

## Evaluation of crime pattern in Khanna local government using geographic information system

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### Abstract

Sustainable development can only take place in an atmosphere of peace and tranquility. The state of insecurity in Rivers State and Nigeria at large has been on the rise over the past decade. The Nigerian security agencies have not been able to effectively tackle and nib crime activities in the bud. This has led to the loss of lives, businesses, and other attendant socio-economic effects. The distribution of crime across the landscape is geographically random since crime is a human phenomenon, hence geography plays an important role in law enforcement and criminal justice. Geographic information system (GIS) can help the security agency in tactical planning and response; allocating resources quickly and more effectively, determine mitigation priorities, analyze historical events, and predict future trends and patterns. The main aim of this paper is crime modeling and analysis using the Geo-information system. This paper uses GIS to visualize, analyze, and explain criminal activities within Khanna local government in a spatial context. To achieve this, crime data and records covering over seven years were obtained from the Nigerian Police Force in Bori. Supplementary and attribute data were collected through fieldwork using the Global Positioning System (GPS) to provide the coordinates of crime points and scenes in the local government and other associated data. A spatial database was created using ArcGIS software. The crime hotspot map and crime density map of the study area was produced using the ArcGIS pro tool- Gi-Bin fixed 234-FDR at 99%,95%, and 90% confidence level respectively for the hot spots and cold spots respectively. The maps and results from the spatial analysis performed can help the police to carry out patterns and trends analysis across multiple jurisdictions; enlist community action, enhancing implementation of various policies to reduce crime in the study area. It can also provide tools and techniques to capture, forecast future crime occurrence in the area and reduce crime incidences.

**Keywords:** Crime pattern; Sustainable development; Crime hotspot; Geographic information system

### 1. Introduction

Geographic Information System (GIS) is a unique tool and a system designed to serve environmental needs which has been defined as “a computer system for capturing, storing, querying, analyzing and displaying geographical data” [1].

GIS approach is needed and will be helpful in the evaluation of crime pattern. Crime pattern is a way of explaining why crimes are committed in certain areas. Crime is not random; it is either planned or opportunistic. According to the theory, crime happens when the activity space of a victim or target intersects with the activity space of an offender.

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A person's activity space consists of locations in everyday life, for example home, work, school, shopping areas, entertainment area etc. These personal locations are also called nodes. The course or route a person takes to and from these nodes with various nodes creating a perimeter. This perimeter is a person's awareness space.

Crime pattern theory claims that a crime involving an offender and a victim or target can only occur when the activity space of both cross paths. It means crime will happen if an area provides opportunity for crime and it exists within an offender's awareness space.

Consequently, an area that provides shopping mall has a higher rate of crime. This is largely due to the high number of potential victims and offenders visiting the area and the various targets in the area. It is highly probable that an area like this will have a lot of car theft because of all the traffic in and out of the area. It is also probable that people may fall victim of pursue snatching or pick pocketing because victims typically carry cash with them. Therefore, crime pattern theory provides analysts an organized way to explore patterns of behavior. Criminals come across new opportunities for crime every day. These opportunities arise as they go to and from personal nodes using personal paths, for example, a victim could enter an offender awareness space by way of a liquor store parking lot or a new shopping Centre is being built in an area where crime occurs a couple of miles away, chances are, it will exist in some if not all in all offender's awareness space. This theory aids law enforcement in figuring out why crime exists in certain areas. It also helps predict where certain crimes may occur.

Khana is the busiest local government in Ogoni land and is occupied by different categories of people. The establishment of educational institution in Bori, which is in Khana L.G.A also increase the rate of crime in this local government. All the Government efforts to control the rate of crime does not have any major effect in reducing crime in Khana L.G.A.

GIS is to empirically measure and display the geographic location of where these crimes occur in Khana LGA. In the mission-critical nature of law enforcement, information about the location of a crime incident, suspect or victim is often crucial to determining the number and size of the response.

GIS helps co-ordinate vast amount of location-based data from multiple sources. It enables the user to create layers for the data and view the data most critical to the particular issue.

Government in the state made efforts to control the rate of crime by introducing different control measures but without much success.

The response of the government has come in form of increase for policing capacity, legalization of activities of vigilant groups and re-introduction of militarized approaches of law enforcement. Similarly, the public at large has resorted to self-measures. These measures include formation of vigilant groups that involve in lynching of criminal suspects due to the frustration and the inability of police to bring down the level of crime.

The rate of crime occurrence has grown sharply in Khana LGA as a result of increased population, economic inequalities and deprivation, social disorganization, inadequate government service of law enforcement, unemployment and social-political conditions. It is quite understood that a local government area with high rate of criminal activities will discourage both local and foreign investors. Currently, some banks and other investors had stopped operations in this local government because of experience of robbery attack. This problem requires control, which can also be solved using Geographic Information System (GIS) approach.

Most criminal activities depend on spatial information thus having spatial dimensions. Ineffective management of this spatial information affects decision making. Over the year crime has been manually managed and controlled in Khana LGA, Rivers state. This probably due to lack of awareness of the benefits of GIS in crime control and management in the state. Manual process does not provide accurate, reliable and comprehensive data round the clock nor does it help in trend prediction and decision support. Geographic Information System (GIS) is such leading emerging tool which can perform active role in the evaluation of crime since nearly all criminal activities have geographic dimension.

Khana as the Headquarter of all other local government area in Ogoni land is occupied by both indigenes and non-indigenes. Every normal human being wants peace in any environment they live. People generally desire to stay in a peaceful environment, but occurrence of crime reduces the peace of any environment which requires adequate control. The prevalent crimes in the local area are assault, stealing, kidnapping, murder, robbery, occasional harm etc. Government in the state made efforts to control the rate of crime by introducing different control measures but without much success.

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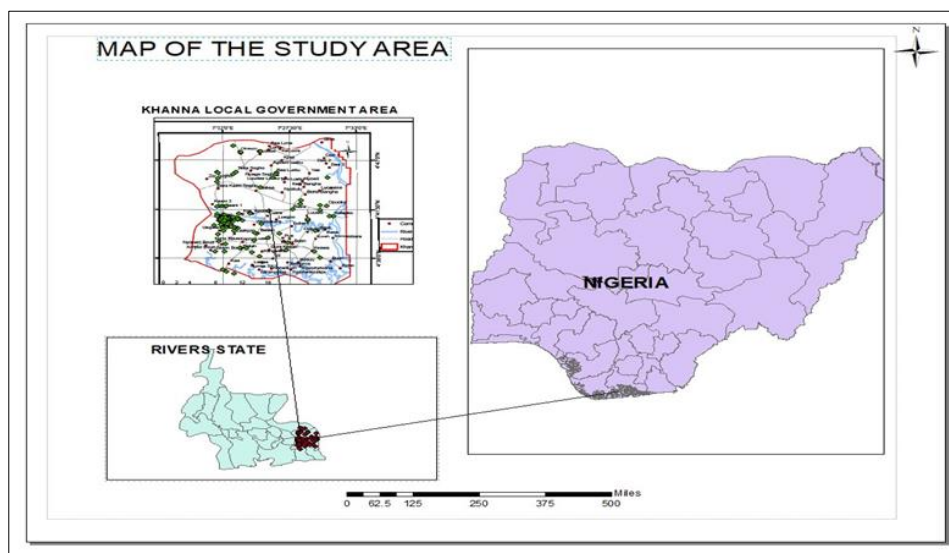
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It has been shown previously [2] that a related problem like this was handled by using Geographic Information System (GIS) approach. This study is aimed at evaluating crime patterns in Khana Local Government Area of Rivers State using Geographic Information System (GIS) approach.

## 2. Methodology

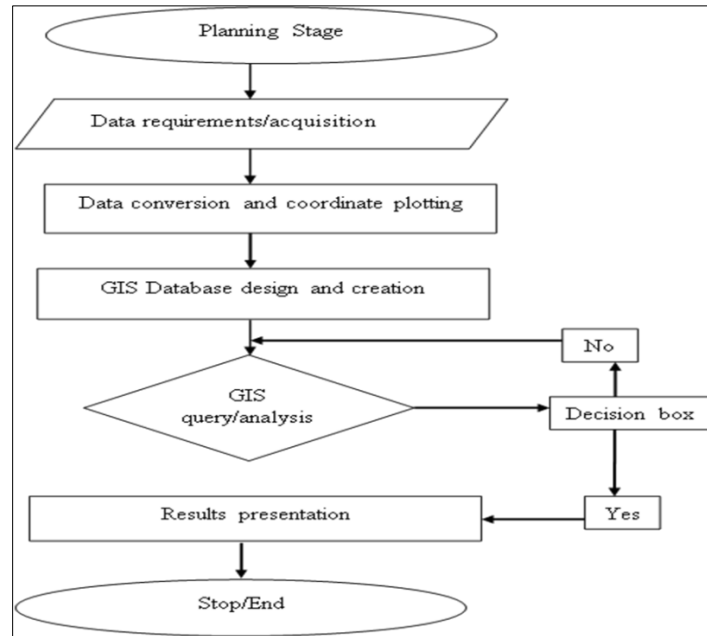
### 2.1. Study area

Khanna local government is the largest local government in Ogoniland and Rivers state by extension. Ogoniland has a population of close to 832,000 (according to the 2006 National Census). The region is divided administratively into four local government areas: Eleme, Gokana, Khana, and Tai. See Figure 1.



**Figure 1** Locator map of the study area

The methodology is divided into various steps such as: data requirement, sources of data, data acquisition, data processing and analysis and GIS analysis. See Figure 2.



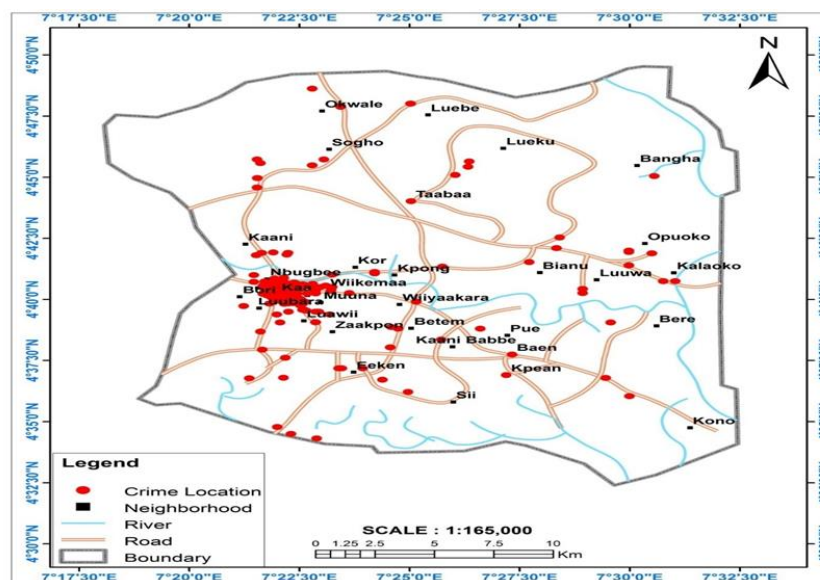
**Figure 2** Research Design/Methodology

### 3. Data acquisition

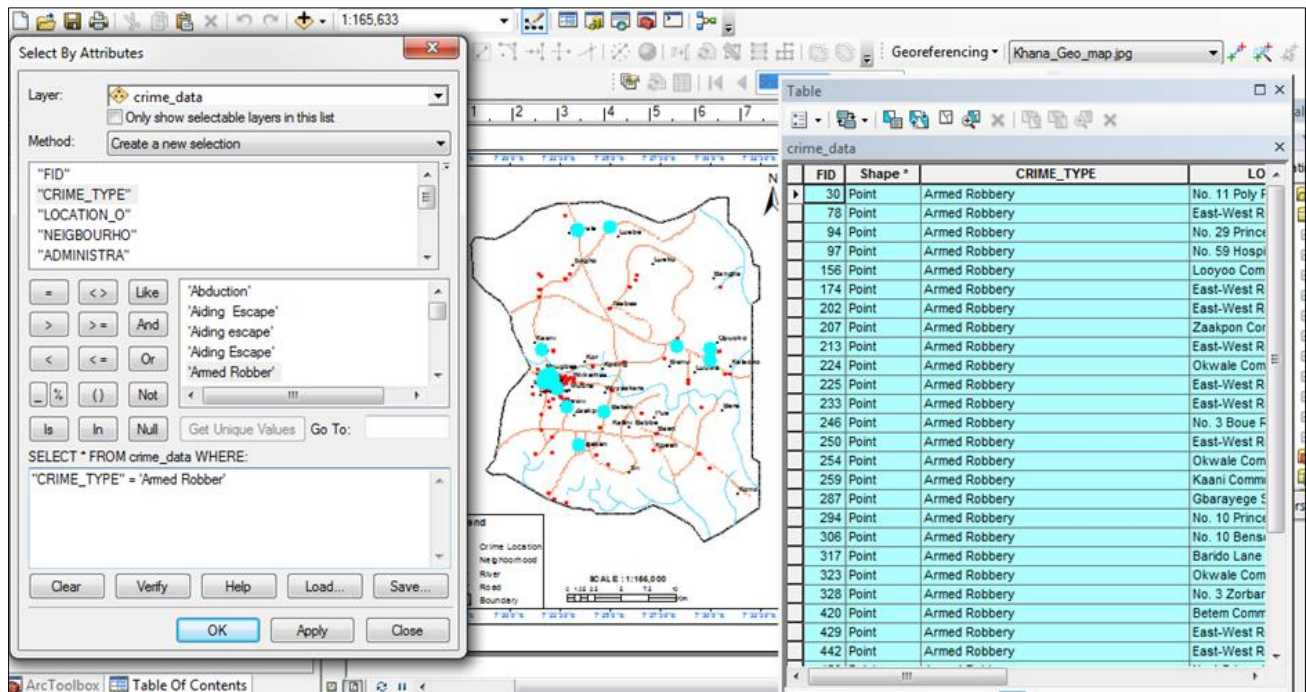
Police crime records were obtained from the Nigerian Police in Bori, Khanna local government area covering crime incidence in the local government. Supplementary and attribute data was collected through field work using Global Positioning System (GPS) which will provide the co-ordinates of all crime scenes with additional data was sourced from documentary sources including journals, newspapers, magazines.

The police crime records data was extracted and put in excel file in form of text and exported and transformed into a shape file in GIS environment. Geo-referencing was carried out on identified abnormalities such as projection and symbolization errors, which are quite common of such convectional maps and was rectified before adopted for the study. Spatial database was created using 10.4, same was used for the data visualization and the analysis.

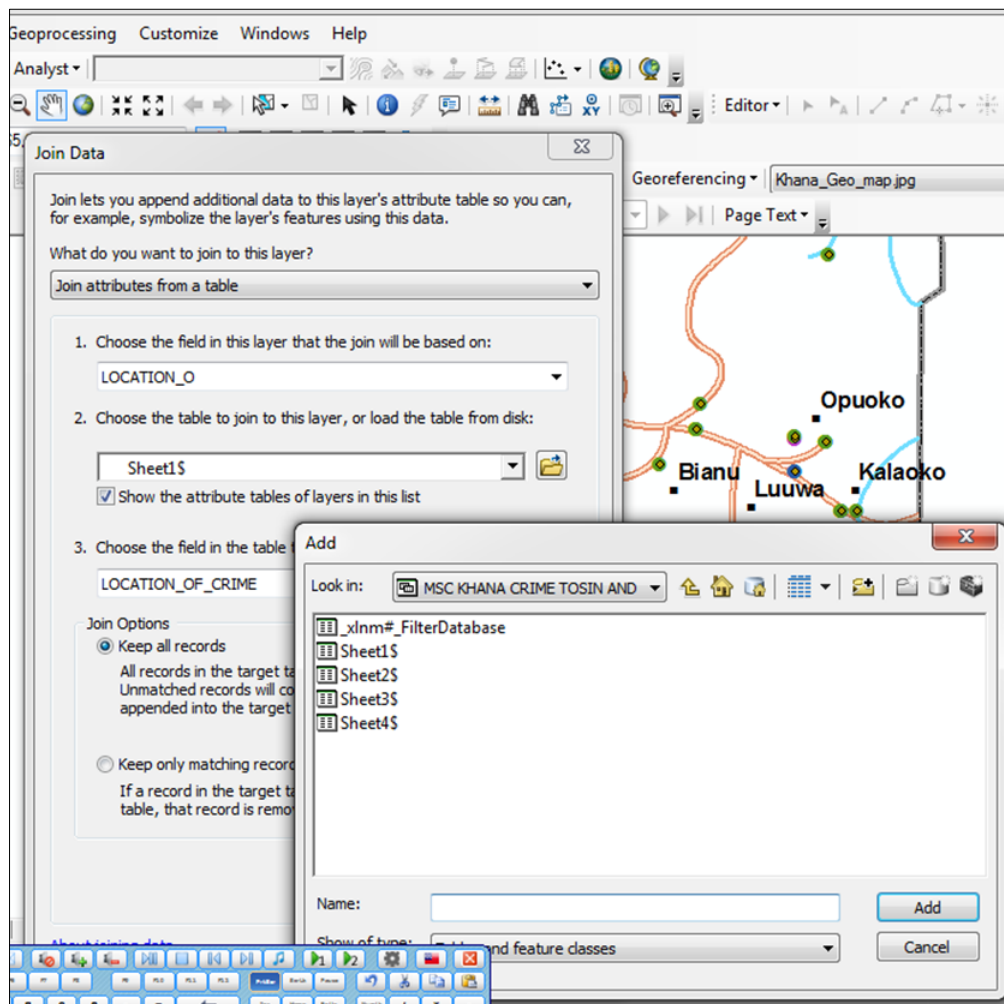
### 4. Results



**Figure 3** Spatial Distribution of Crime in Khana LGA



**Figure 4** Spatial Query of Crime type in Khana LGA



**Figure 5** Process of Database Linking and Joining



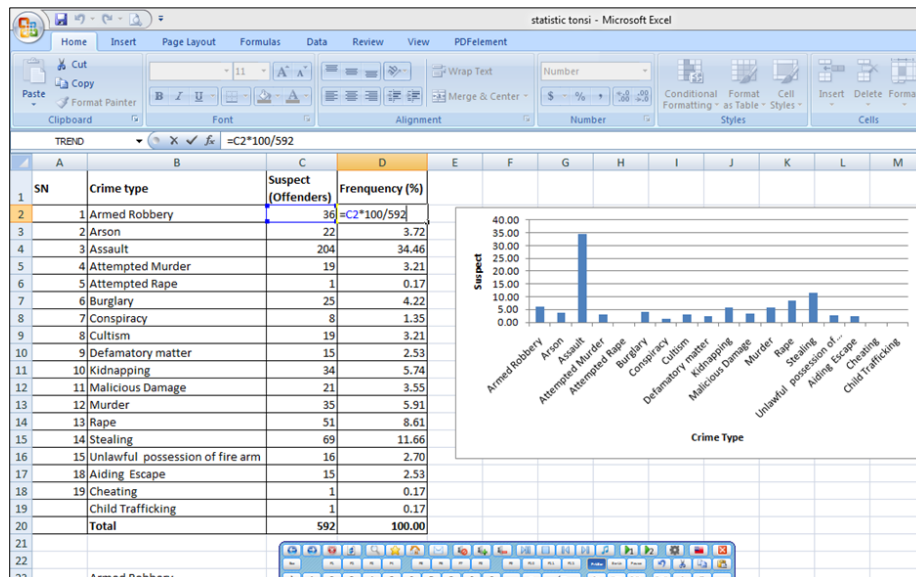


Figure 6 process of statistic method applied

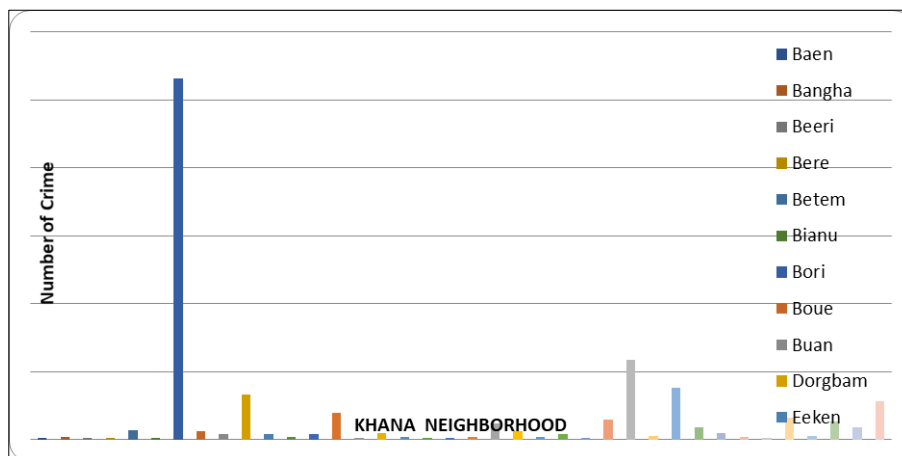


Figure 7 Histogram of Spatial location of Crime in Khana LGA

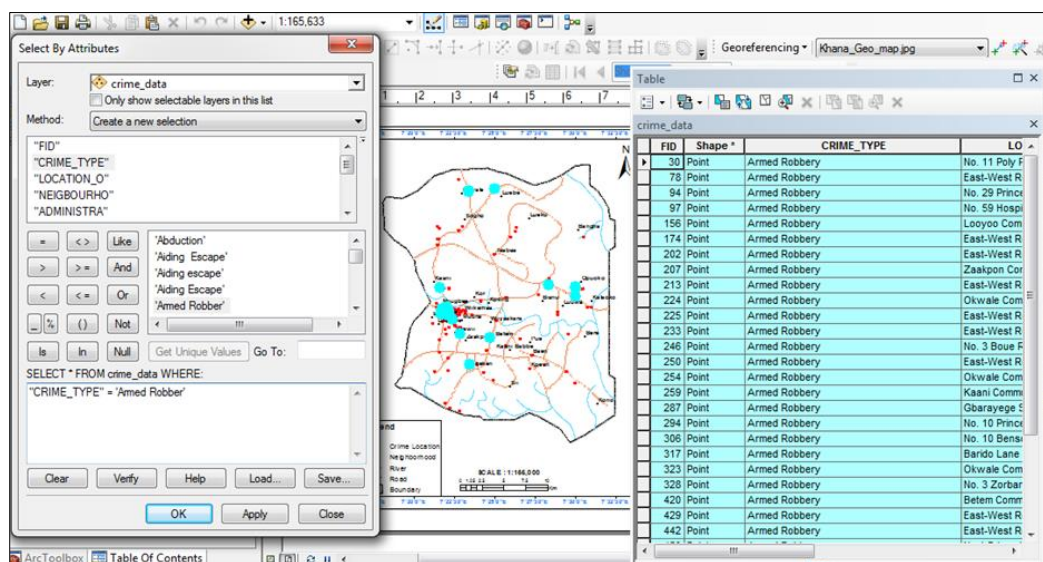
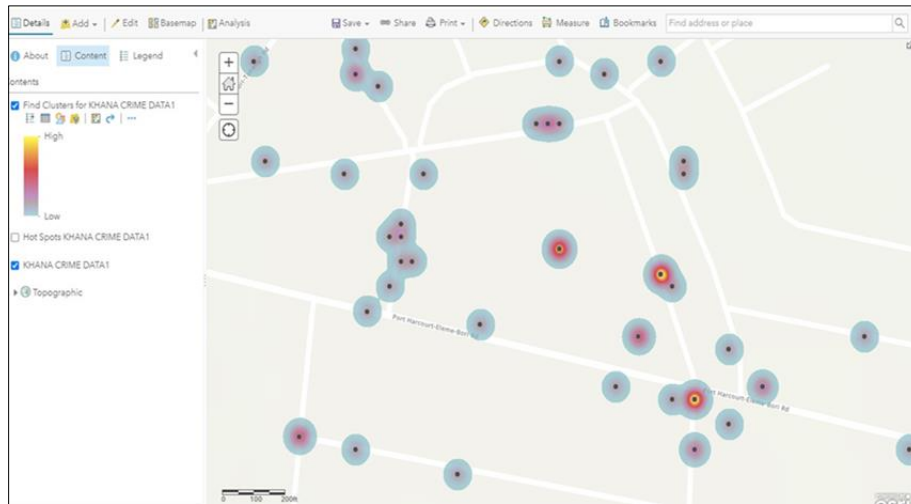
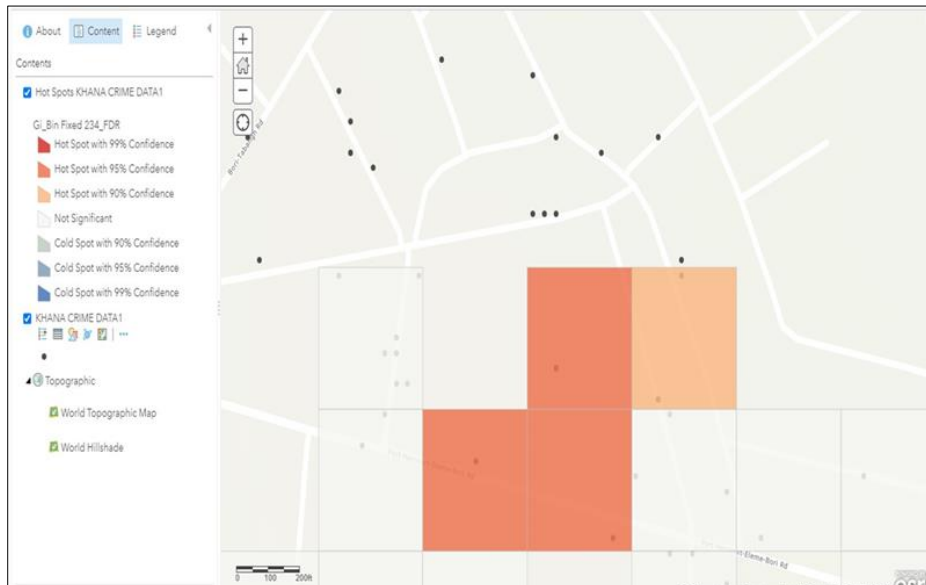


Figure 8 Spatial Query of crime type



**Figure 9** Crime Hotspot in Khanna



**Figure 10** Hot spot analysis

**Table 1** Estimation of rate and magnitude of crime from 2009 to 2019

Year of Crime	Crime (Suspect)	Frequency (%)	Annual rate (%)	Magnitude
2009	61	10.30	-5.41	Highly Decreased
2010	29	4.90		
2011	29	4.90	0.25	Stabilized
2012	32	5.41		
2013	53	8.95	3.55	Increased
2014	60	10.14	0.34	Stabilized
2015	60	10.14		
2016	59	9.97		
2017	30	5.07	-1.63	Decreased
2018	59	9.97	7.60	highly Increased



**Figure 11** Graph showing the magnitude of crime from 2008 to 2019 in the study area

**Table 2** Evaluation of Crime per Land Use

Crime type	Residential		Commercial		Total	Frequency (%)
	Residential	Frequency (%)	Commercial	Frequency (%)		
Armed Robbery	24	4.05	12	2.03	36	6.08
Arson	16	2.70	6	1.01	22	3.72
Assault	168	28.38	36	6.08	204	34.46
Attempted Murder	17	2.87	2	0.34	19	3.21
Attempted Rape	0	0.00	1	0.17	1	0.17
Burglary	19	3.21	6	1.01	25	4.22
Conspiracy	7	1.18	1	0.17	8	1.35
Cultism	17	2.87	2	0.34	19	3.21
Defamatory matter	13	2.20	2	0.34	15	2.53
Kidnapping	31	5.24	3	0.51	34	5.74
Malicious Damage	16	2.70	5	0.84	21	3.55
Murder	32	5.41	3	0.51	35	5.91
Rape	48	8.11	3	0.51	51	8.61
Stealing	54	9.12	15	2.53	69	11.66
Unlawful possession of fire arm	15	2.53	1	0.17	16	2.70
Aiding Escape	15	2.53	0	0.00	15	2.53
Cheating	1	0.17	0	0.00	1	0.17
Child Trafficking	1	0.17	0	0.00	1	0.17
Total	494	83.45	98	16.55	592	100.00

## 5. Discussions

The record on the research shows that 592 suspects grouping into 18 crimes. The histogram figure 6 show that Assault is the highest crime committed in the area, about 34.46% of suspects were recorded. The other crime committed by average suspects involve stealing (11.66%), Rape 8.61%, murder (5.91%), kidnapping (5.74%) and armed robbery (6.08%). The crime committed by low suspects involve, aiding escape (2.53%), Arson (3.72%), attempted murder (3.21%), attempted rape (0.17%), Burglary (4.22%), Cheating (0.17%), child trafficking (0.17%), Cultism (3.21%), Defamatory matter (2.53%), malicious damage (3.55%) and unlawful possession of firearm (2.70%). The figure 3. is the spatial pattern of crime type in the study area.



- From 2009 to 2010 the crime is highly decreased from 10.30 % to 4.90% at rate of 5.41% per year
- From 2010 to 2012 the crime stabilized from 4.90 % to 5.41 % at rate of 0.25% per year
- From 2012 to 2013 the crime increased from 5.41 % to 8.95% at rate of 3.55% per year
- 2013 to 2016 the crime remains almost constant from 8.95% to 9.75% rate of 0.34% per year
- From 2016 to 2017 the crime reduced from 9.75% to 9.97% at rate of 1.63% per year
- From 2017 to 2019 the crime highly increased from 9.97% to 20.27% at rate of 7.60% per year

The Crime in the study area varies based on land use. The table 2 shows that the total crime committed in residential area is 83.45% while commercial area is about 16.55%. The histogram (figure 7) show that assault crime is the highest in residential and commercial area. Other major crime committed in residential are: Rape (8.11%), murder (5.41%) stealing (9.12%) and kidnapping (5.07%), while other major crime committed in commercial are: stealing (2.53%) and arm robbery (2.03%). The table 2 is the spatial Pattern of Crime per Landuse in the study area.

## 6. Summary of Findings

Crime data incidence reports obtained from the police stations were used to plot the crime maps using Arc GIS 10.4 to show the spatial pattern map of crime type in the study Area.

Considering the spatial distribution of crime in the study area, it shows that Bori is the highest neighborhood in Khana where crime always occur, this can be attributed to large populations, since it is the headquarter of the local government. Crime at Eeken, Muuna, KaariBabbe, Nortern and Wiiyaakara are als; getting worse.

Summarily the study shows that assault is the type of crime that is the highest committed in the area, because they are common crimes, which may be as a result of unemployment and rate of poverty in the area.

## 7. Conclusion

The results of findings in this study show that GIS is a good and effective means to evaluate the patterns of crime. Receiving cooperation from all relevant authorities, GIS is a reliable tool to map and analyze the frequencies of crime with a view to determining the cause of such crime and how they can be handled.

Also, with GIS police and other law enforcement agencies could synergize with GIS experts to produce maps showing the crime hot spot by performing simple query.

GIS is an effective tool, and is of great benefit to the law enforcement agencies bin their efforts to evaluate the pattern of crime, which will in no doubt reduce crime rate.

## Compliance with ethical standards

### *Acknowledgments*

The authors would like to thank the Nigerian Police, Bori for providing the crime data for this study, the data has been of immense help in making this research possible.

### *Disclosure of conflict of interest*

Aogo OJ conceived, designed the research, collected data, carried out most analysis and did most of the writings., Akpee D and Ojiko JC implemented the analysis including exploratory data analysis and visualization of data and data processing. Ono MN supervised the writing and statistical analysis. Uchenna UD helped in the data collection. All of the authors have read and approved the final manuscript and contributed to the writing.

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