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# ORIGINAL RESEARCH ARTICLE

# Crime hotspots and its effect on socio-economic activities using Geographical Information System (GIS) in 3 selected local government areas in northern Taraba, Nigeria

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## ABSTRACT

This study examines crime hotspots in Northern Taraba, Taraba State, Nigeria, using GIS. The prevalence of crime has escalated in Nigeria and Taraba State, especially in the northern region, where Jalingo, the state capital, is situated. The study focused on identifying crime hotspots in Northern Taraba and assessing the socio-economic consequences associated with high crime rates in the study area. The data was acquired from the field and from the Nigerian Police Force. The findings indicate that the most prevalent offenses are theft (20.9%) and thuggery/cultism (12.9%). The study period revealed that the rates of murder (12.5%), armed robbery (10.8%), kidnapping (6.2%), rape (8%), housebreaking (11.4%), false pretense and cheating (9.4%), mischief (4.4%), and the possession of firearms (3.4%). Jalingo exhibited the highest number of criminal incidents over the past decade, with a total of 3105. Ardo-kola followed with 1285 incidents, while Yorro LGA had the lowest record with 547 incidents. The hotspot of criminal activity is mostly focused on the central regions of Jalingo, Yorro, and Ardo-kola. The vulnerabilities to crime in high-density residential neighborhoods stem from several factors, including uneven plot layouts with narrow dirt streets, the existence of marketplaces, a large population, and the lack of police divisions for reporting crimes. The impacts of crime encompassed resource depletion, hindered development, loss of life, insecurity, property destruction, social isolation, and reputational damage. A substantial percentage of participants expressed strong agreement or disagreement regarding the escalation of crime rates in the surveyed region during the past five years. The study recommends the allocation of resources towards combating criminal activities, particularly in the designated areas with high crime rates. It is also imperative for the Nigerian police to meticulously document crime cases, including the precise geographical coordinates of crime incidents, in order to facilitate hotspot research.

*Keywords:* crime hotspot; northern Taraba; effects; GIS; socio-economic activities

## 1. Introduction

The incidence of crimes such as stealing, terrorism, kidnapping, rape, and murder, among others, has become a daily occurrence in Nigeria in general and in many parts of Taraba State in particular. Chinedu and

Bartholomew[1] have attributed this increase in crime to the rising number of unemployed youths and the country's poor economic situation. The government has allocated billions of naira to curb this rising incidence of criminality without much success[2].

The government has spent billions of naira procuring and distributing equipment such as utility vehicles, communication gadgets, weapons, and bulletproof vests, as well as building and renovating dilapidated police stations. More so, there has been the introduction of Joint Task Force (JTF) operations, the integration of the army, navy, and police force, and other operations to join hands with the police to root out crime and acts of terrorism in the state and the country at large. Among all these efforts from the government, the police still need to be more efficient in controlling and managing crime in the state. This might be attributed to their old and manual ways of fighting crime. Irrespective of the government's massive investment in the Nigerian police force by way of personnel training and crime-fighting equipment, crime has remained the bane of the social and economic well-being of the people of Taraba, especially the northern part of the state, making the once peaceful state now a haven for criminals.

The problem of crime such as stealing, terrorism, kidnapping, rape, murder, and others in Taraba State is an issue because it is primarily a settlers' area inhabited by people from other parts of Nigeria, especially the north-eastern states of Borno, Yobe, and Adamawa, as a result of the Boko Haram insurgency. Based on the state's historical, political, administrative, and nodal attributes, it has witnessed an arithmetic progression in commercial growth, population, and civilization. Simultaneously, it has also witnessed a corresponding and progressive growth in crime. In the Jalingo metropolis and other parts of the northern senatorial district, crime is increasing, occurring in different forms, thus stimulating the need to tackle it before it expands beyond control. It is widely acknowledged that the state is a favourable environment for illegal activity due to its capacity to offer anonymity for individual crimes and the physical space for a well-structured and coordinated criminal underground[3]. As a result of the increasing modernization and social sophistication of the country, inequality, and the continuous rise in unemployment, especially among young school leavers and university graduates, urban crimes have significantly increased in recent times. Kidnapping, for instance, has been on the increase in Taraba State since 2019. The Nigerian Police Force anti-kidnapping unit in Taraba State command, after serious efforts to curb kidnapping in Taraba State, apprehended a young man who pointed to the buildings of people and gave the details of the occupants to the kidnappers in Jalingo. His targets are businessmen and women who he knows can pay ransom and others in the Sabongida area, and they confessed to the crime. Banditry and stabbing have also increased in Northern Taraba. Recently, in the space of 48 h, Jalingo witnessed the stabbing of a teacher to death by an ex-student of the school. At the Taraba State University Mosque, a non-student of the university stabbed a student of the university, which almost caused his death if the university authority did not act immediately.

Despite trying their best, law enforcement agencies are becoming frustratingly helpless as criminals become more sophisticated every day. As a result, the citizens daily grapple with the fear of the unknown and the insecurity of their lives and property, with little or no hope of remedy. Unfortunately, there is little or no application of the inadequate pin-on-maps in some stations within the state, let alone GIS. Moreover, it is worrisome that law enforcement agencies still need to use computerization to facilitate efficient record keeping, case analysis, quick reference and retrieval, and information storage. Computerization is necessary to strategize, effectively organize combat, and eliminate crimes[4].

The non-application of GIS and geo-databases in the fight against crime in this technological age is costly and counterproductive[5]. The means of getting offenders is very limited to the police force and vigilantes as they are not fully exposed to modern technologies that will help them combat crime properly. Considering the area's population density, the emerging dimensions and complexities of crime in Taraba and Nigeria require

serious and proactive crime management programs and control. Such management measures will require adequate information and knowledge of the spatial patterns of crime incidence and hotspots in all settlements to ensure effective monitoring and control. It is, therefore, with this in mind that this research work is carried out. This research explores the analytical approach to crime using GIS technology in northern Taraba.

Globally, there is an increasing number of crime rates due to the new socioeconomic order, and this has raised the need to find new ways to handle information about criminality. The term crime is rich in meaning, expressed simply as a violation of the law involving a victim and an offender. Laws, however, vary between and within nations. Crime is a human phenomenon that violates the existing laws of any country and is punishable under various existing countries' laws[6]. A crime is an act or an instance of negligence against the law and is punishable upon conviction. A crime against an individual includes any threat of force or the actual use of force against somebody, as well as accidents that result in death due to an individual's intent or negligence. Crime is a universal phenomenon and has always been associated with society.

Crime is a pervasive issue that governments worldwide grapple with since numerous innocent individuals suffer injuries and fatalities as a result of the actions of criminals around them. Crime is a significant issue of human security that people worldwide face[7]. Nations like the United States of America, Mexico, Mali, South Africa, Yemen, Afghanistan, Iraq, and Nigeria, among others, have a course to contend with rising incidences of crimes like homicide, robbery, and cybercrime, among others. Undoubtedly, insecurity in towns and cities is a significant challenge to the Nigerian authority and its security operatives. The occurrence of crime in Nigeria does not differentiate between social classes since both the affluent (haves) and the less privileged (have-nots) are equally susceptible to encounters with criminals regularly[4,8]. The negative consequences, such as tragedy, suffering, significant loss, and grief caused by those harmful trips, have been widespread and have had a lasting impact on our national mindset and social harmony[8]. Global criminal activities encompass a range of offenses, such as armed robbery, kidnapping, banditry, drug trafficking, traffic violations, rape, murder, drug abuse, corruption, assault, and stalking[9,10].

Protecting lives and properties in human settlements is crucial for the economic, health, and overall welfare of individuals in any community. Crime is a significant societal issue that requires careful consideration since its prevalence contributes to the economic, social, and psychological hardships experienced by the majority of individuals. Violence and property offenses have emerged as a significant global peril to human life and socioeconomic endeavors[11].

In 2017, the United Nations Office on Drugs and Crime (UNODC) observed that crime fuels corruption, infiltrates business and politics, and destabilizes the growth and development of any society. The UNODC maintained that crime undermines governance, as it makes life miserable, short, and harsh, continues to instill fear in people, and generates a general sense of insecurity around them[12]. Salim[13] noted that various variables like poverty levels, family stability, individual and societal health, and demographic and political considerations are related to and have an influence on crime. Crime affects the victims' psychological, financial, physical, and spiritual well-being[14]. The effects of crime on the socioeconomic stability of society cannot be overemphasized, as people always have the fear of being attacked or killed by criminals.

The inability of security agencies to effectively combat societal crimes has adversely retarded growth and development in most communities, states, and countries around the world[15,16]. According to Ejemeyovwi[17], for a crime to occur, there must be victims, offenders, and properties located at a point over a given period, just as Mehran[18] defined crime as an act that seems to violate and breach an existing law of a state. For a crime to occur, there needs to be an individual motivated to commit the crime, a target suited for the crime, and lacking any form of protection such as closed circuit television (CCTV). Balogun et al.[8] observed that the

quick report of up-to-date information on crime-prone areas to security agencies would contribute to effective policing, thereby reducing crime in society.

The spatial distribution of criminal activity is assumed to be unequal[19]. They tend to concentrate in certain places for reasons that have been explained about the interaction of victims and offenders and the strength of guardianship[19]. Crimes vary according to the time and place where they occur. Areas of concentrated crime are often referred to as hotspots. An accurately identified and visualized crime hotspot map will significantly benefit police practices by aiding threat visualization, resource allocation, and crime prediction[20]. A geographic view of crime can add another dimension to understanding the nature of the crime, its occurrence, and its location. In order to gain a deeper understanding of the reasons, security authorities at the local, regional, and national levels have utilized advanced decision-support tools like Geographic Information Systems (GIS) and other information technologies[21]. These tools assist them in identifying more effective solutions[22,23].

The development of user-friendly GIS tools has facilitated the growth of crime mapping and analysis inside law enforcement agencies[22,23]. GIS enthusiasts may readily access software, training, and resources related to this field. Analysts at law enforcement agencies utilize crime mapping to effectively map, visualize, and analyze patterns of criminal incidents. Geographic Information Systems (GIS) facilitate crime mapping, enabling crime analysts to identify hotspots of criminal activity and various trends and patterns[24].

Therefore, Geographic Information Systems (GIS) and data mapping applications for crime mapping have become necessary in law enforcement agencies worldwide, making them one of the most valuable tools available. GIS enables analysts to superimpose additional datasets, such as census demographics, store, bank, and school locations, etc., in order to gain a deeper understanding of the root causes of crime and assist law enforcement authorities in formulating effective plans to address the issue. GIS is valuable for law enforcement activities, including allocating police officers and dispatching them to emergencies[25].

A Geographic Information System (GIS) utilizes geography and computer-generated maps to integrate and retrieve vast quantities of location-based data. GIS enables police personnel to strategize emergency response efficiently, prioritize mitigation efforts, analyze past incidents, and forecast future occurrences[23,26]. GIS can also provide essential information to emergency responders upon dispatch or on their journey to an incident, aiding in strategic planning and response. GIS aids in the identification of prospective suspects, hence expanding the pool of individuals under investigation when no leads are apparent. Geographic Information Systems (GIS) are crucial in crime mapping and analysis. Response capabilities frequently depend on diverse data obtained from numerous agencies and sources. Agencies can allocate resources more efficiently by accessing and processing information rapidly while presenting it in a spatial and visual style. In law enforcement, timely and accurate information regarding the location of a crime, incident, suspect, or victim is paramount in determining the appropriate and proportionate response[26]. A Geographic Information System (GIS) utilizes geography and computer-generated maps to integrate and retrieve vast quantities of location-based data. GIS enables police personnel to strategize emergency response efficiently, prioritize mitigation efforts, analyze past incidents, and forecast future occurrences[23,26]. GIS can also provide essential information to emergency responders upon dispatch or on their journey to an incident, aiding in strategic planning and response. GIS aids in the identification of prospective suspects, hence expanding the pool of individuals under investigation when no leads are apparent. Geographic Information Systems (GIS) are crucial in crime mapping and analysis. Response capabilities frequently depend on diverse data obtained from numerous agencies and sources.

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This software is utilized globally by police departments of various sizes to offer mapping solutions for crime investigation, criminal tracking, traffic safety, community policing, intranet/internet mapping, and various other functions. GIS aids law enforcement officials in identifying probable crime locations by analyzing intricate, apparently unconnected factors and presenting them in a visual, multi-layered spatial interface or map. Additionally, it aids in the identification and segregation of gang members, high-risk or possibly violent offenders, and hazardous areas within a facility, thereby ensuring the protection of convicts. Enhanced command and control capabilities lower the likelihood of internal violence. Integrating GIS features with position identification devices like GPS enables monitoring the movement of high-risk convicts or at-risk workers within a specific area[26]. The cost-effectiveness of having the crime analyst generate the information outweighs the alternative of patrol personnel doing it themselves.

Crime mapping has been a crucial component of the crime analysis process for a significant period[8,27]. The use of maps in crime studies has been traced back to at least 1900 (New York City Police Department). Most developed nations have migrated from the "pin on maps" to computer GIS. Unfortunately, most developing nations, including Nigeria, still utilize analog and outdated file systems. In most cases, police operations are carried out based on intuition, tip-off information, and the simple "trial-and-error" method.

Furthermore, the old pin maps helped show where crimes occurred, but they had severe limitations because the prior crime patterns were lost as they were updated. The maps, being analogs, are usually challenging to manipulate. In addition, pin maps are tricky to read when several types of crimes, usually represented by pins of different colors, are mixed. Pin maps occupied much space, wasted much time, and needed to be more capable of developing a logical national database. Based on these disadvantages, researching a better way to map and manage crime becomes paramount.

It is important to state that some studies similar to ours exist, such as Crime Mapping and Hotspots Assessment in Jalingo metropolis, Taraba State, Nigeria[28], which used GIS to analyse crime data in Jalingo, the capital of Taraba State. It identified crime hotspots, investigated spatio-temporal patterns of crime, and assessed the relationship between crime and socio-economic factors. The study found that crime was concentrated in specific areas of the city and that there was a positive correlation between crime rates and poverty, unemployment, and population density. The weakness of the Okonofua et al.[28] study was that it only examined Jalingo, while our study covered three local government areas with Jalingo inclusive to provide more insight into crime flow effects and control in the city centre and its environs.

Similarly, in Geospatial Appraisal of Crime Hotspot Distribution in Bauchi Metropolis, Baba et al.[29] employed GIS to map and analyse crime hotspots in Bauchi, another city in Northern Nigeria. It used crime data from the police force and identified areas with high concentrations of different types of crime. The study also examined the influence of environmental factors, such as land use and infrastructure, on crime distribution. Though this study was conducted in one location, the northeast, the study area and its crime scenarios are totally different from our study in Northern Taraba, which covered three LGAs.

Additionally, crime mapping and hot spot analysis using geospatial data in the Jalingo metropolis of Taraba State, Nigeria[30] are similar to our study. However, the striking difference between it and the current study is that our crime data covered a longer period and covered more local government areas, including Jalingo, which was their focus. It also used GIS to map crime incidents and identify hotspots, but only in Jalingo. The study further analysed the temporal variations in crime rates. It explored the potential factors contributing to crime occurrence, but it did not cover the socio-economic effects on citizens. It is important to note that while these studies provide valuable insights, the specific context of Northern Taraba requires additional research to fully understand the unique crime patterns and their impacts on the region's socio-economic activities.

This study on crime hotspots and their effect on socioeconomic activities in Northern Taraba answered the following questions: What are the different kinds of crimes recorded in the study area? What is the spatial distribution of crime in the study area for the past 10 years? Where are the high crime density areas (hotspots) in the study area? Moreover, what are the socioeconomic costs of high crime rates in the study area?

# 2. Materials and methods

## 2.1. The study area

The study area, northern Taraba (6°30′ and 9°36′N; 9°10′ and 11°50′E), is situated in north-eastern Nigeria, along the Nigerian-Cameroun border[31]. It is bordered on the north by Bauchi State, in the east by Adamawa State and Plateau State to the west, and in the northeast and southwest by Gombe State and Gassol local government areas, respectively (**Figures 1** and **2**).
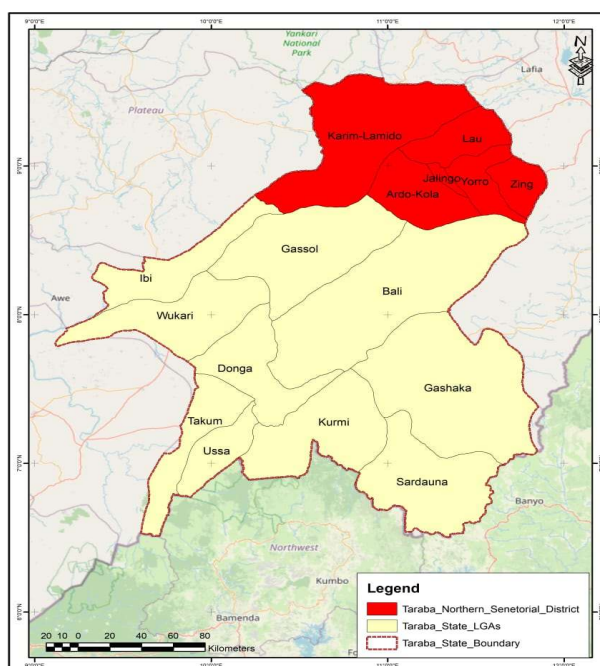


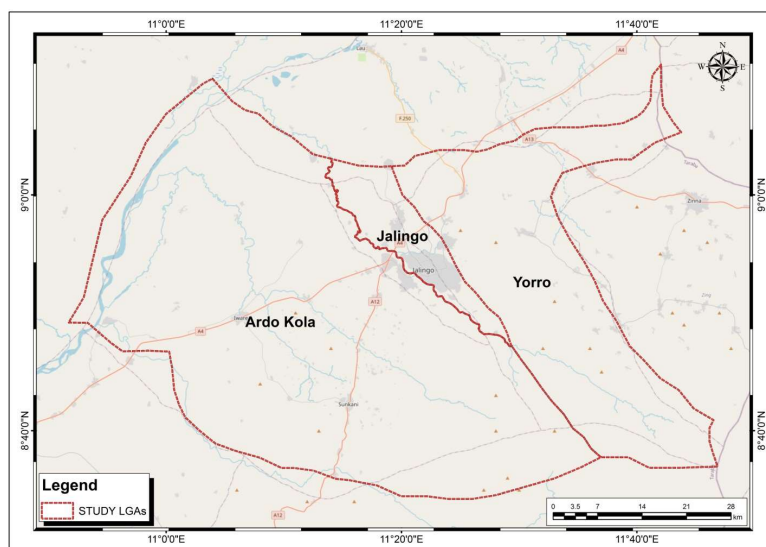**Figure 1.** Map of Taraba showing the northern Taraba.

**Figure 2.** Map of the study area.

**Climate and seasons:** The climate of the study region is characteristic of a tropical, humid region. It is characterized by alternate periods of dry and wet spells with a mean annual rainfall of about 1300 mm, distributed over seven months (April to October), with a peak in August[32]. It has a mean minimal and maximum temperature of about 21.30 °C and 34 °C in December and April, respectively, and an earth temperature of 0–20 cm and a soil depth of 25–30 °C. The mean annual evaporation is approximately 10 mm; relative humidity could be as high as 77.9% and as low as 16.3% between August/September and February/March, respectively. The area receives high radiation (5.7 h daily) and moderate to light wind speed[32].

**Geology and soils:** The soil types are the tropical ferruginous and lithosol soil groups derived from basement complex formations and deposits of Tertiary rocks[31]. A sandy surface horizon with clay subsoil characterizes it. The soil is naturally fertile for agricultural productivity and susceptible to erosion[33], especially on hill slopes and flood plains, where land is used beyond its capabilities, using techniques of soil and crop management that are ecologically incompatible.

**Vegetation:** Nigeria possesses a land area of 923.769 km$^2$, with the Savanna region accounting for approximately 86% (794,441 km$^2$) of this total[33]. The Savanna region is characterized by the presence of four primary ecological zones, namely the Derived Savanna, Guinea Savanna, Sudan, and Sahel Savanna. Martensson[33] conducted a further classification of the Guinea Savanna, resulting in the subdivision of this region into two distinct sub-regions: the Southern Guinea Savanna and the Northern Guinea Savanna. The latter encompasses an approximate size of 600,252 km$^2$, which accounts for 60% of the entire landmass of the nation[32]. The research area is situated inside the northern Guinea Savanna, an ecological region characterized by a combination of short grasses and a sparse tree population. Additionally, the area has protected forest reserves, as documented by Yusuf et al.[31]. Several species of trees are known to include locust bean, Shear butter, eucalyptus, baobab, and silk cotton tree.

**Demographic characteristics:** According to the 2006 National Population Census, the population of Taraba State was recorded at 2,300,736 individuals. The state exhibits an annual population growth rate of approximately 3.1%. According to the findings of Oruonye and Bashir[34], it is estimated that the state population will reach a total of 2,599,521 individuals by the year 2010, based on the observed growth rate.

From an administrative perspective, the research region is situated within six local government areas in Taraba State, namely Ardo Kola, Jalingo, Lau, Karim-Lamido, Yorro, and Zing. There exists a total of sixty-

two districts within the six local government areas. According to the TADP[35], there exists a variation in the number of major villages within each district, ranging from 21 to 47. Furthermore, it is estimated that each village is home to from 305 to 874 agricultural families.

The research area exhibits a wide ethnic composition, with the Mumuye, Fulani, Jibukona, Wurkum, Jenju, Karimjo, Chamba, Bandawa, Yandang, and Kunini groups being the dominating populations[34]. The research area has a significant presence of many ethnic groups, among which Karim Lamido stands out as the most diversified[34].

**Land use:** Agriculture is the predominant traditional livelihood pursued by the inhabitants residing in the northern region of Taraba State, as documented by Yusuf and Ray[36]. The agricultural system and practice exhibit typical subsistence farming characteristics, primarily consisting of mixed or single cropping[31]. The sizes of farms exhibit variation based on geographical location, which is influenced by factors such as population density, farm accessibility, and the individual tastes of the tenants. Guinea grain, maize and yam are the primary agricultural commodities, extensively cultivated by nearly every farming household. Additional crops commonly cultivated in the region include millet, rice, cassava, potatoes, groundnuts, beans, and vegetables. In order to mitigate the potential for soil erosion and protect the long-term productivity of soil and crops, farmers commonly cultivate a diverse range of crops. Farming activities typically rely heavily on manual labor. They are predominantly characterized by using traditional techniques involving rudimentary instruments such as hoes, cutlasses, machetes, and axes. These tools have been handed down several generations ago[36]. The research area exhibits a significant presence of animals, particularly cattle, goats, sheep, pigs, and poultry. Culturing crops and raising livestock pose a significant risk to the inherent resilience of the local vegetation, thereby leading to soil degradation.

## 2.2. Research method

This study employed a descriptive survey research design. The selection of this particular design is predicated upon the researcher's interest in examining the pre-existing conditions within the field under investigation. The research design was carefully constructed to ensure that no variables were altered.

This study included two methodologies. The initial phase involved conducting a reconnaissance survey, followed by administering questionnaires. These methods were employed to acquire a comprehensive understanding of the research area. For the objective of this study, questionnaires were administered, and reports on crimes committed during ten years (2012–2021) were acquired from police stations located in three designated local government areas within the northern senatorial district of Taraba State. The aforementioned local government districts encompassed Jalingo, the capital of the state, as well as Yorro and Ardo Kola local government areas. The researcher gained insight into the primary categories of criminal activity occurring in the study area using the information obtained from local police stations. Additional surveys were administered to collect data from the general public. The questionnaires were delivered randomly to persons residing in the specified places. This methodology evaluated the crime situation and its impact on socioeconomic activities within the designated study area. The second approach involved a systematic methodology for utilizing Geographic Information Systems (GIS) in managing crime, leveraging the geographical attribute data acquired through field data collection. By obtaining the crime report provided by the police stations, which included information regarding the types of crimes perpetrated and the diverse areas where these crimes occurred, it became feasible to gather the coordinates corresponding to the crime locations. The geographic coordinates of the indicated locations were acquired through handheld GPS devices. Typically, inquiries about crime location, time and date of occurrence, government agency involvement or intervention, and local security measures

were posed prior to the implementation of mapping procedures on spatial attribute data. Multiple sources of information were critically analyzed to ascertain the legitimacy and credibility of the data.

The research area's crime data, gathered from police stations and the responses from the conducted public questionnaire, were used to identify the various crime categories. A comprehensive inventory of all categories of criminal activities observed within the designated research region was compiled. A database containing these records was established within the ArcGIS environment to facilitate the retrieval and analysis of information.

The spatial distribution of crimes in the research area was investigated using ArcGIS software, as reported by Olusina and Olaleye[23]. The spatial data was plotted within the ArcGIS environment, wherein the attribute table displayed comprehensive information regarding the crime location, the nature of the crime, and the temporal aspect. This analysis involved examining the locations, properties, and connections of elements in spatial data using overlay and other analytical approaches. The purpose was to gather knowledge that could be employed in many aspects of the research analysis.

Kernel Density Estimation in ArcGIS delineated the spatial distribution of high crime concentrations within the designated study region. This is an approximation of the percentage of overall criminal activity that is likely to take place in a specific geographical point on a map. The process involves superimposing a designated rectangular grid onto a specified region of interest. The subsequent step is the computation of an approximation for the crime density within each grid cell, utilizing a weight function known as the Kernel. The Kernel is a mathematical function characterized by its predetermined shape and bandwidth, representing the search radius. The Kernel Density Estimation is given by the Equation (1)[37]:

$$f(x,y) = {}^1\!/_{nh^2} \sum_{i=1} K\binom{di}{h} \tag{1}$$

where f($x$, $y$) is the density estimate at location ($x$, $y$), h is the search radius (bandwidth or kernel size), $n$ is numbers of observations (total number of crimes), $K$ is a kernel function and di is the distance between the location ($x$, $y$) and location of the $i$th observation.

The mean and standard deviation of the kernel density estimation was used to determine the hotspot and also a raster map was generated, where the intensity of crime is presented by continuous surface.

## 3. Results and discussions

### 3.1. Prevalent types of crimes committed in northern Taraba

In an attempt to identify the types of crime committed in the study area, the police divisions in various local governments, area command, and state command records for ten years from 2012 to 2021 were analyzed, and the result is presented in **Table A1**, and **Figure 3**. **Table A1** displays crime data for various places, latitude, and longitude information in an unidentified region. The total number of crimes committed in the study area is displayed horizontally. In contrast, the total number of all crimes committed in each ward of the study area is displayed vertically. In addition to the total number of crimes, the list of crimes includes murder, armed robbery, kidnapping, rape, theft, housebreaking, False pretense and cheating, mischief, and thuggery/cultism. Theft (20.9%) and thuggery/cultism (12.9%) were the offenses with the most significant incidents noted practically everywhere. Murder, armed robbery, kidnapping, rape, housebreaking, false pretense and cheating, mischief, and the passion for firearms are 12.5%, 10.8%, 6.2%, 8%, 11.4%, 9.4%, 4.4%, and 3.4%, respectively during the study period.
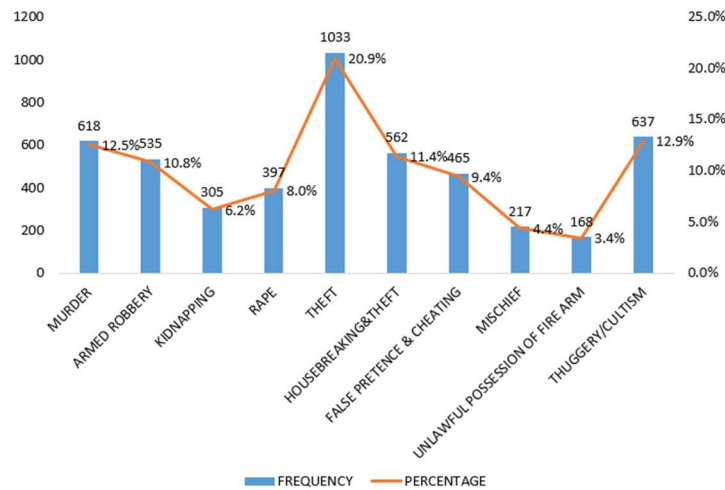
**Figure 3.** Prevalent types of crimes in northern Taraba.

Author's analysis.

## 3.2. Spatial distribution of crime in northern Taraba

The spatial distribution of crimes in the study area is presented in **Figure 4**. This shows that Jalingo, the state capital, had the highest crime incidences of 3105 in the past ten years. This is followed by Ardo-kola, with 1285 crime incidences. Yorro LGA, with the lowest record, had five times less than Jalingo, with 547 crime incidences.
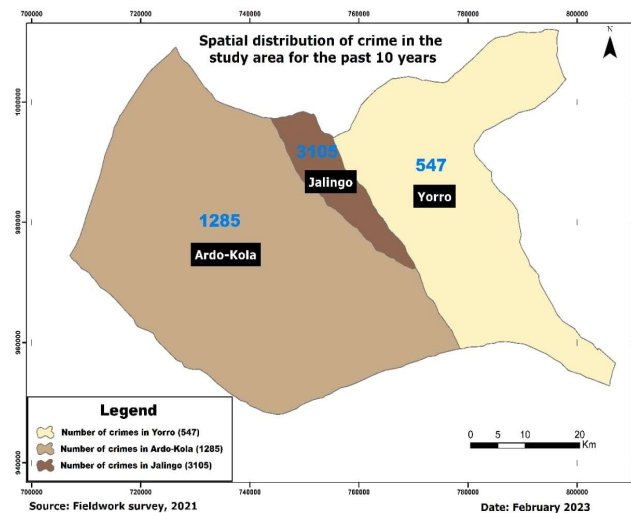


**Figure 4.** Spatial distribution of crime in the study area.

Author's analysis.

## 3.3. Crime hotspots in northern Taraba

Maps illustrating the spatial distribution of crime hotspots were generated using geocoded crime data from police divisions within the designated study area. These maps illustrate overall crime hotspots and distinct categories of crime hotspots. Kernel density hotspot maps were generated for every type of crime in the region.

**Figure 5** displays the spatial distribution of reported crimes within the study zone, revealing that crime tends to be concentrated in the central areas of the towns comprising the study area. The susceptibility to criminal activities in high-density residential areas, commonly called urban villages, can be attributed to several factors. These include the presence of irregular plot layouts characterized by narrow, unpaved streets,

the existence of bustling markets, a significant population size, and the lack of dedicated police divisions for reporting crimes[38].
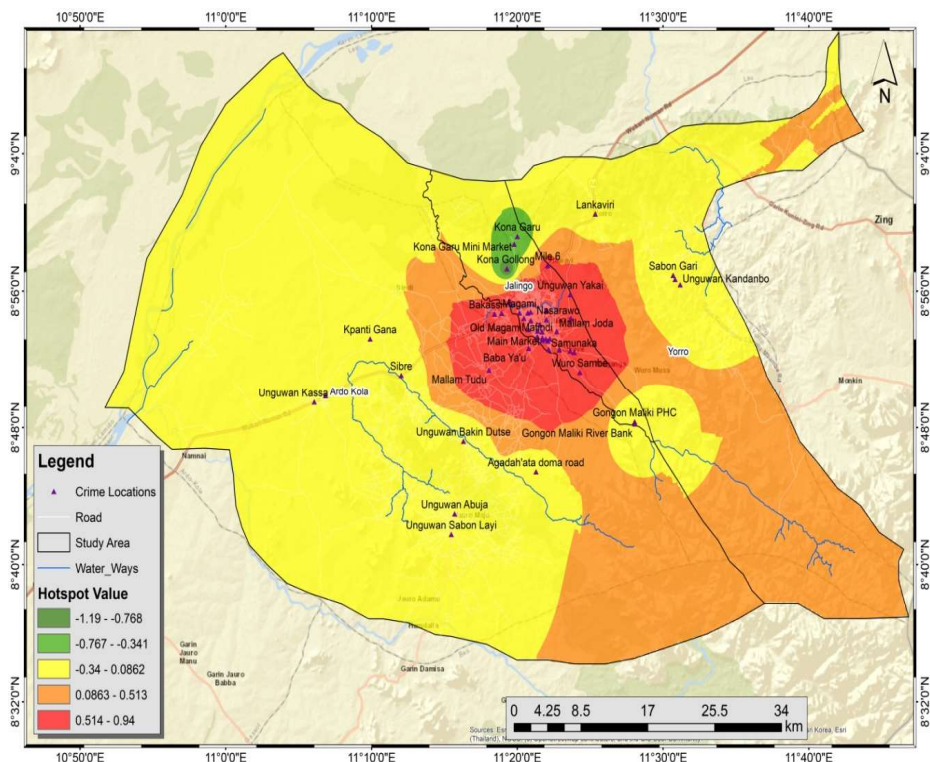


**Figure 5.** Hotspot of crime.

Author's analysis.

**Figure 6** shows the crime hotspot of armed robbery. The areas with red spot show the places with high rate of armed robbery, while the spots marked yellow has the least cases of armed.
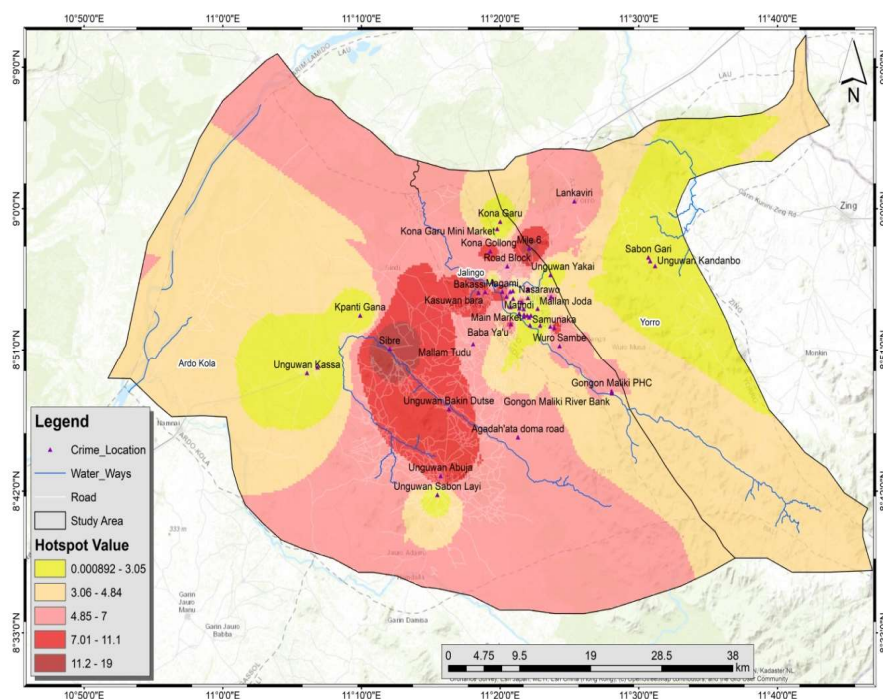


**Figure 6.** Hotspot of armed robbery.

Author's analysis.

The crime hotspot map emphasizing kidnapping cases in the designated area is shown in **Figure 7**. The shows that kidnapping is a common crime in the study area as all the three local government areas sampled has witness the case.
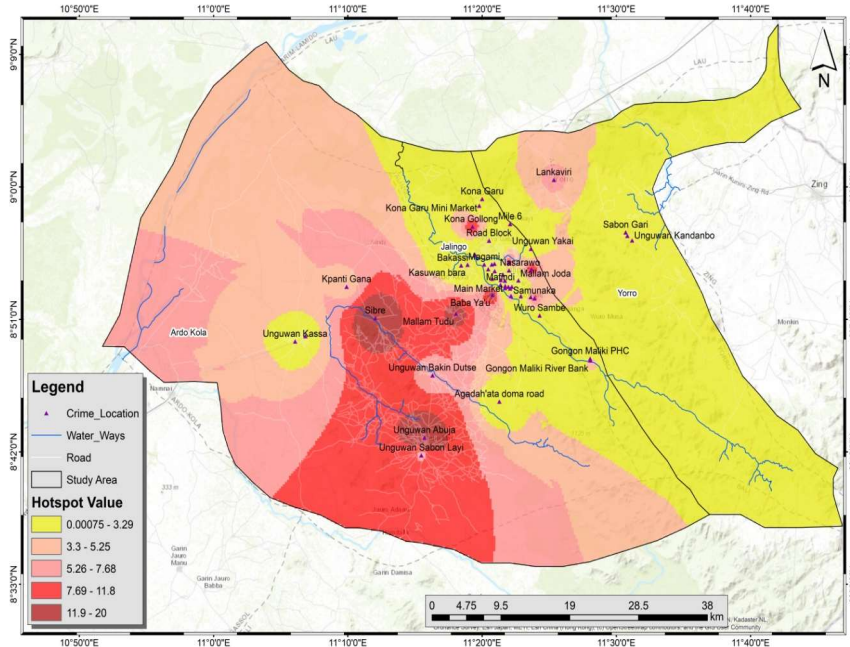


**Figure 7.** Hotspot of kidnapping.

Author's analysis.

The research areas for false pretense and cheating hotspot are seen in **Figure 8**. The map shows that the main regions where false pretense & cheating is significantly prevalent are Nukkai and Mafindi.
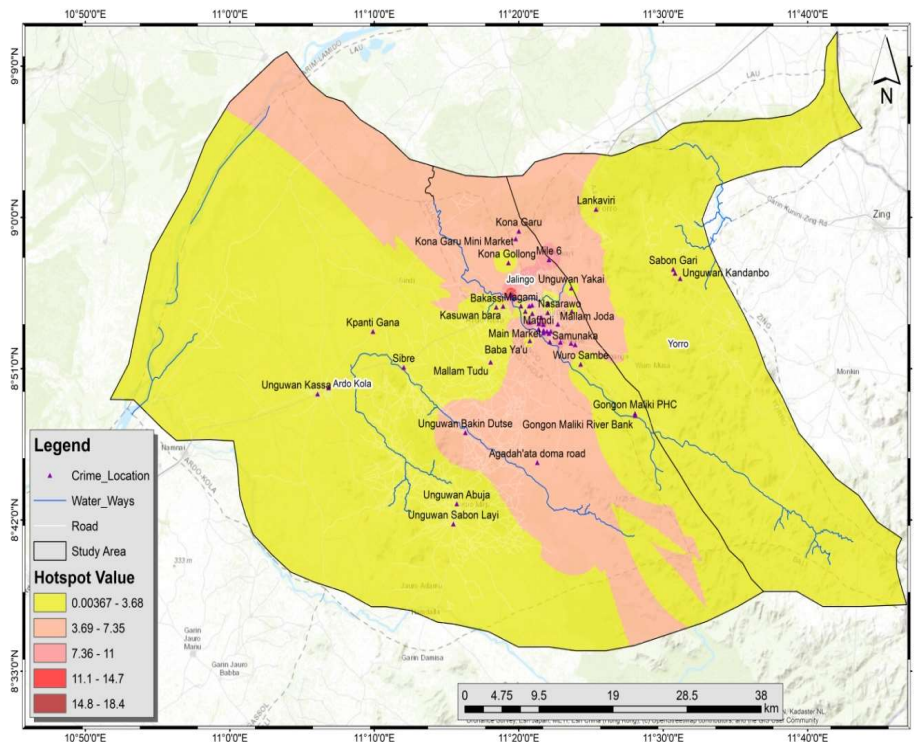


**Figure 8.** Hotspot of cheating.

Author's analysis.

**Figure 9** shows a map of crime hotspots that focuses on house breaking and theft that have occurred in the area under investigation. The map shows that there are further hotspots spreading toward the northern regions of the research area, with the center region experiencing a substantial prevalence of house breaking and theft.
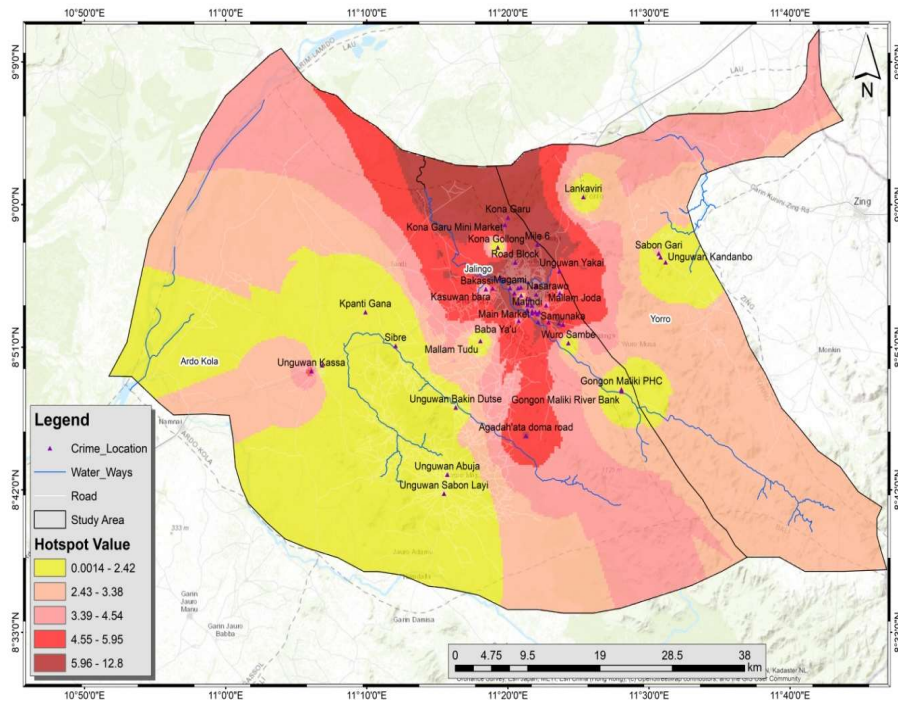


**Figure 9.** Hotspot of house breaking and theft.

Author's analysis.

A map of crime hotspots that highlights Mischief within the research area is shown in **Figure 10**. The map clearly shows that Ardo kola has the highest density of this crime.
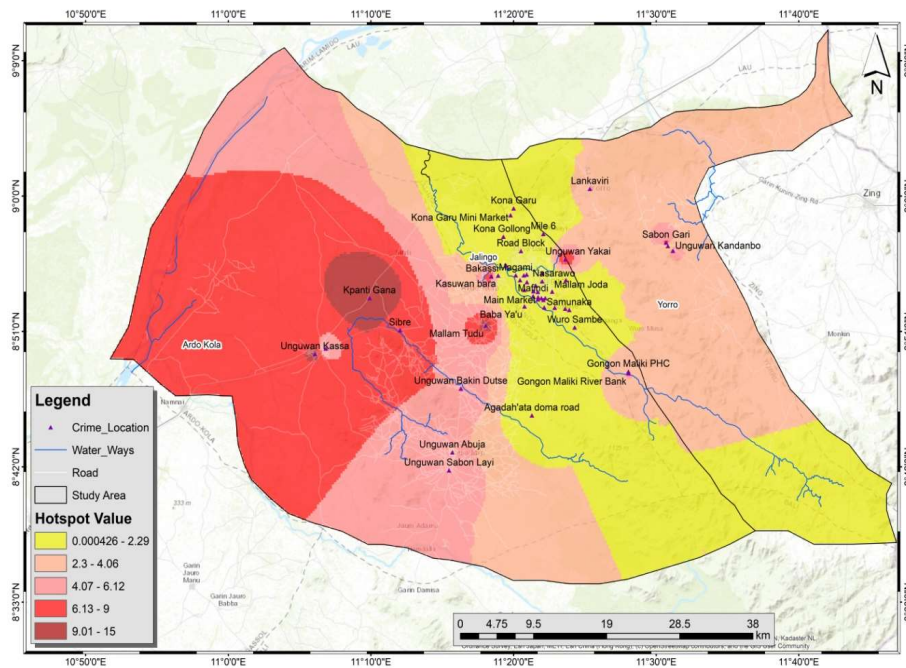


**Figure 10.** Hotspot of mischief.

Author's analysis.

The hotspot of murder is depicted in **Figure 11**, which shows that the research area's Kona Garu, Kona Mini Market, Kona Gollong, Sibre, Nukkai, and Nasarawo locations had a significant concentration of murder cases. These can be linked, among other things, to the towns' overall low economic activity and poverty. The study's findings are consistent with those of Adewuyi, et al[39] in Abuja Municipal, who found that homicide crime is influenced by the amount of economic activity in a given area.
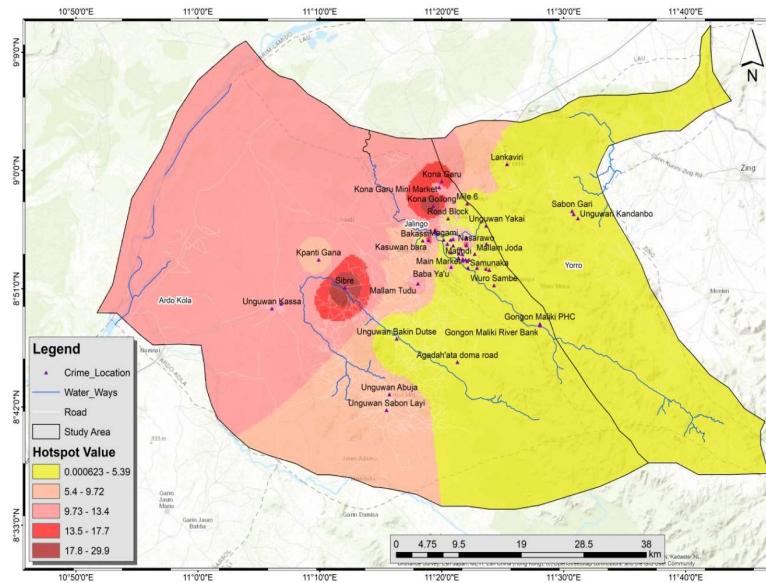


**Figure 11.** Hotspot of murder.

Author's analysis.

The distribution of rape-related hotspot crimes in the research area is shown in **Figure 12**. The graph shows that Agadah'ata Doma Road and the center to northern regions have a disproportionately high prevalence of rape. Agadah'ata Doma Road is a notoriously active area for rape crimes. This shows that local variables might contribute to a higher occurrence of these crimes in this area. Numerous elements, such as inadequate lighting, a lack of surveillance, or restricted access to law enforcement resources, may impact. To identify the root reasons, more research and analysis would be required.
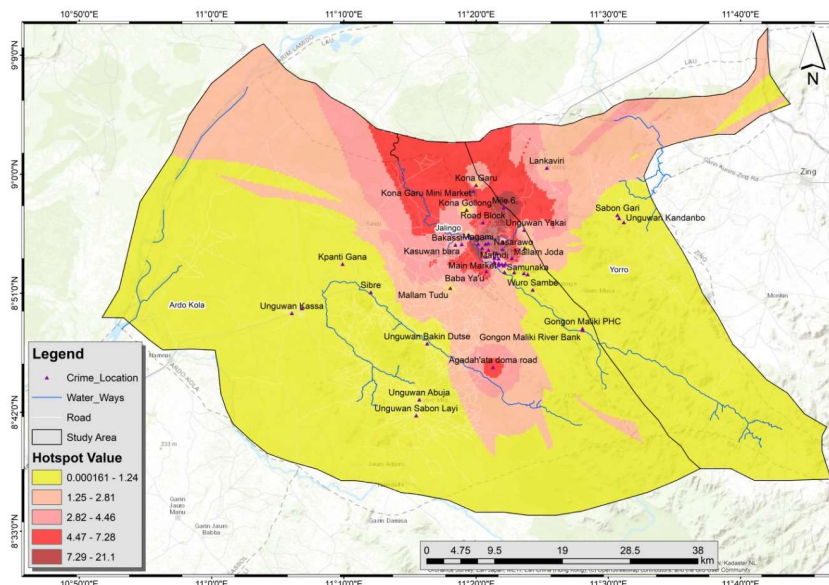


**Figure 12.** Hotspot of rape.

Author's analysis.

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Additionally, rape crimes are more prevalent in the research area's center to northern parts. This pattern can signify particular socioeconomic or demographic traits that make these areas more prone to such crimes. Higher crime rates may be caused by elements like poverty, social inequality, and restricted access to healthcare or education.

The location of theft-related crime hotspots in the research area is shown in **Figure 13**. The figure shows that theft offenses are prevalent practically everywhere but primarily concentrated in a few regions, including Sibre, Unguwan Bakin Dutse, Wuro Sembe, Mile 6, Nukkai, and Magami. These places have theft hotspots, implying they can be more prone to property-related crimes. Various circumstances may cause this pattern. For instance, locations with a large concentration of homes or businesses may see increased criminal activity. Additionally, places with insufficient security measures, such as poor illumination or a lack of law enforcement presence, may make it easier for criminals to operate.
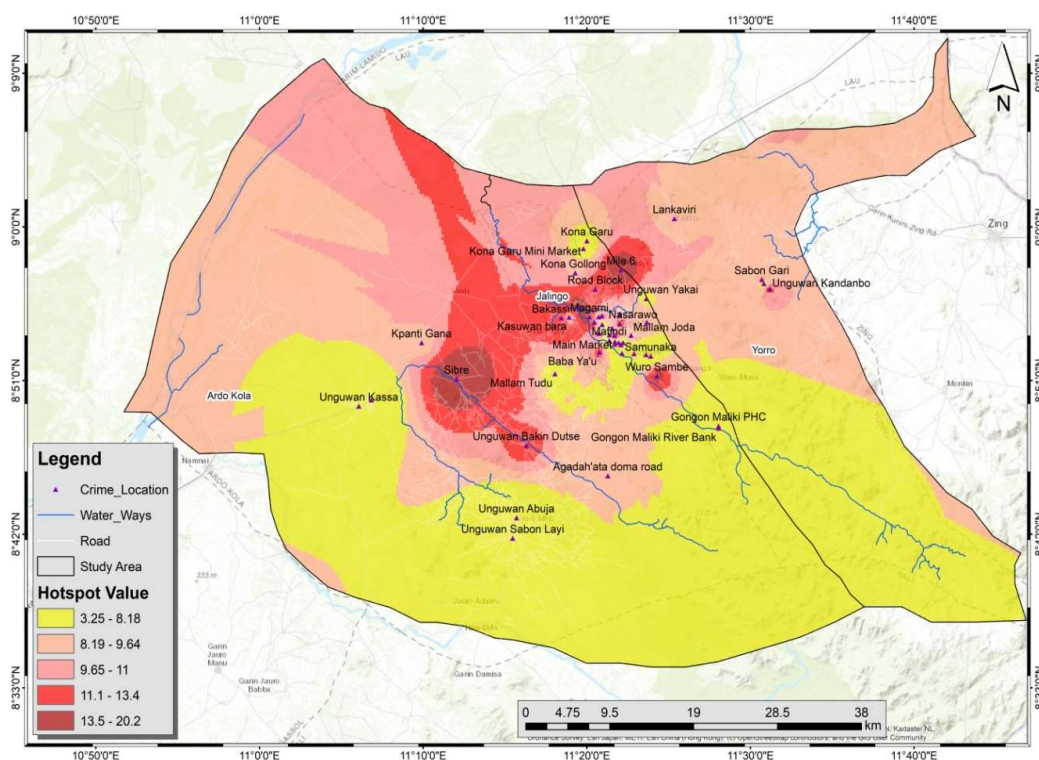


**Figure 13.** Hotspot of theft.

Author's analysis.

The distribution of thuggery-related crime hotspots in the research area is shown in **Figure 14**. The figure shows that specific localities, such as Lankaviri, Unguwan Abuja, Unguwan Sabon Layi, and several central areas, are disproportionately concentrated in thuggery offenses. The high frequency of thuggery crimes in these localities raises the possibility that local characteristics make such crimes more common there. Thuggery frequently entails violent, intimidating, and harassing acts, all of which can be impacted by a variety of socioeconomic, cultural, and demographic factors. There might be particular social dynamics, rivalries, or conflicts in places like Lankaviri, Unguwan Abuja, and Unguwan Sabon Layi that contribute to a higher prevalence of thuggery. Political tensions, resource competition, or the presence of organized groups are just a few examples of factors that might lead to acts of violence and thuggish conduct.
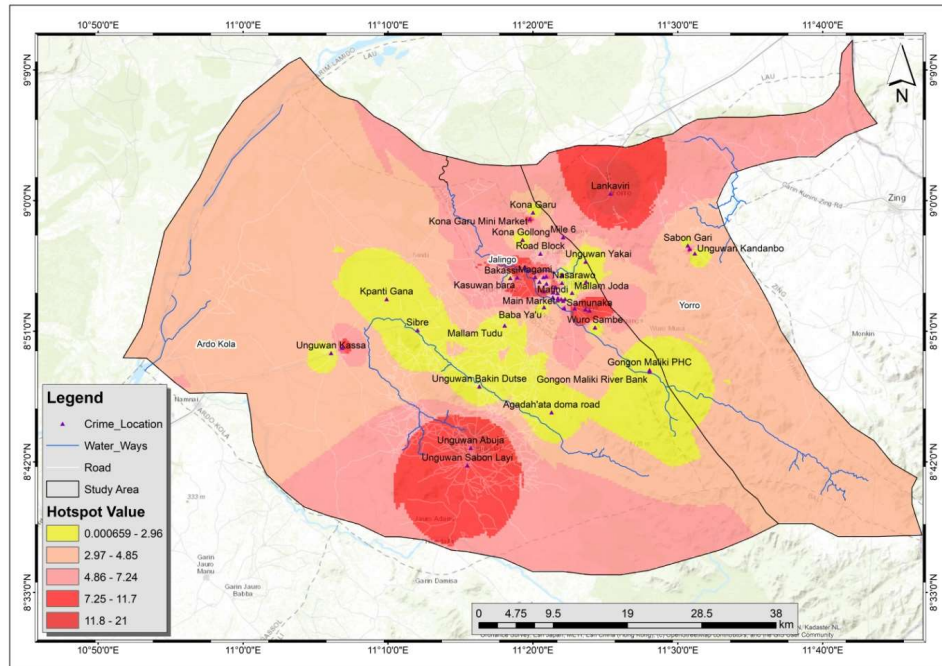
**Figure 14.** Hotspot of thuggery/cultism.

Author's analysis.

**Figure 15** displays the distribution of crime hotspots related to the unlawful possession of firearms in the study area. The figure indicates that this particular crime is predominantly concentrated in Sibre and Kona Garu. The prevalence of unlawful possession of firearms in Sibre and Kona Garu suggests the existence of specific factors that contribute to a higher incidence of this crime. Various factors, including social, economic, and cultural aspects, can influence unlawful possession of firearms.
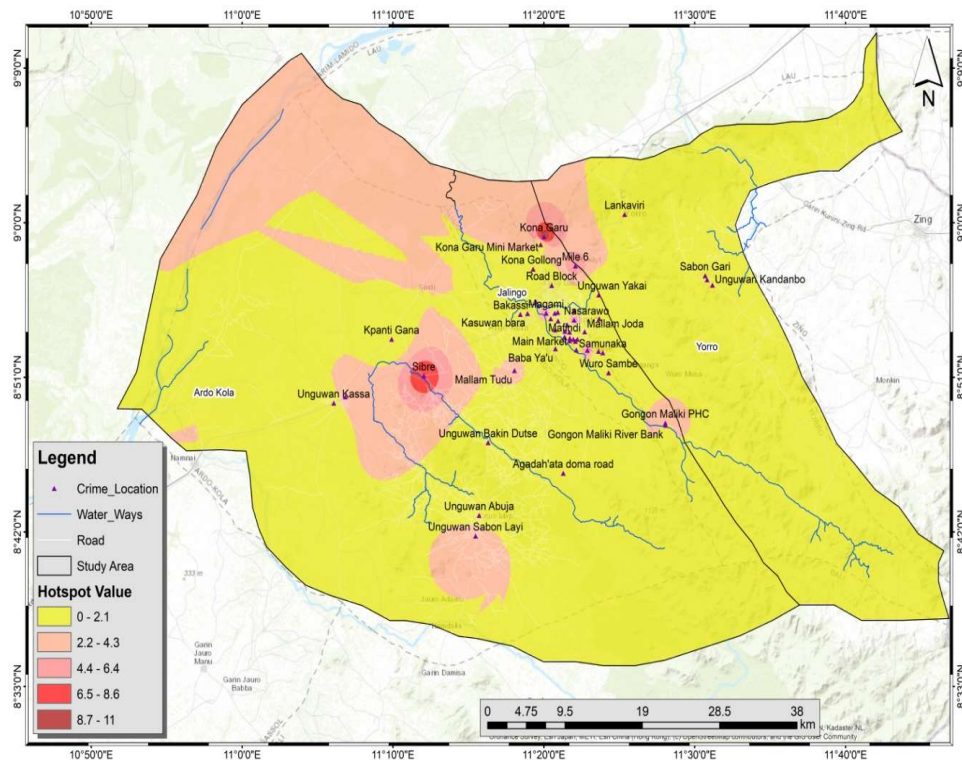


**Figure 15.** Hotspot of unlawful possession of fire arm.

Author's analysis.

### 3.4. Effects of high crime rate on the socioeconomic activities in northern Taraba

**Figure 16** shows the impact of crime on socio-economic activities in the study area. The various effects of crime are categorized as Lost Resources (36.4%), Under-development (25.3%), Loss of Lives (18.5%), Insecurity (16.4%), Destruction of Properties (1.9%), Social Withdrawal (1.1%), and Bad Image (0.4%). These results show that resources such as mineral deposits and economic trees like the African rosewood have entirely been lost to crime in Northern Taraba, thus leading to underdevelopment. The loss of lives and Insecurity have characterized socio-economic activities. These crimes led the state government to bind all mining and forest logging activities. They contacted various federal security agencies, such as the army and the navy, to have their presence active in the Taraba State capital, Jalingo, in 2023.
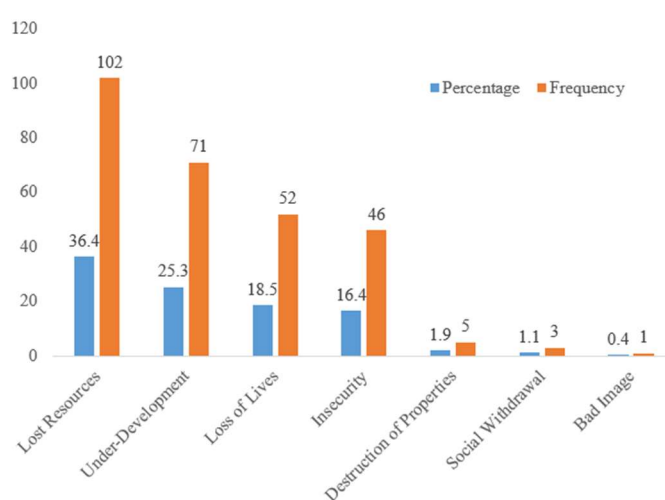


**Figure 16.** Effects of crime on socio-economic activities.

Author's analysis.

**Table 1** displays the extent to which crime impacts socioeconomic activity in the research area, as determined by respondents' level of agreement or disagreement with certain claims. Based on the provided data, a significant number of respondents express a strong inclination or general agreement with the notion that the crime rate has witnessed an escalation over the course of the past five years. Specifically, out of the total sample, 142 persons (constituting 47.33% of the respondents) strongly agree, while 137 individuals (representing 45.67% of the respondents) express agreement. A mere 0.33% of the participants expressed dissent towards this assertion. A significant proportion of participants express a high concurrence or general agreement with the correlation between crime and the escalation of both the poverty rate and poverty prevalence within the locality. A total of 142 participants, accounting for 47.33% of the sample, expressed strong agreement, whereas 139 individuals, representing 46.33% of the sample, expressed agreement with the aforementioned statement. In relation to the influence on Small and Medium Enterprises (SMEs), as argued by Kartalis[40], a total of 149 individuals (49.67%) expresses strong agreement, while 130 individuals (43.33%) express agreement, with the notion that criminal activities have impeded the progress of SMEs. A minority of individuals (0.33%) expressed dissenting views regarding this remark. Moreover, a substantial majority of participants, namely 156 persons (constituting 52% of the total responses), express a strong consensus regarding the positive correlation between ensuring security and the subsequent augmentation of private sector investment and profitability of enterprises. Consequently, this alignment is anticipated to facilitate the promotion of sustainable economic development within the Taraba Northern senatorial zone. Furthermore, a total of 124 respondents, constituting 41.33% of the sample population, expressed agreement with the

aforementioned assertion. There was no significant opposition or disagreement shown by any persons towards the last two claims.

**Table 1.** Severity of effects of crime on socio-economic activities.

| Severity of effects of crime on socio-economic activities | Strongly agree | | Agree | | Disagree | | Strongly disagree | |
|---|---|---|---|---|---|---|---|---|
| | **Freq** | **%** | **Freq** | **%** | **Freq** | **%** | **Freq** | **%** |
| The rate of crime has increased in the last five years | 142 | 47.33 | 137 | 45.67 | 1 | 0.33 | 0 | 0 |
| Crime has increased the poverty rate and poverty incidence in your area | 142 | 47.33 | 139 | 46.33 | 0 | 0 | 0 | 0 |
| SMEs growth has been retarded by criminal activities | 149 | 49.67 | 130 | 43.33 | 1 | 0.33 | 0 | 0 |
| Provision of security will increase private sector investment and profitability of firms, thus fostering sustainable economic development in Northern Taraba | 156 | 52 | 124 | 41.33 | 1 | 0.33 | 0 | 0 |

**Table 2** presents the factors contributing to criminal activities and explores their major causes, minor causes, and factors that are not considered causes. **Table 2** further provides frequencies and percentages for each factor.

**Table 2.** Factors causing criminal activities.

| Reason | Major cause | | Minor cause | | Not a cause | |
|---|---|---|---|---|---|---|
| | **Frequency** | **%** | **Frequency** | **%** | **Frequency** | **%** |
| Unemployment | 64 | 21.33 | 192 | 64 | 15 | 5 |
| Politics | 70 | 23.33 | 165 | 55 | 39 | 13 |
| Poverty | 123 | 41 | 60 | 20 | 55 | 18.33 |
| Frustration | 3 | 1 | 0 | 0 | 247 | 82.33 |
| Decay in family value | 110 | 36.67 | 111 | 37 | 54 | 18 |
| Illiteracy/ignorance | 48 | 16 | 126 | 42 | 83 | 27.67 |
| Drug abuse | 2 | 0.67 | 5 | 1.67 | 219 | 73 |
| Love for money | 193 | 63.33 | 83 | 27.67 | 2 | 0.57 |
| Peer influence | 71 | 23.67 | 198 | 66 | 8 | 2.67 |
| Greed | 215 | 71.67 | 64 | 21.33 | 0 | 0 |
| Impatience | 1 | 0.33 | 4 | 1.33 | 240 | 80 |
| Bad governance | 210 | 70 | 67 | 22.33 | 2 | 0.67 |
| Population density | 5 | 1.67 | 9 | 3 | 211 | 70.33 |
| Low wages | 31 | 10.33 | 23 | 7.67 | 177 | 56 |
| Inflation | 1 | 0.33 | 6 | 2 | 218 | 72.67 |

# 4. Discussions

## 4.1. Prevalent types of crimes committed in northern Taraba

The study clearly identified ten crime types in the study between 2012 and 2021 based on crime categorization by the Nigerian Police Force. These included Murder, Armed robbery, Kidnapping, Rape, Theft, Housebreaking, False pretense and cheating, Mischief, Unlawful possession of firearm, and Thuggery/cultism (**Figure 3**). It can be clearly seen that Theft has the highest percentage with 20.9% in the study area and is closely followed by Thuggery/cultism with 12.9%. It can also be observed that Unlawful possession of firearm

with 3.4% was the least crime committed within the study area. This result revealing crime types are similar with the ones identified by Ayuba et al.[41] in Kaduna metropolis, and that identified in Katsina State by Bala et al.[42].

## 4.2. Spatial distribution of crime in northern Taraba

The general distribution of crime incidence in the study area presented in **Figure 4** shows that Jalingo had the highest crime incidence of 3105 in the past ten years. If one is familiar with the study area, one will not be surprised because it could be as a result of the fact that Jalingo been the state capital with high population concentration and also because of the presence of large markets. This agrees with the result of Ayuba et al.[41] in Kaduna metropolis.

## 4.3. Crime hotspots in northern Taraba

Areas with crime incidence more than the average were considered hot spots. Cool spots are places or areas with less than the average amount of crime or disorder. Some hot spots may be hotter than others. A visual inspection of these **Figures 6–15** reveals that different types of crime exhibit different geographical patterns and that crime tends to concentrate in certain places but not in others. Crime studies that examine the spatial distribution of crime clearly demonstrate that certain land uses and population characteristics are associated with crime hotspots. In this study, it is observed that crimes tend to concentrate in the urban centres. This was consistent with what was already known generally about the geographic distribution of crime in metropolitan areas[43,44].

In the study area, the majority of armed robberies occurred in Sibre, Unguwan Bakin Dutse, Unguwan Abuja, Kona Gollong, Mile 6, Bakassi, Magami, Sabon Gari, and Samunaka. Because of certain characteristics, including better housing conditions, the presence of higher educational institutions like Taraba State University, the completion of a major road segment, and higher economic activity than the surrounding communities, these communities may be more susceptible to armed robberies.

From the result in **Figure 7**, Kona, Gollong, Sibre, the Specialist Hospital Area, Unguwan Abuja, Unguwan Sabon Layi, and the Sabon Gari River bank area are among the places on the map where kidnapping is most common. It is clear from the data that these regions have seen more kidnapping instances on average than the neighborhood as a whole. For law enforcement organizations, local governments, and citizens to be aware of the potential threats connected to these particular places, this information is essential.

Additionally, false pretense & cheating is a minor issue in the town's core area and spreads to the study area's southern and northern parts (**Figure 8**). False pretense & cheating offenses are concentrated in Nukkai and Mafindi, according to data analysis, indicating a higher incidence of such instances there than in other parts of the region. For local authorities, educational institutions, and people living in or near these hotspots to be aware of the pervasive cheating activities, this information is essential.

The data analysis shows that stealing and home breaking are disproportionately prevalent in the central region of the study area, indicating a higher frequency of these crimes there than in other parts of the region. Such instances also occur in the research area's northern regions, including places like Unguwan Kassa. This could be as a result of high population density in these areas than other areas.

**Figure 10** shows that the northwest region, as well as places like Mallam Tudu, Kasuwan Bera, and Unguwan Yakai, has a high prevalence of mischief. According to the data analysis, compared to other locations of the research area, these areas have a noticeably greater frequency of mischief. Infractions including vandalism, property destruction, or other disruptive activities are commonly referred to as mischief.

## 4.4. Effects of high crime rate on the socioeconomic activities in northern Taraba

The most prevalent effect reported is Loss of Resources, with a frequency of 102, accounting for approximately 34% of the total. Under-development is the second most common effect, with 71 individuals, representing around 23.67% of the total population. Loss of Lives is the third largest category, consisting of 52 individuals, making up about 17.33% of the total. Insecurity has a frequency of 46 individuals, accounting for approximately 15.33% of the population. Destruction of Properties has a frequency of 5 individuals, representing approximately 1.67% of the total. Social Withdrawal has a frequency of 3 individuals, accounting for approximately 1% of the population. Lastly, Bad Image has the lowest frequency, with only 1 individual, representing approximately 0.33% of the total.

**Unemployment:** This factor is considered a major cause of criminal activities by 64 individuals, accounting for approximately 21.33% of the total. 192 individuals perceive it as a minor cause, representing 64% of the respondents, while 15 individuals do not consider it a cause.

**Politics:** 70 individuals, or 23.33% of the respondents, identify politics as a major cause of criminal activities. 165 individuals view it as a minor cause, accounting for 55% of the total. On the other hand, 39 individuals do not consider it a cause.

**Poverty:** The majority of respondents (123 individuals or 41%) believe that poverty is a major cause of criminal activities. 60 individuals (20%) perceive it as a minor cause, while 55 individuals (18.33%) do not consider it a cause.

**Frustration:** Only 3 individuals (1%) identify frustration as a major cause of criminal activities. None of the respondents perceive it as a minor cause, but 247 individuals (82.33%) do not consider it a cause.

**Decay in family values:** 110 individuals (36.67%) consider the decay in family values as a major cause of criminal activities, while 111 individuals (37%) view it as a minor cause. 54 individuals (18%) do not consider it a cause.

**Illiteracy/Ignorance:** 48 individuals (16%) perceive illiteracy/ignorance as a major cause, while 126 individuals (42%) see it as a minor cause. 83 individuals (27.67%) do not consider it a cause.

**Drug abuse:** Only 2 individuals (0.67%) consider drug abuse a major cause, while 5 individuals (1.67%) view it as a minor cause. The majority of respondents (219 individuals or 73%) do not consider it a cause.

**Love for money:** The majority of respondents (193 individuals or 63.33%) believe that a love for money is a major cause of criminal activities. 83 individuals (27.67%) perceive it as a minor cause, while 2 individuals (0.57%) do not consider it a cause.

**Peer influence:** 71 individuals (23.67%) identify peer influence as a major cause, while 198 individuals (66%) consider it a minor cause. 8 individuals (2.67%) do not consider it a cause.

**Greed:** A significant proportion of respondents (215 individuals or 71.67%) view greed as a major cause of criminal activities. 64 individuals (21.33%) perceive it as a minor cause, and none of the respondents consider it not a cause.

**Impatience:** Only 1 individual (0.33%) considers impatience a major cause, while 4 individuals (1.33%) view it as a minor cause. The majority of respondents (240 individuals or 80%) do not consider it a cause.

**Bad governance:** The majority of respondents (210 individuals or 70%) identify bad governance as a major cause of criminal activities. 67 individuals (22.33%) perceive it as a minor cause, while 2 individuals (0.67%) do not consider it a cause.

**Population density:** Only 5 individuals (1.67%) consider population density a major cause, while 9 individuals (3%) perceive it as a minor cause. The majority of respondents (211 individuals or 70.33%) do not consider it a cause.

**Low wages:** 31 individuals (10.33%) view low wages as a major cause, while 23 individuals (7.67%) consider it a minor cause. 177 individuals (56%) do not consider it a cause.

**Inflation:** Only 1 individual (0.33%) perceives inflation as a major cause, while 6 individuals (2%) view it as a minor cause. The majority of respondents (218 individuals or 72.67%) do not consider it a cause.

# 5. Summary and conclusion

From the findings, a total of ten crime types were recorded as prevalent in the study area for ten years, from 2012 to 2021. These include murder, armed robbery, kidnapping, rape, theft, housebreaking and theft, false pretense and cheating, mischief, unlawful possession of a firearm, and thuggery or cultism.

The study also analyzed the spatial distribution of crimes in the study area. This revealed that Jalingo, which is the state capital, had the highest crime incidences, which could be a result of the high population, the location of large markets, and higher institutions of learning.

The hotspot analysis of crime in the study area reveals that different types of crime exhibit different geographical patterns and that crime tends to concentrate in certain places (mostly urban settlements) but not in others.

The study also examined the impact of crime on socio-economic activities in the study area. The various effects of crime were categorized as loss of resources, underdevelopment, loss of lives, insecurity, destruction of properties, social withdrawal, and bad image. A significant proportion of respondents strongly agreed or agreed that the rate of crime in the study area has increased in the last five years.

In conclusion, crime is not spread evenly across the landscape. It clumps in some areas and is almost absent in others. This study has shown how GIS as a tool can be used effectively to analyze crime and display crime maps for adequate planning in terms of resources and personnel deployment towards combating crime in the study area. The study identified a total of 10 different crime types across the study area. Crime can have significant effects on socioeconomic activities in several ways, including loss of lives, destruction of property, disruption of social services, social withdrawal, bad image, and so on.

# 6. Recommendation

This research therefore recommends that effort be put towards fighting crime, especially in the identified hotspots. Also, crime cases should be recorded in detail alongside the geographical coordinates of crime incidence spots by the Nigerian police so as to allow for hot spot analysis at the spot level rather than at the street or neighbourhood level. Crime hotspots create a negative perception about the safety and security of the area, leading to a decline in tourism, business investments, and property values. This can have long-term effects on the local economy and quality of life for residents. Implementing community engagement programs to address the concerns of residents and visitors, highlighting efforts to improve safety measures and reduce crime rates. This can help change perceptions and attract investments.

Crime hotspots can perpetuate a cycle of poverty and unemployment. High crime rates deter businesses from operating in the area, leading to a lack of employment opportunities. This may result in a higher concentration of poverty and limited access to resources and essential services. Establish economic development initiatives in crime hotspots, such as small business grants, job training programs, and

partnerships with existing businesses. This can create employment opportunities and help alleviate poverty. Finally, more security formations should be established within the study area to reduce crime. This is because areas with more security formations in the study area had fewer crime incidences compared to areas with fewer security formations.

# 7. Limitations and future research directions

The study results could have been more robust for regional policy drives if the study had been done for a longer period and covered all six LGAs that make up Taraba North. However, our study made significant contributions because it vividly showed the status of crimes in three of the six LGAs, which are the major locations where a series of crimes have been reported in the most recent period, and due to their nearness to the Taraba State capital, Jalingo. Future studies should employ a combination of machine learning and artificial intelligence (AI) for a methodological change in how crime studies in the area are conducted.

# Author contributions

Conceptualization, MA and VNO; methodology, MA, VNO and MBY; software, KH, NBJ and AB; validation, VNO, MBY and MA; formal analysis, KH and NBJ; investigation, AB; resources, VNO; data curation, MA; writing—original draft preparation, VNO; writing—review and editing, OVN and MBY; visualization, KH; supervision, VNO; project administration, MBY. All authors have read and agreed to the published version of the manuscript.

# Conflict of interest

The authors declare no conflict of interest.

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# Appendix

**Table A1.** Information on crime statistics in northern Taraba.

| LGA ward areas | Latitude | Longitude | Murder | Armed robbery | Kidnapping | Rape | Theft | House breaking & theft | False pretence & cheating | Mischief | Unlawful possession of fire arm | Thuggery/ Cultism | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Jalingo (Kona Ward) | | | | | | | | | | | | | |
| Kona Garu | 8.986667 | 11.33278 | 28 | 0 | 8 | 16 | 23 | 16 | 0 | 3 | 14 | 67 | 175 |
| Kona Garu Mini Market | 8.979167 | 11.32917 | 10 | 0 | 0 | 4 | 18 | 25 | 24 | 0 | 0 | 0 | 81 |
| Kona Gollong | 8.955278 | 11.32083 | 47 | 26 | 11 | 0 | 10 | 14 | 0 | 2 | 9 | 0 | 119 |
| Mile 6 | 8.958333 | 11.3675 | 8 | 17 | 0 | 27 | 40 | 28 | 31 | 1 | 6 | 43 | 209 |
| Road Block | 8.939444 | 11.34139 | 22 | 49 | 0 | 51 | 71 | 44 | 47 | 0 | 24 | 33 | 341 |
| Nukkai | 8.923056 | 11.32417 | 7 | 8 | 0 | 9 | 17 | 10 | 8 | 0 | 0 | 26 | 85 |
| Barade Ward | | | | | | | | | | | | | |
| Magami Gindin Mongoro | 8.9125 | 11.34472 | 0 | 13 | 0 | 24 | 18 | 15 | 12 | 0 | 0 | 53 | 135 |
| Magami | 8.9125 | 11.33528 | 0 | 0 | 20 | 6 | 13 | 0 | 0 | 0 | 9 | 41 | 89 |
| Old Magami | 8.907222 | 11.34028 | 13 | 20 | 9 | 0 | 28 | 10 | 0 | 0 | 0 | 0 | 80 |
| Agadah'ata doma road | 8.757222 | 11.35417 | 0 | 8 | 0 | 5 | 11 | 13 | 8 | 0 | 0 | 0 | 45 |
| Magami GDSS | 8.905 | 11.34833 | 0 | 0 | 0 | 10 | 5 | 0 | 0 | 0 | 0 | 0 | 15 |
| Sabon Layi | 8.901111 | 11.35861 | 48 | 36 | 0 | 53 | 103 | 43 | 28 | 0 | 6 | 105 | 422 |
| Mayo Gwoi Ward | | | | | | | | | | | | | |
| Mayo Gwoi | 8.913333 | 11.34806 | 32 | 10 | 0 | 10 | 52 | 16 | 17 | 0 | 2 | 26 | 165 |
| Unguwan Fulani | 8.915 | 11.36611 | 0 | 6 | 11 | 12 | 9 | 8 | 0 | 0 | 0 | 0 | 46 |
| Nasarawo | 8.905833 | 11.36611 | 4 | 1 | 0 | 20 | 14 | 9 | 0 | 0 | 0 | 0 | 48 |
| Mallam Joda | 8.894444 | 11.37778 | 5 | 0 | 0 | 17 | 12 | 4 | 7 | 0 | 0 | 0 | 45 |
| Specialist Hospital Area | 8.907222 | 11.39389 | 0 | 9 | 10 | 0 | 9 | 4 | 0 | 0 | 6 | 0 | 38 |
| Kachalla Sambe Ward | | | | | | | | | | | | | |
| Wuro Sambe | 8.854722 | 11.40417 | 4 | 10 | 4 | 0 | 15 | 0 | 0 | 1 | 9 | 0 | 43 |
| Samunaka | 8.874167 | 11.39778 | 0 | 7 | 13 | 5 | 11 | 10 | 13 | 1 | 4 | 0 | 64 |
| Sabon Gari Mini Market | 8.876667 | 11.38083 | 5 | 3 | 0 | 21 | 14 | 14 | 26 | 0 | 0 | 22 | 105 |
| Sabon Gari River Bank | 8.876667 | 11.38083 | 9 | 14 | 14 | 36 | 26 | 0 | 0 | 0 | 0 | 0 | 99 |
| Gate one Sabon Gari | 8.875556 | 11.39306 | 7 | 11 | 0 | 0 | 9 | 13 | 18 | 0 | 0 | 0 | 58 |
| Majidadi Ward | | | | | | | | | | | | | |
| Mafindi | 8.889444 | 11.35556 | 0 | 0 | 0 | 0 | 7 | 7 | 0 | 0 | 0 | 0 | 14 |
| Gadan Boboji | 8.895 | 11.35583 | 6 | 0 | 0 | 0 | 5 | 13 | 31 | 0 | 0 | 12 | 67 |
| Water Board | 8.896389 | 11.34528 | 13 | 14 | 8 | 9 | 25 | 18 | 10 | 0 | 7 | 32 | 136 |
| Main Market | 8.894167 | 11.36111 | 6 | 0 | 0 | 0 | 38 | 57 | 54 | 0 | 0 | 0 | 155 |
| Sarkin Dawaki Ward | | | | | | | | | | | | | |
| Unguwann Primary Education Board | 8.876944 | 11.36861 | 14 | 10 | 16 | 3 | 8 | 12 | 7 | 0 | 0 | 10 | 80 |
| Umaru Tafida | 8.885833 | 11.36111 | 0 | 0 | 0 | 0 | 6 | 3 | 0 | 0 | 0 | 0 | 9 |
| Kasuwan Yalwa | 8.885278 | 11.3675 | 11 | 17 | 0 | 0 | 12 | 10 | 13 | 0 | 0 | 18 | 81 |
| Turaki "A" Ward | | | | | | | | | | | | | |
| Unguwan Gadi | 8.888333 | 11.36139 | 22 | 3 | 0 | 16 | 24 | 3 | 17 | 0 | 0 | 43 | 128 |
| Atiku Street | 8.887222 | 11.36528 | 0 | 0 | 0 | 0 | 4 | 5 | 0 | 0 | 0 | 0 | 9 |
| Behind Nepa Office Unguwan Gadi | 8.887222 | 11.36972 | 6 | 0 | 0 | 6 | 6 | 16 | 4 | 0 | 0 | 0 | 38 |

**Table A1.** (*Continued*).

| LGA ward areas | Latitude | Longitude | Murder | Armed robbery | Kidnapping | Rape | Theft | House breaking & theft | False pretence & cheating | Mischief | Unlawful possession of fire arm | Thuggery/ Cultism | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Yorro (Pantisawa "A" ward) | | | | | | | | | | | | | |
| Pantisawa Roundabout | 8.945 | 11.51306 | 8 | 7 | 0 | 1 | 16 | 4 | 3 | 6 | 0 | 10 | 55 |
| Sabon Gari | 8.948889 | 11.51083 | 5 | 3 | 1 | 1 | 18 | 6 | 5 | 14 | 0 | 5 | 58 |
| Pantisawa "B" Ward | | | | | | | | | | | | | |
| Unguwan Kandanbo | 8.939722 | 11.51889 | 2 | 8 | 2 | 0 | 12 | 4 | 4 | 10 | 0 | 0 | 42 |
| Sumbu "A" Ward | | | | | | | | | | | | | |
| Unguwan Yakai | 8.930278 | 11.39333 | 3 | 4 | 0 | 1 | 13 | 7 | 8 | 6 | 3 | 0 | 45 |
| Lankaviri | 9.008333 | 11.42194 | 13 | 15 | 8 | 5 | 42 | 16 | 13 | 17 | 7 | 36 | 172 |
| Gongon Ward | | | | | | | | | | | | | |
| Gongon Maliki PHC | 8.805833 | 11.46694 | 4 | 6 | 4 | 2 | 18 | 4 | 3 | 4 | 0 | 0 | 45 |
| Gongon Maliki River Bank | 8.803889 | 11.46722 | 16 | 12 | 11 | 0 | 23 | 9 | 5 | 12 | 13 | 0 | 101 |
| Ardo-Kola (Lamido Borno Ward) | | | | | | | | | | | | | |
| Baba Ya'u | 8.878056 | 11.34556 | 19 | 30 | 43 | 5 | 36 | 17 | 11 | 18 | 7 | 13 | 199 |
| Kpanti Gana | 8.887222 | 11.16444 | 7 | 9 | 5 | 0 | 7 | 2 | 0 | 12 | 0 | 0 | 42 |
| Mallum Tudu | 8.856944 | 11.30028 | 12 | 10 | 20 | 3 | 16 | 4 | 6 | 26 | 13 | 8 | 118 |
| Jauro Yinu Ward | | | | | | | | | | | | | |
| Kasuwan bara | 8.912222 | 11.31472 | 36 | 21 | 3 | 6 | 33 | 12 | 8 | 0 | 0 | 15 | 134 |
| Bakassi | 8.911389 | 11.30667 | 19 | 12 | 2 | 8 | 29 | 9 | 4 | 0 | 0 | 0 | 83 |
| Iware Ward | | | | | | | | | | | | | |
| Sibre | 8.851667 | 11.2 | 25 | 23 | 5 | 0 | 15 | 0 | 0 | 17 | 10 | 0 | 95 |
| Unguwan Kassa | 8.825278 | 11.10056 | 22 | 6 | 10 | 0 | 26 | 6 | 2 | 15 | 3 | 4 | 94 |
| Unguwan Samunaka | 8.831389 | 11.11333 | 31 | 17 | 12 | 0 | 13 | 5 | 2 | 14 | 4 | 1 | 99 |
| Sarkin Dutse Ward | | | | | | | | | | | | | |
| Unguwan Bakin Dutse | 8.786944 | 11.27111 | 33 | 18 | 18 | 0 | 10 | 2 | 6 | 20 | 2 | 0 | 109 |
| Sunkani Ward | | | | | | | | | | | | | |
| Unguwan Abuja | 8.716389 | 11.26111 | 14 | 16 | 24 | 2 | 24 | 6 | 4 | 8 | 3 | 6 | 107 |
| Unguwan Sabon Layi | 8.696389 | 11.25722 | 22 | 19 | 13 | 3 | 19 | 9 | 6 | 10 | 7 | 8 | 116 |
| Total | | | 618 | 535 | 305 | 397 | 1033 | 562 | 465 | 217 | 168 | 637 | - |
| Percentage | | | 12.5 | 10.8 | 6.2 | 8.0 | 20.9 | 11.4 | 9.4 | 4.4 | 3.4 | 12.9 | - |

Source: Author's analysis.