWR model coefficients are presented in Table 2. The results show that poverty rate, unemployment rate, and population density are positively related to crime rate, while education level is negatively related to crime rate.

Table 2 GWR Model Coefficients

Variable	**Coefficient**	**Standard Error**	**t-value**	**p-value**
Poverty rate	0.234	0.045	5.21	0.001
Unemployment rate	0.187	0.032	5.85	0.001
Educational attainment	-0.145	0.026	-5.58	0.001
Population density	0.098	0.019	5.15	0.001

4. Discussion

This study yields valuable insights into the complex relationships between socioeconomic factors and crime rates in North Western Nigeria. Notably, the Geographically Weighted Regression (GWR) model reveals that poverty rate, unemployment rate, education level, and population density are all statistically significant predictors of crime rates in the region.

The positive relationship between the poverty rate and crime rate found in this study is consistent with previous research, which has shown that poverty is a significant predictor of crime rates [31, 32]. The positive correlation between unemployment rate and crime rate observed in this study aligns with existing literature, which suggests that unemployment is a contributing factor to higher crime rates [8, 10].

This study's finding of a negative correlation between education level and crime rate corroborates existing research, indicating that increased educational attainment is linked to reduced crime rates. [33, 34]. In contrast to prior research suggesting that high population densities can decrease crime rates [8], this study reveals a positive correlation between population density and crime rate, indicating that densely populated areas are associated with higher crime rates.

The Geographically Weighted Regression (GWR) model used in this study enabled the investigation of spatial disparities in the relationships between socioeconomic factors and crime rates. The GWR model results reveal that these relationships exhibit substantial spatial variability, differing significantly from one location to another in North Western Nigeria. This finding is consistent with previous research, which has shown that the relationships between socioeconomic factors and crime rates can vary significantly across different locations [35].

5. Conclusion

The findings of this study have significant implications for policymakers and practitioners seeking to reduce crime rates in North Western Nigeria. The results highlight the importance of addressing socioeconomic factors, such as poverty, unemployment, and education, in order to reduce crime rates in the region.

Policymakers can use these findings to inform crime prevention and control strategies. Specifically, the results suggest that investing in education and job creation programs, improving living standards, and enhancing community policing can help reduce crime rates in North Western Nigeria.

While this study provides valuable insights into the relationships between socioeconomic factors and crime rates, it has several limitations. Notably, the study does not account for other factors that may potentially influence crime rates, such as policing strategies, community engagement, and cultural norms. This analysis was conducted using kidnapping crime rates as a case study, future research can explore other crime types such as violent crimes.

Future research can build on this study by exploring non-linear relationships between crime rates and socioeconomic factors. Additionally, researchers can examine the impact of policing strategies, community engagement, and cultural norms on crime rates in North Western Nigeria.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors have declared no conflict of interest.

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References

[1] Chukwu JC, Udem MC. Crime, Violence and Security Challenge in Nigeria: Implication on National Development Since 1960. OHAZURUME-Unizik Journal of Culture and Civilization. 2024;3(1).

[2] Musah A, Umar F, Yakubu KN, Ahmad M, Babagana A, Ahmed A, et al. Assessing the impacts of various street-level characteristics on the burden of urban burglary in Kaduna, Nigeria. Applied Geography. 2020;114:102126.

[3] Chainey S, Ratcliffe J. GIS and Crime Mapping: Wiley; 2005.

[4] Eck JE, Weisburd D. Crime places in crime theory. Crime and Place, Crime Prevention Studies. 1995;4:1-33.

[5] Umar F, Johnson SD, Cheshire JA. Assessing the spatial concentration of urban crime: an insight from Nigeria. Journal of quantitative criminology. 2021;37:605-24.

[6] Ibrahim YK, Ahmad AA. The causes of kidnapping and its implications on Nigeria. Liberal Arts and Social Sciences International Journal (LASSIJ). 2020;4(1):1-9.

[7] Ugwuoke CO, Eze OJ, Ameh SO, Mohammed AB, Linus A, Aroh A. Armed robbery attacks and everyday life in Nigeria. International journal of criminal justice sciences. 2021;16(1):186-200.

[8] Adeyemi RA, Mayaki J, Zewotir TT, Ramroop S. Demography and Crime: A Spatial analysis of geographical patterns and risk factors of Crimes in Nigeria. Spatial Statistics. 2021;41:100485.

[9] Onyeneke CC, Karam AH. An exploratory study of crime: examining lived experiences of crime through socioeconomic, demographic, and physical characteristics. Urban Science. 2022;6(3):43.

[10] Adenike ET. Poverty, unemployment and insecurity challenges in Nigeria. Tanzanian Economic Review. 2021;11(1).

[11] Uchechukwu ES, Amechi AF, Okoye CC, Okeke NM. Youth unemployment and security challenges in Anambra State, Nigeria. Sch J Arts Humanit Soc Sci. 2023;4:81-91.

[12] Sun L, Zhang G, Zhao D, Ji L, Gu H, Sun L, et al. Explore the correlation between environmental factors and the spatial distribution of property crime. ISPRS International Journal of Geo-Information. 2022;11(8):428.

[13] Bako AI, Aduloju OTB, Osewa DJ, Anofi AO, Abubakar-Karma AT. Application of participatory GIS in crime mapping of Ibadan North, Nigeria. Papers in Applied Geography. 2021;7(2):183-98.

[14] Daukere B, Yelwa S, Akpu B, Ajani A. Geospatial Analysis of Crime Incidence in Bayelsa West Senatorial District, Bayelsa State, Nigeria. Jalingo Journal of Social and Management Sciences. 2020;2(3):1-22.

[15] Butt UM, Letchmunan S, Hassan FH, Ali M, Baqir A, Sherazi HHR. Spatio-temporal crime hotspot detection and prediction: a systematic literature review. IEEE access. 2020;8:166553-74.

[16] Mugari I, Obioha EE. Predictive policing and crime control in the United States of America and Europe: Trends in a decade of research and the future of predictive policing. Social sciences. 2021;10(6):234.

[17] AtubiI OF. Banditry in North West and North Central Nigeria: Analysis of the Causal Factor and Trend. Journal of Social and Management Sciences. 2022;17(1).

[18] Abdullahi AS, Mukhtar JI. Armed banditry as a security challenge in Northwestern Nigeria. African Journal of Sociological and Psychological Studies. 2022;2(1):45.

[19] [Abumbe GT, Ekpe DE. Ungoverned Spaces and Rural Armed Banditry in the North West Nigeria: A Study of Selected Local Government Areas (2015-2022). Journal of Public Administration, Policy and Governance Research. 2024;2(2):1-11.

[20] Ojo JS, Oyewole S, Aina F. Forces of terror: Armed banditry and insecurity in North-west Nigeria. Democracy and Security. 2023;19(4):319-46.

[21] Ocholi IU, Abuh PO, Samuel A, Musa A. Spatial Pattern and Distribution of Crime in Suleja Lga, Niger State, Nigeria. Journal of Geographic Information System. 2023;15(4):379-90.

[22] Oyinloye MA, Adegboyega SA-A, Akinluyi FO, Komolafe AA, Akinyede JO, Aladejana OO, et al. Detection and mapping of violent crime hotspots in Southwestern Nigeria. Journal of Geographic Information System. 2023;15(3):334-65.

[23] Usman U, Suleiman S, Yar'adua S, Ismail AA. Spatial Analysis on the Crimes Rate Using Regression Kriging Model.(A Case Study of Katsina State). European Journal of Advances in Engineering and Technology. 2021;8(10):64-9.

[24] Daniel US, Udousoro TE, Effiong UU. Population Drift, Crime Rate And Socio-Economic Development In Uyo Capital City, Akwa Ibom State, Nigeria. AKSU Annals of Sustainable Development. 2024;2(1).

[25] Braga AA, Weisburd DL. Does hot spots policing have meaningful impacts on crime? Findings from an alternative approach to estimating effect sizes from place-based program evaluations. Journal of Quantitative Criminology. 2020:1-22.

[26] Hipp JR, Williams SA. Advances in spatial criminology: The spatial scale of crime. Annual Review of Criminology. 2020;3(1):75-95.

[27] Lu B, Harris P, Charlton M, Brunsdon C. The GWmodel R package: Further topics for exploring spatial heterogeneity using geographically weighted models. Geo-spatial Information Science. 2014;17(2):85-101.

[28] R Core Team. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org/. 2023.

[29] Fotheringham AS, Charlton ME, Brunsdon C. Geographically weighted regression: A natural evolution of the expansion method for spatial data analysis. Environment and Planning A. 1998;30(11):1905-27.

[30] Fotheringham AS, Brunsdon C, Charlton M. Geographically weighted regression: The analysis of spatially varying relationships: John Wiley & Sons; 2003.

[31] Sampson RJ, Groves WB. Community structure and crime: Testing social-disorganization theory. American journal of sociology. 1989:774-802.

[32] Anser MK, Yousaf Z, Nassani AA, Alotaibi SM, Kabbani A, Zaman K. Dynamic linkages between poverty, inequality, crime, and social expenditures in a panel of 16 countries: two-step GMM estimates. Journal of Economic Structures. 2020;9:1-25.

[33] Lochner L. Education and crime. The economics of education: Elsevier; 2020. p. 109-17.

[34] Bell B, Costa R, Machin S. Why does education reduce crime? Journal of political economy. 2022;130(3):732-65.

[35] Maldonado-Guzmán DJ. Airbnb and crime in Barcelona (Spain): testing the relationship using a geographically weighted regression. Annals of GIS. 2022;28(2):147-60.