Geospatial Analysis of Crime Hotspots and Optimal Security Agency Allocation in Bauchi Metropolis, Nigeria

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ABSTRACT

This study analyzes the spatial patterns of crime hubs by identifying and mapping crime locations and police stations within Bauchi Metropolis to determine their spatial distribution and relationships, and further provided recommendations for new police station locations. Geospatial techniques, including Geographic Information System (GIS) analysis, were used for kernel density estimation, crime hub analysis, proximity analysis, and location allocation of police station. The findings revealed that 34.17% of Bauchi Metropolis was overserved by police station, 38.04% adequately served, and 27.79% underserved. Within a 3km buffer, 75.02% was overserved by security agencies, 14.87% underserved, and 10.11% adequately served. Miri (30.12%) and Birshi (19.95%) accounted for 50.7% of reported crimes, underscoring the need for targeted interventions. Although 89.02% of the area fell into the "Least Crime Hub" category, zones like Birshi, Dan Iya, and Miri were categorized as "Less" and "Moderate Crime Hubs," requiring proactive measures to prevent escalation. Proximity analysis revealed that police stations like "E' Division" were overburdened due to proximity to multiple crime hubs, highlighting the need for resource reallocation. To reduce crime, law enforcement efforts should focus on increasing police presence, community engagement, and strategic resource distribution, including the placement of permanent stations and targeted crime prevention programs in vulnerable areas.

Keywords: Crime Hotspots, Geospatial Analysis, Police Coverage, Spatial Crime Patterns, Bauchi Metropol

Background of the Study

Crime has a deep effect on societies which influence various daily life activities such as livelihood, economic and governance, the rise in crime rates in the society often lead to loss of life, economic setbacks, and social instability for instance countries like Honduras, El Salvador, and Venezuela have experience the effect of crime violence. Globally, there are high rates of violence homicide, with over 117,000 homicides recorded in Latin America and Caribbean in 2023 alone, which places the country in median homicide rate at around 20 per 100,000 people (Kimunge, 2023; Eller, 2024). Such violence does not only undermine public safety but also deters investment and weakens state institutions (Achumba, Ighomereho, and Akpor-Robaro, 2013).

Globally, crime remains a significant challenge with 83% of the world's population living under high criminality conditions (Global Organized Crime Index, 2023). Crime is a public wrong punishable by law which includes various anti-social behavour such as murder, robbery, burglary, rape, drunk driving, child neglect and failure to pay taxes are example of crime (Felson and Boba, 2010). It is important to note that each criminal act is associated with the characteristics of a particular location. Key essentials for understanding crime from an environmental viewpoint include accessibility, disclosure, incentives, and the availability of targets (Umar, 2017; Wortley and Townsley, 2016; Umar, Cheshire, and Johnson, 2015). The perception of a place's physical features and the routine activities of its residents can significantly influence decisions regarding resource allocation, partly based on where police presence and intervention are most or least required (Joseph, 2018; Ibrahim and Kuta, 2015). By understanding the relationship between crime and the environment, policymakers and law enforcement agencies can make more informed decisions to distribute scarce resources effectively. The internal

security is vital for crime prevention, underscored by the saying, “the enemy outside the fence has a facilitator inside (Adalemo, 2020). Effective crime prevention requires temporal analysis, crime hubs analysis and kernel density estimation which aids law enforcement in making informed decisions on resource distribution. Geographic Information System (GIS) has proven effective in analyzing crime patterns and trends, (Ahmed and Salihu, 2018). GIS technology, combined with remote sensing serve as is a powerful tool for crime mapping and analysis, supporting various levels of policing and strategic crime reduction (Chainey and Ratchiffe, 2005). It is against this background that the study uses advanced geospatial techniques to determine areas where crimes are high in Bauchi metropolis.

Effective crime management is important for maintaining public safety, upholding justice, and preserving order. Crime management institutions include police departments, federal agencies (e.g., NPF, NSCDC), community police, and vigilante groups, all of which play significant roles in crime prevention through community-oriented and data-driven approaches. (Tilley, 2012; Akech, 2005).

The dynamics of crime in Bauchi metropolis are influenced by socio-economic factors, demographic composition, and geographical attributes, which highlight levels of poverty, limited access to education, and high unemployment rates contribute significantly to property crimes and other unlawful activities. (Nwagboso, 2018). It’s against this background that this study analyzes the spatial patterns of crime hubs by identifying and mapping crime locations and police stations within Bauchi Metropolis to determine their spatial distribution and relationships.

Statement of the Problem

Several decades ago, people lived freely with virtually no crime, fostering an environment of harmony, security, and mutual trust for instance, countries like New Zealand and Switzerland are often known for their low crime rates which is attributed to strong social cohesion, efficient security agencies, and high standards of living (Akella and Cannon, 2017; Roberts, 2024).

In Bauchi Metropolis, crime is alarming with a noticeable increase in various forms of criminal activities, which offenses range from robbery, theft, and assault, to more severe crimes such as drug trafficking, car and motorcycle theft, and vandalism. The rise in violent crimes such as armed robberies, kidnappings, homicides, and gang-related activities particularly is a thing of concern. These crimes have instilled a pervasive sense of fear and instability within the communities which affect daily life and causes distrust among residents. The temporal crime data collected from the security agency (Nigeria Police force) from 2014 to 2023 revealed the frequency of crimes occurrence which is categorized into organized crime, property crime, violent crime, consensual crime, and white-collar crime. Organized crime is the most prevalent, with armed robbery leading at 6,637 cases, making up 43.9% of all reported crimes. Other notable organized crimes include theft (476 cases, 3.2%) and kidnapping (454 cases, 3.0%). Property crimes are also significant, with motorcycle snatching being the second most common crime at 2,825 cases (18.7%), followed by fraud (746 cases, 4.9%), phone snatching (173 cases, 1.1%), and vandalization (84 cases, 0.6%). Violent crimes are led by culpable homicide with 928 cases (6.1%) and rape with 904 cases (6.0%), alongside other offenses like causing grievous hurt (222 cases, 1.5%) and criminal breach of trust (199 cases, 1.3%). Consensual crimes, while less frequent, include unlawful possession of firearms, with 189 cases (1.3%) being the most recorded. The least frequent crimes, such as "enticing of married women" (6 cases), "escape from lawful custody" (4 cases), and "criminal force" (2 cases), are rare or potentially underreported (NPF report, 2023). The increasingly prevalence of the criminal activities pose more threat to the residence despite the effort putting by the security agencies to address the prevalence of crime, geospatial techniques have been adopted to map the impact of crime and also give suggestion of to allocate security agency outpost in other to address problem of security.

This study aims at analyzing the Temporal and Spatial Patterns of Crime Hubs in Bauchi metropolis. This was achieved through the following objectives: To analyze the spatial relationships between the crime hubs and police station in Bauchi metropolis

Scope/limitation of the Study

This study is centered on analyzing spatial crime hubs using data exclusively obtained from the Police. It does not include data from other formal security agencies, such as the Nigeria Security and Civil Defence Corps (NSCDC) or the National Drug Law Enforcement Agency (NDLEA), nor does it consider inputs from informal security outfits. The research is geographically limited to Bauchi metropolis. It is important to note that the identified crime hubs are not static; they are dynamic and subject to change over time.

Significance of the Study

The significant of the study explores the spatial relationship between crime hubs and police stations in Bauchi Metropolis, analyzing these patterns, the study provides decision maker with strategic data for deployment of police personnel and logistics, as well as identify optimal locations for new police stations. The outcomes of this research work provide valuable insights for future researchers and support the development of more resilient urban environments in the region.

LITERATURE REVIEW

The prevalent of criminal has deeper effect on societies which influence various daily life activities such as livelihood economic and governance. The rise in crime rates often lead to loss of life, economic setbacks, and social instability (Kimunge, 2023; Eller, 2024). These issues did not only undermine public safety, but also hinders economic development by deterring investment and infrastructural development in the societies. The prevalence of organized crime, Property crime, violence crime and consensual crime in these regions fosters corruption and weakens state institutions, by making it difficult for governments to enforce laws and protect their citizens (Achumba, Ighomereho, and Akpor-Robaro, 2013).

The global trend of crime is particularly pronounced in regions with low resilience to different types of crime, such as parts of Africa and Asia, where the proficiencies to counter criminal activities are inadequate. Crimes exhibition across the Globe and Region differ base on scope, scale, and intent. Their operation ranges from the actions of solitary individuals to organized criminal groups. The Criminal activities can occur at all levels, which may involve individuals of all genders and age groups who are motivated by the resources they get from the act, which results from broad classification of crime into two main categories: Ordinary Crimes and Serious Crimes (MacDonald, *et al.,* 2013).

In many developing countries, crimes are plagued not just by ordinary volume especially the type of crimes related to terrorism, theft, and robbery. In the recent time, increase in crime led to a renewed interest in developing anti-crimes products. Several researchers conducted series of finding across the Globe to ascertain level of crime in various countries. Crime such as armed robbery, burgling of houses, kidnapping, drug trafficking, and car, motorcycle and phone snatching among other offences specified by the Countries. For instance, Latin America's homicide rate is twice the world's average, making it the most violent region in the world after Sub-Saharan Africa. The violence disproportionately affects the poor, eroding their assets and livelihoods. The abnormally high levels of crime and violence constitute a key obstacle to the development of the region (Wedlock and Tapley, 2021).

Nigeria in recent times has witnessed an unprecedented level of insecurity. This has made national security threat to be a major issue for the government and has prompted huge allocation of the national budget to security. In order to ameliorate the incidence of crime, the Federal Government has embarked on criminalization of terrorism by passing the Anti-Terrorism Act in 2011, installation of Computer-based Closed Circuit Television cameras (CCTV) in some parts of the country, enhancement of surveillance as well as investigation of criminal related offences, heightening of physical security measures around the country aimed at deterring or disrupting potential attacks, strengthening of security agencies through the provision of security facilities and the development and broadcast of security tips in mass media (Azazi, 2014). Despite these efforts, the level of insecurity in the country is still high. In addition, Nigeria has consistently ranked low in the Global Peace Index signifying a worsened state of insecurity in the country (GPI, 2012; Adagba, Ugwu, and Eme, 2012).

Uhunmwuangho and Aluforo (2011) are of the view that the efforts of government have not yielded enough positive result.

In recent years, there has been a significant increase in criminal activities in a variety of settings, including towns, farms, streets, road, and places of businesses, worship, and homes. The prevalence of these crimes is not unique to Nigeria, but is a global problem (UNICEF, 2015). In urban crime, prevalent in rapidly growing cities, includes domestic violence, cybercrime, and economic offenses, exacerbated by urbanization and socio-economic challenges. There is a general consensus among criminologists that urban areas have higher rates of crime than rural areas, not all cities or neighborhoods experience similar levels of crime and violence; there is widespread variation in crime levels across urban spaces (Chandra and Tripathi, 2024).

The dynamics of crime and its nature expose the state to security threat. The types of criminal activities perpetrated within the communities, including armed robbery, kidnapping, and car and motorcycle snatching, are rapidly increasing. There has been an increased crime rate in Bauchi metropolis and the major crimes committed in the metropolis include kidnapping, murder, burglary, fraud, robbery, cyber-related, rape, bribery and corruption, money, etc. Terrorism is on the increase in the country. Nigeria is the third country affected by terrorists. Genocide is another severe threat that Nigerians faced in recent times. Nigeria is the second country in Africa with the highest risk of mass killing and the sixth in the world. Also, the quest for wealth makes some engage in drug trafficking (Richard, 2021).

Crime management in Nigeria involves a multi-agency approach with various law enforcement institutions, such as the Police, Nigeria Security and Civil Defence Corps (NSCDC), National Drug Law Enforcement Agency (NDLEA), Army, Air Force, Department of State Services (DSS), and vigilante groups, collaborating to ensure public safety and security (Gberinyer, Okoro, and Adishi, 2024). The Nigerian Police Force is primarily responsible for crime prevention, investigation, and apprehension of offenders, playing a central role in maintaining law and order. Other agencies like the NSCDC focus on protecting critical national assets and infrastructure, while the NDLEA addresses drug-related offenses. The Army and Air Force provide support in counter-insurgency operations, especially in conflict-prone regions, while the DSS focuses on intelligence gathering and counter-terrorism. Vigilante groups, though informal, complement these agencies by offering community-based security solutions, often acting as the first responders in rural areas where formal law enforcement presence is limited (Nwankwo, 2020; Temidayo, 2022).

The frequency of criminal activities reported from different location made some of these location crime hotspots and they are numerous across Bauchi metropolis. The crime are not limited to human slaughter and injury, armed robbery, kidnapping, drug trafficking, car and motorcycle snatching and other offences specified by the security agencies. The resultant effect of such crime in Nigeria often leads to death, and psychological and bodily pains of the victims (Opeyemi, 2015).

The distribution of crime across the landscape or globe is geographically not random since crimes are human phenomena (Chainey, 2014). For crimes to occur, offenders and their targets - the victims and/or property - must exist at the same location for a period of time (Ejemeyovwi, 2015). However, recent worries about this value as well as the pervasiveness of security issues that have a direct impact on society have elevated it to the top of the list of safety priorities. Violent confrontations and crimes have significantly increased in recent years in a variety of contexts, including towns, farms, streets, road, companies, places of worship, and residences. Unexpectedly, educational institutions are not exempt especially the primary and early secondary schools (basic education) which is the foundation of education as aptly stated by Uloko and Ada (2022). This violence is pervasive around the world, not only in Nigeria (UNICEF, 2015).

Research finding by Umar (2017) shows that 70% of the communities' crime hotspot are randomly close to each other, 15% of the communities' shows that the crime hotspot is clustered with more effect, only 15% of the communities are free and disperse. The analysis established that criminal activities have increasing impact across multiple locations due to the clustering and randomly closeness of the hotspots to each other which further increase the vulnerable of the communities to different typology of crime.

According Irvin-Erickson and Vigne (2015), spatiotemporal patterns of crime at the Washington DC Metro Rail stations are characterized by transportation nodes and places. The study examined the crime data for five (5) years from 2007 to 2012 which is used to analyze the crime-generating and crime-attracting characteristics of the stations as transportation nodes and places. The finding shows important spatiotemporal variation in crime patterns at the Metro Rail stations, which identify several hotspots of crime at the stations, including areas with high rates of theft, assault, and robbery. The crime rates vary with time of day and day of the week, with higher rates of crime occurring during rush hour and on weekends. Recommendations from the study can be implemented to inform crime prevention at the Metro Rail stations. The law enforcement agencies should focus on the identified hotspots and times of high crime activity to improve their effectiveness of the crime.

Criminal occurrence, as described by Daukere *et al*., (2020), has undesired costs in terms of loss, death, and psychological and bodily pains of the victims. The study analyzed crime events in Bayelsa West Senatorial District of Bayelsa State, Nigeria, using geospatial techniques. The Divisional Police Headquarters in Bayelsa West Senatorial District provided data on police crime records. The research area's administrative map was obtained from Bayelsa State's Ministry of Land and Survey and used as a base map. Nearest Neighbour Analysis (NNA) and Kernel Density Estimation (KDE) were used to determine the pattern and density of crime hotspots in the area, as well as descriptive statistics. The findings of the investigation demonstrated the presence of nine (9) different crime types based on police records. Also, theft/stealing had the highest incidence rate of 30.6 percent, while hurt/Fighting and kidnapping had the lowest incidence rates, each with 3.5 percent. At a 0.01 percent significance level, the NNA result of the spatial pattern of crime yielded a clustered point with a Nearest Neighbour Ratio (NNR) of 0.491906. The KDE analysis reveals that crime is concentrated in high-population, high-economic-activity areas, with different types of crime exhibiting diverse spatial patterns. As a result, it was recommended that community policing committees be established in Ekeremor, Sagbama, and other affected towns and villages in the LGAs.

Binbin, Longbiao, Sha, Fangxun, Shijian and Gang, (2020) explored the use of multisource crowd sensed data for spatio-temporal analysis of urban crime. The study investigated the potential of integrating data from multiple sources, including social media, open data, and crowd-sourced data, to improve the accuracy and timeliness of crime analysis. The findings show that integration of multisource crowd sensed data can improve the accuracy and timeliness of crime analysis. The data analyze demonstrate the effectiveness of their approach through a case study of crime analysis in the city of Chicago, which identified several hotspots of crime in the city and analyzed the spatio-temporal patterns of crime in these areas. The findings of the study were recommended to law enforcement agencies that the integration of multisource crowd sensed data can provide law enforcement agencies with more timely and accurate information about crime patterns, allowing them to respond more effectively to emerging threats which will help in the prevention and reduction in crime in urban areas.

METHODOLOGY

Design

The flowchart gives the methodological overview that was employed in this research work which includes, the conceptual structure of the research work shows that the research followed step by step procedure such as reconnaissance (Office and Field) survey, Data collected from primary and secondary sources, data pre-processing, data manipulation and interpretation using geospatial techniques to give necessary recommendations in other to enhance security deployment and improve security of residents within metropolis. Mix method was adopted for the data analysis.

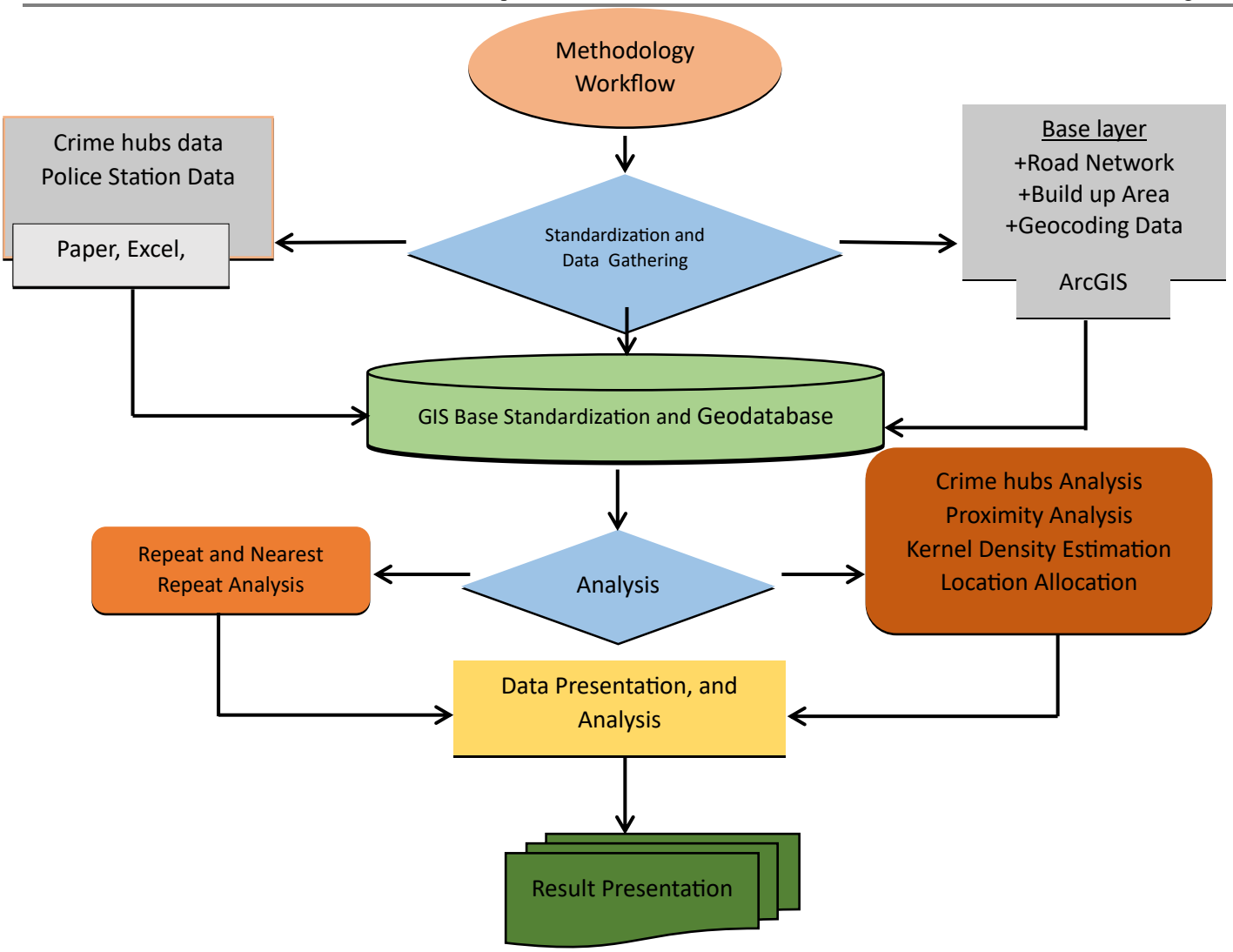


Figure. 1: Research Methodology chart

Location and extent

Bauchi Metropolis is located between 10°15'26.23" and 10°16'30.25" north of the equator and 9°46'36.32" and 9°47'44.94" east of the Greenwich meridian, and a surface area of around 1,536.279km^2 (Bauchi State Government (BASG, 2015), is situated in the North-East geopolitical zone of Nigeria, is a significant area within Bauchi metropolis.

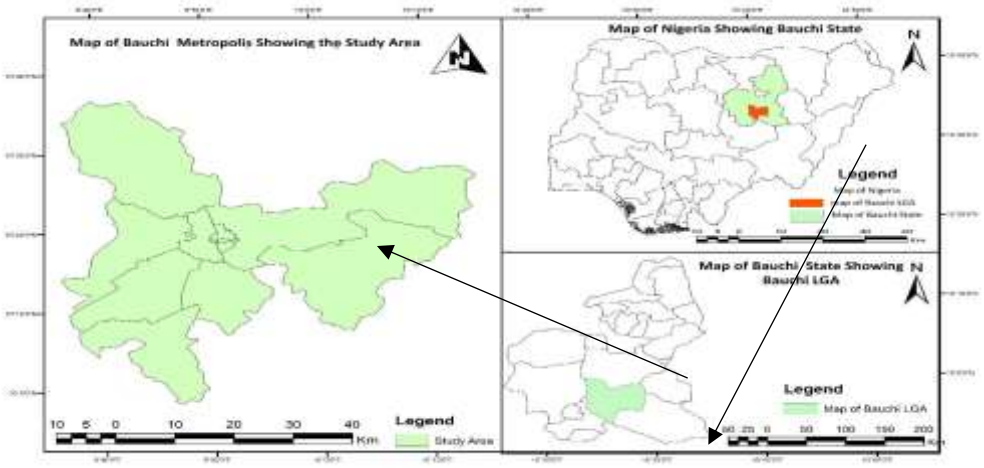


Figure 2: Map of the Study Area

Bauchi metropolis has an estimated population of over 1,046,751 as of 2024, with a demographic profile that is predominantly youthful which reflect the broader Nigerian population pyramid. Economically, the Metropolis depend on agriculture and government work which serves as the means of livelihood. The crime are shaped by a complex interplay of environmental, socio-economic, and cultural factors with the city's geographical layout, characterized by distinct zones, creates natural hideouts and pathways that are frequently exploited by organized crime networks. Some of the ward within the metropolis are predominantly affected by property crimes, including burglary, theft, and white-collar offenses, often fuelled by economic disparities and high unemployment rates.

Security in Bauchi Metropolis is upheld by a network of established security institutions which play important role in maintaining law and order. The Nigeria Police Force (NPF) serves as the primary law enforcement agency that is responsible crime prevention, investigation, and community police. Complementing the efforts of the NPF is the State Security Service (DSS), the focuses on intelligence gathering, counterterrorism, and addressing threats to national security.

Types and Sources of Data

Table 1: categorizing the types of data collected based on spatial and attribute data for the spatial analysis of crime hubs in Bauchi Metropolis:

Table 1: Spatial and Attribute data

Data Type	Spatial Data	Attribute Data
Crime hubs Locations	Coordinates (Northern and Eastern) of crime hubs	There are twelve (12) ward
Police Stations	Coordinates of police stations and their coverage areas	Data were collected for police station and their outpost Police Division are 5 Police outpost are 12 crime reports from 2014-2023 were collected
Road Networks	Geographic layout of roads, highways, and alleys	Road types (paved, unpaved), traffic density, accessibility, and hubs
Wards/Neighbourhoods	Boundaries and geographic extent of wards and neighbourhoods	Population density, types
Hubs	Spatial clusters of high crime incidence	Type of crime in the hubs are Organize crime, Property crime, Violence crime and consensual. And the classification are base 24 hubs within the 12 ward
Natural Features	Rivers, Mountain and other hideouts	Potential for criminal activity, visibility, and access routes

Sources: Primary data Coordinate of the crime hubs and that of police station were collected, using Handheld GPS

Primary data Coordinate of the crime hubs and that of police station were collected, using Handheld GPS. **Secondary data** of crime hubs within Bauchi Metropolis were collected from the Nigeria Police Force headquarters in Bauchi and the data include detailed attribute information crime hubs and police stations. This data includes crime types (such as theft, robbery, and drug-related offenses etc.) and their hubs. The data also covers operational attributes of police stations, including their locations, and response capabilities. Street guide map of Bauchi metropolis obtained from Ministry of Lands and Housing, Bauchi, as well as academic journals, online resources.

Data Collection

Data were collected based on spatial data collection and attribute data collection.

Spatial Data Collection

It is the process that involves close collaboration with the Nigeria Police Force which enabled the researcher to collect different category of spatial data which included the precise coordinates of twenty-four (24) crime hubs, providing a detailed spatial perspective on where these events occurred. Coordinate of five (5) police station divisions and twelve (12) outpost which highlight the spatial distribution of law enforcement resources and their role in extending police services to remote areas.

Attribute Data Collection

Detailed information related to crime hubs and law enforcement infrastructure which included data on the types of crimes prevalent in each hub, categorized as organized crime, property crime, violent crime, and consensual crimes across the twenty-four (24) hubs within the twelve (12) wards were collected. The data also covered operational details of police stations and outposts, such as the number and location of the police divisions (5) and outposts (12), as well as historical crime reports from 2014 to 2023. The street guide map of the study area were downloaded for the purpose of data analysis.

Data Processing/Analysis

The data collected were analyze following these step-by-step procedures for data analysis:

Geo-referencing of the Map

The map was digitized and further geo-referenced, which aligns the digitized map with a coordinate system. The geo-referencing involves identifying control points on the map on a specific location with known geographic coordinates, like road intersections or prominent landmarks, GIS software was used to match these points with their corresponding coordinates on ground. Applying transformations polynomial adjustments, the accuracy of the map process was verified using Root Mean Square Error (RMSE) metrics which ensured that the geo-referenced map accurately represents the physical space.

Table 2: Coordinates of the Georeferenced points used in Bauchi metropolis

S/N	Northern	Easting
1	1082613	639484.8
2	1093732	641742.5
3	1086764	644602
4	1088573	643999.6
5	1089553	644838.4

Digitization of Street Guide Map

The first step in determining the temporal and spatial patterns of crime hubs is the digitization of the street guide map, the map was then imported into ArcGIS 10.8 and digitized manually. During digitization process, key features such as streets, landmarks, road, streams and administrative boundaries are traced to create vector layers. Digitization was important for the purpose of accurate digital representation of features in the environment that provide reliable foundation for subsequent spatial analyses. The attributes information such as street names, road and types of landmarks are also assigned to the digitized features to enhance the map's usability.

Plotting the Coordinates of Crime Hubs

After geo-referencing, the coordinates of crime hubs and Police station are plotted on the map and this process involves importing crime data, which includes the coordinates of the crime hubs and Police station into the GIS

software environment. Each crime hubs were represented as a point on the map, with different symbols or colors used to distinguish between various crime and Police station. Data was also integrated which allow for the analysis of crimes hubs. This step provides a clear visual representation of crime distribution across the study area by facilitating the identification of their spatial and temporal patterns. The plotted data serves as the basis for further analysis, revealing areas with high concentrations of criminal activity.

Determination of the Spatial Distribution of Crime Hubs and Police Stations

The spatial distribution of crime hubs and police stations was accurately determined through leveraging on advanced geospatial analysis techniques. Initially, the geographic coordinates of crime hubs locations, police stations, and outposts were accurately obtained using handheld GPS receiver. These coordinates were then imported into the ArcGIS 10.8 environment, where a point overlay analysis was conducted. This process allowed for a comprehensive mapping of crime hubs and the distribution of law enforcement facilities across the study area.

The creation of a geo-database was integral to this process that involved the compilation of attributes and geometric data for all recorded crimes hubs, formatted in Microsoft Excel, and subsequently imported into ArcGIS 10.8. The geo-database served as the foundation for crime hubs analysis and spatial queries enabled the detailed examination of crime patterns. Through this mapping process, a detailed visualization of crime patterns and hubs were achieved by providing a clear understanding of the spatial distribution of crime hubs and the proximity of these hubs to police stations and outposts.

Analysis of Spatial Relationships between Crime Hubs and Police Stations

The spatial relationships between crime hubs and police stations were analyzed using a combination of proximity analysis, Nearest Neighbour (NN) analysis, Kernel Density Estimation (KDE) and further give recommendation for location allocation of police station for area that are vulnerable. The NN analysis was conducted using the Arc Toolbox in ArcGIS 10.8, where the average NN value was calculated to assess the proximity of crime hubs to the nearest security outposts. This analysis provided insight into whether crime distribution within the area was clustered, random, or dispersed (Comaniciu, Ramesh and Meer, 2003).

Kernel Density Estimation (KDE) was used to map crime hubs by estimating how the density of criminal eventsvaried across the study area. KDE produced a smooth map that depicted the density of crimes at every location, allowing users to identify crime hubs based on density contours. Points closer to the center of the KDE window were given more weight, making this method particularly effective in generating a visually pleasing and informative visualization of crime intensity (Goldsmith, 1999; Gor and Olligschlaeger, 1998; Anderson, 2009).

Proximity analysis further refined the understanding of spatial relationships by creating buffers around identified crime locations and police stations. These buffers classified areas into different risk zones, ranging from a 300-meter "Danger Zone" with the highest crime likelihood to areas beyond 1,000 meters, classified as "Safe Zones." For police operations, a similar buffer analysis defined zones according to the operational reach of police resources, ensuring strategic deployment and optimal resource allocation (O'Sullivan and Unwin, 2010; Schiavone, 2019). This dual-layered approach, combining proximity and density analyses, provided a robust framework for understanding the spatial dynamics between crime hubs and law enforcement facilities by facilitating targeted interventions and enhancing public safety across the study area through allocating new point were police station can be sighted due to the need.

Assessing Police Division and Outpost Coverage

The table on Police Division and Police Outpost Coverage within Settlements in Bauchi Metropolis was developed through spatial analysis of police station and outpost locations relative to the various wards. Utilizing Geographic Information Systems (GIS), data on the geographical locations of police stations and crime incidents were collected and analyzed to evaluate the level of police service coverage across different wards. The approach involved categorizing the wards into "Over-served," "Served," and "Underserved" based on the proximity of police outposts and the population density within each ward. The percentages reflect the extent of coverage for

each category. Data sources included official police station records, demographic data, and crime statistics, with spatial data analysis supported by maps and GIS software.

Data Presentation and Analysis of Result

The data collected were presented using tables, and figures. The results obtained were compared with the objectives of the study to ascertain if the objectives were achieved.

Crime Hubs Relationship to Police Station

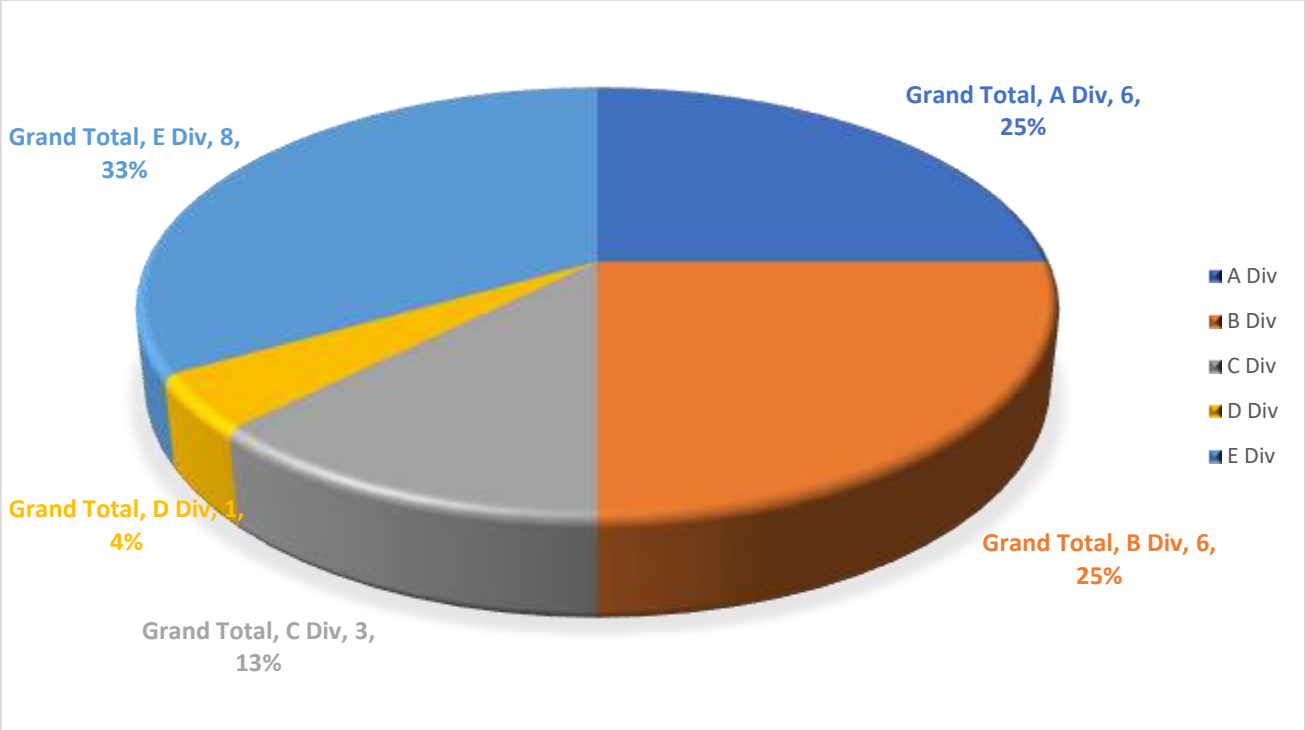


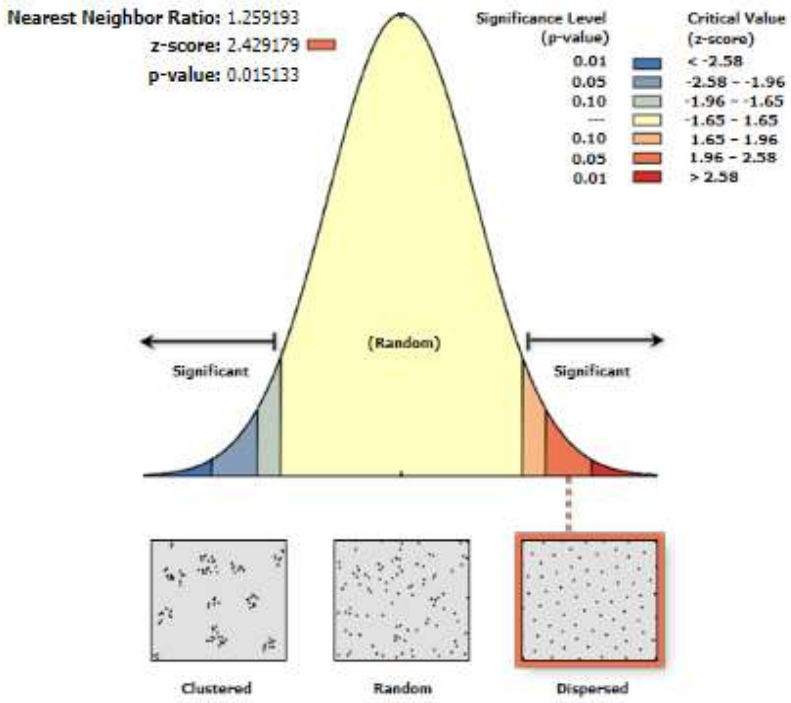
Figure 3: Coverage of Police activities in relation to crime hubs

The pie chart illustrates the distribution of crime hubs across different police divisions in terms of their outreach. E Division holds the largest share, accounting for 33% of the crime hubs. Both A Division and B Division each have an equal share of 25%, indicating a similar level of crime presence or outreach in these areas. C Division follows with 13%, while D Division has the smallest share of just 4%. This data suggests that E Division may require more intensive policing efforts due to its higher concentration of crime hubs, while D Division currently faces the least challenge.

Table 7 (**in Appendix 1**) shows the data from 2014 to 2023 reveals the frequency and distribution of various crimes, categorized into organized crime, property crime, violent crime, consensual crime, and white-collar crime. Organized crime is the most prevalent, with armed robbery leading at 6,637 cases, making up 43.9% of all reported crimes. Other notable organized crimes include theft (476 cases, 3.2%) and kidnapping (454 cases, 3.0%). Property crimes are also significant, with motorcycle snatching being the second most common crime at 2,825 cases (18.7%), followed by fraud (746 cases, 4.9%), phone snatching (173 cases, 1.1%), and vandalization (84 cases, 0.6%). Violent crimes are led by culpable homicide with 928 cases (6.1%) and rape with 904 cases (6.0%), alongside other offenses like causing grievous hurt (222 cases, 1.5%) and criminal breach of trust (199 cases, 1.3%). Consensual crimes, while less frequent, include unlawful possession of firearms, with 189 cases (1.3%) being the most recorded. The least frequent crimes, such as "enticing of married women" (6 cases), "escape from lawful custody" (4 cases), and "criminal force" (2 cases), are rare or potentially underreported.

Spatial Pattern Analysis: Unveiling Crime hubs through Kernel Density Estimation

Based on the results presented in Table 4 and Table 5, several observations and discussions can be made regarding the distribution and severity of crime hubs within Bauchi Metropolis.



Given the z-score of 2.42917937799, there is a less than 5% likelihood that this dispersed crime hubs pattern could be the result of random chance

Average Nearest Neighbor Summary

Observed Mean Distance:	1248.9996 Meters
Expected Mean Distance:	991.9049 Meters
Nearest Neighbor Ratio:	1.259193
z-score:	2.429179
p-value:	0.015133

Dataset Information

Input Feature Class:	Crime_Hub
Distance Method:	EUCLIDEAN
Study Area:	94452031.795991
Selection Set:	False

Figure 4: Nearest Neighbour analysis of crime hub in relation to the built-up area

The above figure illustrate a spatial analysis using Moran's I and a crime hubs analysis with Gi* statistics for assessing the spatial pattern of data points. The Spatial pattern shows a Moran's Index of -0.218159, indicating a weak negative spatial correlation with a z-score of -1.08639 and a p-value of 0.278958. This suggests that the spatial pattern does not significantly deviate from randomness, implying that the distribution is more dispersed than clustered in some wards. Table 3 show the Distribution of Crime Hubs across Wards in Bauchi Metropolis

Table 3: Categorization of Crime Hubs by Severity Levels in Bauchi Metropolis Wards

Ward	Least Crimehub (%)	Less Crimehub (%)	Moderate Crimehub (%)	High Crimehub (%)	Extreme Crimehub (%)
Kundun Durum	7.28	0	0	0	0
Tirwun	13.61	0.37	0	0	0
Dan Dango	12.82	0.04	0	0	0
Birshi	16.17	2.05	1.13	0.41	0.2

Miri	28.4	1.09	0.55	0.08	0
Hardo	0.07	0.07	0.01	0	0
Dan Amar B	0.26	0.39	0.39	0	0
Dawaki	1.68	0.31	0	0	0
Dan Kade	0.23	0.02	0	0	0
Dan Amar A	0	0.07	0.21	0	0
Dan Iya	8.12	2.47	0.47	0.04	0
Grand Total	**88.64**	**6.88**	**2.76**	**0.53**	**0.2**

Source: Crime data from Bauchi State Police Command Headquarter for 10 years (2014-2023)

Table 3 provides further insights into the severity levels of crime hubs across the different wards. According to the data, the majority of crime hubs (89.02%) fall under the "Least Crime hub" category, indicating a relatively low severity level. However, it is important to note that wards like Birshi (2.05%), Dan Iya (2.47%), and Miri (1.09%) have a significant proportion of crime hubs classified as "Less Crime hub" and "Moderate Crime hub." These areas may require more immediate attention and targeted interventions to prevent the escalation of crime severity.

Interestingly, only a small percentage of crime hubs (0.52% and 0.20%) fall under the "High Crime hub" and "Extreme Crime hub" categories, respectively. While these percentages may seem insignificant, it is crucial to address these high-risk areas promptly to prevent further escalation of criminal activities and ensure public safety.

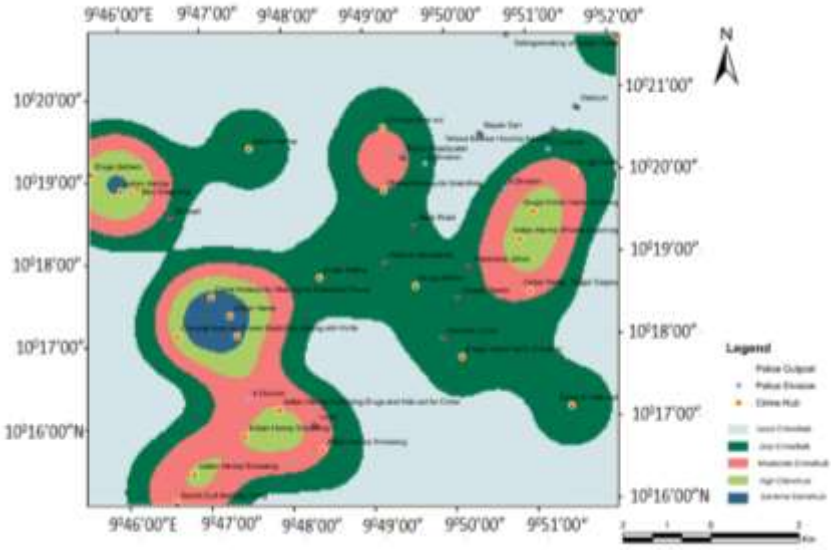


Figure 5: Kernel Density estimation of Crime Hub Concentrations showing the impact of the crime hubs in the study area (Source: Digital street guide map from Google map, 2024)

The Kernel Density Estimation map of Crime Hub Concentrations in Bauchi Metropolis, Bauchi State reveals a spatial distribution of criminal activities across the region for the period of 10 years from 2014-2024 respectively. The map highlights areas with varying crime intensities, categorized from least to extreme, using a color gradient ranging from light green to red. Key high-risk zones, identified by intense red areas, include regions associated with drug trafficking, theft, and criminal hideouts. The placement of police stations, marked by blue and purple dots, indicates some areas of effective coverage, while others, particularly those with high crime concentrations, appear under-served.

The spatial patterns and severity levels of crime hubs discussed above are further visualized, which presents the

kernel density distribution of crime hubs within Bauchi Metropolis. The kernel density map provides a clear visual representation of the hotspots and concentrations of criminal activities across the different wards. As observed in Figure 6, the wards of Miri and Birshi stand out as prominent hotspots, with high kernel density values indicating a significant clustering of crime incidents. These areas are depicted in darker shades, highlighting the need for targeted interventions and increased law enforcement presence.

On the other hand, wards like Dan Kade, Hardo, and Makama A exhibited lower kernel density values, represented by lighter shades, suggesting a more dispersed distribution of crime hubs or lower overall crime rates in these areas.

Proximity of Crime hubs to Security Agency Station for intervention

Table 4: Population density of the Built-up Area

Ward Name	Population (est. 2023)	Built-up Area (Sqkm)	Total Area (SqKm)	Population Density (per Sqkm)
Birshi	148,995	19.80	204.08	7,525
Dan Amar A	33,575	1.26	1.26	26,647
Dan Amar B	91,136	3.68	4.66	24,765
Dan Dango	26,364	1.42	161.61	18,566
Dan Iya	133,822	30.63	50.03	4,369
Dan Kade	34,527	1.09	1.10	31,676
Dawaki	99,231	7.83	8.94	12,673
Hardo	16,960	0.66	0.66	25,697
Kangere	66,146	1.77	397.86	37,371
Makama A	54,004	2.18	2.18	24,772
Makama B	47,959	2.44	2.44	19,655
Miri	85,851	12.81	205.33	6,702
Tirwun	208,181	28.43	496.12	7,323
GRAND TOTAL	**1,046,751**	**114**	**1,536**	**247,741**

Source: Est. 2023

Table 5: Crime Hub Locations, Types, and Distances to Nearest Police Stations

Crime Type	Location	Police Station	Distance (m)
Bike Snatching	Wunti Dada near market.	Tambari outpost	1006.163
Indian hemp	Wunti Dada near Tankin Ruwa	Tambari outpost	1172.939
Drug Sellers	Wunti Dada Adjacent Market	Tambari outpost	2003.478
Indian hermp	Guru Near Jonah Shop (Indian hermp)	Tambari outpost	2385.232
Indian Hemp,Thugs and Dagery	Railway	Dutsen tanshi divisional police station	1446.557
Indian hemps and phone snatching	Karofi Near Shagari Quarters	A' Division	1044.045
Indian hemps and Drug sellers	Gwallaga Junction	Fed Sect outpost	728.1798
Criminal hide out	Gudum Fulani	Gudun outpoust	403.0091
Drug seller	Abujan Kwata	'C' Division	1293.334
Selling and smoking of Indian hemp	Turiwun T.per park	Gidadubu outpost	1493.405
Indian hemp smoking	Rafin Zurfi Behind Bubes Hotel	E' Division	1741.606
Drug Selling	Dass Park	Fed Sect outpost	1969.29
Drugs and Indian hemp smoking	Bakaro	A' Division	839.0805

Drugs and Indian hemp smoking	I.D.C Gate	Federal Low Cost Police Station	959.6132
Secret cult meeting point	Gwallameji, Near Linking Finger	E' Division	2872.673
Street prostitution and Indian hemp smoking	Kaduna Road, GRA, Salama Hotel	G.R.A Police Station Yandoka	952.3006
Street prostitution and Indian hemp smoking	Old Airport, Bauchi	Fed Sect outpost	1059.695
Indian hemp smokers	Kagadama River	Lushi outpost	1295.515
Smoking of Indian hemp and snatching of phones	Tsakani Lushi, opp. Bethel prayer house	Lushi outpost	576.2527
Indian hemp, Drugs and Hide out for crime	Ambassador, Yelwa Tudu	E' Division	579.5228
Phone snatching stabbing with knife	Sabon Kaura close to ATBU fence	E' Division	1503.079
Indian hemp	Sabon Kaura market	E' Division	1954.905
crime hide out for motorcycle snatchers and phone	Sabon Kaura behind Samnat shopping complex	E' Division	2158.114
Indian hemp and drugs	Sabon Kaura close to Suraiya investment	E' Division	1833.318

Table 5 titled "Crime Hotspot Locations, Types, and Distances to Nearest Police Stations," presents a comprehensive overview of various crime hotspots, categorized by the type of criminal activity prevalent in each location. It includes details such as the specific remark or name of the location, the geographic coordinates (longitude and latitude), the name of the nearest police station or outpost (Police Station), and the calculated distance from the hotspot to the respective law enforcement facility (Distance).

Examining the distances, it is evident that certain police stations or outposts have a larger concentration of crime hubs within their vicinity, suggesting a higher workload and potential strain on resources. For instance, the "E' Division" station appears to cover multiple crime hotspots, such as "Gudum Fulani," "Rafin Zurfi Behind Bubes Hotel," "Gwallameji, Near Linking Finger," and "Ambassedor Yelwa Tudu," with distances ranging from a few hundred meters to over 2.8 kilometers. This implies that the "E' Division" station may be responsible for responding to a substantial number of crimes reports within its jurisdiction.

On the other hand, stations like "Dutsen tanshi divisional police station" and "Federal Low-Cost Police Station" seem to have fewer crime hubs in their immediate surroundings based on the available data and also the dweller are mostly government employees and business men. However, it is important to note that the data provided may not represent the complete picture, and there could be additional crime hotspots not included in this specific dataset.

The distance between a crime hub and the nearest police station can significantly impact the response time and effectiveness of law enforcement efforts. Crime hubs located farther away from police stations may experience delays in response times, potentially allowing criminal activities to escalate or perpetrators to escape before authorities arrive. Conversely, crime hubs in close proximity to police stations may benefit from more rapid intervention and increased visibility of law enforcement presence, which could act as a deterrent.

Location Allocation of Police Station

Table 6: Spatial and Attribute Allocation data of Police Station Recommended Points in Bauchi Metropolis

S/N	**Easting**	**Northing**	**Location name**
1	595882.9156	1140410.835	Dan'Amar A
2	594775.8774	1138662.831	Kengere

3	591880.9715	1134798.948	Dandango
4	587237.3368	1139315.401	Hardo
5	587891.7066	1136923.764	Bishir
6	584544.4074	1135316.114	Bishir
7	583433.2286	1137978.838	Miri
8	585152.1951	1142186.38	Miri
9	590842.794	1143649.251	Hardo

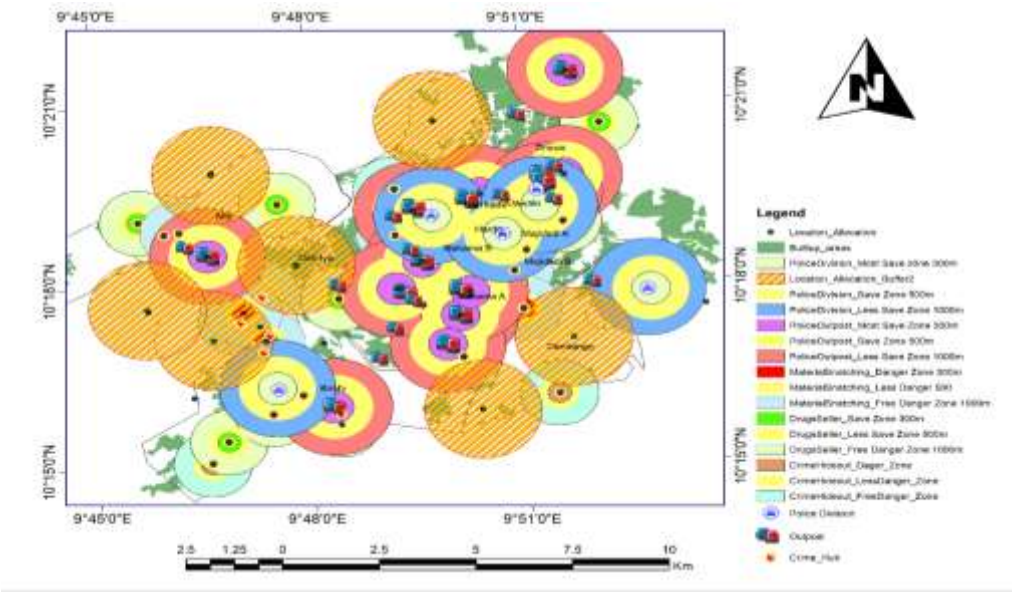


Figure 6: Map showing Location Allocation of Police Station in the study area (Source: Digital street guide map from Google map, 2024)

The map displays a strategic layout of location allocation of the police station across the built-up areas of Bauchi Metropolis which aimed at addressing crime hubs indicated by red and yellow circular symbols. These crime hubs are predominantly concentrated in wards such as Birshi, Miri, and Dan Amar A, which are highlighted with distinct colors on the map. The recommended outposts, marked with blue symbols, are strategically positioned near these crime hubs, suggesting a focus on improving police presence in vulnerable areas. The green-shaded areas represent the built-up zones where increased policing is necessary. The distribution of the recommended outposts across the metropolis appears to be well-planned, with a focus on high-crime regions to enhance law enforcement efficiency and community safety.

DISCUSSION OF FINDINGS

Police Outpost Coverage Analysis in Bauchi Local Government Area

The findings in Table.3 highpoints the uneven distribution of Police Division police outpost coverage across different wards in Bauchi metropolis, underscoring significant disparities in resource allocation. Birshi ward presents a rare case of balanced coverage with similar percentages of overserved, served, and underserved populations, totaling 16.25%. This balance suggests a more equitable distribution of police services in Birshi compared to other wards. In contrast, Dan Amar A and Dan Amar B exhibit higher proportions of overserved residents, with little to no representation of served or underserved populations. These Figures suggest that these wards might be experiencing a redundancy in police presence, where Police personnel are strategically station and potentially being concentrated in areas that do not necessarily require such heavy coverage, thereby limiting the availability of police services in other regions that might need them more.

Moreover, the disparities between wards such as Dan Dango and Dan Iya further emphasize the unevenness in police outpost distribution. Dan Dango has a very low overall coverage (1.17%), indicating that it might be

under-policed, while Dan Iya, with a total coverage of 26.56%, shows a significant overserved population (21.59%). Such a high percentage of overserved areas in Dan Iya could mean that resources are disproportionately allocated, potentially leading to inefficiencies in law enforcement operations. Similarly, the substantial totals in Miri and Tirwun reflect significant served and underserved populations, indicating a more diverse but still uneven allocation of police services. The data o Hardo and Dan Kade, showing the lowest totals driven solely by overserved and underserved populations, respectively, further emphasizes the disparities in police coverage, suggesting that a strategic reevaluation of resource distribution is necessary to address the needs of underserved areas and ensure more balanced coverage across the metropolis.

Analyze the spatial relationships between the crime hubs and police station in Bauchi metropolis

The pattern of crime hubs in Bauchi Metropolis using statistical crime data from 2014 to 2023 shows varied trends across different crime categories. Organized crimes like armed robbery and motorcycle snatching have consistently increased, indicating a rise in property crimes related to vehicles, with a significant spike in armed robbery cases in 2023. Kidnapping also shows a notable upward trend in recent years. On the other hand, crimes such as culpable homicide and rape exhibit fluctuating trends, with periods of sharp increases, particularly around 2018, followed by a slight decrease in the subsequent years. Meanwhile, crimes like phone snatching and house theft have remained relatively stable with low numbers, indicating minimal significant change over the years. The data highlights the dynamic nature of crime in Bauchi Metropolis, with some crimes escalating while others remain steady or fluctuate.

The Kernel Density Estimation (KDE) map, along with proximity analysis and statistical evaluation, highlights the spatial distribution of crime hubs and the placement of police stations in Bauchi Metropolis. The analysis reveals several areas with varying crime densities, ranging from low to extreme, with the highest concentrations observed in the central and southwestern regions, particularly in the wards of Miri and Birshi. Criminal activities such as Indian hemp smoking, drug selling, and phone snatching are prevalent in these areas. While police stations are scattered across the metropolis, with some strategically located near high-crime areas, the KDE suggests that certain extreme crime hubs, especially in the central region, may still require enhanced police intervention to effectively mitigate criminal activities. The proximity analysis map further demonstrates that although in most of this crime hubs area, there are no police outposts, but due to the Vulnerability of the environment moveable police personnel strategically patrol to create more awareness in other to impose fear into the heart of criminals. Many crime hubs still fall within a critical radius of law enforcement but their operation is based on discretion, there is a raising concern for law enforcement agency to strategically station their men in this most vulnerable area deterring crime. The overlapping high-density crime zones and police coverage areas suggest that mere proximity to law enforcement may not be sufficient to curb criminal activities, this indicating a need for more proactive and visible policing strategies.

The table complements these visual findings by providing granular details about specific crime locations and their distances from the nearest police stations. For instance, while some crime hubs, like those in Gudum Fulani and Gwallaga Junction, are situated relatively close to law enforcement outposts (within 500 to 1000 meters), others, such as those in Gwallameji and Sabon Kaura, are farther away, exceeding 1000 meters from the nearest police station. This spatial disparity in police coverage highlights the uneven distribution of law enforcement resources and the challenges in responding promptly to criminal activities. The KDE map also reveals smaller, localized hotspots within certain wards, such as Dan Iya and Kundun Durum, which, although not the highest in overall crime rates, still require attention due to the concentrated nature of criminal activities. These findings emphasize the necessity of a multi-faceted approach to crime prevention, which includes targeted interventions, enhanced resource allocation, and community engagement, particularly in high-density crime areas like Miri and Birshi, while also addressing regions with moderate to high crime severity levels.

Identification of suitable locations for police stations

The geospatial technique using kernel density estimation and proximity analysis has revealed that the Central and South-Western wards of Bauchi Metropolis have high-density crime hubs, primarily due to insufficient police presence and manpower shortages. These areas, including wards such as Birsh, Miri Hardo, and Bakaro, show significant vulnerability to crimes like material snatching and drug dealing. As a result, strategic locations

within these targeted wards have been recommended for the establishment of permanent police stations to enhance law enforcement coverage and effectively combat rising crime levels in the most affected areas.

This research highlights the diverse spatial patterns observed in crime hotspots. Major offenses such as armed robbery and motorcycle snatching display increasing trends, reflecting rising concerns about organized and property crimes. Violent crimes, including culpable homicide and rape, also show an upward trend, though with occasional fluctuations. Conversely, a decline in theft rates may indicate successful law enforcement efforts or shifts in criminal activity. Understanding these patterns is essential for law enforcement and policymakers to efficiently allocate resources and develop targeted crime prevention strategies.

The findings of this study align with those of Irvin-Erickson and Vigne (2015) and Taiye, Patrick, Anthonia and Emmanuel (2017), both of whom analyzed crime data over five-year intervals. Their research also identified high rates of crimes like robbery, burglary, and theft. However, this study reveals that crimes such as armed robbery, motorcycle snatching, culpable homicide, and rape show higher prevalence, which is consistent with the emerging trends identified in this research.

Impact of the Criminal Activities in Resident of Bauchi Metropolis

The increase in criminal activities and uneven distribution of police outposts across Bauchi Metropolis undermines public safety, discourages investment, and widen socio-economic disparities between wards. Under-policed areas like Sabon Kaura face rising crime and weakened community trust, while over-policed zones reflect inefficient use of limited resources. High-crime areas such as Miri and Birshi remain vulnerable due to inadequate coverage, threatening social stability and economic activities. The findings highlight the urgent need for a more balanced, data-driven approach to policing that enhances security, supports equitable urban development, and fosters long-term socio-economic growth across the metropolis

CONCLUSION

The spatial analysis of police station distribution and crime hubs within Bauchi metropolis has provided valuable insights into the prevailing law enforcement landscape and its implications for public safety. Through the integration of Geographic Information System (GIS) techniques and spatial analysis tools, this study has unveiled crucial findings that can inform decision-making processes and guide targeted interventions.

The study's findings revealed significant disparities in the distribution of police outposts and divisional headquarters across the metropolis. While some areas were identified as overserved, with a higher concentration of law enforcement facilities, others were classified as underserved, potentially leading to longer response times and inadequate police coverage. This imbalance in resource allocation raises concerns about equitable access to law enforcement services and highlights the need for strategic adjustments to ensure efficient utilization of resources and comprehensive coverage across all communities.

Furthermore, the analysis of crime hotspots through kernel density estimation highlighted the existence of distinct spatial patterns and severity levels of criminal activities. Wards such as Miri and Birshi emerged as prominent hotspots, with high concentrations of crime incidents, indicating the need for targeted interventions and increased law enforcement presence in these areas. Conversely, wards like Dan Kade, Hardo, and Makama A exhibited lower crime rates, potentially due to factors such as socioeconomic conditions, community engagement initiatives, or differences in urban infrastructure.

The study also examined the proximity of crime hubs to the nearest police stations, shedding light on the potential response times and the ability of law enforcement agencies to effectively address criminal activities. Locations situated farther away from police stations may experience delays in response, allowing criminal activities to escalate or perpetrators to evade capture, while crime hubs in close proximity may benefit from more rapid intervention and increased deterrence through visible law enforcement presence.

RECOMMENDATIONS

The following recommendations are considered in line with the findings of this study:

1. There is need for increasing law enforcement presence and community engagement efforts in the vulnerable wards and also to implement strategic interventions such as heightened policing and awareness programs to reduce crime and ensure safety.
2. The government need to re-evaluate the police resource distribution to strategically target most build up area in other to improve coverage in underserved wards and to also optimize resource allocation in overserved areas. This strategic adjustment will enhance the overall effectiveness and efficiency of law enforcement operations.
3. The security agencies need to intensify law enforcement efforts in the high-risk wards, focusing on combating escalating organized crime and ensuring residents' safety. This includes deploying more focused and enhanced police interventions in identified crime hubs
4. The government need to adopt a proactive approach by strategically stationing permanent police station and their personnel in the most vulnerable areas. This will enhance police visibility, engage the community, and utilize targeted interventions to curb escalating crime rates in high-density areas while addressing moderately affected regions.

Contribution to knowledge

1. This research provides a detail spatial analysis of crime hubs and police station locations in Bauchi Metropolis which highlight vulnerable wards like Miri and Birshi with high crime rates. It offers critical insights into the overlap between crime-prone areas and law enforcement coverage for the purpose of improving security and safety of the communities.
2. Geospatial techniques like kernel density estimation and proximity analysis was used identifies suitable locations for location allocation of new police stations in high-crime areas. These findings will support policymakers in making data-driven decisions for improving law enforcement effectiveness and reducing crime in underserved areas.

Recommendations for Further Research

Further research should explore the temporal patterns of crime hotspots in Bauchi Metropolis using time series analysis, which this study could not employ due to the unavailability of detailed temporal data. Future researchers are encouraged to adopt this approach to reveal trends over time, offering deeper insights into crime dynamics and enabling more precise forecasting and intervention strategies to combat emerging crime patterns.

REFERENCES

1. Achumba, I. C., Ighomereho, O. S., and Akpor-Robaro, M. O. M. (2013). Security challenges in Nigeria and the implications for business activityes and sustainable development. Journal of economics and sustainable development, 4(2).
2. Adagba, O., Ugwu, S. C., and Eme, O. I. (2012). Activities of Boko Haram and Insecurity Question in Nigeria. Arabian Journal of Business and Management Review, 1(9), 77-99.
3. Ahmed, M. and Salihu, R.S. (2018). Spatiotemporal Pattern of Crime Using Geographic Information System (GIS) Approach in Dala L.G.A of Kano State, Nigeria. American Journal of Engineering Research (AJER), 2(3), 51-58.
4. Akech, J. M. (2005). Public law values and the politics of criminal (in) justice: Creating a democratic framework for policing in Kenya. Oxford University Commonwealth Law Journal, 5(2), 225-256.
5. Akella, A. S., and Cannon, J. B. (2017). Strengthening the weakest links: strategies for improving the enforcement of environmental laws globally. In Transnational environmental crime (pp. 459-492).
6. Azeez. (2014). Security Surveillance on Selected Hotspots areas in Akure—A Case Study of Akure South Local Government, Ondo State, Nigeria (B Tech Thesis). Department of Urban and Regional Planning, Federal University of Technology, Akure.
7. Binbin, Z., Longbiao, C., Sha, Z., Fangxun, Z., Shijian, L., and Gang, P., (2020). Spatio-temporal analysis of urban crime leveraging multisource crowd-sensed data. Personal and Ubiquitous Computing. https://doi.org/10.1007/s00779-020-01456-6
8. Chainey, S. (2014). Crime Mapping. In: Bruinsma, G. and Weisburd, D. (Eds) Encyclopedia of Criminology and Criminal Justice, New York: Springer.

9. Chainey, S., and Radcliffe, J. (2013). GIS and crime mapping. John Wiley and Sons.
10. Chandra, S., and Tripathi, M. S. (2024). Intersectionality of White-Collar Crime and Social Justice. CPJ Law Journal, 62.
11. Daukere, B.E., Yelwa, S.A. Akpu, B. and Ajani, A.O. (2020). Geospatial Analysis of Crime Incidence in Bayelsa West Senatorial District, Bayelsa State, Nigeria. Jalingo Journal of Social and Management Sciences, 2(3), 1-22.
12. Eller, J. D. (2024). In the Shadow of the Giant: Gun Violence in Latin America and the Caribbean. In Gun Violence and Prevention-Connections, Cultures, and Consequences. IntechOpen.
13. Felson, M., and Boba, R. L. (Eds.). (2010). Crime and everyday life. Sage.
14. Frederick, A. et al. (2023). Geospatial Appraisal of Crime Hotspot Distribution in Bauchi Metropolis. Scientific and Academic Publishing [abstract retrieved from ResearchGate on June 24, 2024]
15. Gberinyer, J. T., Okoro, I., and Adishi, E. (2024). Criminal Intelligence Management and Joint Security Operations in Benue State: Taming the Interagency Collaboration Debacle. Journal of Crime and Criminal Behavior, 4(2), 193-212.
16. Ibrahim, S. and Kuta, A.A. (2015). Challenges in Using Geographic Information Systems (GIS) to Understand and Control Crime in Nigeria. IOSR Journal of Humanities and Social Science (IOSR-JHSS), 20(3), 43-48.
17. Irvin-Erickson, Y., & La Vigne, N. (2015). A spatio-temporal analysis of crime at Washington, DC metro rail: Stations' crime-generating and crime-attracting characteristics as transportation nodes and places. Crime science, 4, 1-13.
18. Joseph, A.O. (2018). Examination of Impact of Rape on the Victim and the Socio-Development of Nigeria. Afro Asian Journal of Social Sciences, 9(3), 1-8.
19. Kimunge, J.(2023) 21st Century Reflections: A Special report.
20. Legendre, P., and Legendre, L. (1998). Spatial autocorrelation: Models, analysis and interpretation. New York: Springer-Verlag.
21. MacDonald, J.M., Hipp, J.R. and Gill, C., (2013). The Effects of Immigrant Concentration on Changes in Neighborhood Crime Rates. J. Quant. Criminol, **29**, 191–215. https://doi.org/10.1007/s10940-012-9176-8.
22. Nwagboso, C.I. (2018). Nigeria and the Challenges of Internal Security in the 21st Century. European Journal of Interdisciplinary Studies, 4(2); 15-33.
23. OPEYEMI, K. I. (2015). CIVIC CENTRE DESIGN WITH EMPHASIS ON HIGH-LEVEL SECURITY (Doctoral dissertation, DEPARTMENT OF ARCHITECTURE, UNIVERSITY OF LAGOS).
24. Richard, A. (2021). Presentation on Security Safety technique to Field Staff. OXFAM Nigeria
25. Roberts, S. (2024). Rebuilding Trust in a Divided Community: An Integrated Approach. Pepperdine Dispute Resolution Law Journal, 24(1), 461-478.
26. Temidayo, O. J. (2022). Appraisal of the role of the Police in the Criminal Justice System in Nigeria.
27. Tilley, N. (2012). Modern approaches to policing: community, problem-oriented and intelligence-led. In Handbook of policing (pp. 401-431). Willan.
28. Uhunmwuangho, S. O., and Aluforo, E. (2011). Challenges and Solutions to Ethno-Religious Conflicts inNigeria: Case Study of the Jos Crises. Journal of Sustainable Development in Africa, 13(5),109-124.
29. Umar, F. (2017). Understanding Spatial Patterns of Urban Crime in a Developing Country. Thesis submitted for the award of a Doctor of Philosophy (Ph.D.) Degree, University College, London.
30. Umar, F., Cheshire, J.A. and Johnson, S.D. (2015). Understanding the Spatial Pattern of Urban Crime: A Developing Country's Perspective. The 23rd Conference on GIS Research UK, 15th – 17th April, 2015, University of Leeds, Leeds - UK.
31. UNICEF (2015). Nigeria's Boko Haram Insurgency Forces One Million Children from School. The U.N. News Center. U.N. News Service, 22nd December 2015. Web. 29th March. 2017.
32. Wasserman, S., and Faust, K., (1994). Social network analysis: Methods and applications. Cambridge University Press.
33. Wortley, R. (2016). Felson's routine activity theory: A review and assessment. In R. Wortley and S. M. Brown (Eds.), Rational choice and situational crime prevention (pp. 17-36). New York, NY: Springer.

Appendix 1

Table 7 : The dynamics of crime temporal pattern

SN	Crime	Crime Category	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	sum	Percentage
1.	Armed Robbery	Organize crime	411	580	443	553	524	701	680	730	885	1130	6637	43.9%
2.	Motorcycle snatching	Property Crime	213	218	243	309	275	283	321	316	319	328	2825	18.7%
3.	Culpable Homicide	Violence crime	93	61	51	58	110	100	114	117	114	110	928	6.1%
4.	Rape	Violence crime	34	33	11	33	76	78	176	186	151	126	904	6.0%
5.	Fraud	Property Crime	59	40	26	39	56	78	98	87	161	102	746	4.9%
6.	Theft	Organize crime	82	74	53	33	38	60	44	30	36	26	476	3.2%
7.	Kidnapping	Organize crime	10	21	31	44	26	47	49	74	85	67	454	3.0%
8.	Cheating	Property Crime	37	19	41	31	18	41	22	32	53	42	336	2.2%
9.	Causing Grievous hurt	Violence crime	48	21	29	13	16	19	21	14	23	18	222	1.5%
10.	Mischief by fire	Organize crime	16	14	13	9	11	108	10	9	14	11	215	1.4%
11.	criminal Breach of trust	Violence crime	24	18	31	9	11	16	36	27	6	21	199	1.3%
12.	Unlawful Possession of firearm	Consensual Crime	14	16	35	14	16	15	27	21	14	17	189	1.3%
13.	Phone snatching	Property Crime	18	12	19	17	13	29	9	26	19	11	173	1.1%
14.	Breach of Public Peace	Violence crime	12	16	26	0	3	42	9	2	6	25	141	0.9%
15.	Thugs and Thugery	Organize crime	8	12	17	3	9	4	21	11	7	10	102	0.7%
16.	Vandalization	Property Crime	7	18	12	3	8	4	7	11	5	9	84	0.6%
17.	Car Snatching	Property Crime	4	6	9	7	6	4	13	11	9	14	83	0.5%
18.	Criminal intimidation	Violence crime	12	7	15	11	6	7	12	7	2	4	83	0.5%
19.	Robbery	Organize crime	4	8	7	4	9	6	11	7	4	18	78	0.5%
20.	Caught in possession of Indian Hemp	Consensual Crime	7	11	17	7	4	6	1	5	3	6	67	0.4%
21.	House Theft	Property Crime	4	11	8	6	2	9	2	5	7	4	58	0.4%
22.	Impersonation	Consensual Crime	6	9	7	5	2	6	3	0	4	0	42	0.3%
23.	Extortion	Property Crime	4	1	7	5	1	0	2	4	11	7	42	0.3%
24.	Unlawful society	Organize crime	2	3	0	1	0	0	3	4	0	2	15	0.1%
25.	enticing of married women	white coller crime	3	0	0	2	0	0	0	0	1	0	6	0.0%
26.	Escape from lawful custody	Violence crime	1	2	0	0	0	0	0	0	0	1	4	0.0%
27.	Criminal force	Violence crime	0	2	0	0	0	0	0	0	0	0	2	0.0%

Source: Crime data from Bauchi Police Headquarter for 10 years