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Geospatial hotspots mapping of banditry/kidnapping in USSA and Takum local government area of Taraba state

Jibatswen Agbutsokwa Hosea [1, *], Eyong Eteng Eyong [1], Jagila Jantiku [1], Epsar Philip Kopteer [1], Hamza Yahaya [2], Taiwo Hassan Abdulrasheed [1], Moses Olorunfemi Areh [1], Philip Okoh Amodu [1], Umar Tanko Muhammad [1], Vivian Aaron Ibrahim [1], Elizabeth Rizga Jackson [1], Nazifa Musa Bauka [1], Onumaegbu Ndidi Monica [1], Ezekiel Ojei [1], Hosea Agbu Wunukhen [3], Vivian Chisom Nwabughiogu [1] and Etinosa Omobude [1]

[1] National Space Research and Development Agency (NASRDA), Abuja, Nigeria.
[2] Hydroelectric Power Producing Area Development Commission Lokoja, Kogi State.
[3] Taraba State Ministry of Finance Budget and Economic Planning, Jalingo.

Abstract

Banditry and kidnapping are an organized crime committed by outlaws typically involving the threat or use of violence and unlawful abduction and confinement of a person against their will, it is a heinous crime posing a great security challenge to the democratic governance and peaceful coexistence of a community or country. This study aims to provide an overview of the geospatial hotspot mapping of banditry and kidnapping in Ussa and Takum local government areas of Taraba State with the objectives to map out banditry and kidnapping hotspot in the study area, to examine the spatial pattern of settlement within the study area and to investigate the socio-economic and environmental factors that correlate with the hotspots of banditry and kidnapping and to analyze the land use land cover (LULC) changes. The utilization of Geographic Information Systems (GIS) technology, satellite imagery, settlement data and administrative boundaries has help in identifying areas with high levels of criminal activity, known as hotspots, and analyze the underlying factors contributing to these patterns. Through the collection and analysis of data on reported incidents of banditry and kidnapping, has help in creating maps that highlighted the distribution of these crimes within the study area. The information collected was overlayed with data on socio-economic factors, such as population density, poverty rates, and access to infrastructure, to identify potential risk factors associated with criminal activity in these areas. Geospatial hotspot mapping of banditry and kidnapping in this area has enabled researchers to identify temporal patterns in criminal activity, this will allow government and law enforcement agencies to allocate resources more effectively and respond proactively to emerging threats. The findings mapped out comprehensive overview of bandit attacks hotspot areas in Taraba State between 2021 to 2023. Moreover, the study highlighted vulnerable elements which need government attention, interventions and security actions as a result of bandit's attacks such as settlements, roads and schools, this project also recognized other social infrastructures at the high risk of attacks by bandits which includes healthcare facilities, water sources and markets places. The study revealed that more banditry attacks were recorded in Takum, Ussa LGAS of Taraba state sharing boundaries with each other.

Visualizing trends in criminal activity over time, researchers have been able to identify potential patterns and predict future hotspots, allowing for more targeted intervention strategies in the area

Keywords: Banditry; Kidnapping; Takum and Ussa; Hotspots; GIS; Landsat

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* Corresponding author: Jibatswen Agbutsokwa Hosea

1. Introduction

Banditry and kidnapping are an organized crime committed by outlaws typically involving the threat or use of violence and unlawful abduction and confinement of a person against their will, it is a heinous crime posing a great security challenge to the democratic governance and peaceful coexistence of a community or country [1, 2, 3]. Globally, the patterns of banditry/ kidnapping vary greatly from country to country and from year to year, though trends can be discerned and analyzed. Of the three centers of greatest political turmoil in the world - Latin America, southern Africa and the Middle East - only in one (Latin America) has kidnap and extortion been a major ingredient of this turmoil [4,5]. Colombia has, for several years, had the highest kidnap rate in the world, followed (a long way behind) by Guatemala and Italy, but in 1985-86 it looked as if Peru might overtake all of them [6]. In Latin America, a high proportion of kidnaps have in the past been politically motivated though the trend is now towards more of a criminal motivation. In Italy the great majority of kidnaps have always been by criminal gangs and of Italians rather than expatriate businessmen. Other forms of extortion, notably product extortion, have occurred predominantly in the industrial countries of Western Europe, and in the USA, Australia and Japan [7, 8, 9].

In the sub-Saharan region of Africa, banditry and kidnapping is widespread in the Northern region and the activities of bandits include; kidnapping, arson, cattle rustling, looting, raping, killings among others [10]. The wave of kidnapping activities has started to attract attentions beginning from the well reported kidnapped and abduction of an expatriate oil worker in the oil rich region of the Niger Delta around 25th February, 2006 [11].

However, the menace of armed-banditry and kidnapping has recently become reoccurring incidences threating the peace and survival of people living in the region particularly in the Northern states of Nigeria [10]. It has become an order of the day and no longer attract the attention it deserves from the National and international governments, institutions and organizations. Only few cases hit the headlines of the National Dailies, even though it occurs on a daily basis and seems to defy all possible remedies. People are harassed, rape, kidnapped, killed and their properties are destroyed, homes are set ablaze by mostly Fulani herders (also known as Bandits) and few other miscreants.

In Nigeria, banditry and kidnapping is rampant in especially in states such as Zamfara, Taraba, Katsina, Sokoto, Niger, Kaduna, Kebbi, Niger, Abuja and Kogi. The kidnapping groups usually operate both in the rural and urban areas in Northern Nigeria, and often demand for high ransom payment from the families of the victims, and consequently leave the families and victims financially bankrupt, in many instances bandits enforce levies to many communities in the rural areas [12]. It has since become easiest and lucrative business to the gang of criminals, fueling and aiding this devilish act is the lackadaisical attitude on the part of security agencies, activities of informants and saboteurs.

Historically, banditry and kidnapping in the Northern states of Nigeria has found its way into the region due to climate change and the resultant depletion of grazing resources for the herdsmen that led to encroachment of land resources belongings to farmers [13]. Subsequently, the eruption of farmers-herders clash and conflict which later metamorphosed into communal and ethnic rivalry. Handling the situation with kid gloves and leaving the situation unchecked by the authority, herdsmen later formed militia groups, who carry out kidnapping and other evil acts in the region [14]. The militia groups were commonly called bandits, but later the Nigerian government proscribed and described them as terrorists group in January 2022. As a result of constant attacks and kidnapping by bandits, from 2018 more thousands of people were killed, others were displaced [12]. [15], further reported that between 2018 to 2020 an estimated 4,900 people lost their lives to bandit's attacks, and about 309,000 were internally displaced, while 60,000 refugees were reported [10]. United Nations High Commissioner for Refugee and Nigerian government issued reports of 2019 that over 200,000 persons were internally displaced in several communities of Zamfara, Katsina Sokoto and Taraba States between January to August 2019, mostly Women, Children and elderly people. Zamfara State government also reported that banditry has resulted to an estimated 22,000 widows and 44,000 orphans in Zamfara State since 2011 [16].

Therefore, identifying high crime areas or hotspots plays a key role in how law enforcement agencies operations and address crime in problem areas. For strategic and problem-solving purposes, identifying high crime areas can be useful for the development and evaluation of police responses, and testing for spatial displacement or diffusion of benefits [17].

Nigeria for quite longer 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 [18]. 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 [19]. Hence, [20, 21], are of the view that the efforts of government have not yielded enough positive result.

Geographic Information System (GIS) is an essential tool for crime analysis in the twenty-first century. It allows for thorough mapping and analysis of crime data from several agencies and sources, improving reaction times. By swiftly obtaining and analyzing information and presenting it in a spatially interesting manner, agencies may deploy resources more effectively. A great deal of location-based data from different sources may be coordinated with the help of GIS software. According to [22, 23, 24], and others, the user can overlay data and see the information that is most important to the particular question or goal.

Combining the crime hotspot detection methodology with cluster analysis is one of the important ways to examine the geographical distribution and trends of crimes, which aids in their control and prevention. References: [25, 26, 27]. The identification of the crime cluster depends heavily on the integration of crime analysis with the state-of-the-art automated system and computerized database [28, 29]. Additionally, it facilitates easy supervision and oversight of criminal situations.

With the use of GIS, the crime area on a map can be displayed by combining traditional law enforcement data with spatial data. Based on research conducted by [30, 31], it is possible to determine the locations of crime hotspots, map the geographic distribution of crime, and take appropriate action to avoid crime episodes.

A number of tools, including SatScan, CrimeStat, SAS, SPSS, Hotspot Optimization Tool (HOT), ArcGIS, and others, have facilitated the evolution of numerous computational and statistical approaches, including space–time permutation method (STPM), Kernel Density, and Getis–Ord Gi [32, 33, 34].

The location, form, size, and direction of a cluster of criminal episodes have been analyzed using a variety of research and traditional approaches [35, 36, 37]. Cluster analysis is among the most used Hotspots for crime may be mapped and examined using Geospatial Appraisal of Crime Hotspot Distribution. It identified places with high concentrations of various forms of crime using police force crime statistics. It may also be used to investigate how the distribution of crime is impacted by environmental variables, such infrastructure and land use [34, 38, 39].

In the Jalingo metropolis of Taraba State, Nigeria, crime mapping, hot spot analysis, and the temporal fluctuations in crime rates utilizing geospatial data were employed [40, 41, 42]. This benefited efforts for crime prevention and control. Remote sensing, geographic information systems, and related technologies can be applied in residential areas. For example, earth observatory satellites can be used to gather baseline data for monitoring intelligence gathering for mapping urban crime. They can also be used to effectively manage various aspects of day-to-day city life, including transportation [43].

The association between crime hotspots and coldspots, police divisional stations, slum settlements, and the different parks and gardens in the research region may then be determined by doing a proximity analysis. This may lead to a strong association between crime and parks and gardens as well as a positive correlation between slum settlements and crime [44, 45].

The Takum and Usa local government in Taraba has gained the moniker "kidnappers den for innocent citizens" since it has witnessed and recorded several kidnapping cases [46]. According to the police, the accused received about 30 million naira in ransom from the victims' families [47].

The state and the nation as a whole are experiencing uncertainty due to this growing problem, which makes people feel insecure in their homes, on their farms, and in public areas like stores and markets. These are now commonplace and have irreversibly changed the harmony in our nation and society [48].

The terrible event that results from these kidnapping and banditry activities includes increased hunger brought on by people's fear of visiting the farm, as well as illnesses and deaths that inflict a great deal of pain and loss [49].

Even though there have been numerous attempts to contain the situation three suspected kidnappers were captured by Nigerian Army troops in Taraba during a raid on their hiding places the illegal activities persist because authorities have not yet successfully employed geospatial techniques for mapping, locating reliable crime data, and monitoring potential

crime scenes [50]. Furthermore, spatial analysis has been used in several studies on crime. Most of these studies looked at a specific set of crimes in a location over an extended period of time [31].

As a result, in Takum and Ussa LGAs of Taraba state, it is essential to develop crime hotspots mapping in areas with inadequate security equipment, areas of overlap, and areas requiring constant police patrol. Buffering analysis revealed banditry and kidnapping escape routes to their hideout. Neighborhood and statistical analyses with GIS also aid in this process.

This study aims to use a Geospatial in hotspot mapping of banditry/kidnapping hotspot in Usa and Takum local Government area of Taraba State with the objectives to map out banditry and kidnapping hotspot in the study area, to examine the spatial pattern of settlement within the study area and to investigate the socio-economic and environmental factors that correlate with the hotspots of banditry and kidnapping.

1.1. Study Area

Takum and Usa LGAs are roughly located between latitude 6o 22'N to 7o 30'N and longitude 9o 40'E to 10o 20'E, latitude 70 11' 00''N and longitude 100 02' 00'' E respectively [51, 52]. Takum shares boundaries with Donga and Wukari LGAs to the north, Benue State to the west and south-west, Ussa LGA to the east, and the Republic of Cameroon to the east and south-east. The 2006 national census found that Takum LGA, which has a size of 2,542 km2, is home to 135,349 people (68,863 men and 66,486 women). Three districts Chanchanji, Kashimbila, and Takum districts and eleven political wards make up Takum LGA [53].

Conversely, the United States of America shares borders with the Republic of Cameroon to the north and east, Kurmi LGA to the north-east, Takum LGA of Taraba to the west, and Donga LGA to the north. A population estimate of 247, 619 individuals reside in these towns. These two LGAs are home to the Kuteb, Ichen, Kpanzon, Tiv, Chamba, and Hausa tribes. Farmers, government employees, and dealers make up the majority of the workforce [54, 55].
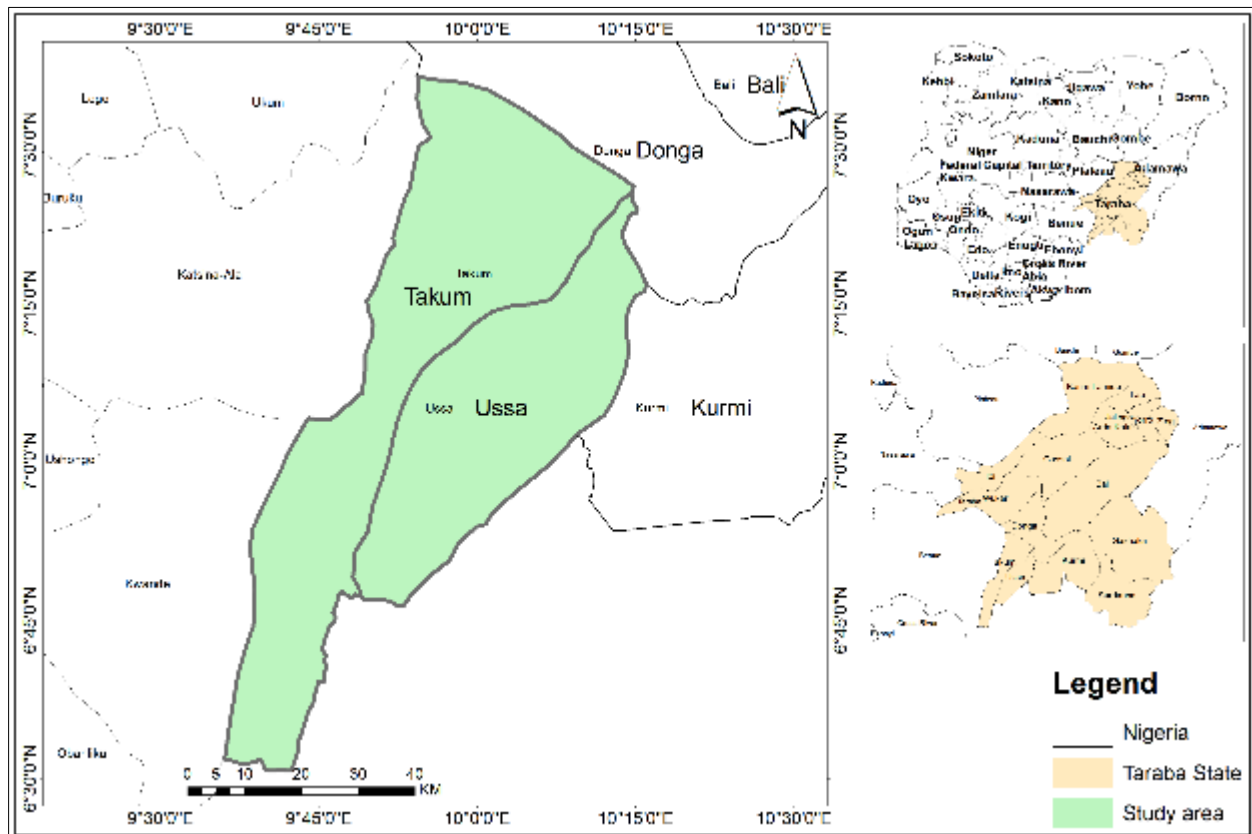

Figure 1 Study Area Map

Given that the two LGAs are situated on the windward side of the Mambilla plateau, which increases rainfall, and that annual rainfall decreases with increasing latitude due to orographic factors, the two LGAs experience a tropical wet and dry climate with an annual temperature of 31.41°C (88.54°F), which is 1.95% higher than Nigeria's norms [52, 56].

The region is covered with woody Savannah flora, namely the Agro-ecological zone, which is made up of trees, tall grasses (>2 m), and bushes, especially along the riverbank. Secondary forest regeneration is also seen. In addition to maize (Zea may), cassava (Manihot spp.), rice (Oryza sativa), fluted pumpkin (Telifera occidentalis), banana (Musa spp.), and other tree crops including oil palm, mango, banana, cocoa, and Gmelina arborea, the area is also home to several farmed crops. Cowpea (vigna ungiculata) and ground nuts (Arachis hypogeal) are produced in vast amounts [56]. The primary parent materials in the study area's geology are sand stone materials, which range from Cretaceous sediments to pre-Cambrian to Cambrian undifferentiated basement complex. Tropical alfisols or luvisols make up the majority of the soil in the research locations [57].

2. Material and methods

2.1. Primary and secondary data Approach

The design techniques employed in this research were remote sensing and GIS which served as guiding principle or main approach for information gathering on banditry and related attacks in Takum and ussa LGA, Taraba state. The study combined both geospatial and non-spatial technology procedures and crime data to expose the dynamics of banditry, its correlation in ungoverned spaces and impact on the socio-economic well-being of the state. Overlay and different interpolations were led and hotspots analysis done. These spaced based systems were used as exploratory or correlational to systematically obtain accurate answers by the use of the scientific means of gathering and interpreting this information. Primary and secondary data were the sources of the information used in this study. The primary data source was a field survey that used the Global Positioning System (GPS) to determine the positions of the police, army, vigilante, Taraba marshal, and hunters' checkpoints as well as the hotspots for kidnappings. Secondary data source: United States Geological Survey (USGS) satellite imagery (landsat 8) of the research region obtained at a resolution of 30 meters.

2.2. Data Collection

Procedures of data collection leveraged on exploitation of some space-based tools and other relevant devices of information gathering while data processing and analysis were achieved by use of different processes, approaches and techniques in software's also using hardware which presented a platform for visualization. Attack map of the study area which was composed and interpolated with terrain data, land cover, settlements and roads thematic layers served as a guide. Ground positioning System (GPS) receiver coordinates were captured at the areas of interest within the study area. Sentinel 2 satellite imagery acquired, other datasets were Settlement, Administrative boundaries, Armed Conflict location and Event Data (ACLED). Similarly, interviews were also conducted and physical observations made. This served as field or raw dataset. Other ancillary datasets were also used.

2.3. Data Processing and Spatial Analyses

Techniques employed included spatial, correlation and proximity analyses. That assisted in identifying and explaining relationships between variables such as bandits' hideouts, incidents and its closeness to ungoverned spaces or critical infrastructures. Density mapping was then carried out to picture the concentration of banditry attacks and the affected critical infrastructure and settlements. The hotspots map of the study area, then isolated hotspot, cold spot and safe areas. Buffer analysis of some of the local government areas with high incidents to establish remote causes of attacks. Network analysis to evaluate the accessibility and connectivity of areas of interest influencing banditry and governance, and statistical analysis to determine the significance of various factors in relation to banditry incidents and ungoverned spaces.

The database was used for hotspot analysis and queries. A GPS was used to find the abduction location's whereabouts. After importing the coordinates of the numerous crime scenes into the ArcGIS environment, point overlay analysis, or mapping, was done on a base map of the study region to create a map showing the locations of the kidnappings. The crime hotspot map of the study region was created using the data from the kidnap hotspots and the locations of the corresponding crime scenes. It is a heat map that uses ArcGIS software to utilize the Kernel Density Estimation (KDE) method.

2.4. Land use land cover (LULC)

Landsat 8 satellite images of the study region for the year 2020 were collected from USGS in order to categorize the land cover and land use of the area. The raster image of Landsat 8 has a resolution of 30 meters. The picture was pre-processed before classification, and post-processed following classification. The divisional police stations in the research region were located using the coordinates obtained from the portable GPS device (Garmin 84). For the divisional police stations, a geodatabase was constructed.

Table 1 Dataset Sources and Types

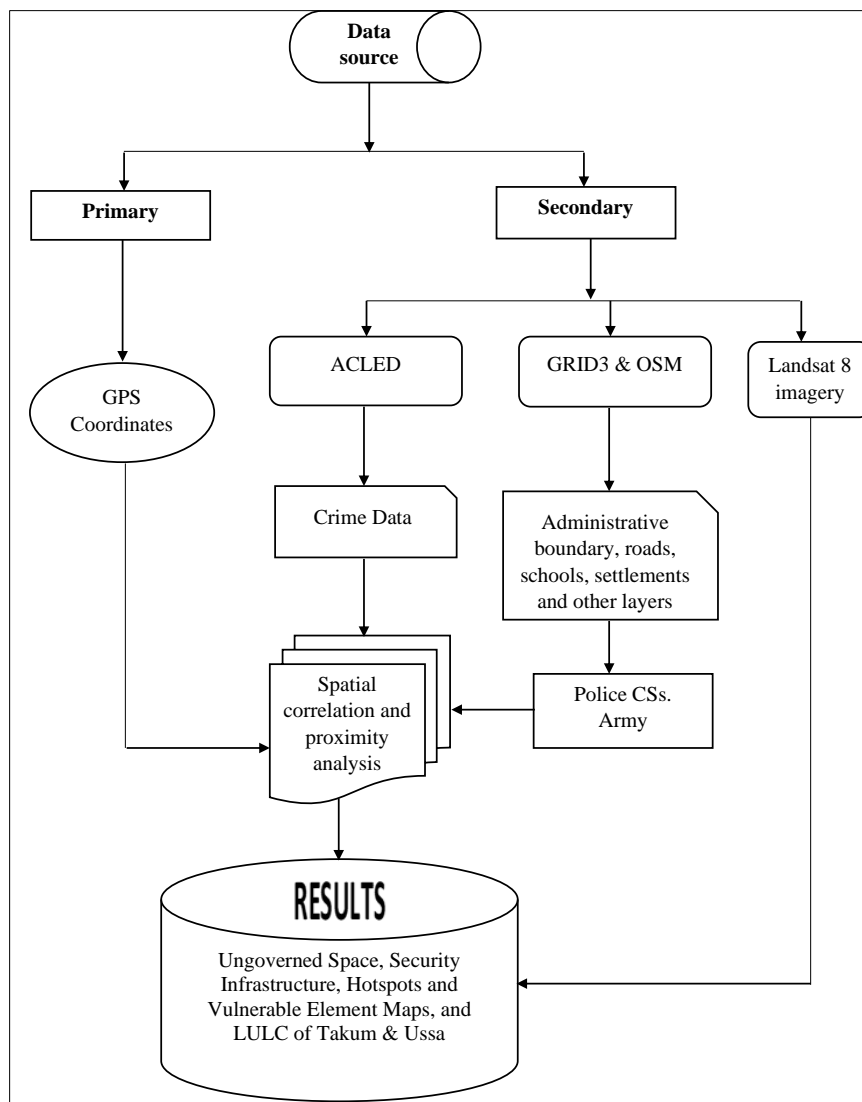| Data	Format	Type	Date	Spatial resolution (meters)	Sources
Sentinel-2	Raster	Secondary	2022	20	ESA
Landsat 8	Raster	Secondary		30	NASRDA Archives
Settlement data	Vector	Secondary	2022	Vector	Open Street Map GRID3
ACLED	vector	Secondary	2021-2023	Vector	ESA
Administrative Boundry	Vector	Secondary	2022	Vector	GRID3

Figure 2 Methodology Workflow

3. Results and discussion

3.1. Project Results

This part of the study presents project investigation, results and discussions of the findings from the project. The results of the investigations of banditry, related attacks and its nexus with ungoverned spaces in Niger State was therefore presented.

3.2. Identification of Ungoverned Spaces in Takum Ussa L.G.A, Taraba State

The spatial location of the ungoverned spaces as identified, characterized by their remote and inaccessible nature, in Taraba state are shown in figure 4. These regions represent significant challenges for governance and security due to their isolation and limited state presence.

3.3. Carrying out spatial analysis of the security infrastructure in the study area

The spatial location of security infrastructures in the study area is shown in figure 3. There are twenty-one police stations and one correctional Centre. On average, there is a police station in each LGA which is grossly inadequate. The closest two police stations are; police out post Lefu and Doki police station with a distance of twelve point nine (12.9) kilometers and the furthest Erena divisional police station and Bangi police stations with one hundred and thirty point eight (130.8) kilometers distant apart. This definitely would make policing difficult. Other stations also have varying distances in between these thresholds.

3.4. Mapping of banditry hotspots in the study area

The study mapped out areas of frequent attacks by the bandits in Niger state as shown in figure 4.3. the north east of the state experienced worst and more repeated attacks than other parts. The hotspots cover Takum and Ussa LGAs. The safe areas are northern part and far South. The rest suffered moderate attacks. Bandits and other related attacks were mapped using datasets obtained from several secondary sources, primarily from the Armed Conflict Location and Event Data Project (ACLED). The dataset covered incidents that occurred between 2021 and 2023, providing a comprehensive overview of the temporal and spatial distribution of these attacks within the study area.
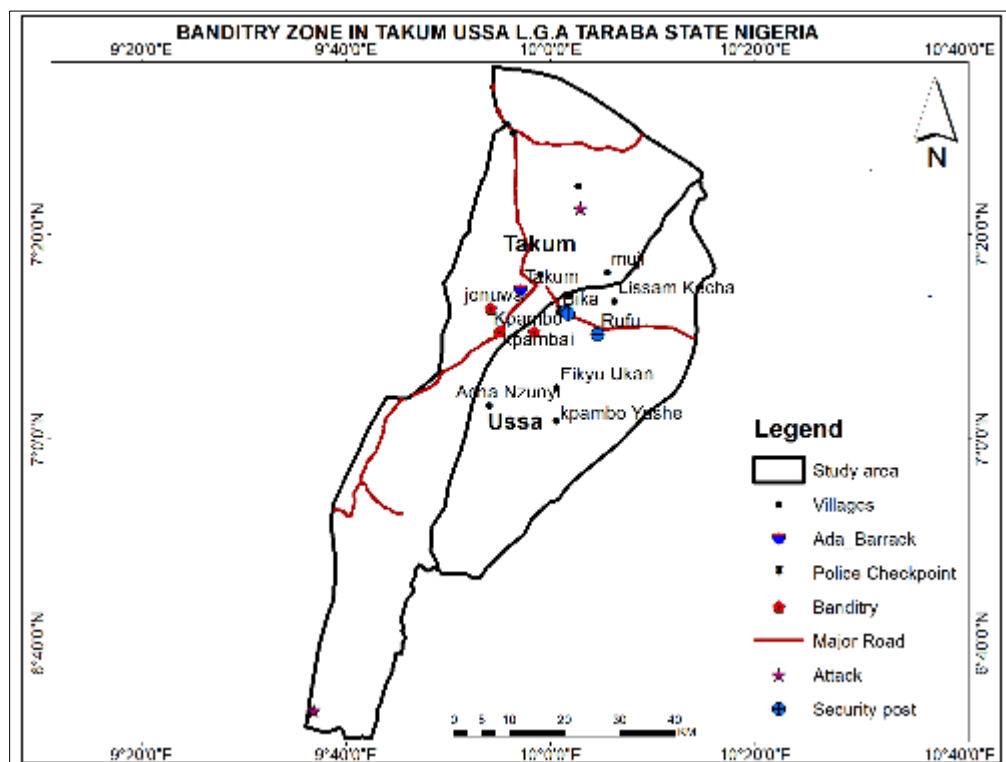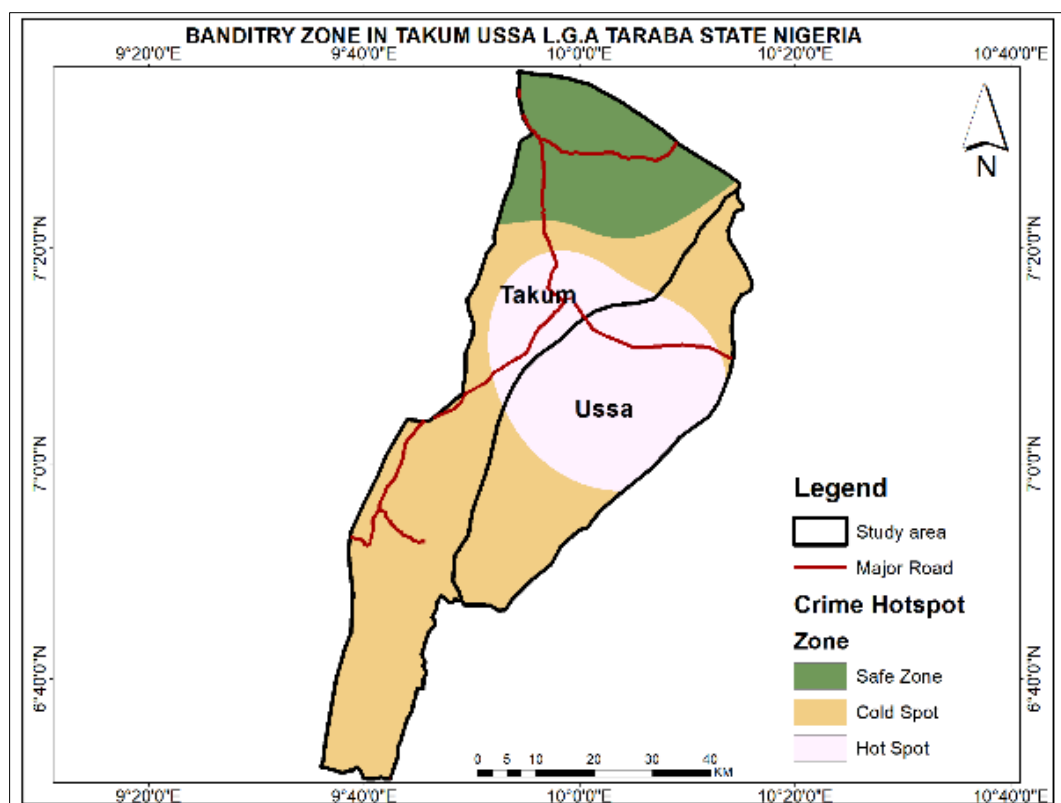

Figure 3 Map showing Security Infrastructure

Figure 4 Map showing banditry hotspots

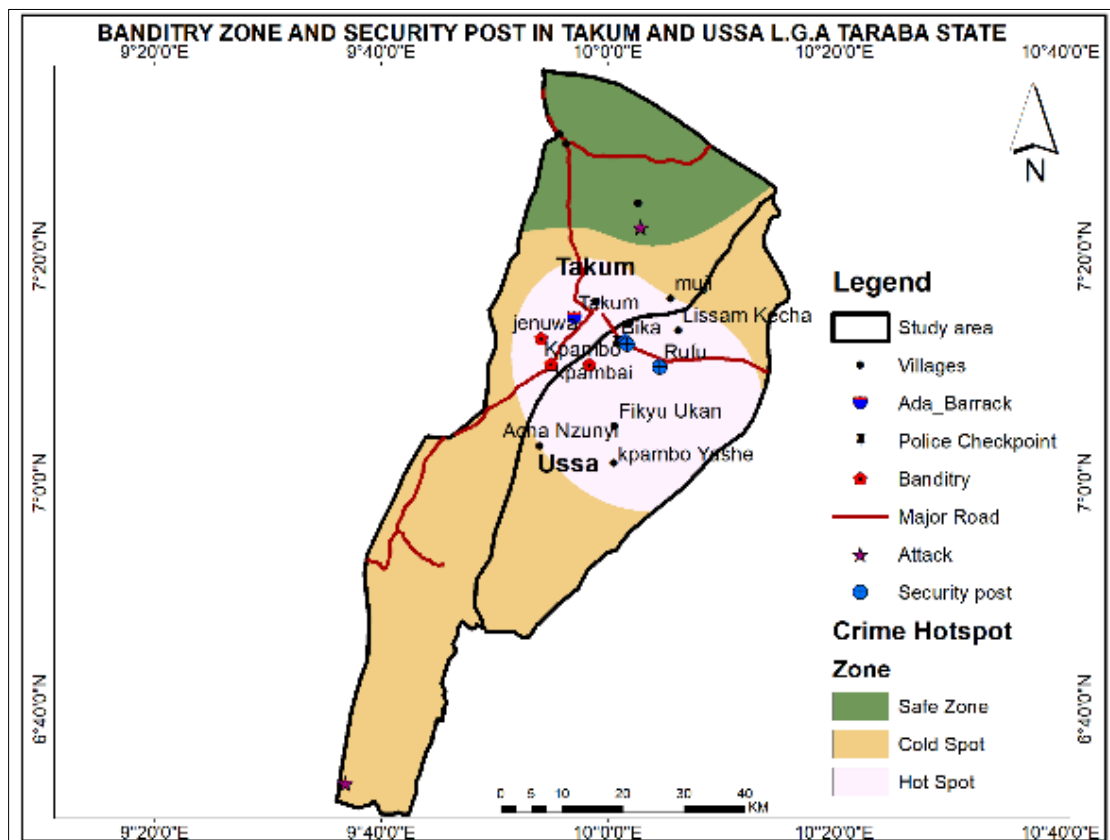## 3.5. Identification of vulnerable elements within study area

Figure 5 Vulnerable Elements Map

3.6. Evaluation of security infrastructure as it relates to banditry activities

The result here is presented in figures 6 and 7. A comprehensive spatial analysis of the relationship between security assets and bandit attacks within Taraba State has yielded significant findings. The bandits and other related attacks were mapped and labelled hotspots while the counter attacks by the security forces to neutralize these criminals is labelled event type attacks as shown in figure 7. The police stations as earlier mentioned are grossly inadequate and its spatial distribution contributes immensely to the ineffectiveness of its personnel. It is clearly seen that the area of the hotspot has less presence of police stations depicting lacked of personnel that the opponents took advantage of. It is either that there is a police station with inadequate personnel or no police station at a place of need. The analysis also pointed to the fact that bandits used some of the forested areas only to hide and move long distances to attack where such opportunities are available.
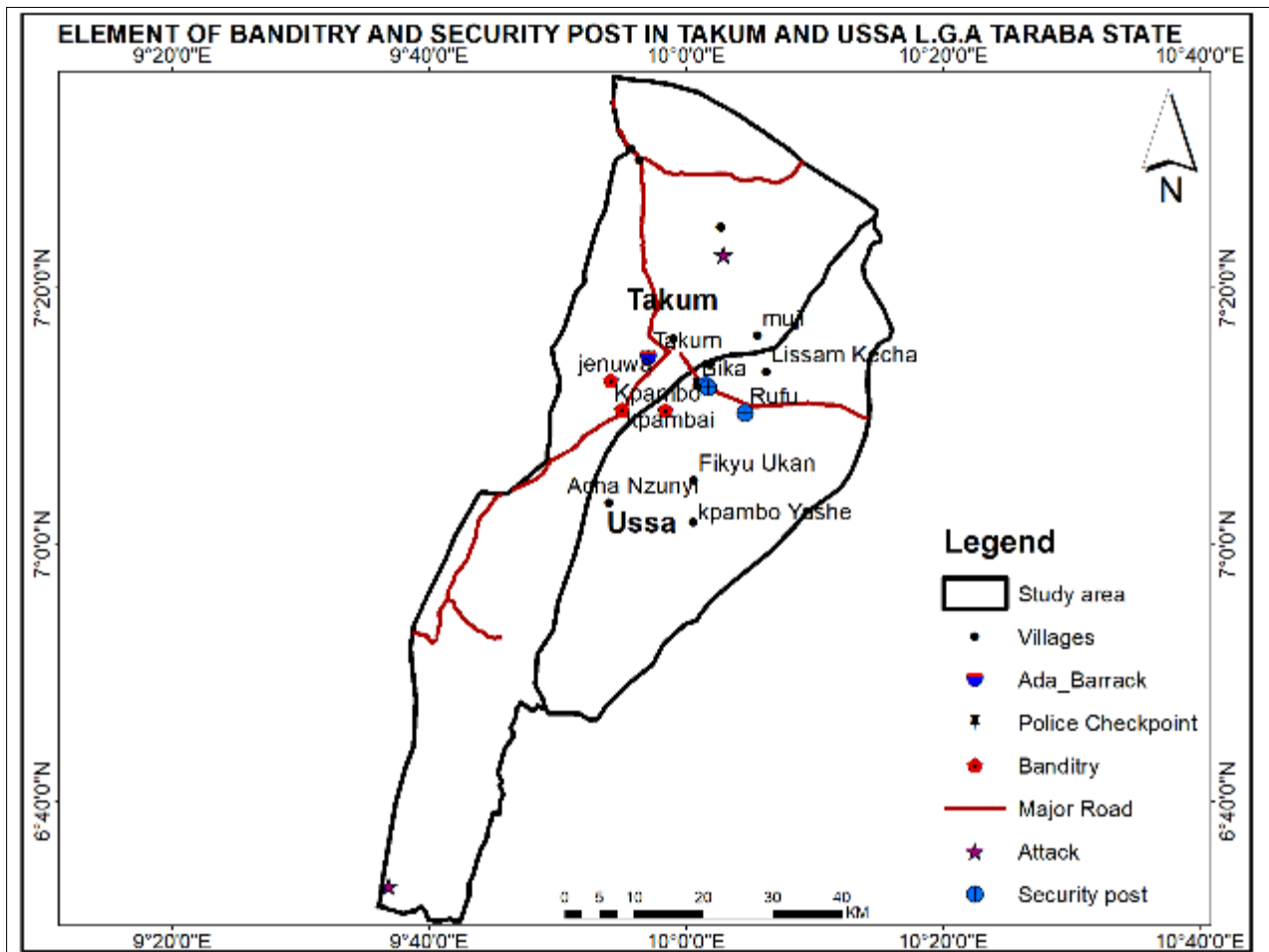

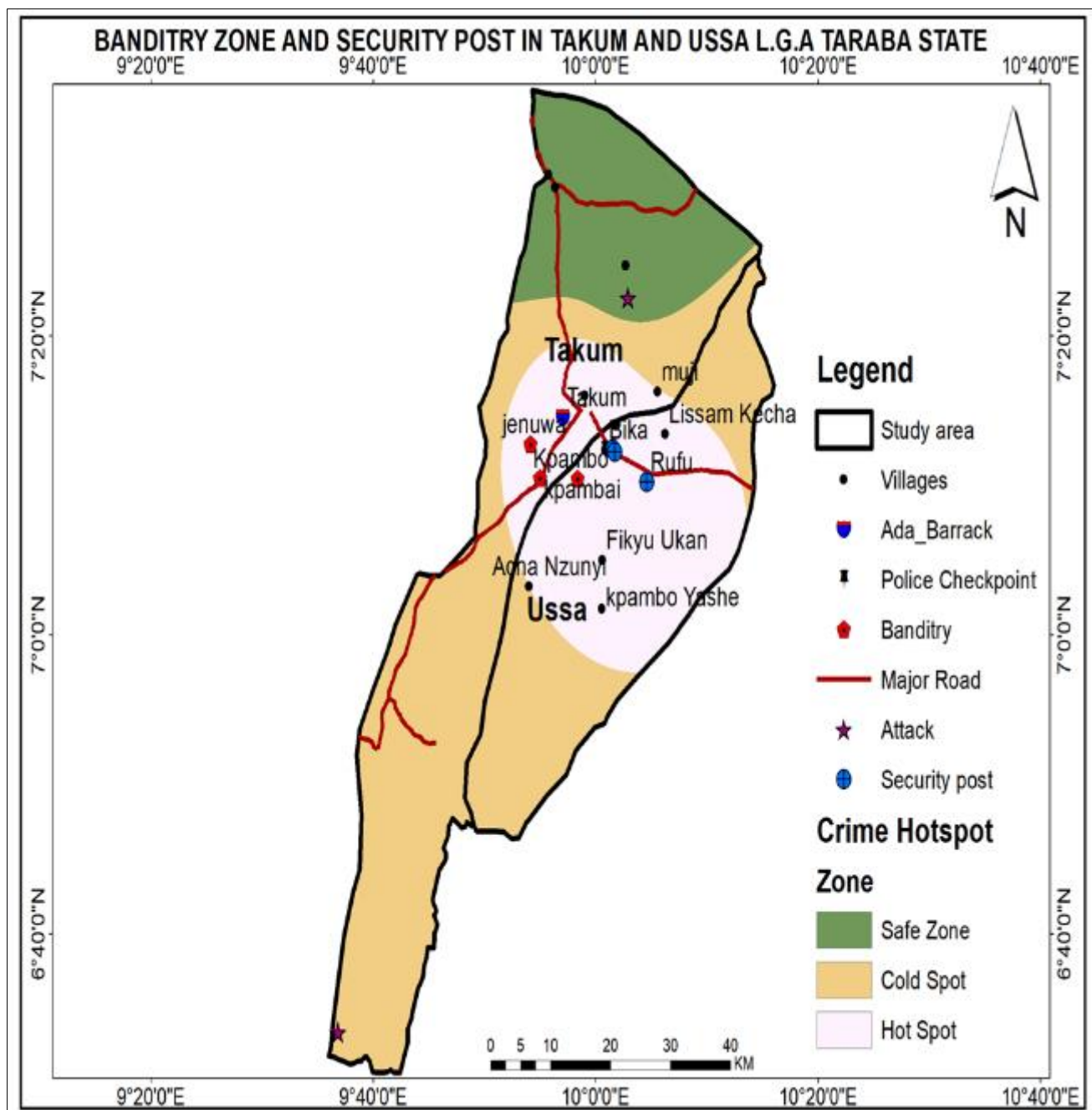**Figure 6** Security Infrastructure and Banditry activities relationship

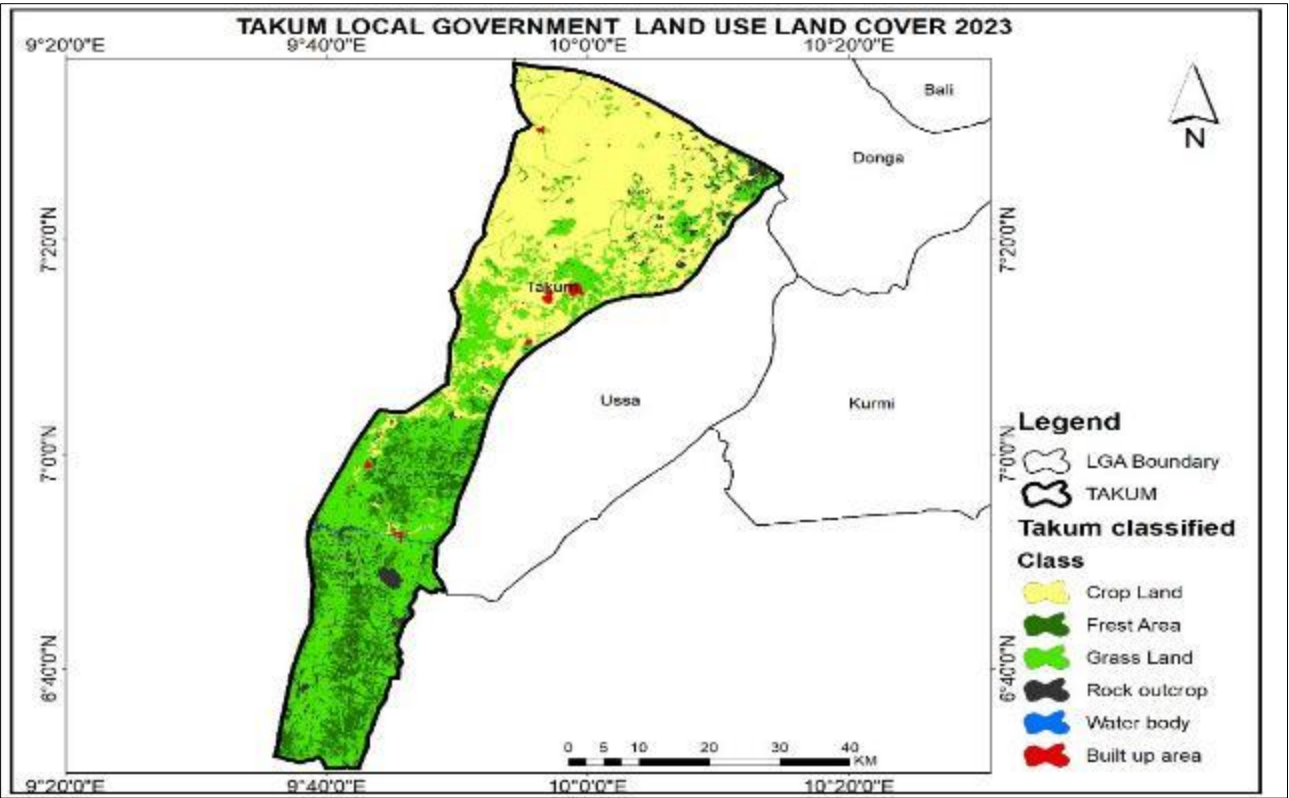**Figure 7** Security Infrastructure and Banditry activities relationship
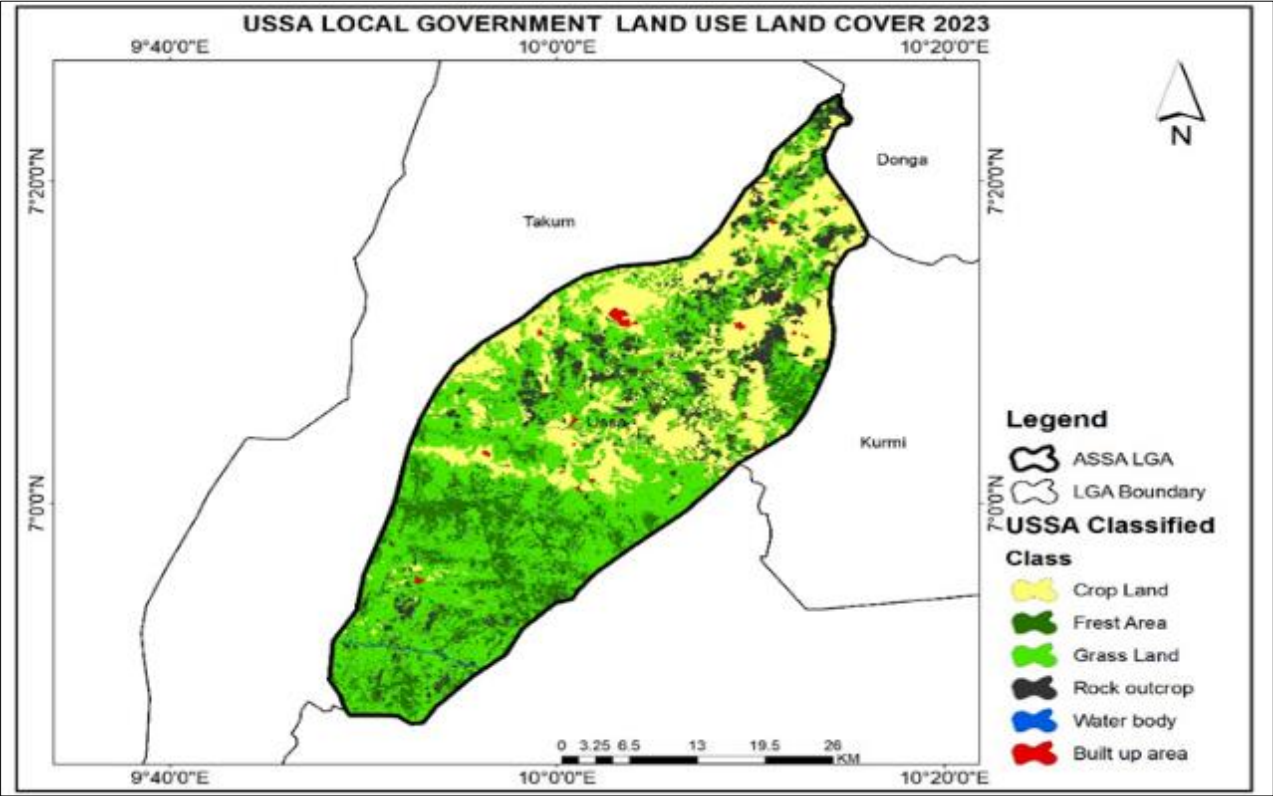
Figure 8 LULC of Takum
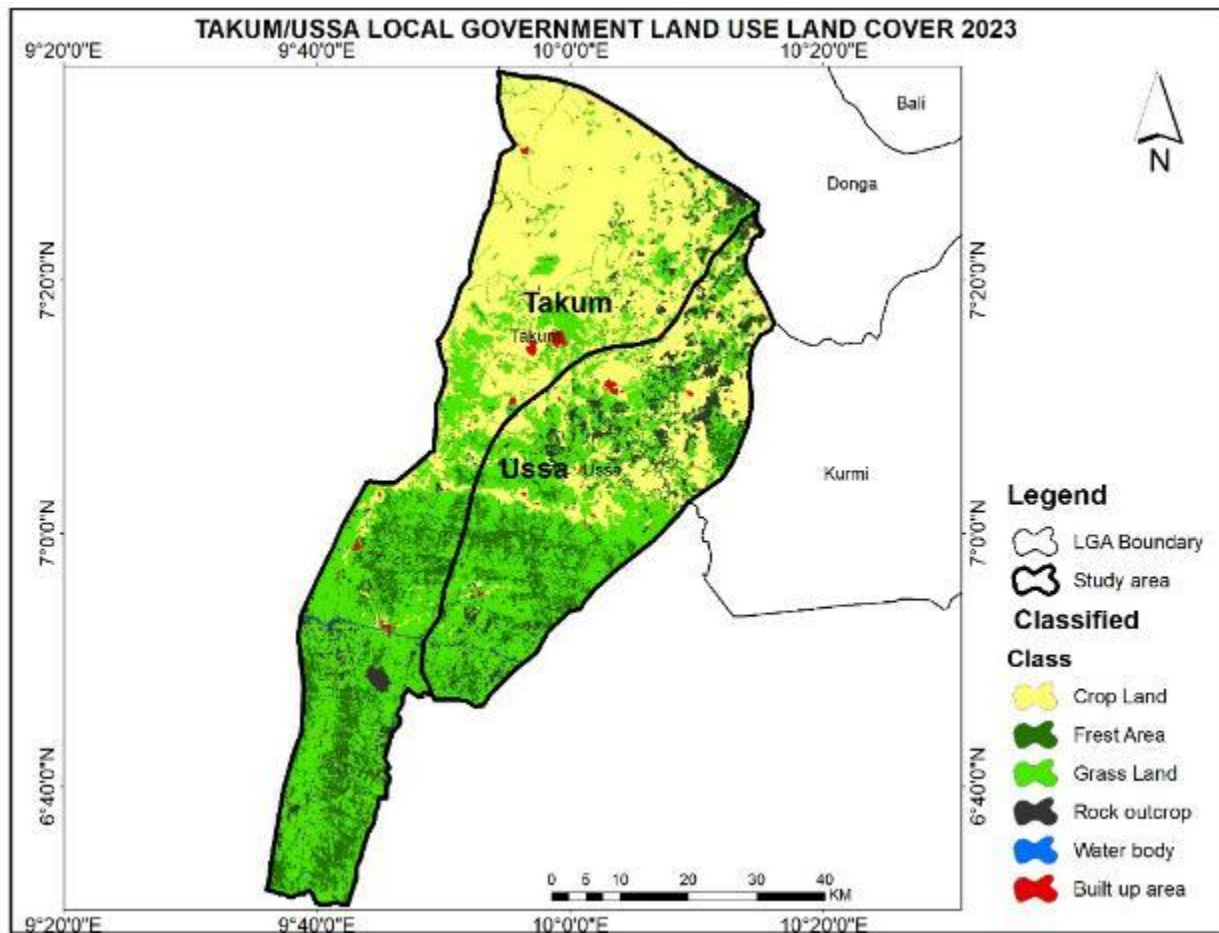

Figure 9 LULC of Ussa

Figure 10 LULC of Takum and Ussa

The land use land cover classification (LULC) in Takum and Ussa shows that there are still large areas of forests, grasslands, and wetlands in the region that are crucial for biodiversity and ecosystem services. This provides a detailed picture of how the landscape in this region is changing over time. The use of GIS technology and analyses offers a valuable insight in understanding the trends and patterns of land use and land cover in Takum and Ussa. This information is essential for making informed decisions about sustainable land management practices and conservation efforts in the region. As we continue to study and monitor these changes, we can work towards creating a more harmonious relationship between humans and the environment in Takum, Ussa and beyond. The LULC classification in Takum and Ussa provides valuable insights into how the land in the area is being utilized and how it may be contributing to the rise of banditry and kidnapping (See Figures 8, 9 and 10).

One of the key reasons for the connection between land use patterns and banditry and kidnapping in Takum and Ussa, Taraba state is the presence of large expanses of farmland that are often isolated and poorly secured. These remote agricultural areas provide ideal hiding spots for criminals to carry out their illicit activities without being easily detected. Additionally, the lack of proper infrastructure and security measures in these areas further exacerbates the problem, making it easier for criminals to operate with impunity. The LULC classification in Takum and Ussa, also highlights the presence of forested areas and water bodies, which can serve as additional hideouts for criminals. These natural features provide cover and shelter for bandits and kidnappers, allowing them to evade capture and continue their criminal activities. This result shows the identification and mapping of the study areas using geospatial technology (See Figures 8, 9 and 10). Government can therefore work with researchers, local communities, policymakers and security agencies to protect people's lives and properties, these valuable habitats and ensure their long-term sustainability.

Table 2 Table showing places of security infrastructure from the closest bandit attacks

CHECKING_P	VILLAGE	LGA	LATITUDE	LONGITUDE
police check point	Bika	Yangtu SDA	7.206012	10.014623
vigilante group of Nigeria	Lissam	Ussa	7.206595	10.025663
Taraba Marshall	Lissam	ussa	7.20656	10.026704
Nigeria Hunters security service	Rufu	Ussa	7.170333	10.076524
Ada Barracks	Takum	Takum	7.242782	9.95089
Ussa divisional police station	lissam	Ussa	7.203991	10.028881
BANDITRY	kpambai	Yangtu	7.175134	9.916873
BANDITRY	Kpambo	Ussa	7.173907	9.972792
BANDITRY	jenuwa	Yangtu	7.2126	9.902336
KIDNAPPING	muji	Takum-ussa	7.270982	10.092983
KIDNAPPING	Lissam Kecha	Ussa	7.223753	10.104232
KIDNAPPING	Lissam Shinkafa	Ussa	7.233584	10.030635
CRIME HIDEOUT	kpambo Yashe	Ussa	7.029353	10.009508
CRIME HIDEOUT	Acha Nzunyi	Yangtu	7.05386	9.899843
CRIME HIDEOUT	Fikyu Ukan	Ussa	7.083433	10.010351

4. Conclusion

Despite the huge amount invested by Government at Federal and States levels in security, yet the targeted goals have not been achieved, largely due to conservative and traditional means adopted in fighting bandits, kidnappers and other criminals. It is however, safe to say that these measures did not take into consideration that these criminal elements were taking advantages of ungoverned spaces to carry out their worrisome activities of banditry, Kidnapping and other criminal activities both in Takum, Ussa and its neighboring LGAs, as a result of which lives and properties were being lost.

Also, the research mapped out security infrastructures and conducted spatial analysis of these infrastructures in relation to ungoverned spaces to ascertain whether there is security presence in these areas or not. The study used datasets acquired from different secondary sources, particularly the Armed Conflict Location and Event Data Project (ACLED) to map bandits' activities and other related attacks. The findings mapped out comprehensive overview of bandit attacks hotspot areas in Taraba State between 2021 to 2023. Moreover, the study highlighted vulnerable elements which need government attention, interventions and security actions as a result of bandit's attacks such as settlements, roads and schools, this project also recognized other social infrastructures at the high risk of attacks by bandits which includes healthcare facilities, water sources and markets places. The study revealed that more banditry attacks were recorded in Takum, Ussa LGAS of Taraba state sharing boundaries with each other.

Lastly, the study carried out extensive spatial analysis of the relationship between security infrastructures and bandits' attacks within the study area, the findings deduced that to effectively fight insurgency, more security presence would be needed at strategic locations.

Recommendations

To effectively address banditry and kidnapping in Ussa and Takum Local Government Areas, it is recommended that the following steps be taken:

- Data Collection and Analysis: The first step in geospatial hotspot mapping is to collect and analyze data on banditry and kidnapping incidents in the area. This data should include the date, time, location, and nature of each incident. By aggregating this information, patterns and trends can be identified to determine hotspots of criminal activity.
- Collaboration with Stakeholders: It is essential to collaborate with local law enforcement agencies, community leaders, and other stakeholders to gather accurate and up-to-date information on criminal activities. By working together, a comprehensive understanding of the security challenges in the area can be achieved, leading to more effective interventions.
- Implementation of Targeted Interventions: Once hotspots of banditry and kidnapping have been identified, targeted interventions should be implemented to address the root causes of criminal activities. This may include increased police presence, community policing initiatives, and social programs aimed at addressing poverty and unemployment, which are often drivers of crime.
- Monitoring and Evaluation: It is crucial to continuously monitor and evaluate the impact of interventions in reducing banditry and kidnapping in Ussa and Takum Local Government Areas. By tracking changes in crime patterns and measuring the effectiveness of interventions, adjustments can be made to improve the overall security situation in the area.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest is to be disclosed.

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