Journal of Law and Global Policy (JLGP) E-ISSN 2579-051X P-ISSN 2695-2424
Vol 9. No. 1 2024 www.iiardjournals.org

Geospatial Analysis of Crime Cases in Apete Community, Ido Local Government Area, Oyo State, Nigeria

BABATUNDE, Akeem Adesola
Department of Surveying and Geoinformatics, Faculty of Environmental Studies,
The Polytechnic, Ibadan, Nigeria
Email: Bakeem44@yahoo.com

DOI: 10.56201/jlgp.v9.no1.2024.pg46.57

Abstract
This study utilizes Geographical Information System in mapping crime case within Apete community, Ibadan in Ido Local Government Area, Oyo State, Nigeria with the aim of depicting the crime hotspots on maps using GIS approach. The methodology involved acquisition of spatial location of crime areas using handheld GPS and crime data of different crime cases between 2022 and 2023. 171 and 281 crime cases were committed and officially reported in the year 2022 and 2023 and the data were collected from the Oyo State Police Headquarters Iyaganku Ibadan. Statistical analysis was done using Average nearest neighbor (ANN), Kernel and Point densities using density statistical tools from ArcGIS 10.8 to reveal the intensity of crime within the study area. The result from the study showed that internet fraud with 244 cases have the highest crime cases followed by stealing with 169 cases and cybercrime with 111 cases between 2022 and 2023 and is based on crime committed and number of arrest made. The result from the analysis average nearest neighbor revealed dispersed pattern with 1.51 ($p<0.01$) and z-score 6.90 ($p<0.000$). However, the result from kernel density estimation revealed area of crime hotspots with high to low intensity crime rate that will help the local security and other law enforcement agent to assist the community and the inhabitants in order to minimize the occurrence of different crime cases in the study area. The result of correlation analysis revealed significant relationship between number of crime committed and time crime committed, number of arrest with time crime committed, time crime reported and number per crime committed. It can be concluded that, there is need for more Police station and more law enforcement agent, local security guide to minimize the occurrence of crime in the study area.

Keywords: *Hotspots, Statistical analysis, Density, Intensity, Pattern, enforcement agent*

Introduction

Ocholi et al. (2023) examines the Spatial Pattern and Distribution of Crime in Suleja LGA, Niger State, Nigeria. The study used GIS and statistical methods to analyse the pattern and distribution of crime incidence. Their study reveals that the crime distribution pattern is generally clustered with a Global Moran's I index of 0.097, a Z-score of 1.87, and a P-value < 0.06. Furthermore, the study reveals that armed robbery (61), kidnapping (40), car theft (33), culpable homicide (31), rape (29), and robbery (13) cases rank the highest in crime rate. The result of their study

revealed Chaza, Kwam-ba, Madalla, Suleja central, and Gaboda are the major crime hotspot zones at 90% confidence, as analysed using the Getis-Ord Gi* (Hot spot analysis).

Adzande et al. (2018) examined the social and physical correlates of crime in Makurdi town with a view to predicting their influence on the emerging crime pattern, especially in a rapidly developing city in the global south. The study looked at the determinants of the distribution of opportunities for crime within built environment.

Aov et al. (2017) looked at the occurrence and distribution of crime in Makurdi Metropolis. The study ap plies the use of Geographic Information Systems (GIS) in crime analysis. Ayuba et al. (2016) examined the Geo-spatial Analysis of Crime in Kaduna Metropolis, Nigeria. The study employs geospatial techniques and secondary records. A result of the study shows that theft/stealing ranks the highest among recorded crimes with 19.29%.

Okon et al. (2021) studied mapping the incidences of crime in Makurdi Metropolis, Benue State, North-Central, Nigeria. The study used GIS applications in identification, mapping and presentation of crime patterns and trends in Makurdi. Findings of the study using the one-way ANOVA indicate a statistically significant difference in the distribution of crime incidents among the 5 Police jurisdictions ($F(4, 100) = 3.767$, $p < 0.05$). The study recommended that for proper crime analysis, GIS units should be established in all police stations.

Olajuyigbe et al. (2015) studied spatial analysis of factors responsible for the spread of crime activities in Akure, Nigeria, using GIS Techniques. The study found that the main road network that traverses Akure Metropolis, provides easy access and exit to criminals, and constitutes a dominant axis of crime events as facilities located along the road usually experience armed robbery attacks or burglary.

Adeolu (2019) studied locational analysis of Police stations and Crime Spots in Ikeja Lagos Nigeria. Geographic Information Systems were employed to collect coordinates of locations of police stations and crime spots. Nearest Neighbour Analysis was employed to determine the spatial pattern of police stations and crime spots.

Nazmfar et al. (2020) studied the analysis of the spatial distribution of crimes in urban public spaces in Tehran parks. The study applies a geostatistical approach to study and analyse the distribution of criminal activities in urban parks with respect to their proximity to city centres. The investigation found out that the lack of adequate security and surveillance services during the night is responsible for the illicit and criminal activities that go on in the parks.

Oyinloye et al. (2017) investigated the spatial distribution of crime in Akure, Nigeria: The GIS Perspectives. This study utilized GIS technology to access the spatial distribution of crime in selected communities in Akure. The findings of the study using GIS analysis shows that theft and battery are the dominant crimes committed in the study areas and poor building conditions are responsible for it. Statistical analysis of geographical data has been greatly enhanced in recent years with the advent of GIS (Wen et al., 2002).

Therefore, this study used spatial analysis to map the spatial distribution of crime cases in Apete community, using spatial statistics technique, and kernel and point densities. Ahmadi (2003) asserted that crime mapping and spatial analysis is a critical tool in the study and control of crime However, this study aimed at using GIS to analyse the crime cases in Apete in Ido LGA, Oyo State using spatial statistical tools in ArcGIS and IBM SPSS 20.

Materials and Methods

The Study Area

Apete is a populated community in Ido Local Government Area, Oyo State, Nigeria. The populated referred to because it the nearest community to a tertiary institution of learning (The Polytechnic, Ibadan, Nigeria). The total population of Apete community according to 2006 population census was 103,261 persons. It lies at approximately at longitude 3.8643°E and latitude 7.4488°N The major occupation of the people in Apete community is farming.

Methods of Data Acquisition/Analysis

Geographical Location (x, y coordinates) of places where crime was committed was acquired using handheld GPS based on the data collected from the Nigeria Police Force Iyaganku, Ibadan. The data were acquired through the assistance of two Police officers. Analysis was done using GIS statistical tool through ArcGIS 10.8 to assess the intensities of crime at various point from kernel and point densities within the study area. Moreso, Average Nearest Neighbor tool was used to determine if the crime is either cluster, random or dispersed and as well as their statistical significant level. However, correlation analysis was done to assess the level of crime cases significant relationship.

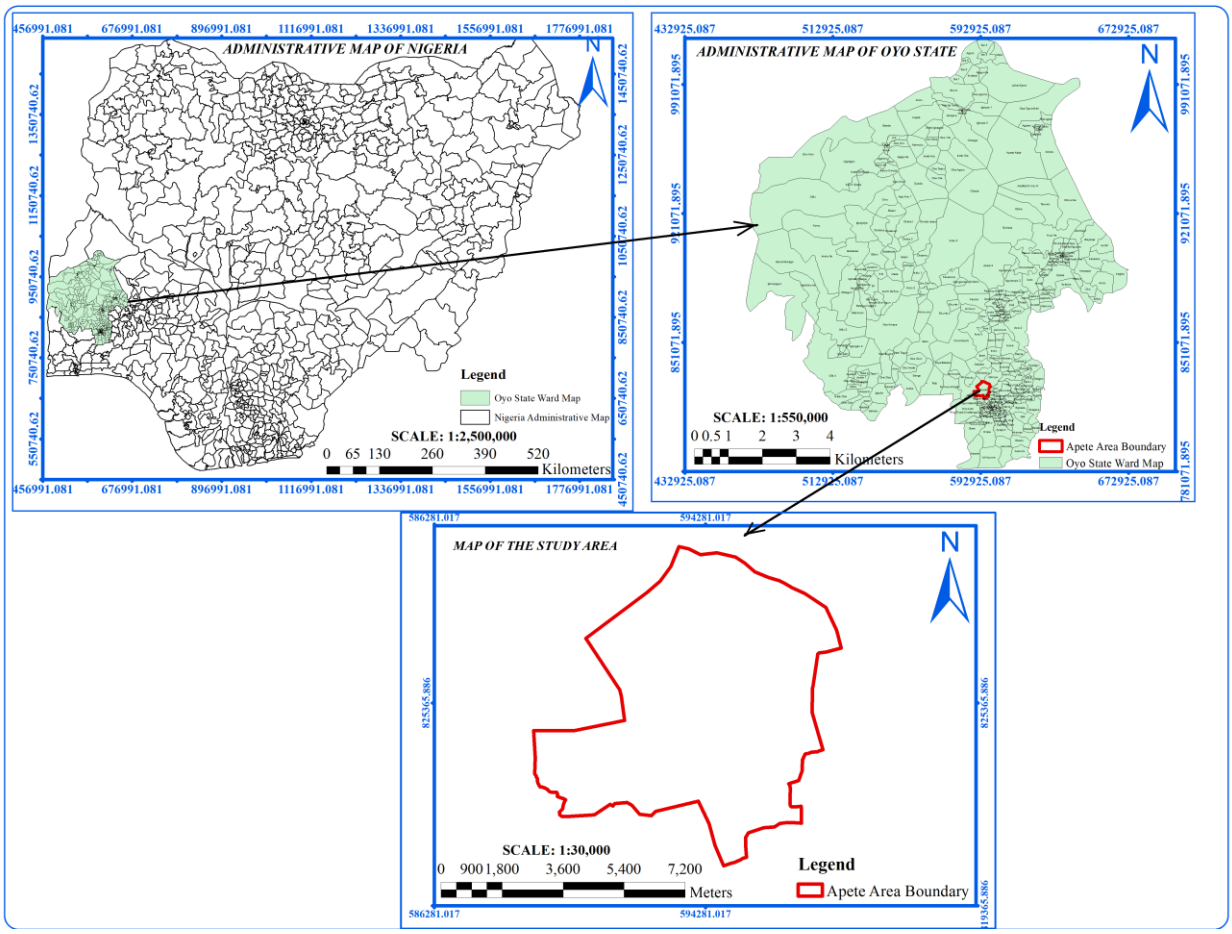
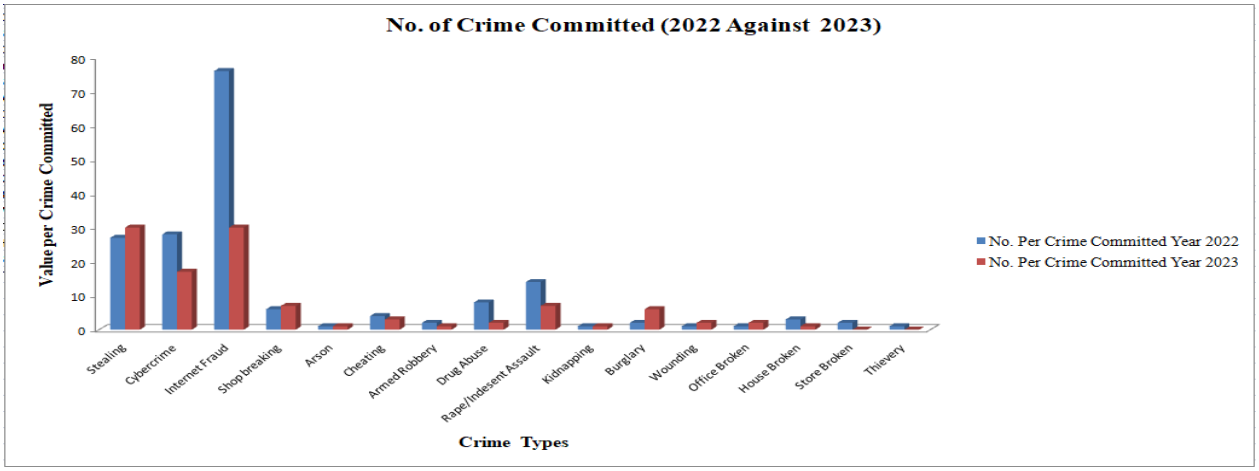


Figure 1: Study Area Map

Table 1: Summary of Crime Data obtained from Police by crime committed and arrest made

Crime Name	No. Per Crime Committed		No. of Arrest		Overall Total
	2022	2023	2022	2023	2022 and 2023
Stealing	27	30	73	39	169
Cybercrime	28	17	45	21	111
Internet Fraud	76	30	99	39	244
Shop breaking	6	7	9	12	34
Arson	1	1	1	1	4
Cheating	4	3	4	3	14
Armed Robbery	2	1	1	1	5
Drug Abuse	8	2	10	4	24
Rape/Indesent Assault	14	7	14	13	48
Kidnapping	1	1	1	1	4
Burglary	2	6	7	9	24
Wounding	1	2	1	4	8
Office Broken	1	2	3	3	9
House Broken	3	1	6	2	12
Store Broken	2	0	4	0	6
Thievery	1	0	3	0	4
Total	177	110	281	152	720



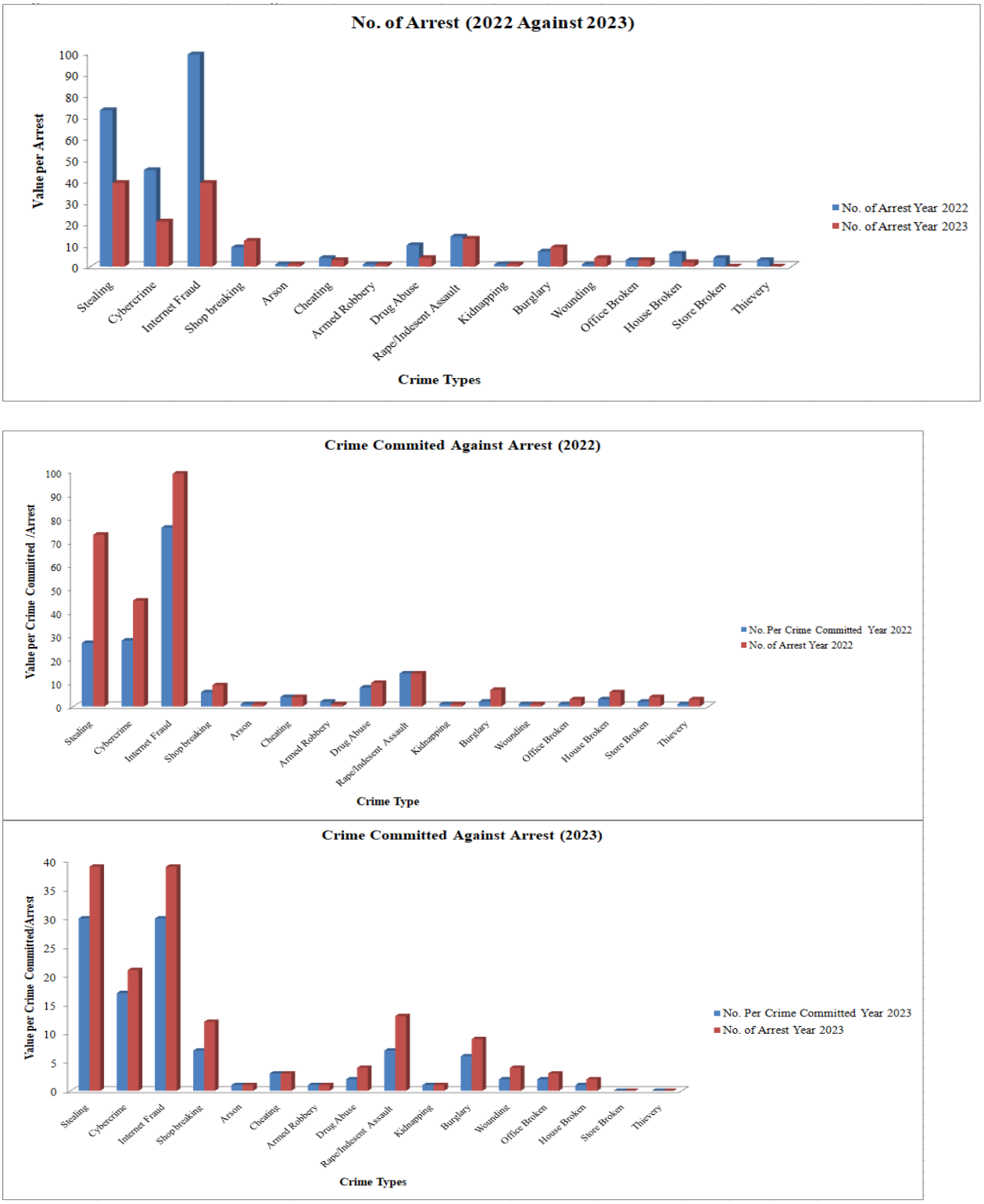


Figure 2: No of Crime Committed and No. of Arrest across Category

Table 2: Geographical coordinates of crime hotspots

Crime Name	Year Crime Committed	Easting (m)	Northing (m)
Stealing	2022	596772	823677
Stealing	2022	597005	824313
Stealing	2022	596182	823158
Stealing	2022	596311	824081
Cybercrime	2022	595296	823696
Cybercrime	2022	596888	825451
Internet Fraud	2022	596811	826167
Internet Fraud	2022	595932	825389
Shop breaking	2022	596539	824881
Arson	2022	595565	824795
Cheating	2022	597325	824934
Armed Robbery	2022	596049	824452
Drug Abuse	2022	595630	824271
Drug Abuse	2022	596083	822636
Rape/Indesent Assault	2022	595738	821969
Rape/Indesent Assault	2022	595281	822614
Rape/Indesent Assault	2022	595570	823179
Kidnapping	2022	594208	822942
Burglary	2022	594854	822172
Burglary	2022	594893	821282
Wounding	2022	593205	822427
Office Broken	2022	591601	823334
House Broken	2022	590283	823481
Internet Fraud	2022	593557	824260
Internet Fraud	2022	590283	822510
Store Broken	2022	591351	824269
Store Broken	2022	594248	825355
Thievery	2022	592872	825842
Stealing	2023	595134	826270
Stealing	2023	593551	826939
Stealing	2023	594924	828912
Cybercrime	2023	597022	827951
Cybercrime	2023	595479	827347
Internet Fraud	2023	593983	828128
Internet Fraud	2023	593783	823391

Shop breaking	2023	596276	826865
Arson	2023	592934	823815
Cheating	2023	594647	823785
Armed Robbery	2023	595997	823727
Wounding	2023	594552	824626
Wounding	2023	594333	826254
Rape/Indesent Assault	2023	592878	823135
Rape/Indesent Assault	2023	595273	825592
Kidnapping	2023	592658	827174
Burglary	2023	597305	827076
Burglary	2023	595034	823184
Office Broken	2023	596343	828922
House Broken	2023	593216	825109
Internet Fraud	2023	596115	828274
Internet Fraud	2023	594598	827445

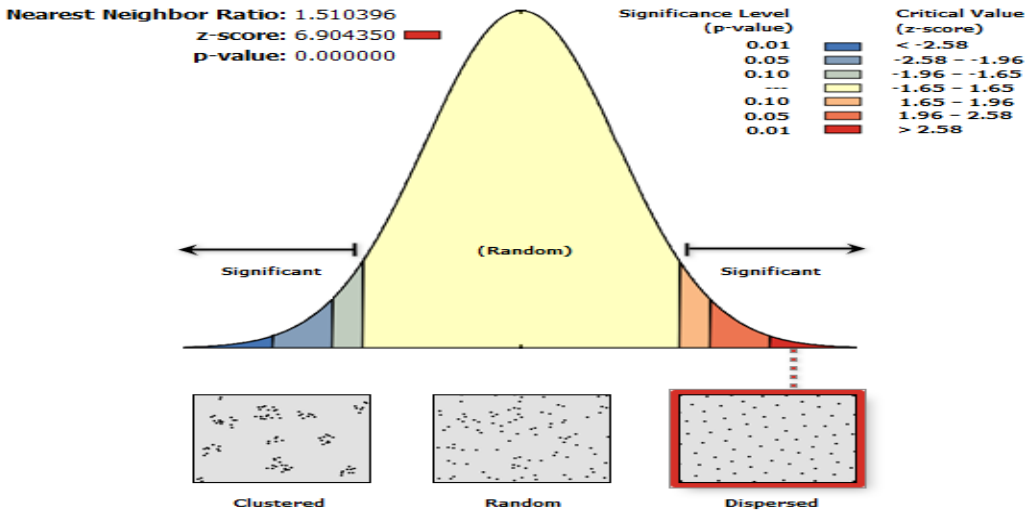


Figure 3: Average Nearest Neighbor Statistical Result

Given the z-score of 6.90434970651, there is a less than 1% likelihood that this dispersed pattern could be the result of random chance.

Average Nearest Neighbor Summary
Observed Mean Distance: 731.2139 Meters
Expected Mean Distance: 484.1208 Meters
Nearest Neighbor Ratio: 1.510396
z-score: 6.904350

p-value: 0.000000

Hotspot analysis

Locations with major crime hotspots were situated at North-Eastern part of the study area. The result as depicted from figure 4 below showed that all the hotspot detected was situated at residential area and as well tertiary institution of learning area. Figure 2 and Table 1 present the cases of crime committed and number of arrest made.

Distance Analysis

Results obtained from the Average Nearest Neighbour analysis revealed the crime cases pattern is exhibiting a dispersed pattern with 1.51 ($p<0.01$). The z-score for Apete crime cases within the district is 6.90 ($p<0.000$). The nearest neighbor ratio of 1.51 is determined from the ratio of observed mean distance to the expected mean distance (Figure 3).

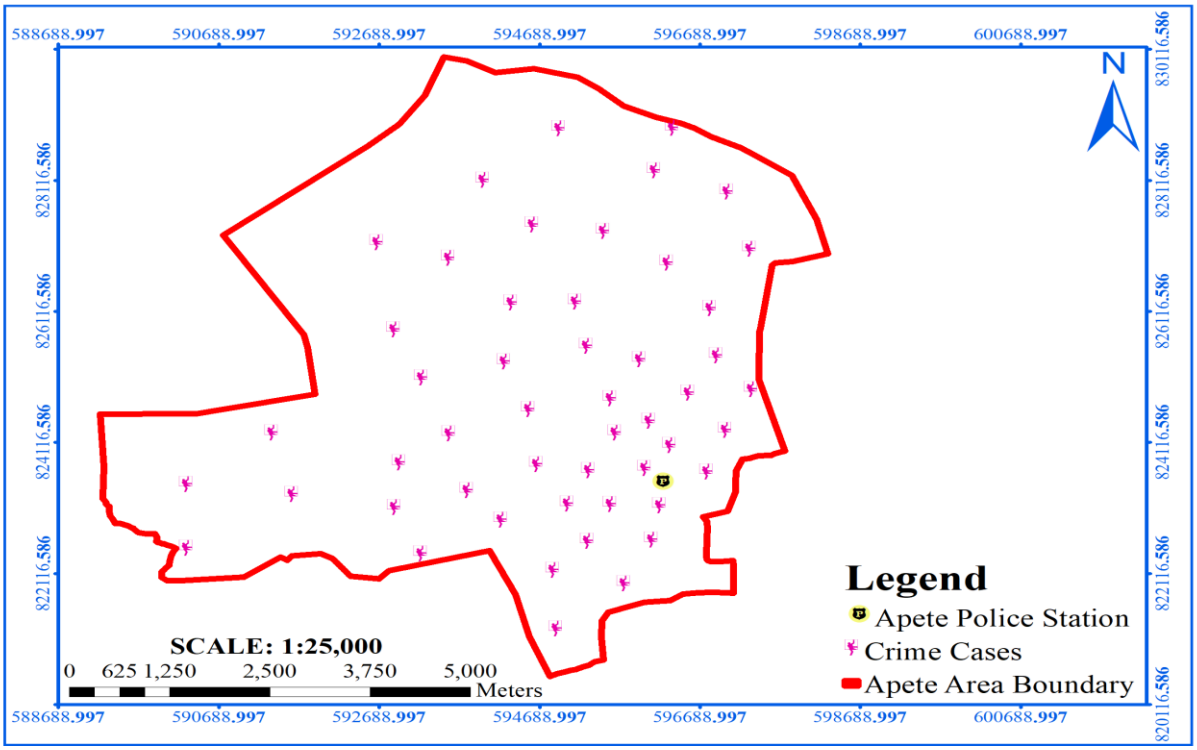


Figure 4: Crime Case Location Map

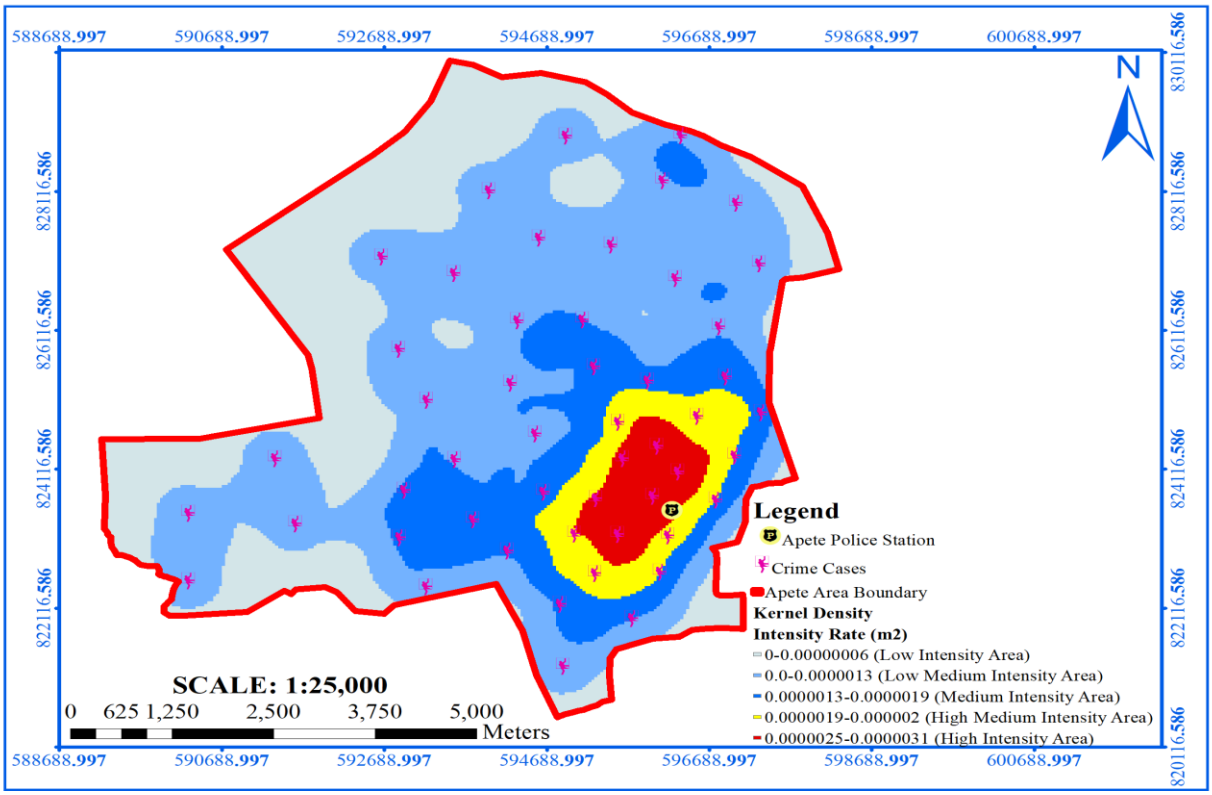


Figure 5: Kernel heat Map of area under Apete Police Station between (2022 and 2023) cases

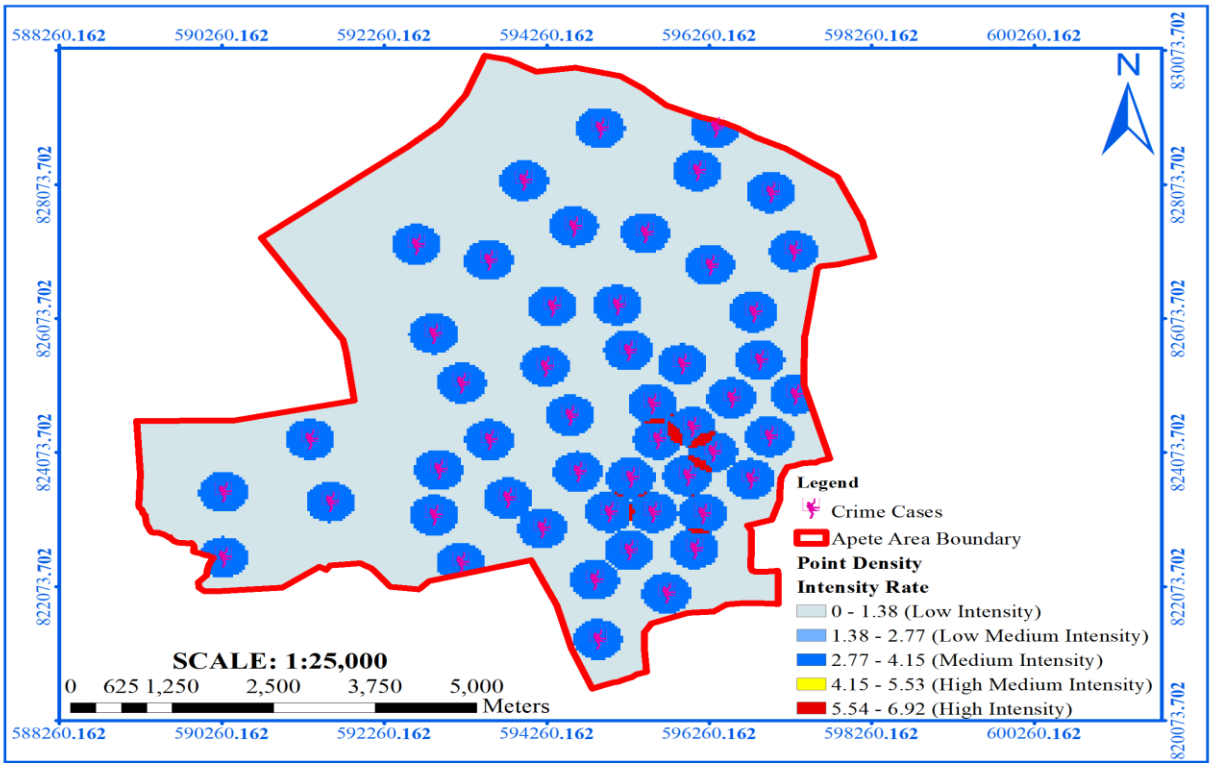


Figure 6: Point Density Map of the study between (2022 and 2023) cases

Kernel density estimation (KDE) was used to map the density of crime cases within the study area. Moreover, the map was used to identifies hotspots area and most and least intensity areas as the result will help the local security and other law enforcement agent to assist the community and the inhabitants in order to minimize the occurrence of different crime cases in the study area (Figure 5). However, the red colour indicates area with high crime intensity blue colour indicates the medium intensity area and sky blue colour indicates the low intensity area (Figure 5).

The area with high, high medium and medium intensities is as a result that the environment is a student area in which the boundary to the aforementioned intensity areas boundary with an higher institution of learning (The Polytechnic, Ibadan, Nigeria). With only one Police station in a populated community like that of the study area, there will be threat to life and properties of inhabitant.

Pont density from this study (Figure 6) revealed the intensity per unit area from the crime cases that falls within the neighborhood around each cell. The essence of Figure 6 above is to reveal the best way to visualize and interpret the crime cases distribution patterns in the study area. However, the high intensity crime area ranges from 5.54 to 6.92 (red colour) and low intensity from 0-1.38 (sky blue colour).

Table 3: Correlations coefficient Matrix

Variables	Yr Crime Commited	Time Crime Commited	Time Crime Reported	No Per Crime Commited	No. of Arrest
Year Crime Commited	1				
Time Crime Commited	-.078	1			
Time Crime Reported	-.089	.104	1		
No. Per Crime Comm.	-.143	-.341*	-.228	1	
Number of Arrest	-.226	-.330*	-.307*	.886**	1

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

Pearson correlation was used to assess the correlation between some variables. This was done at 2 tailed at significant level 0.05 (95% confidence interval) and 0.01 significant level (99% confidence interval).
The result from the correlation coefficient showed that, the number of crime committed correlate with the time crime committed at -0.341 but with negative significant relationship at 0.05 significant level (95% confidence interval) and as well the number of arrest has relationship with time crime committed at -0.330, time crime reported at -0.307 with negative correlation at 0.05 significant level (95% confidence interval) and as well with number per crime committed at 0.886 which shows strong and positive correlation at 0.01 significant level (99% confidence interval) (Table 3).

Conclusion

This study has used GIS and spatial statistical tools to analysed crime cases in Apete community, Ido Local Government Area, Oyo State, Nigeria. The findings from this study showed that internet fraud have the highest crime cases followed by stealing and cybercrime both in 2022 and 2023 and are based on crime committed and number of arrest made. And this can be attributed to the student population in the study area. Moreso, through statistical tool from Average Nearest Neighbor, it revealed dispersed in the crime patterns. However, the findings on intensity of crime revealed high to low intensity and the result of correlation analysis revealed significant relationship between number of crime committed and time crime committed, number of arrest with time crime committed, time crime reported and number per crime committed. It can be concluded from the study that the crime hotspots in the study area are not cluster but dispersed in pattern and study showed that geographic and temporal analyses is of great importance in the crime mapping.

References

Adeolu, A. (2019) Locational Analysis of Police Station and Crime Spot in Ikeja Lagos Nigeria. Researchers World, 10, 23-32. https://doi.org/10.18843/rwjasc/v10i2/04

Adzande, P., Gyuse, T.T. and Atser, J. (2018) Correlates of Crime in Urban Makur di, Nigeria. African Journal of Built Environment Research, 2, 21-40

Ahmadi, M. (2003) Crime Mapping and Spatial Analysis. Thesis, University of Twente, Enschede.

Aov, K.F., Okon, I., Njoku, C.G., Thaddeus, K.A., Iorkua, S.A., Olorundami, T. and Lekam, I.J. (2017) Spatial Analysis of Crime Incidents in Makurdi Metropolis, Benue State, Nigeria. The 58th Association of Nigerian Geographers Annual Conference, Keffi, 12-17 March 2017, 79-83.

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, 17-29.

Nazmfar, H., Alavi, S., Feizizadeh, B. and Mostafavi, M.A. (2020) Analysis of Spatial Distribution of Crimes in Urban Public Spaces. Journal of Urban Planning and De velopment, 146, Article ID: 5020006. https://doi.org/10.1061/(ASCE)UP.1943-5444.0000549

Ocholi, I.U., Abuh, P.O., Samuel, A. and Musa, A. (2023). Spatial Pattern and Distribution of Crime in Suleja Lga, Niger State, Nigeria. Journal of Geographic Information System, 15, 379-390. https://doi.org/10.4236/jgis.2023.154019

Okon, I.E., Agorye, A.O. and Aov, K.F. (2021) Mapping the Incidences of Crime in Makurdi Metropolis, Benue State, North-Central Nigeria. Open Access Library Jour nal, 8, e6577. https://doi.org/10.4236/oalib.1106577

Olajuyigbe, A.E., Adegboyega, S.A.-A. and Adenigba, A.D. (2015) Spatial Analysis of Factors Responsible for Spread of Crime Activities in Akure, Nigeria Using GIS. International Journal of Criminology and Sociological Theory, 8, 1-19. https://doi.org/10.5539/jsd.v8n6p311

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, 21-38.

Wen TH, Lin NH, Chao DY, Hwang KP, Kan CC, Lin KCM et al. (2002). Spatial-temporal patterns of dengue in areas at risk of dengue hemorrhagic fever in Kaohsiung, Taiwan. Int J Infect Dis. 2010; 14(4):334-43.