Geospatial Analysis of Crime Incidence in Bayelsa West Senatorial District, Bayelsa State, Nigeria

Daukere B.E.[1*], Yelwa, S.A.[2], Akpu, B.[3] and Ajani, A.O.[4]

[1]Department of Geography, Nigerian Army College of Education, Ilorin, Nigeria
[2]Department of Geography, Usmanu Danfodiyo University, Sokoto, Nigeria
[3]Department of Geography and Environmental Management, Ahmadu Bello University, Zaria
[4]Department of Geographic Information System, Federal School of Surveying, Oyo, Nigeria
Email: dauksenies2010@gmail.com & BenyB4real@gmail.com

Abstract

Criminal incidence has negative costs in terms of loss, death, psychological and physical pains of the victims. This study applied geospatial techniques in analyzing crime incidents in the Bayelsa West Senatorial District, Bayelsa State, Nigeria. Data of police crime records were obtained from the Divisional Police Headquarters within the Bayelsa West Senatorial District. An administrative map of the study area was acquired from the Ministry of Land and Survey, Bayelsa State which was used as the base map. These data were analyzed using Nearest Neighbour Analysis (NNA) and Kernel Density Estimation (KDE), to derive the pattern and density of hotspots of crime in the area and descriptive statistics were also used. The findings of the study revealed the existence of nine (9) crime types from the police records. Theft/Stealing had the highest incidence rate of 30.6%, while hurt/fighting and kidnapping were the least with 3.5% each. The NNA result of the spatial pattern of crime produced a clustered point at 0.01% significance level with the Nearest Neighbour Ratio (NNR) of 0.491906. The analysis of the KDE shows that crime concentrates on the communities with high population and higher economic activities with different types of crime showing different spatial patterns. The study, therefore recommends that community policing committees should be established in Ekeremor, Sagbama and other affected towns and villages bedevilled by criminal activities in the Local Government Areas.

Keywords: Bayelsa West Senatorial District, Crime, Geospatial analysis, Hotspots, Kernel Density Estimation and Nearest Neighbour analysis

Introduction

The existence of crime is as old as the creation of man itself and man has always looked for ways to combat and reduce it as much as possible. Criminal activities have continued to be a major concern to contemporary society. Its occurrence in the form of kidnapping, thefts, robbery, assaults, homicide, etc. is something that takes place every day in almost all parts of our world (Fajemirokun, Adewale, Idowu, Oyewusi and Maiyegun, 2006). Most nations in the world are faced with unacceptable levels of delinquency and crime (Ackerman and Murray, 2004) which is very pathetic, pervasive, persistent, vulnerable, disastrous and tragic to the progress of development in any country (Ibrahim and Kuta, 2015). A society with a high rate of criminal events is less attractive to both local and foreign investment and this is the present situation that prevails in most parts of Nigeria (Ejemeyovwi, 2015).

Crews (2009) defined crime as any breach of an established rule, regulation, or law committed by person(s) for whom a punishment may ultimately be prescribed by a law enforcement body. Thus, David (1985) stated that crime is an unlawful act which is prohibited by the State and therefore attracts punishment. Crime is a common phenomenon existing for several thousands of years. Due to the different political and economic system, national tradition and cultural background, crime present various patterns in different countries of the world (Xiong, 2016). Crime is a social problem and according to Fitzegard, Molennar and Panson (1981) is universal and has varying forms in all cultures and societies at all stages of organization.

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). Numerous factors, besides the lure of potential targets and simple geographic opportuneness for an offender, influence where offenders choose to commit crime (Fajemirokun *et al*, 2006). Therefore, the study of its geography plays an important role in law enforcement, criminal justice and public safety. Consequently, criminal activity is unevenly distributed across urban environments, simultaneously constrained and supported by both the structure of the environment and the routine movements of the population (Umar, 2017). In addition, Greenburg and Rohe (1984) affirmed that certain physical and environmental factors such as the physical layout of an area, proximity to various services and land use mixes are also likely to influence criminal behaviour which is fundamental to the explanation of criminal activities in a spatial context. That is, physical design affects crime, such as burglary and robbery, through its effect on the degree of

access, ease of entrance and exit, surveillability, and the number of potential targets (Wortley and Townsley, 2016). Brantingham and Brintingham (1984) added that criminal incidences are the outcome of people's (both criminals and potential victims) interaction and movement at particular dwelling areas and time. This explains why crimes are committed in certain areas.

The increasing number of crime rates has raised the need to find new ways to handle information about criminal activities and also to understand its causes and solution. Ferreira, João and Martins (2012) described crime mapping and spatial analysis as new forms of understanding crime pattern and the hideout of criminals. In addition, Johnson (2000) stated that the traditional and age-old system of intelligence and criminal record maintenance has failed to live up to the requirements of the existing crime situation. This method has failed to provide accurate, reliable and comprehensive data that will help in trend prediction and decision support system that will aid in increased productivity and effective utilization of manpower. The study concluded that the only solution to this ever-increasing problem lies in the effective use of Information Technology (IT) of which Geographic Information Systems (GIS) has the capability for crime analysis that comprises the collection and analysis of data relating to a criminal event, criminal and target.
In Nigeria, there are a lot of factors that increase crime rates and criminal tendencies which include the political and economic changes and changes in the social structure which occur due to migration (Onyepuemu, 2015; Umar, 2017). According to the statistics released by the National Bureau of Statistics (2017), Lagos, Abuja, Delta, Kano, Ondo, Oyo, Rivers, Bauchi, Plateau, and Anambra States made the top ten lists of states with high number of crimes. The document revealed that a total of 125,790 cases was reported in 2016 where offenses against property had the highest number of cases. In Bayelsa state, the crime rate is also at an alarming rate with 1.23 per cent share of the total cases reported in the said year. The state is 21 on the list with a total of 1,541 cases reported in 2016. There has been an enormous increase in crime in recent times. These crimes include theft and other stealing, assault, false pretense and cheating, armed robbery, murder, burglary, rape, indecent assault and house breaking etc. (Effiong, Iyiola, Gbiri and Daukere, 2016).

The Bayelsa West Senatorial District has witnessed a remarkable expansion, growth and developmental activities as well as crime since the creation of Bayelsa state in 1996. The high rate of urbanization with increasing economic activities is weakening the social networks and therefore increasing crime activities in the area. This has therefore resulted in increased crime rates and alterations in the social status of the area over time, which constitute incidences of the atmosphere of fear, anxiety and tension with a state of

insecurity (Etebu and James, 2011; Onyepuemu, 2015). The general security of the study area is pathetic where cases of armed robbery attacks, cult activities, murder, drug trafficking and other crimes have become common (Nwagboso, 2018) leading to loss of lives and property. This necessitated the need to apply geospatial techniques in analyzing crime in the Bayelsa West Senatorial District. The objectives are to identify and map crime types, determine the distribution pattern of crime and determine the hotspots of crime among the settlements of the study area.

Description of Study Area

The study area is Bayelsa West Senatorial District, which comprises of Sagbama and Ekeremor Local Government Areas (LGAs) of Bayelsa State, Nigeria. The area is located between Latitudes 4º42′N and 5º23′N of the Equator and Longitudes 5º23′E to 6º32′E of the Greenwich Meridian with a total landmass of 2,771.9km^2 (National Population Commission (NPC) [Nigeria], 2009). It is bounded by Delta State to the North and Yenagoa, Kolokuma/Opokuma and Southern Ijaw LGAs to the South. The study area also has a coastline of approximately 60km on the Bight of Bonny. Many of the communities are almost (and in some cases) completely surrounded by water, making them inaccessible by road (see fig. 1). The climate of the area is characterized by a tropical monsoon climate (Mmom and Akpi, 2014). Rainfall occurs generally every month of the year, but over 80% of it occurs in the months of May to September (Shell Petroleum Development Company of Nigeria Limited, 2005). The soils of the area are of young geologic formation of the Quaternary and recent alluvium underlain by cretaceous sediments and are extensively low-lying. The vegetation in the area is freshwater swamps and lowland rain forests and these different vegetation types are associated with the various soil units of the area (State Employment and Expenditure for Results [SEEFOR] Project Bayelsa State, 2016). Based on the 2006 population census, the study area has an estimated population of 269,588 and 186,869 for Ekeremor and Sagbama LGAs respectively (National Bureau of Statistics, 2011). The patterns of the settlements are mostly linear, patterned along the river / sea or coastal banks. The major road is the Sagbama-Ekeremor-Agge road which is still under construction and most of the villages and towns are not well planned and the pavement are not well laid out (Ebenezer, Noutcha, Okiwelu and Commander, 2014) which can affect patrols by security personnel.

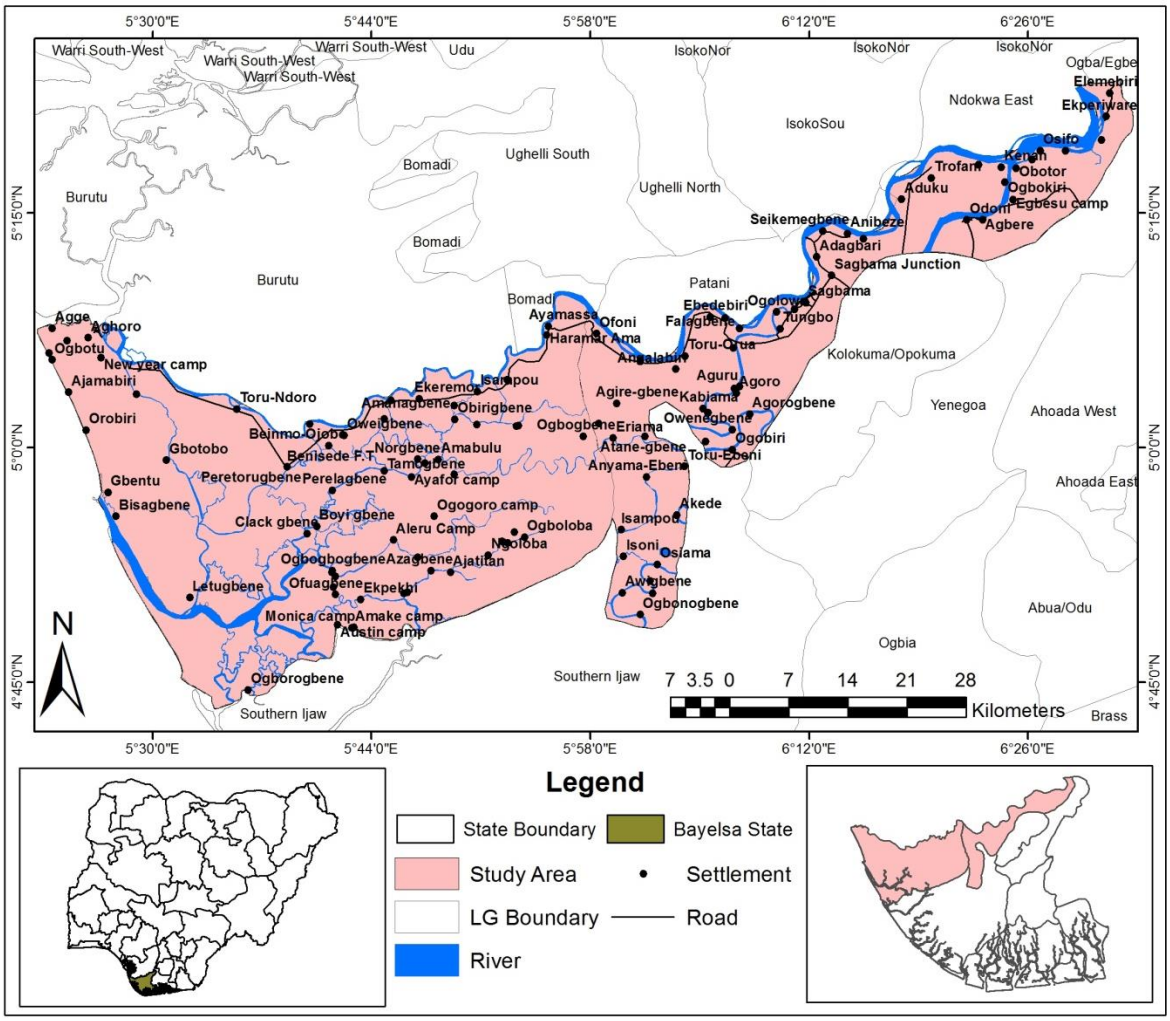


Fig. 1: Bayelsa West Senatorial District
Source: Adapted from the administrative map of Bayelsa State

Materials and Methods

The sources of data for this study were obtained from both primary and secondary sources. Data on the geographical coordinates of the crime scene were collected through their addresses using Garmin eTrex^{R} 20x Handheld GPS Receiver with an accuracy of at least 5 metres. The geographical coordinates were used to produce the distributional pattern and hotspots of crime in Bayelsa West Senatorial District. The administrative map of the study area was acquired from the Ministry of Land and Survey, Bayelsa State. The administrative map at a scale of 1:50,000 were used as the base map for the study. The data on crime rate, types and their addresses which was the secondary source of data were

obtained from the crime records of the Divisional Police Headquarters for the year 2014 to 2018. The selection of the period was borne out of the fact that the period is the most accessible with the availability of current data. This is due to the poor management of crime data, and difficulty in retrieving data from the relevant police authorities. Non-participatory observation was used to identify the condition and the facilities of the various administrative wards in the study area. Other relevant information was also obtained from published materials like journals, conference proceedings, internet, thesis etc.

The geographic coordinates of the crime scene were overlaid on the Geo-referenced and digitized map of the study area in order to map the distribution of the various crime types of the area. The Nearest Neighbour Analysis (NNA) inferential statistical tool in ArcGIS10.5 was employed to determine the spatial pattern in the data. Crime hotspot maps were produced using the Kernel Density Estimation (KDE) in ArcGIS10.5 to show the area with high to low susceptibility to crime within the period of 2014 to 2018 in the area. The technique was used because the method is the most suitable spatial analysis technique for visualizing crime data (Eck, Chainey, Cameron, Leitner and Wilson, 2005; Chainey, Tompson and Uhlig, 2008).

Results of the Findings

Identification and Mapping of Crime Types in Bayelsa West Senatorial District

There were nine (9) crime types recorded in the crime data from the police divisions in the area between 2014 and 2018. These were armed robbery, murder/homicide, theft/stealing, assault, rape, burglary/home breaking, false pretense and cheating, hurting/fighting, and kidnapping. The crime types from the police records are presented in Table 1.

Table 1: Bayelsa West Senatorial District Crime Incidents Report

Crime Type	Frequency	Percentage
Armed Robbery	24	14.1
Murder/Homicide	16	9.4
Theft/Stealing	52	30.6
Assault	30	17.6
Rape	8	4.7
Burglary/Home Breaking	18	10.6
False Pretense and Cheating	10	5.9
Hurting/Fighting	6	3.5
Kidnapping	6	3.5
Total	**170**	**100**

Source: Author's Analysis (2019)

Table 1, revealed that theft/stealing had the highest percentage with 30.6% in the study area and is followed by assault with 17.6%. It also revealed that hurting/fighting and kidnapping has 3.5% each and were the least crime types committed within the study area. This result revealed that theft/stealing is the most common type of crime in the area. The findings of this study are similar to the ones identified by Effiong *et al* (2016) in Yenagoa LGA of Bayelsa State and that of Balogun, Okeke and Chukwukere (2014) in Benin City, Nigeria where their findings revealed the high rate of theft/stealing in the study areas. The high rate of theft/stealing can be attributed to the low level of socioeconomic status of the various wards in the Bayelsa West Senatorial District. This may be attributed to the age structure which is characterized by young people. Cohen and Felson (1979) argued that the absence of guardianship, help increases the opportunity to commit crime. Consequently, the absence of a capable guardian may be a factor of the increase in crime rate because the area is characterized with a young population.

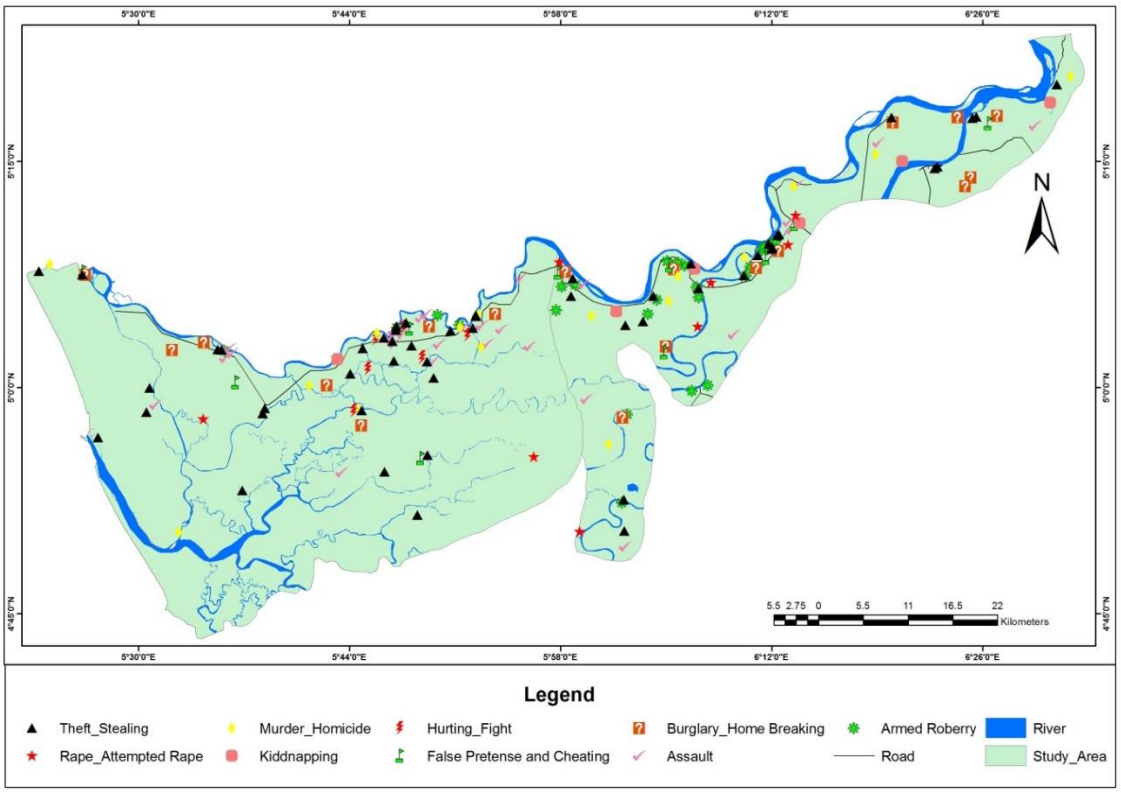


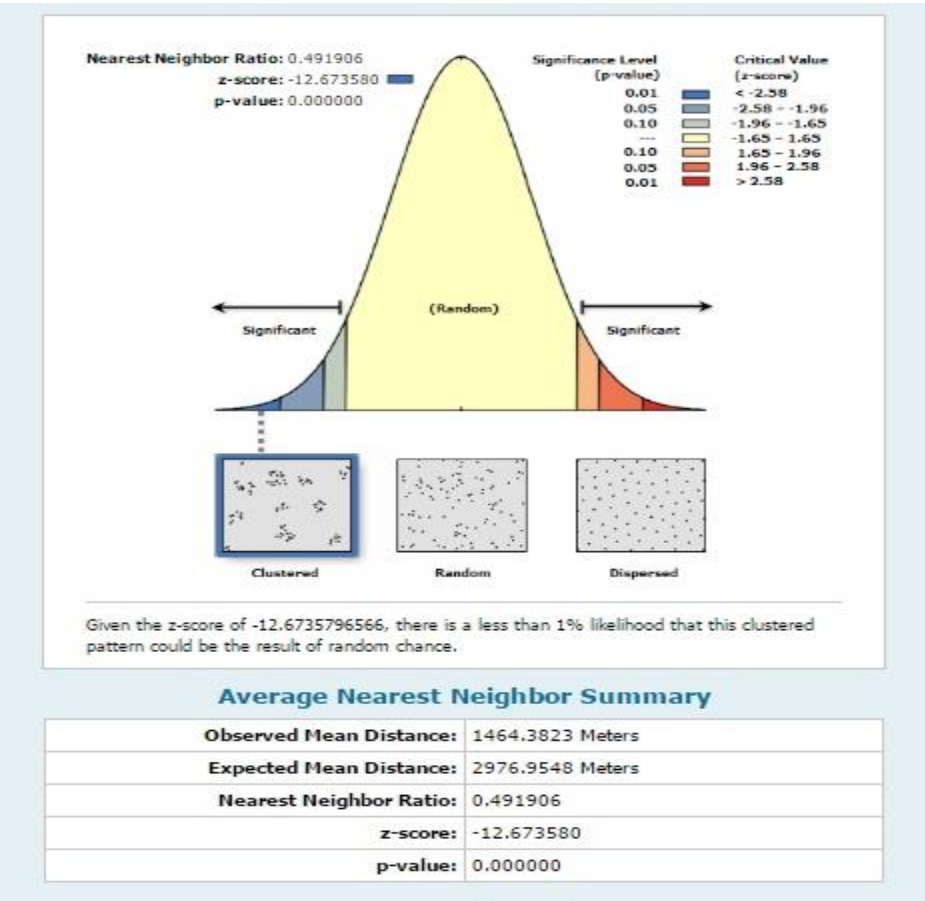
Fig. 2: Crime Types of the Study Area
Source: Author's Analysis (2019)

From Fig. 2, one can also observe that most of the crimes occurred along major Rivers linking major villages and towns. For instance, towns along the major rivers such as

Sagbama, Ebedebiri, Toru-Orua, Ofoni, Aleibiri, Ekeremor and Peretorougbene are all major crime scene locations characterized by increasing economic activities and high population. This study aligned with the outcome of the study conducted in Yenagoa Local Government Area of Bayelsa State, Nigeria by Effiong *et al* (2016). Their study attributed high crime areas to political wards that are characterized by high population with greater economic activities.

Distribution Pattern of Crime in Bayelsa West Senatorial District

The distributional pattern of crime event is to analyze the spatial pattern of crime events within the study area. The Nearest Neighbour Analysis (NNA) inferential statistical tool in ArcGIS10.5 was employed to determine the spatial pattern in the data. The summary of this nearest Neighbour analysis is shown in fig. 3.



Average Nearest Neighbor Summary

Observed Mean Distance:	1464.3823 Meters
Expected Mean Distance:	2976.9548 Meters
Nearest Neighbor Ratio:	0.491906
z-score:	-12.673580
p-value:	0.000000

Fig. 3: Spatial Pattern of Crime Scene
Source: Author's Analysis (2019)

The result in fig. 3 revealed that the observed mean distance between the crime incidents is 1464.4 meters as opposed to the expected mean distance of 2977.0 meters as computed by the ArcGIS 10.5 software. The result further revealed that the spatial pattern of the crime events in the study area is clustered around densely populated areas of Ekeremor and Sagbama communities with higher economic activities with Z-scores of -12.7, that is, there is less than 1% probability that this clustered pattern of the crime incidents could be because of random chance. The clustered pattern of the reported crime events is as a result of high population with increased economic activities in specific areas. These factors also affect the location of police divisions and stations in the study area. The inequality in the population distribution and the presence of government facilities (schools, health care facilities etc.) across the political wards produced the clustered pattern of crime events.

In addition, the influence of geography was seen to also affect the concentration of crime in the study area. Specifically, the highly populated areas with increased economic activities such as Ekeremor and Sagbama were among the settlements with high records of crime in the study area. These settlements appear to be dominated by high influential people and politicians, non-indigenous, some certain business activities and offices of both government and private business establishments. The findings of this study also corroborated by that of Badru, Akintuyi, Omoniyegha and Wunude (2019) whose study revealed a clustered distributional pattern of crime events at University of Lagos, Nigeria, as more of the criminal incidences appear to gather around the same point such as where there are no security posts.

Hot Spots of the Various Crime in Bayelsa West Senatorial District

Maps showing the distribution of all and various crime hotspots were produced from geocoded crime data collected from the police divisions in the study area. The kernel density hotspot maps were produced for the year 2014 - 2018 for all and each of the crime types committed in the area. A visual analysis of these maps (see fig. 4 - 13) suggests that, crime tends to concentrate in particular areas, but not in others and different types of crime show different spatial patterns. This concurred with the existing general knowledge about the spatial patterns of crime in an urban setting (Chainey, 2014; Umar, Cheshire and Johnson, 2015).

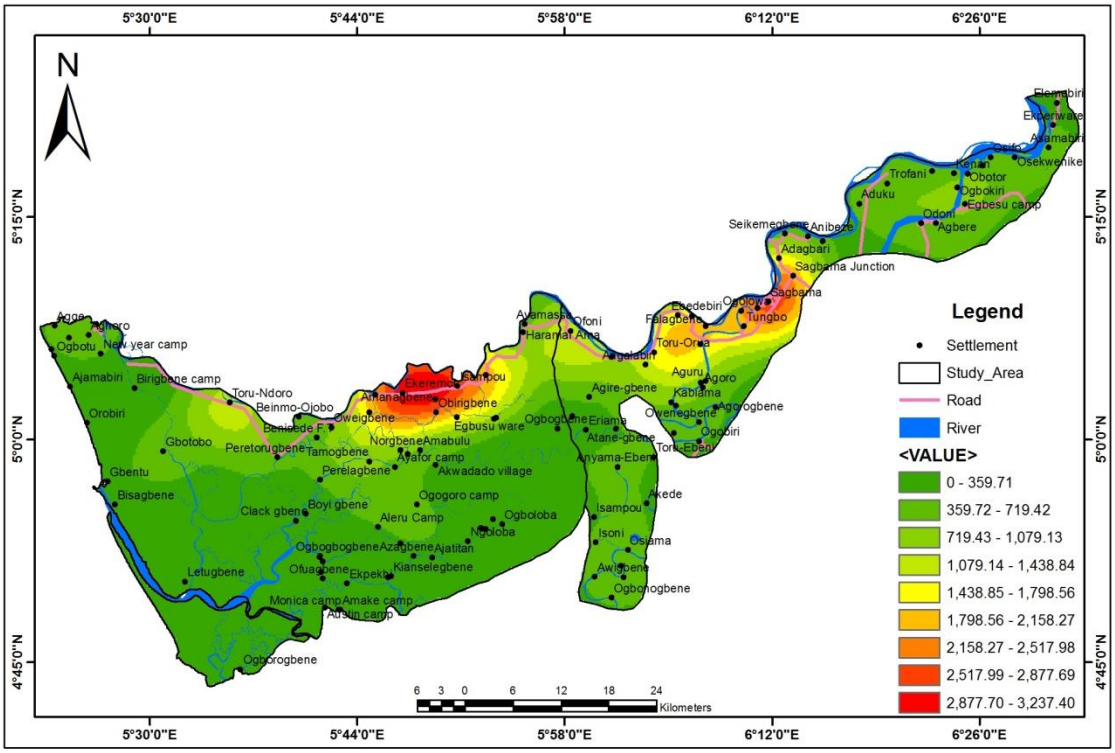


Fig. 4: Hotspot of Crime
Source: Author's Analysis (2019)

The result in fig. 4 shows the hotspots of all incidences of reported crime in the study area which revealed that crime is generally concentrated in Aleibiri, Ekeremor and Sagbama towns in the study area. These communities may be vulnerable to crime because they exhibit certain characteristics such as high-density residential areas, also referred to as urban villages, irregular plot layouts with narrow streets that are mostly unpaved, presence of markets, high population, the presence of police divisions to report crime and higher institution such as the Isaac Jasper Boro College of Education with higher economic activities than the Neighbouring communities among others. Generally, the communities are not planned; the Neighbourhoods are accessible from all fronts with no fence or gate in most buildings or streets, poor road networks, old and derelict buildings, poverty and overcrowded households. The finding of this study corroborates with the findings of Umar *et al* (2015) in Malali – Kaduna, Nigeria where crime concentrated in poor and unplanned Neighbourhoods. The finding of this study also revealed that communities such as Agbere, Toru-Owa, Ofoni, Tungbo, Toru-Ndoro, Turu-Ebene, Osiama, Ogbotobo, Ogbobiri, Adagbabiri recorded low crime events while communities such as Ayamasa, Letugbene, Orobiri, Bisagbene, Atane-gbene etc. recorded no crime. This may be attributed to the

absence of police divisions/stations in the area before the establishment of new police divisions in Toru-Owa and Aleibiri and police stations in Agbere and Egbema-Angalabiri in November, 2018. This may be also attributed to the high cost of the water transport system in the area.

The result in fig. 5 shows the hotspots of armed robbery in the study area. Armed robbery was predominant in Sagbama, Tungbabiri, Tungbo and Toru-Owa communities in the study area. These communities may be vulnerable to armed robbery because they exhibit certain characteristics such as better housing condition, and the presence of higher institution such as University of Africa and Isaac Jasper Boro College of Education including the completed section of the major road from Sagbama to Ekeremor with higher economic activities than the neighbouring communities among others. Generally, the communities are not well planned and the pavement not well laid-out; the Neighbourhoods are accessible from all fronts with the poor road system and overcrowded households. While communities such as Agge, Ajambiri, Gbotobo, Elemebiri, Trofani, Ekpetiama etc. had no or very low density of robbery crime. These communities are characterized by poor housing condition, poor environmental sanitation, old and derelict buildings, poverty, lack of access roads and are surrounded by rivers among others. These characteristics do not encourage armed robbery to strive in the study area. The finding did not agree with Oyinloye, Olamiju and Otokiti (2017) where the authors found out that robbery crime in Oshodi-Isolo area of Akure, Nigeria are concentrated in communities characterized by poor housing condition, poor environmental sanitation, old and derelict buildings and poverty.
Fig. 6 shows hotspot of murder/homicide, which revealed that Aleibiri, Isampou, Owegbene, Toru-Owa and Toru-Angiama had a high density of murder/homicide cases in the area. These may be attributed to poverty and the low economic activities that characterize these communities among others. While Amazor, Letugbene, Asamabiri and Ayamabene had very low density of murder/homicide crime. The finding of the study corroborates with Adewuyi, Eneji, Baduku and Olofi (2017) in Abuja Municipal where the study revealed that homicide crime depends on the volume of economic activities taking place in the district.

The result in fig. 7 shows hotspots of incidence of theft/stealing in the study area. It revealed that Ekeremor, Amanagbene, Obirigbene, Tungbo and Sagbama had high density of theft/stealing cases in the area. The distribution of theft/stealing in the study area could be attributed to the volume of activities taking place in these communities and the presents of police divisions in Ekeremor and Sagbaba towns which are the major commercial hubs of the study area. The finding of this study corroborates with Adewuyi *et al* (2017) in the

Abuja Municipal where the study revealed that theft/stealing largely depends on the volume of activities taking place in the district. Also, the findings of this study corroborate with the finding of Bala, Bawa, Lugga and Ajayi (2015) where the findings of their study revealed that high rate of theft/stealing was due to the presence of markets and other economic activities. On the other hand, Angalabiri, Ogobiri and Osiama had a low density of theft/stealing crime. The low density of theft/stealing in these communities may be attributed to absence of police stations/posts and higher economic activities.

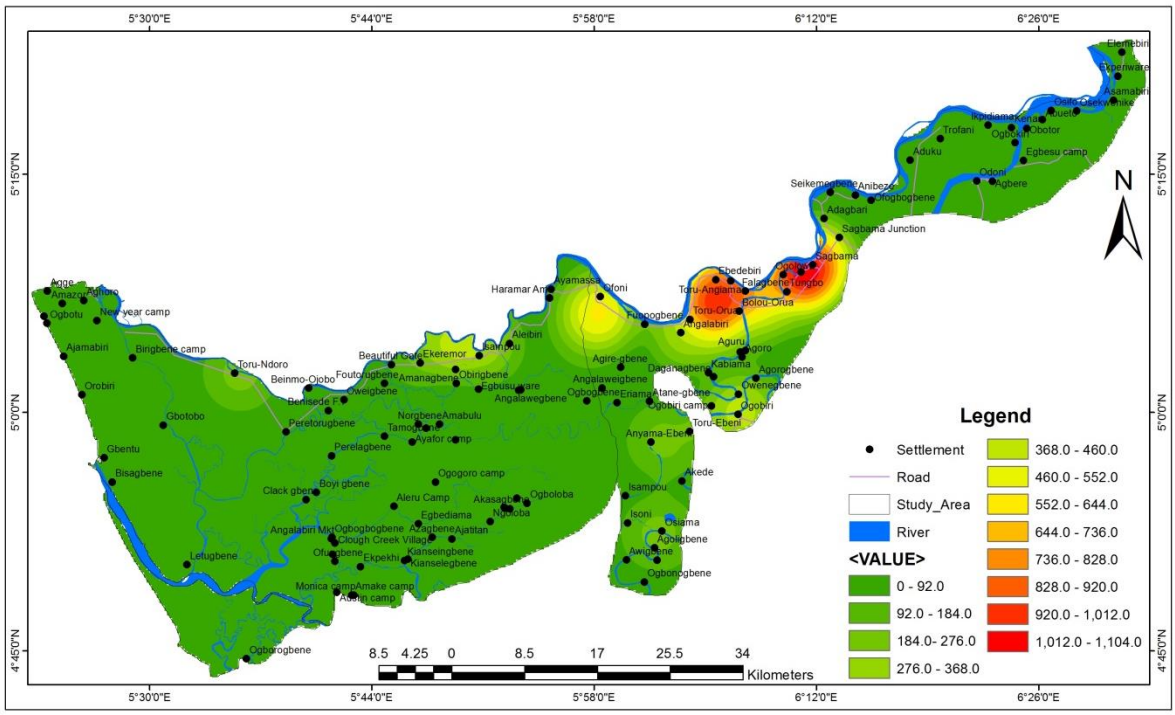


Fig. 5: Hotspot of Armed Robbery
Source: Author's Analysis (2019)

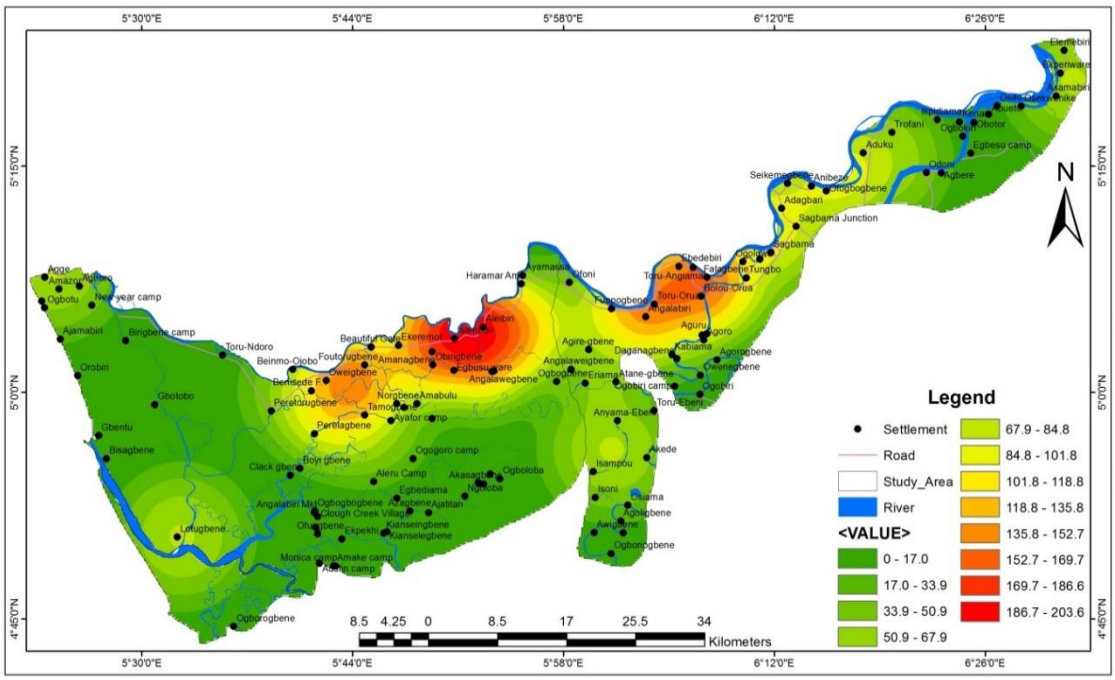


Fig. 6: Hotspot of Murder/Homicide
Source: Author's Analysis (2019)

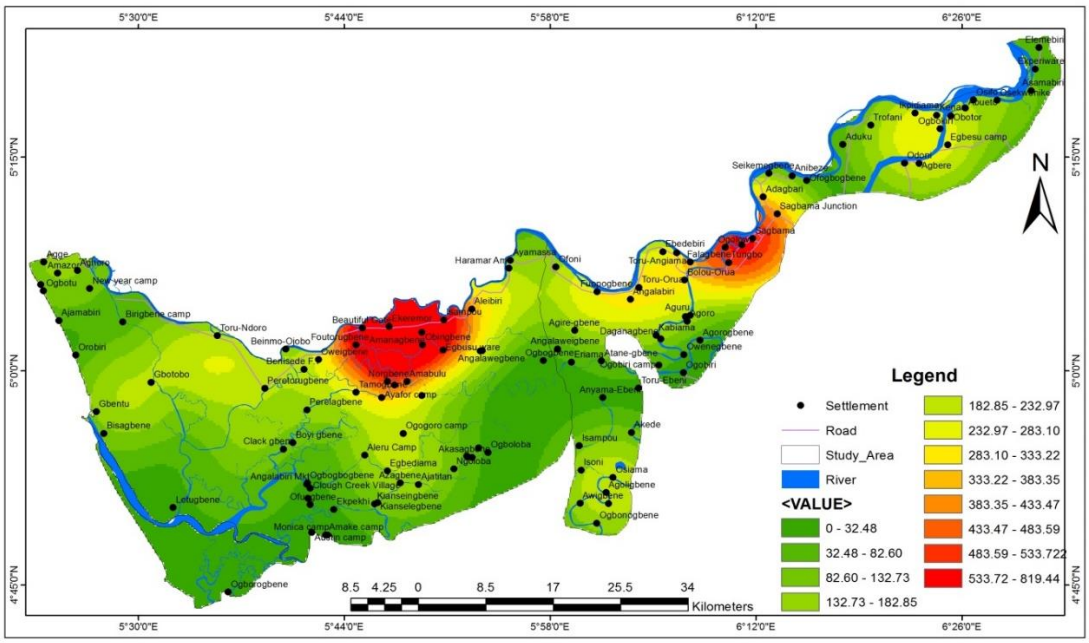


Fig. 7: Hotspot of Theft/Stealing
Source: Author's Analysis (2019)

The result in fig. 8 shows that assault cases were predominant in Ekeremor and its environs in the study area. This may be attributed to the fact that most of the political rallies in the study area are conducted in this town. It is characterized by high volume of economic activities than its surrounding communities with high population. This finding corroborates with that of Ayuba, Mugu, Tanko and Bulus (2016) in Tudun Wada, Kaduna where assault and other related crime are concentrated in areas with high population and the presence of large markets. On the other hand, communities such as Agge, Ayamasa, Elembiri etc. had no assault case reported.

Fig. 9 shows the incidence of rape and attempted rape in the Bayelsa West Senatorial District. Aguru, Bolou-Orua, Sagbama junction and Adagbabiri had high density of rape/attempted rape cases in the study area. This may be attributed to the presence of tertiary institutions which leads to illicit dressing among women in the area, while Ofoni, Awigbene, Ogbotobo communities had a low density of rape/attempted rape cases. The finding of this study corroborates with the findings of Joseph (2018) which attributed the major causes of rape to illicit dressing of women in Nigeria.

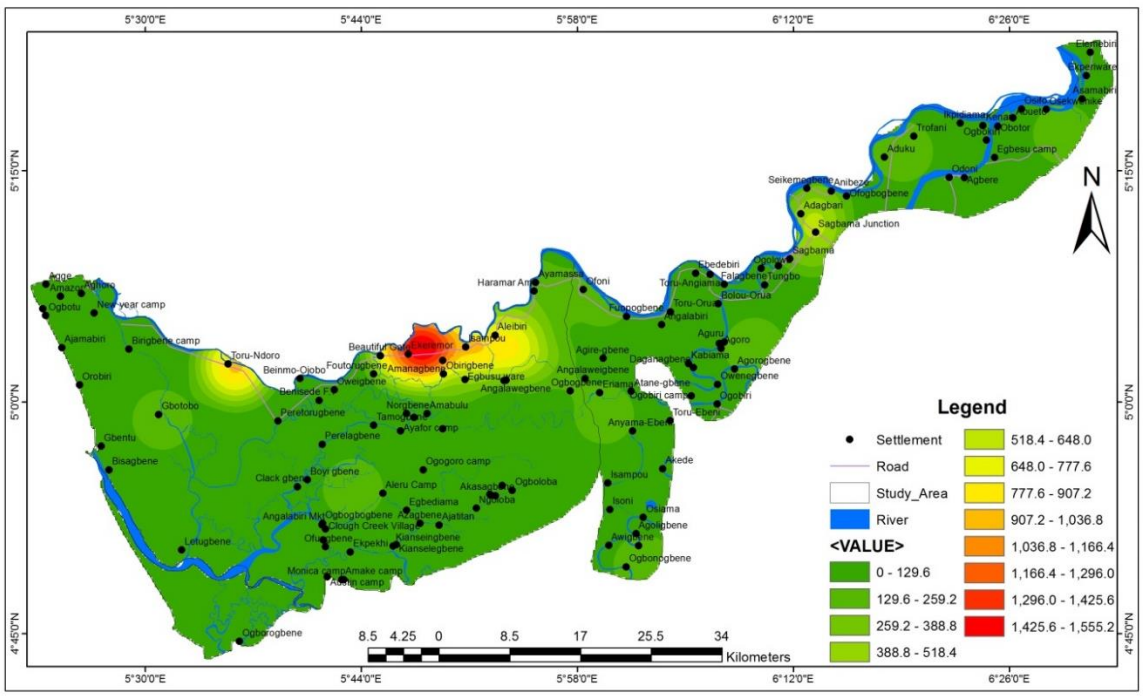


Fig. 8: Hotspot of Assault
Source: Author's Analysis (2019)

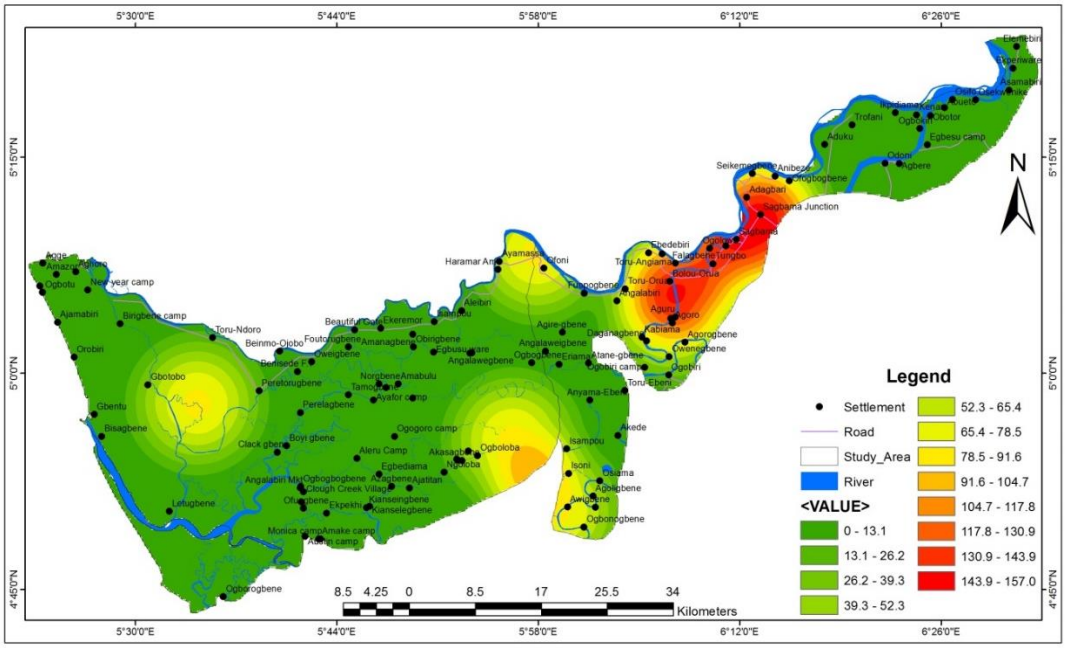


Fig. 9: Hotspot of Rape/Attempted Rape
Source: Author's Analysis (2019)

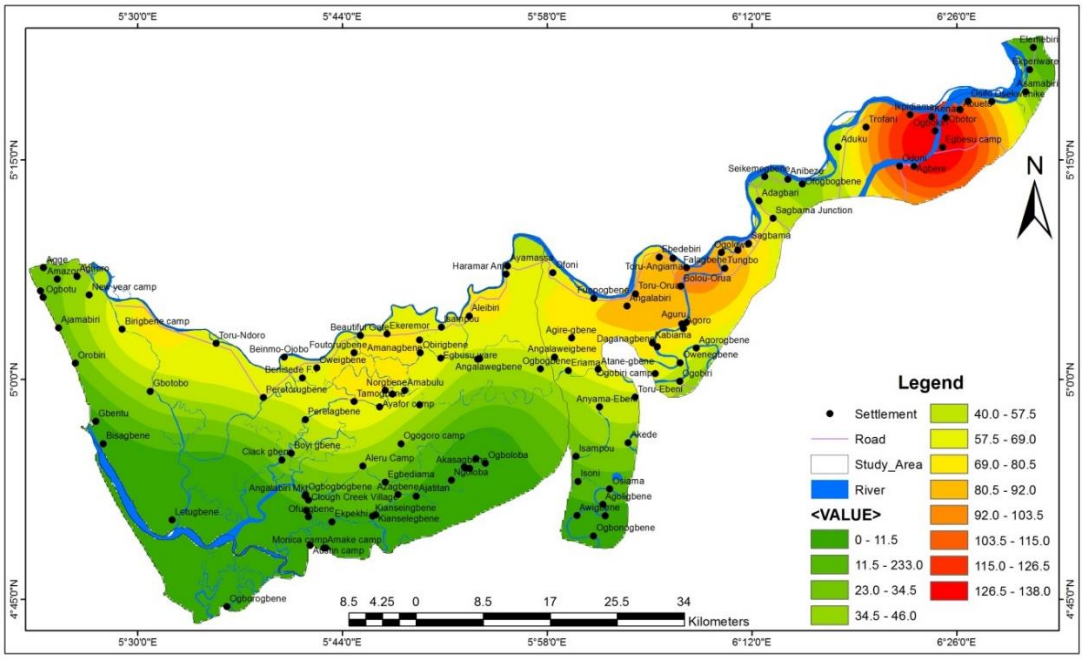


Fig. 10: Hotspot of Burglary/Home Breaking
Source: Author's Analysis (2019)

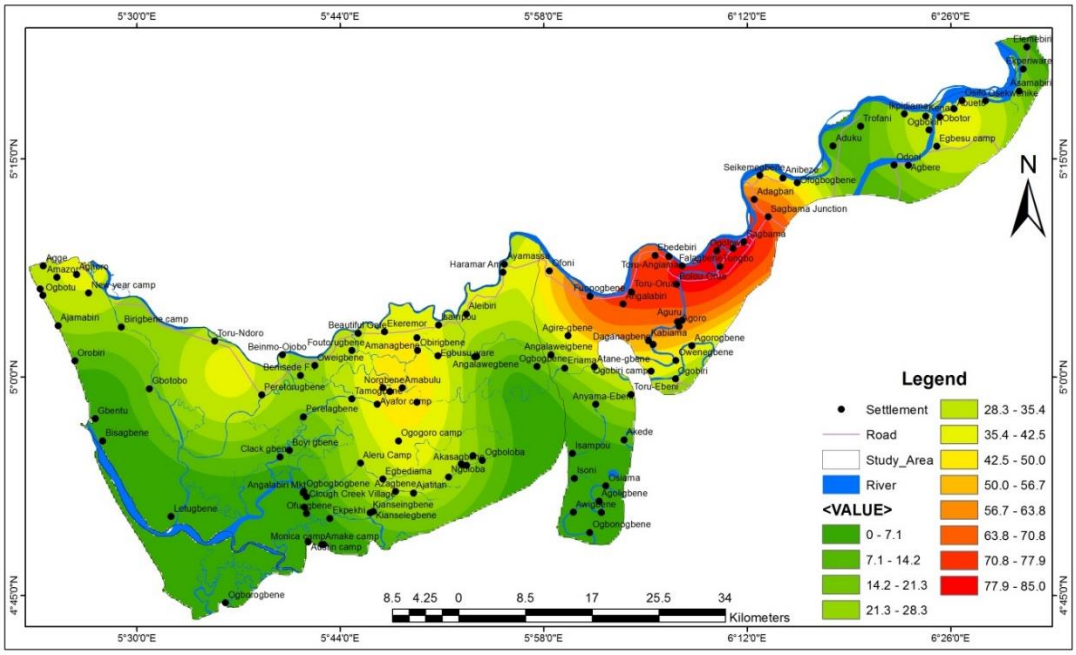


Fig. 11: Hotspot of False Pretense and Cheating
Source: Author's Analysis (2019)

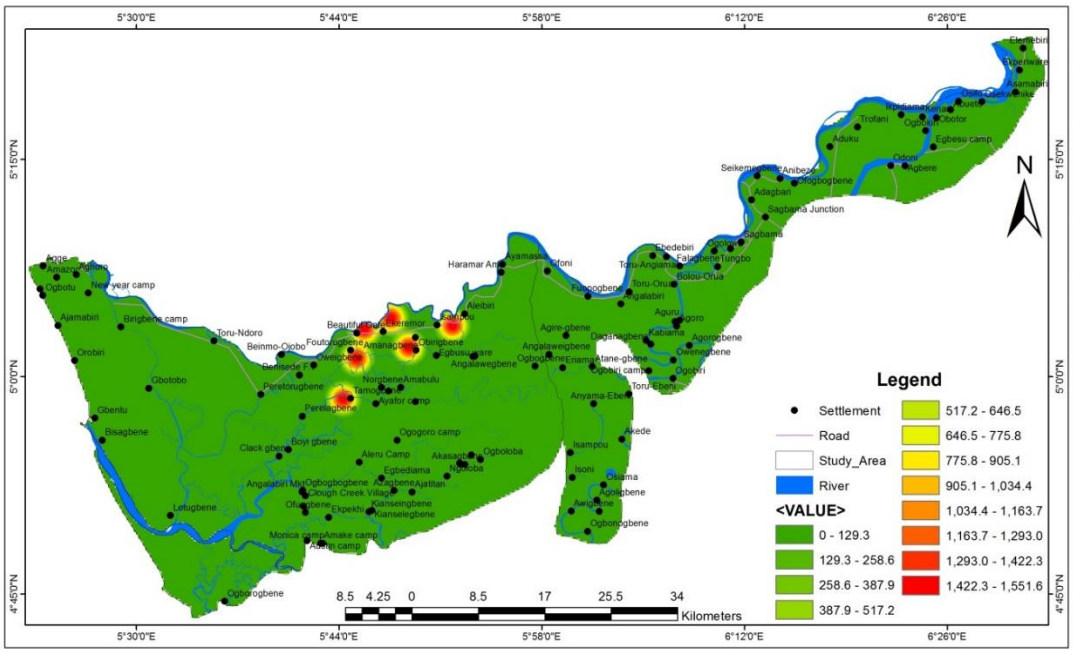


Fig. 12: Hotspot of Hurting/Fighting
Source: Author's Analysis (2019)

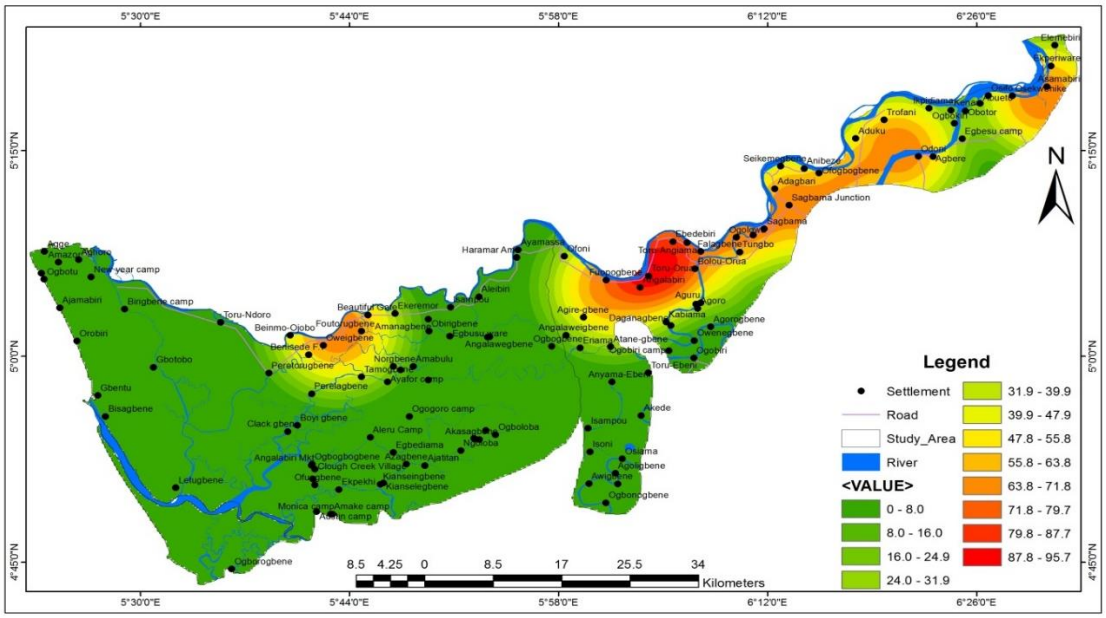


Fig. 13: Hotspot of Kidnapping
Source: Author's Analysis (2019)

The result in fig. 10 shows that Agbere, Odoni, Ogbobiri and Obotor areas had high density of burglary/home breaking cases in the study area. While Bolou-Orua, Toru-Angiama, Ekeremor, Ogobiri, Norgbene, Amabulu, Amazor and Agge had low density of burglary/home breaking cases while communities such as Letugbene, Egbepulugbene, Gbentu, Elemebiri and Asamabiri had no case of burglary/home breaking records. This may be attributed to the presence of retail shops in the communities along the major rivers in the area characterized with the scariest undertone of socioeconomic underachievement and the simultaneous failure of employment-generation and poverty alleviation programs. The finding of the study agrees with Adewuyi *et al* (2017) where the authors attributed the high rate of unemployment and poverty as the major causes of crime in the Abuja Municipal area.

The result in fig. 11 shows that Sagbama, Tungbabiri, Tungbo, Toru-Angiama, Angalabiri, had a high density of false pretense and cheating cases in the area. These communities are characterized by higher population than its surrounding communities. While Tamogbene, Obotor and Ogobiri had a low density of pretense and cheating. The finding corroborates with Ayuba *et al* (2016) in Tudun Wada, Kaduna where pretense and cheating crime are concentrated at areas with high population density.

The result in fig. 12 shows that Tamogbene, Ekeremor, Isampou, Obirigbene and Foutorugbene had a high density of hurting/fighting cases in the area. As mentioned earlier, that most of the political rallies in the study area are conducted in Ekeremor town characterized by high population with higher economic activities than the surrounding communities may be the major cause of hurting/fighting in the area. While there was no such crime recorded in the whole of Sagbama LGA.

The result in fig. 13 shows that Angalabiri, Toru-Orua, Toru-Angiama, Sagbama, Tungbabiri, Tungbo and Oweigbene had a high density of kidnapping crimes. This crime can be perpetuated anywhere, regardless of where the adopted persons resides, all that the criminals need to do is to track their targets or victims. These communities have a high population concentration in the middle and low income class status except Oweigbene community which is characterized by low population but it is an oil host community. The areas have a lot security formation, such as two police divisional headquarters, Counter Terrorism Unit 22 Base, and 16 Field Engineer Regiment are all located very close to the area, hence, this did not pose a great fear in the minds of the criminals. The finding also corroborates with Ayuba *et al* (2016) in Kaduna, Nigeria, where the authors observed that the pattern of kidnapping cut across the study area, regardless of where the victims live.

Conclusion

A criminal incidence has negative costs in terms of loss, death, psychological and physical pains and many others on the victims. High crime events raise significant public policy questions concerning how to perceive, detect, control and prevent criminal activities in an area. Comparison of criminal events among micro-geographic unit like settlements or wards in the levels of reported crime incidence over the years can help focus attention on specific locations that need more support and security patrol to curb the menace of crimes. The capability of GIS in understanding the spatiotemporal pattern of crime events and the potential crime prevention and control cannot be over emphasized. The helpfulness of crime mapping in crime prevention and control is enormous. Security personnel who are newly posted to a place can spend only few minutes studying these crime maps to gain a good understanding of the spatiotemporal distribution of crime events. This will assist in utilizing the limited resources and personnel for effective patrol deployment arrangements. The study has shown how GIS as a tool can be used effectively to analyze crime and display crime maps for adequate planning and the efficient management of resources and personnel to hotspot areas in order to reduce crime in the study area.

Recommendations

The following recommendations were made based on the findings:

1. More police posts should be provided by Government in Ayamasa, Ogobiri, Elemebiri communities so as to boost security and to be easily accessed by the residents in the area.
2. The high risk areas of crime hotspots such as Ekeremor, Sagbama, Toru-Owa etc. should be specially treated. More security personnel (especially policemen) and resources should be deployed to such areas with more patrol by the police authorities.
3. The Local Government Councils (LGCs) should establish community policing committees for the affected towns and villages bedevilled by criminal activities. The committees should include representatives of the security agencies operating in the area, especially the Divisional Police Officers (DPOs), the traditional rulers of such towns/villages, local vigilante and other stakeholders. This will ensure useful and relevant information and suggestions on crime prevention strategy.

References

Ackerman, W.V. and Murray, A.T. (2004). Assessing Spatial Patterns of Crime in Lima, Ohio. *Cities*, 21(5); 423-437.

Adewuyi, T.O., Eneji, P.A., Baduku, A.S. and Olofi, E.A. (2017). Spatio -Temporal Analysis of Urban Crime Pattern and its Implication for Abuja Municipal Area Council, Nigeria. *Indonesian Journal of Geography*, 49(2), 145-154,

Ayuba B., Mugu, B. A., Tanko, H. and Bulus, S. J. (2016). Geo-Spatial Analysis of Crime in Kaduna Metropolis, Nigeria. *Science World Journal*, 11(4), 7-15

Badru, G., Akintuyi, A., Omoniyegha, V. and Wunude, E. (2019). Mapping the Prevalence and Distribution of Crime within University of Lagos Using Geographic Information System. *University of Lagos Journal of Humanities (UJH)*, 7(2), 49-72

Bala, A., Bawa, S., Lugga, M. S. and Ajayi, O. G. (2015). Geospatial Information System for Crime Analysis and Crime Zone Identification-Case Study of Katsina, Nigeria. *Journal of Multidisciplinary Engineering Science and Technology (JMEST)*, 2(1), 6-15

Balogun, T.F., Okeke, H. and Chukwukere, C.I. (2014). Crime Mapping in Nigeria Using GIS. A case study of Benin City, *Journal of Geographic Information System*. 6, 453-466.

Brantingham, P.J. and Brantingham, P.L. (1984). *Patterns in Crime*. New York, NY: Macmillan.

Chainey, S. (2014). Crime Mapping. In Bruinsma, G. and Weisburd, D. (Eds*) Encyclopedia of Criminology and Criminal Justice,* New York: Springer.

Chainey, S.P., Tompson, L. and Uhlig, S. (2008). The Utility of Hotspot Mapping for Predicting Spatial Patterns of Crime. *Security Journal*, 21(1-2), 4-28.

Cohen, L.E. and Felson, M. (1979). Social Change and Crime Rate Trends: A Routine Activity Approach. *American Sociological Review,* 44, 588-608

Crews, G.A. (2009). Education and Crime. In Miller, J. (Ed) *21st Century Criminology: A Reference Handbook*. Thousand Oaks: SAGE Publications

David, J.S. (1985). *Police and People*. London: John Wiley Publication.

Ebenezer, A., Noutcha, A.E.M., Agi P.I., Okiwelu, S.N. and Commander, T. (2014). Spatial Distribution of the Sibling Species of Anopheles Gambiae Sensu Lato (Diptera: Culicidae) and Malaria Prevalence in Bayelsa State, Nigeria. *Parasites and Vectors*, 7(32); 1-6.

Eck, J.E., Chainey, S., Cameron, J.G., Leitner, M. and Wilson, R.E. (2005). *Mapping Crime: Understanding Hot Spots*. Washington DC: U.S. Department of Justice, Office of Justice Programs.

Effiong, E., Iyiola, I., Gbiri, I.A. and Daukere, B.E. (2016). GIS Approach in Analysis of Crime Mapping in Yenagoa Local Government Area of Bayelsa State, Nigeria. *International Journal of Innovative Research & Development,* 5(10); 204-214

Ejemeyovwi, D. O. (2015). Crime Mapping Using Time Series Analysis in Asaba, Delta State, Nigeria: a Remote Sensing and GIS Approach. *European Journal of Basic and Applied Sciences*, 2(2); 52-71.

Etebu, C.E. and James, A.B. (2011). Hostage Taking in the Niger Delta: Implications on Educational Development in Bayelsa State of Nigeria. *Journal of Sociology, Psychology and Anthropology in Practice.* 3(1); 99-109.

Fajemirokun, F., Adewale, O., Idowu, T., Oyewusi, A. and Maiyegun, B. (2006). A GIS Approach to Crime Mapping and Management in Nigeria: A Case Study of Victoria

Island Lagos. *Shaping the Change XXIII FIG Congress Munich, Germany,* October 8 -13

Ferreira, J., João, P. and Martins, J. (2012). GIS for Crime Analysis - Geography for Predictive Models. *The Electronic Journal Information Systems Evaluation.* 15(1); 36-49.

Fitzegard, M.G., Molennar, O.A. and Panson, J. (1981).*Crime and Society*. London: Routledge and K. Paul Ltd.

Greenburg, S. and Rohe, W. (1984). Neighbourhood Design and Crime A Test of Two Perspectives. *Journal of the American Planning Association,* 60(2); 173-184.

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.

Johnson, C.P. (2000). Crime Mapping and Analysis Using GIS, Geomatics 2000: *Conference on Geomatics in Electronic Governance*, Pune, Geomatics Group, C-DAC, Pune University Campus, Pune 411007.

Joseph, A.O. (2018). An Examination of Impact of Rape on the Victim and the Socio-Development of Nigeria. *Afro Asian Journal of Social Sciences*, 9(3), 1-8.

Mmom, P.C. and Akpi, A. (2014). Spatial Analysis of Flood Vulnerability Levels in Sagbama Local Government Area Using Geographic Information Systems (GIS). *International Journal of Research in Environmental Studies*. 1, 1-8.

National Bureau of Statistics, (2011). *Annual Abstract of Statistics*. Federal Republic of Nigeria

National Bereau of Statistics, (2017). *Crime Statistics: Reported Offences by Type and State*. www.nigerianstat.gov.ng Report Date: June 2017

National Population Commission (NPC) [Nigeria] (2009). *ICF Macro: Nigeria Demographic and Health Survey 2008.* Abuja: Nigeria

Nwagboso, C.I. (2018). Nigeria and the Challenges of Internal Security in the 21st Century. *European Journal of Interdisciplinary Studies*, 4(2); 15-33.

Onyepuemu, O.C. (2015). Increase Wave of Violent Crime and Insecurity: A Threat to Socio-Economic Development in Nigeria. *Journal of Humanities and Social Science,* 20(1); 123-133.

Oyinloye, M.A., Olamiju, I.O. and Otokiti, V.K. (2017). Spatial Distribution of Crime in Akure, Nigeria: The GIS Perspectives. *SCIREA Journal of Geosciences*, 2(2), 21-37

Shell Petroleum Development Company of Nigeria Limited, (2005). *Environmental Impact Assessment (EIA) of Benisede Catchment Area FDP Phase II Field Development Plan*. Final Report: SPDC 2004-0044442 (b)

State Employment and Expenditure for Results [SEEFOR] Project Bayelsa State, (2016). *Environmental and Social Management Plan (ESMP) for Small Public Works Activities in the eight (8) Local Government Areas of Bayelsa State.* SFG2386

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.

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.

Wortley, R., and Townsley, M. (2016). Environmental Criminology and Crime Analysis: Situating the Theory, Analytic Approach and Application. In R. Wortley and M. Townsley, M. (eds). *Environmental Criminology and Crime Analysis* (2nd ed). London: Routledge.

Xiong, H. (2016). *Urban Crime and Social Disorganization in China: A Case Study of Three Communities in Guangzhou*. New York Dordrecht London. Springer