

Geospatial Assessment of Crime and Security in Ido Local Government Area, Oyo State, SouthWest Nigeria

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Abstract: Utilization of Information Technology is required in public safety management in the cities and their suburb such as the present Ido area, Ido local government Ibadan. Geographic Information System (GIS) is an important tool that can be used to locate crime area, and thus allow police to proactively respond to the situations before constituting a problem. This research investigates crime and security in Ido Local Government Area of Oyo State, Southwest Nigeria with the aim of mapping and assessing the area prone to crime, leading causes. The methodology adopted in this research was field surveying methods with the use of Hi-target differential GPS to acquire the spatial coordinate (x, y, z) of crime hotspots/locations and police stations in the study area. The local government consists of five areas namely; Omi-Adio with seven (7) communities, Ologuneru with eight (8) communities, Ido with thirteen (13) communities, Apete with fifteen (15) communities and Apata division with eleven (11) communities. The data acquired through field surveying measurement with the Hi-target differential GPS was processed with Hi-target Geomatics Office (HGO) and Global Navigation Satellite System (GNSS) application software in order to acquire the spatial location x, y, z data of the crime hotspots and police stations. Proximity of police stations to crime hotspots was calculated to know how each of the crime hotspot was distant to the police station. Further processing was done with the use of Quick Bird satellite imagery, ArcGIS 10.2.1 (Arcmap 10.2.1) GIS application software in analyzing the location of crime and also identification of crime patterns. The result from the crime data obtained from the field measurement and police was presented in form of charts and map/plan. Generally from the research, it can be concluded that the major crime types common in the study area. Therefore, the security issues in Ido local government has been dealt with but still requires more attentions by the government and the law enforcement agencies.

Keywords: Geographic Information System (GIS), Crime Hotspots, Police Proximity

1. Introduction

Crime can be defined as a culpable disposition of an individual or group as entrenched in the constitution of a state. It is an act of commission or omission with legal criminal implication for which punishment must be served by an individual or group found culpable by a competent court of jurisdiction. Crime is an unlawful act that is punishable by the state law or other statutes. It is an act done by person/group of people which is against the law of a state, country or region. Crime mapping is the use of

Geographic Information System (GIS) to visualize and organize spatial data for more formal statistical analysis. Spatial analysis can be employed in both an exploratory and well as a more confirmatory manner with the primary purpose of identifying how certain community or ecological factors (such as population characteristics or the built environment) influence the spatial patterns of crime. Crime mapping can also be used to visualize and analyze the movement or target selection patterns of criminals. GIS

helps crime officers determine potential crime sites by examining complex seemingly unrelated criteria and displaying them all in a graphical, layered, spatial interface or map. The location of a crime is an important attribute feature, and is included along with law, offender, and target as a dimension of a criminal event [1]. Crime is a 'deviant behaviour that violates prevailing norms, which may be cultural, social, political, psychological and economic conditions' [2]. [3] cited by [4], described crime as a deviant act that is threatening moral behaviours and injurious to society. Moral decadence afflicts the personality of individual, his property and lessens trust among members of the society which may result to threat and fear. Crime as violation of 'property rights' where the focus was prioritized on crime against property [5]. This will not give a comprehensive understanding on crime; hence there are many other areas where crimes are committed. Crime as an act that violates the law of the society or serious offence against the law of the society for which there is a severe punishment by law as expressed by [2]. Many researchers classified crime into violent and property crimes [5-7, 4, 8-13]. This classification is on the basis of entity on which crime is committed. Violent crime as a criminal activity that is clearly an act of brute force engaged in taking of property or a person's life [4]. Similarly Dambazau [10] in his explanation on violent crime said that it is an act of forcible taking of property from a victim and may cause injury or loss of life. Violent crime is the most 'inhumane' crime that continues to plague the societies that have taken the centre stage leading to bloodshed and economic setbacks as noted by [8].

Unemployment and economic hardship have pushed

many 'jobless youths, some of whom are graduates, into various deadly crimes' as opined by [8]. Unemployment is the main causes for 'eruption and escalation of crimes in urban areas across the breadth of Nigeria' as found by [14]. Unemployment is closely linked to crime no matter the region of the World. He also argued that urban crimes are influenced by poverty, unstable jobs, the high cost of living and financial difficulties, limited educational opportunities, inadequate health and sanitation, and inadequate housing as posits by [13]. Unemployment, poverty, poor governance and lack of policy initiatives and implementation to some extent encouraged criminal groups to thrive and appear to be the root cause of urban crimes as believed by [8]. Therefore, urbanization does not have an exclusive hold on urban crime causes but, [13] concludes that it does increase the opportunities to be exposed to criminal activities. Therefore, this study aimed at mapping the crime hotspots and determining police station proximity to crime each crime area in Ido local government area, Oyo State, Southwest, Nigeria.

2. The Study Area

The study area is Ido local government area, Oyo State, Southwest Nigeria. The local government consists of five divisional area with communities under them. The total population of Ido local government according to the 2006 population census was 103,261 [15]. It lies between longitude 3°47'34.99"E and latitude 7°30' 44.49" N. Table 1 described the division areas and place under the study location

Table 1. Places under the five divisions in the study area are the following.

S/No.	Omi-Adio	Ologuneru	Ido	Apete	Apata
1	Aba Teacher	Ajadi	Alako	Adaba	BCJ
2	Abidogun	Alafara	Dada	Arokoto	Bode-Igbo
3	Bakatari	Gbopa	Esaru 1	Awotan	Command
4	Eleso	Olonde	Gbingbin	Fanawole 2	Dogo
5	Gate	Adetokun	Idi-Amu	Fanawole 1	Fatimoh
6	Omi	Elenusonso	Ido	Jeje	Gada/Odo-Ona
7	Oke Oloro	Akatapa	Koguo	Oju Oja 1	Idi-Iroko
8	-	Temidayo	Idiuroko	Oju Oja 2	Ile-Epo Apata
9	-	-	Iloka	Oju Oja 3	Owode 1
10	-	-	Tade	Trailer Park	Owode 2
11	-	-	Iletuntun	Arola	Wire & Cable
12	-	-	Ode Imu	Yidi	-
13	-	-	Idiiko	Akodu	-
14	-	-	-	Ariyibi	-
15	-	-	-	Okeodan	-

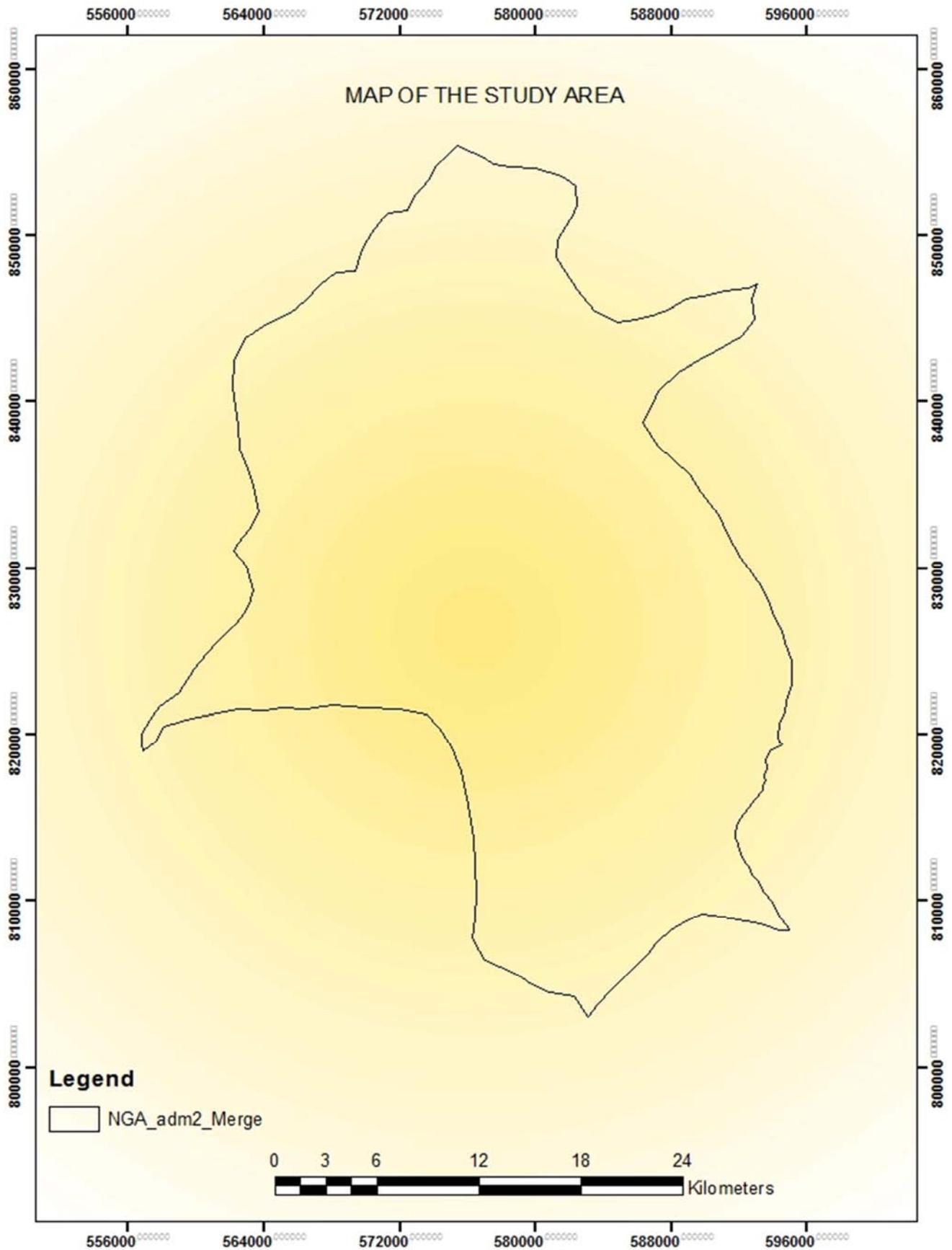


Figure 1. Digitized Map of the Study Area.

3. Material and Methods

For the purpose of this research, the main source of data was adopted from field observations through surveying method as primary data. The primary data source was based on the use of Hi-target differential Global Positioning System to acquire the (x, y, z) coordinates of crime hotspots for mapping purposes. Secondly, the secondary data source was adopted from the x, y, z, coordinate collected from the Oyo State Secretariat Agodi Ibadan, Journals, Books, Conference paper presentation and the information of number of police officers/staff from the police divisional headquarter in the study area.

3.1. Equipment Used

3.1.1. Hardware

- i. Hi-target Differential Global Positioning System with its accessories (Model V30 GT)
- ii. Handheld Global Positioning System (78s) for ground tuiting
- iii. Laptop computer (Dell Version)
- iv. Hp laserjet printer (2015 version)
- v. Safety boot (5 pairs)
- vi. Raincoat/water proof jacket (5)

3.1.2. Software

- i. Quickbird satellite image
- ii. ArcGIS 10.2.1 (Arcmap 10.2.1)
- iii. Microsoft word office 2007
- iv. Microsoft Excel 2007

3.2. Method/Procedures of Data Acquisition

3.2.1. Procedures of Acquiring Data for Crime Hotspots

Hi-target differential GPS which comprises of two GPS (one at control station called base station and the other one on all point to determine called the rover station) was used to acquire the coordinate x, y, z of crime hotspots in the study area. The mode of operation used in acquiring the data was static mode whereby the differential GPS on the base station acquire a single data and continue to refine it to the maximum accuracy while the other GPS which serve as rover

in all crime hotspots to be determined was given a time interval of five (5) minutes to acquire (x, y, z) data for all the hotspots in the study area. The field observation commenced from a known control point at Eleyele hill with control number (ICS 147 P) (table 2). One of the GPS was set on the control point which serves as base station and the other one was used as a rover on all crime hotspots. The spatial locations of the five police division areas were also acquired using the same method (table 3). Table 4 showed number of staff per police station.



Figure 2. Data Acquisition on Control Point (base point) at Eleyele Hill.



Figure 3. Data Acquisition on crime area.

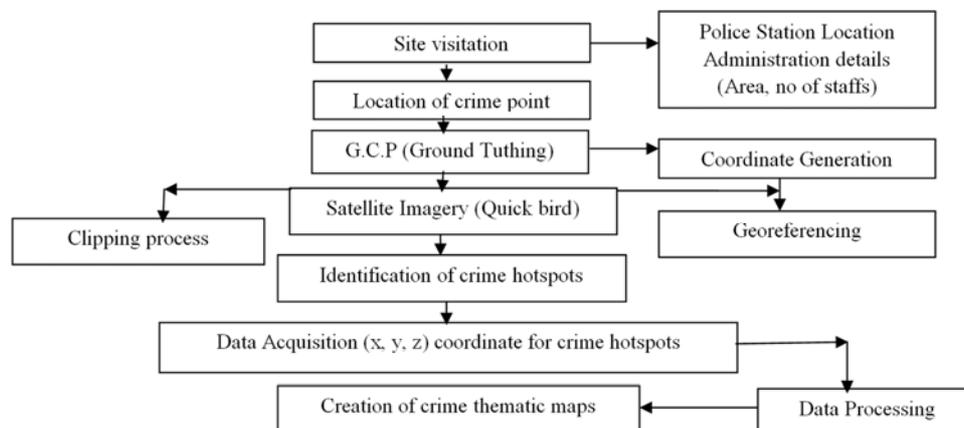


Figure 4. Methodology workflow/framework for the research.

Table 2. Coordinate of control point collected from Oyo State Secretariat.

Control Point	Easting (m)	Northing (m)	Height (m)
ICP 147 P	594068.598	820087.878	257.921

Data processing

The data acquired with the Hi-target differential GPS was downloaded into the computer. Hi-target Geomatics Office (HGO) and Global Navigation Satellite System (GNSS) application software was used to process the data x, y, z acquired from the field (see figures 5-7 for processing detail

for the result of the processed data). The processed data x, y, z were presented from (table 5). Distance from each police division area to the crime hotspots was calculated to know how far each of the crime hotspots is distant to the police station (table 6).

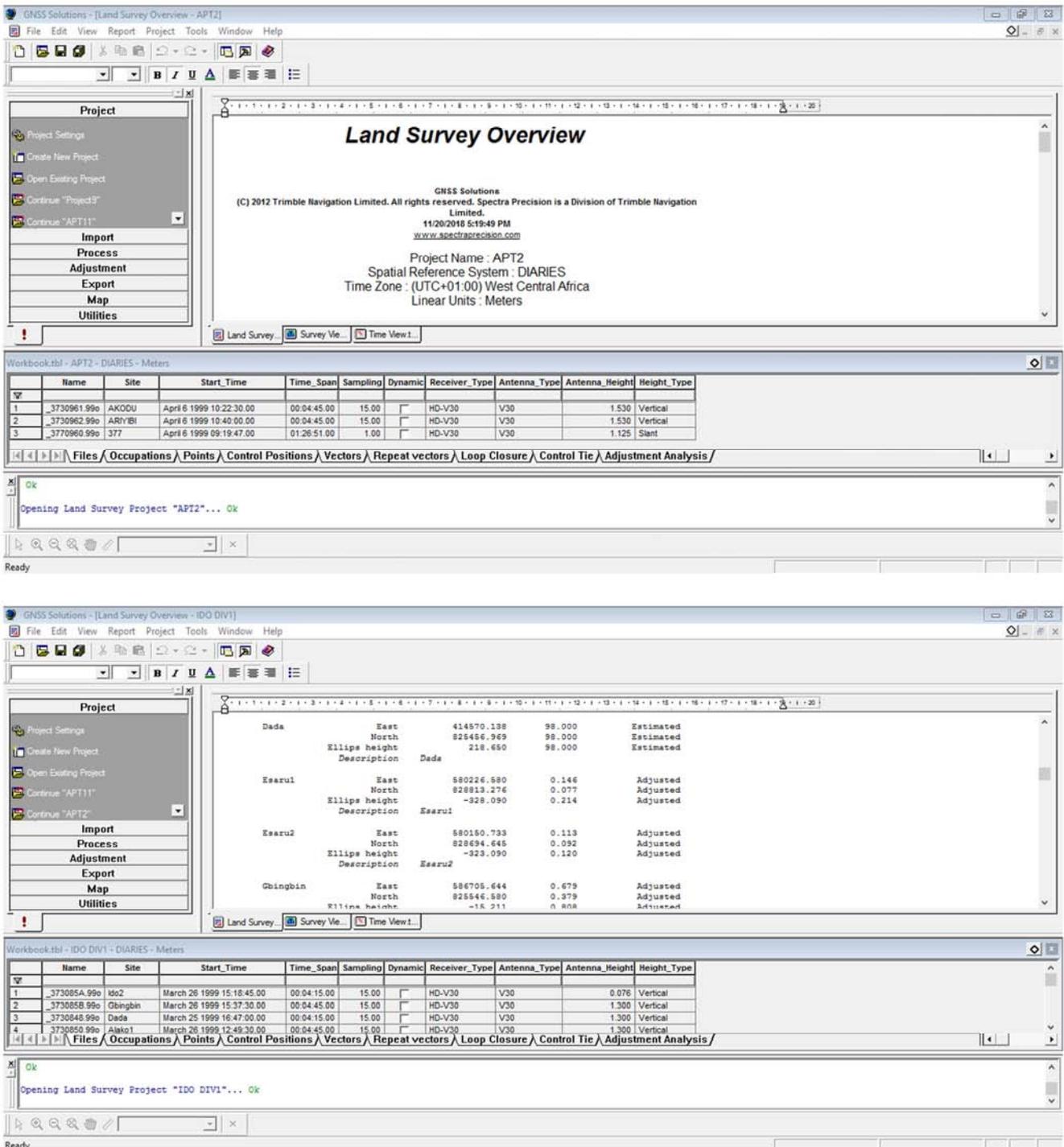


Figure 5. GNSS data under process for the x, y, z.

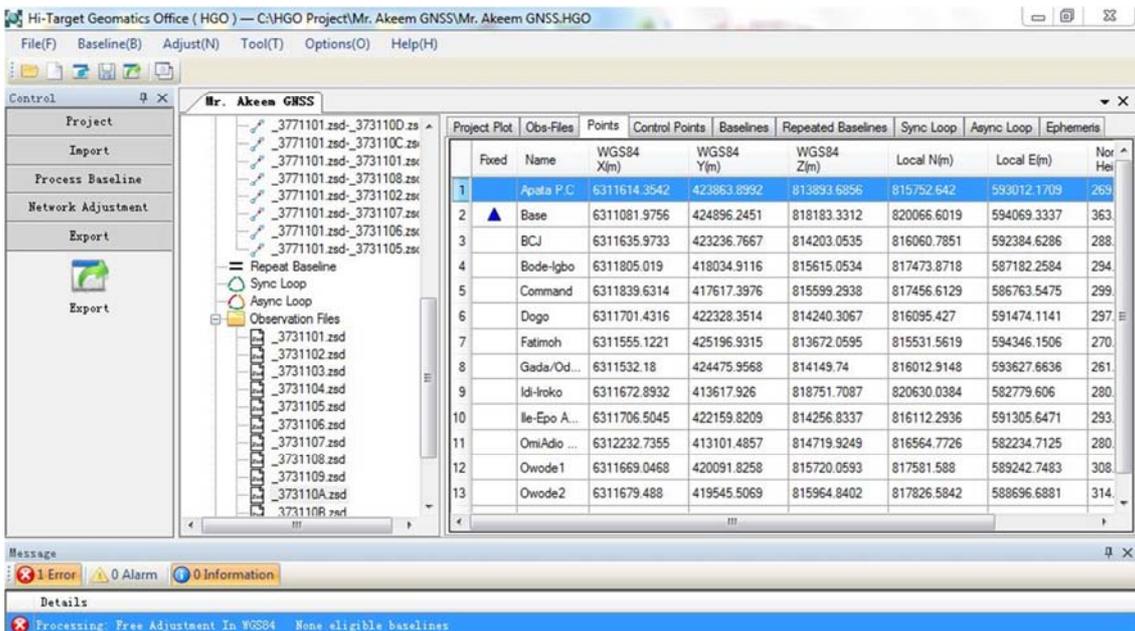
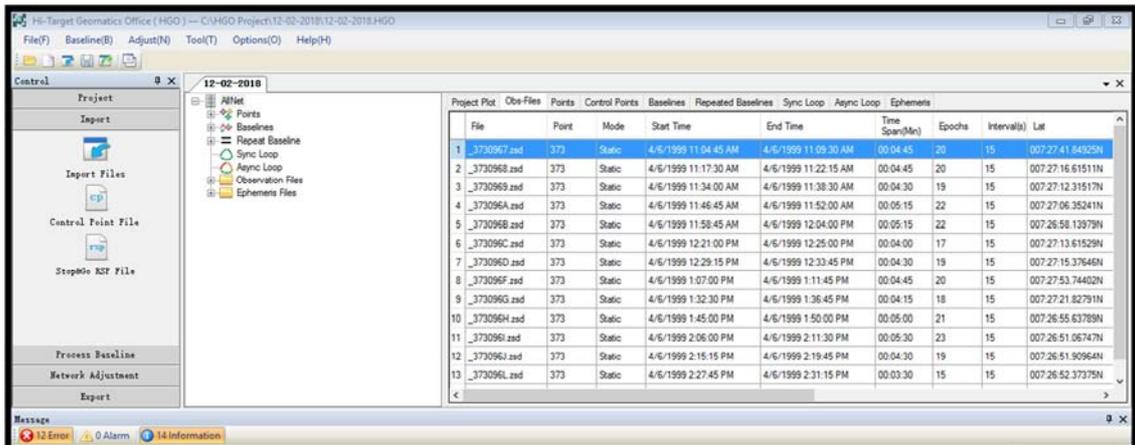


Figure 6. Showing HGO data processing for the x, y, z.

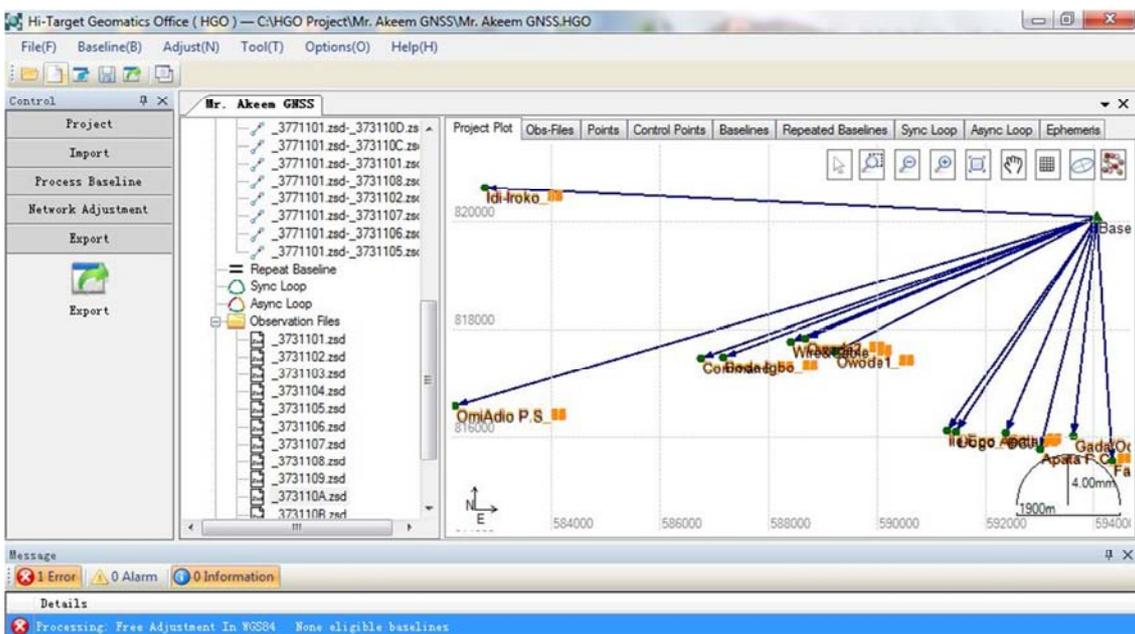


Figure 7. Showing HGO data processing showing crime locations.

Table 3. Number of police officer present in each of the five division area.

Location	Male	Female	Total
Omi-Adio	40	28	68
Ologuneru	6	4	10
Ido	47	23	70
Apete	30	23	53
Apata	40	15	65
Total	163	93	266

The Source of the table 3 above is from Oyo State Police Command and the information was collected in November, 2018.

Table 4. Processed coordinates x, y, z of the police station.

Police Station Location	Easting (m)	Northing (m)	Height (m)
Omi-Adio Police Station	582234.713	816564.773	280.904
Ologuneru Police Station	591685.710	821872.890	217.233
Ido Police Station	584111.510	825947.850	212.089
Apete Police Station	596236.120	823526.710	185.466
Apata Police Division	593012.171	815752.642	269.053

Table 5. Processed data (x, y, z) coordinates of crime hotspots in five Division areas.

Location	Easting (m)	Northing (m)	Height (m)
Omi-Adio Division			
Aba Teacher	582267.188	816565.680	240.101
Abidogun 1	582895.511	817017.921	183.965
Bakatari 1	577118.612	817240.636	397.64
Eleso	578497.342	817376.080	338.871
Gate	582642.469	817092.339	223.597
Omi	582681.321	817003.459	194.829
Oke Oloro	583113.182	816817.829	215.652
Ologuneru Division			
Ajadi	592343.515	821368.325	162.219
Alafara	591341.963	820721.985	111.434
Gbopa	590457.805	822606.910	111.479
Olonde	590971.621	823301.405	137.727
Adetokun	592978.551	820507.383	172.053
Temidayo	579883.140	829049.200	156.345
Akatapa	589758.237	826827.444	180.225
Elenusonso	591256.575	822144.706	122.564
Ido Division			
Alako	575800.594	832637.066	483.389
Dada	583057.103	823279.392	134.076
Esaru	580226.558	828813.276	328.09
Gbingbin	586705.644	825546.580	15.211
Idi-Amu	577254.284	830998.218	485.333
Idi-roko	582779.606	820630.038	280.022
Ido	583373.904	825699.938	106.372
Koguo	579619.457	829773.699	335.205
Ile Titun	583116.066	828718.336	298.560
Idiiko	577770.811	821769.041	215.269
Tade	580988.151	822271.750	308.117
Ode Imu	575609.185	824493.946	255.416
Iloka	577783.488	827963.578	200.055
Apete Division			
Adaba	593915.448	824161.877	199.225
Arokoto	595271.379	823969.821	264.853
Awotan	595170.340	823366.951	242.113
Fanawole 2	596459.322	823703.878	269.459
Fanawole 1	596222.883	823886.849	262.927
Jeje	595376.538	823914.256	263.92
Oju Oja 1	596634.688	823236.537	267.64
Oju Oja 2	596573.916	823266.439	265.368
Oju Oja 3	596753.991	823278.970	268.017

Location	Easting (m)	Northing (m)	Height (m)
Trailer Park	593175.697	825137.709	172.077
Arola	596487.271	824023.054	268.124
Yidi	596164.684	824799.794	267.178
Akodu	595423.965	825524.314	264.595
Ariyibi	595195.186	825481.432	249.491
Oke Odan	595212.620	826625.440	242.003
Apata Division			
BCJ	592384.629	816060.785	288.536
Bode-Igbo	587182.258	817473.872	294.281
Command	586763.548	817456.613	299.148
Dogo	591474.114	816095.427	297.870
Fatimoh	594346.151	815531.562	270.721
Gada/Odo-Ona	593627.664	816012.915	261.344
Ile-Epo Apata	591305.647	816112.294	293.855
Owode 1	589242.748	817581.588	308.413
Owode 2	588696.688	817826.584	314.295
Wire&Cable	588420.990	817770.302	313.781

Table 6. Distance/proximity of Police Station to Crime Area.

Police Station	Crime location hotspots	Distance from Police Station to crime area in km
Omi	Aba Teacher	0.18
	Abidogun	0.82
	Bakatari	5.06
	Eleso	3.71
	Gate	0.63
	Omi	0.62
	Oke Oloro	0.91
	Ajadi	0.88
	Alafara	1.31
	Gbopa	1.41
Ologuneru	Olonde	1.53
	Adetokun	1.93
	Akatapa	0.54
	Elenusonso	0.51
	Temidayo	3.89
	Adaba	2.41
	Arokoto	1.06
	Awotan	1.07
	Fanawole 2	0.37
	Fanawole 1	0.29
Apete	Jeje	0.94
	Oju Oja 1	0.49
	Oju Oja 2	0.42
	Oju Oja 3	0.57
	Trailer Park	3.46
	Arola	1.75
	Yidi	1.39
	Akodu	2.14
	Ariyibi	2.31
	Okeodan	3.29
Ido	Alako	10.68
	Dada	2.87
	Esaru	4.84
	Gbingbin	2.61
	Idi-Amu	8.53
	Ido	0.79
	Koguo	5.91
	Idi-Iroko	5.48
	Ile-titun	2.93
	Idiiko	7.60
Tade	4.83	
Ode Inu	8.64	
Iloka	6.65	

4. Results, Analysis and Discussion

The result presented in figures 8-19 was as a result of field observations on crime hotspots and police station locations

through the field observations by surveying method. The result showed generalized map of crime hotspots and police station, the individual area showing communities where crime occurred in the study area.

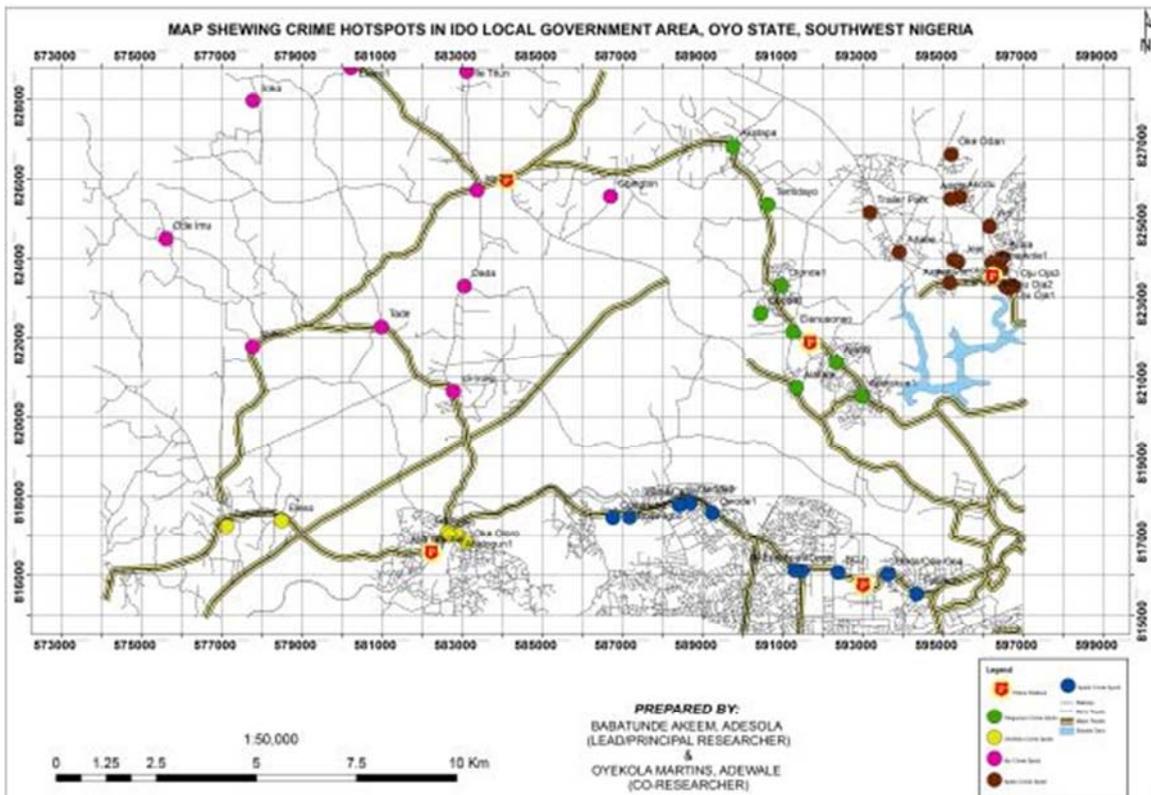


Figure 8. Generalized map showing Crime Hotspots in Ido Local Government Area, Oyo State.

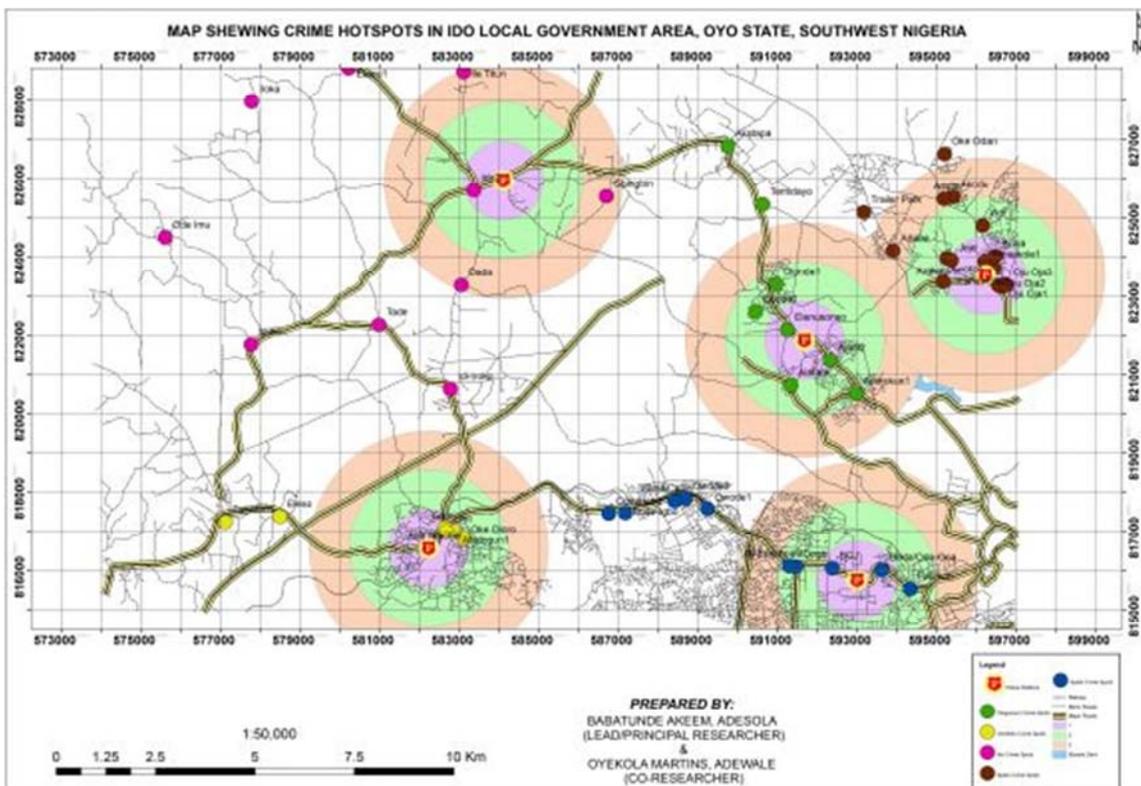


Figure 9. Generalized Map showing 1km, 2km, 3km Buffering in Ido Local Government Area.

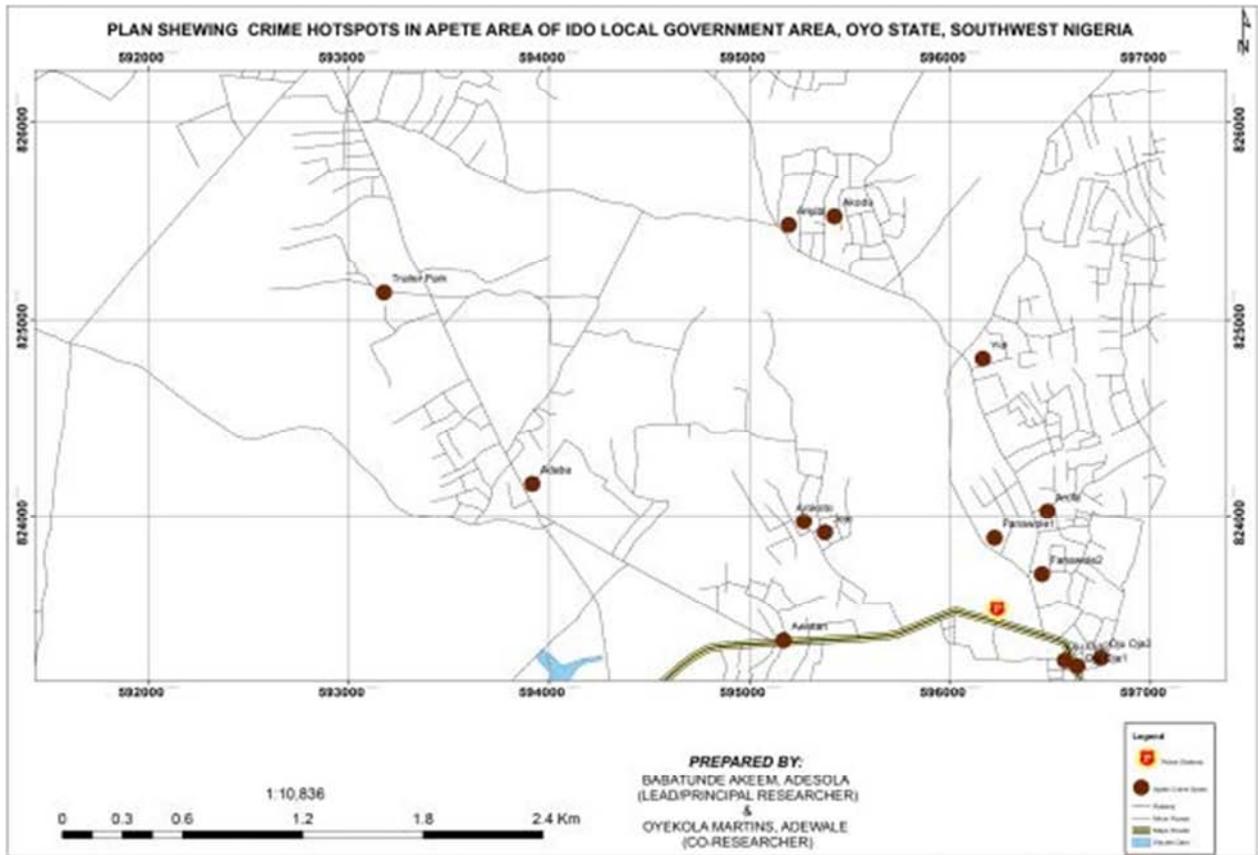


Figure 10. Map showing Crime Hotspots in Apete Area in Ido Local Government Area.

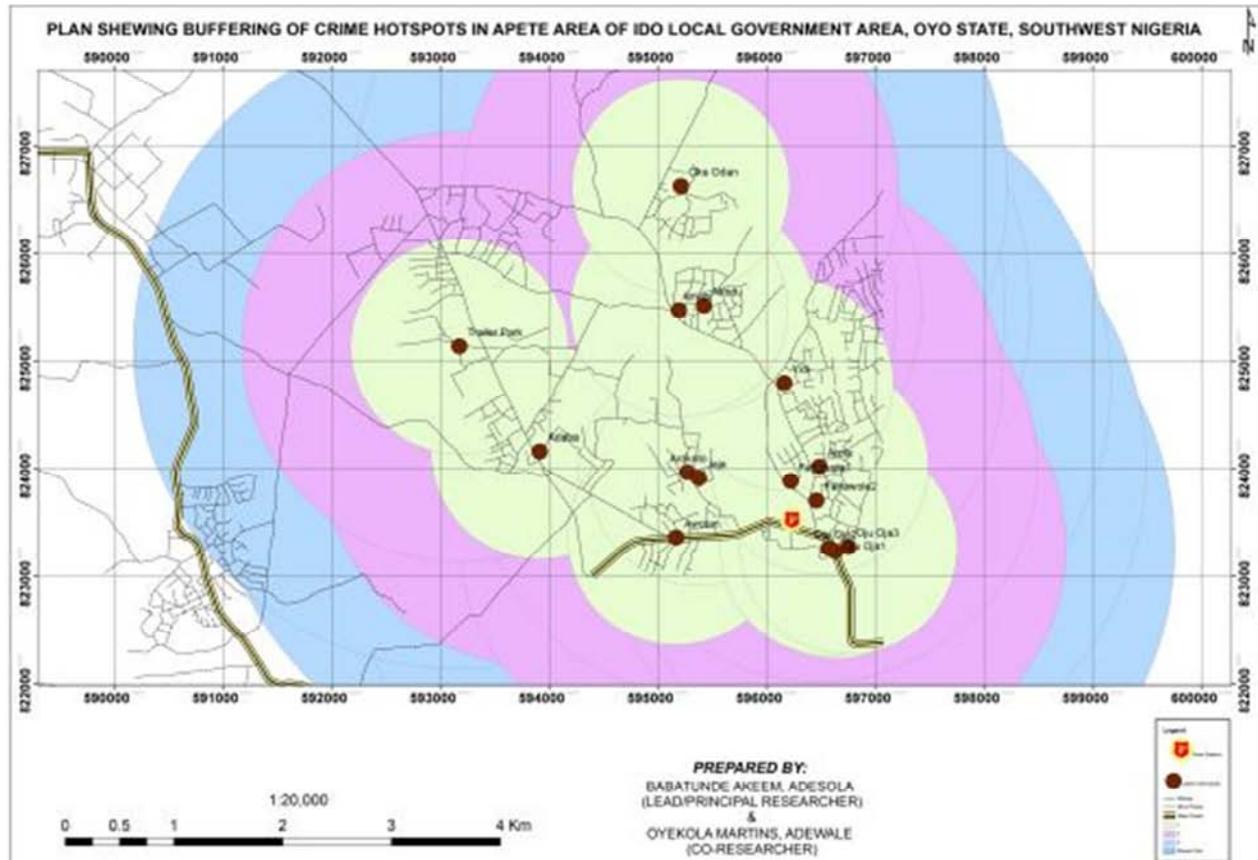


Figure 11. Map showing 1km, 2km, 3km Buffering in Apete in Ido Local Government Area.

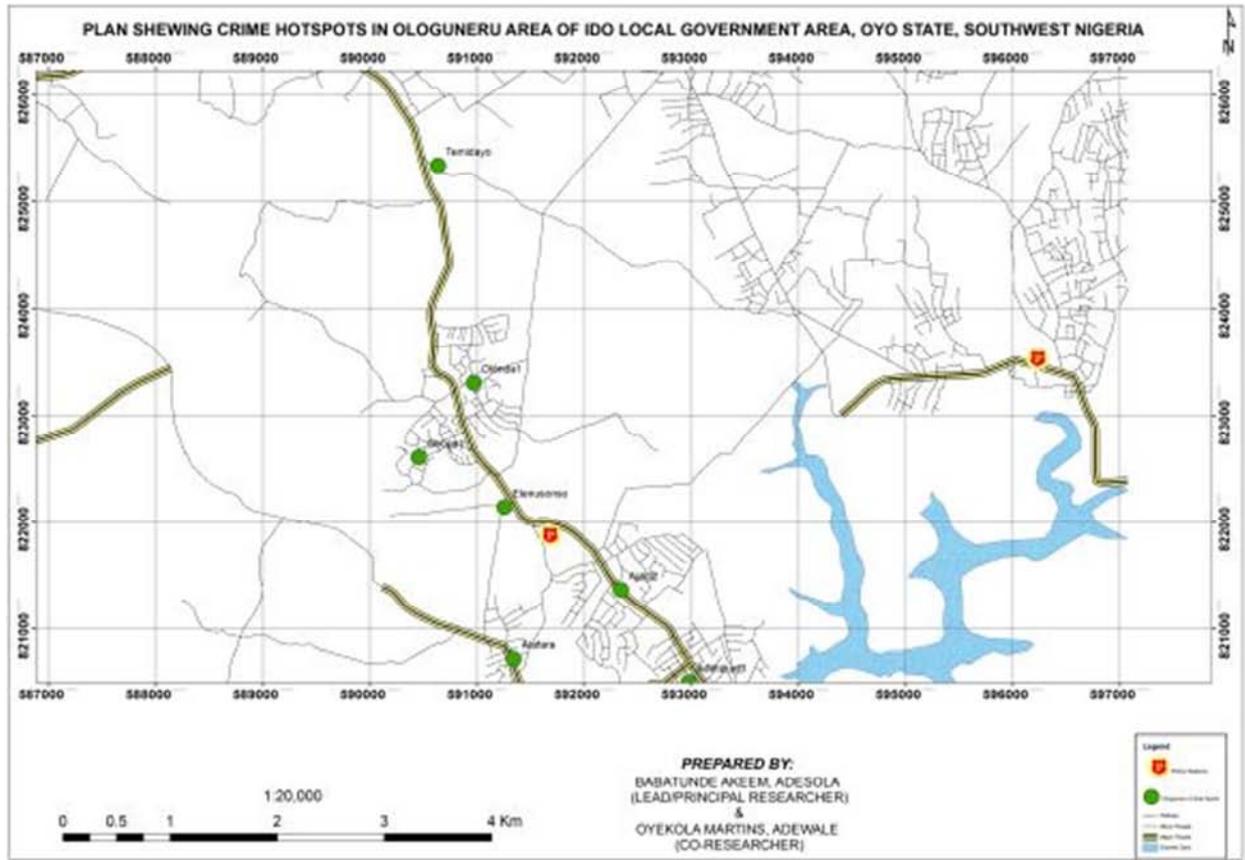


Figure 14. Map showing Crime Hotspots in Ologuneru Area in Ido Local Government Area.

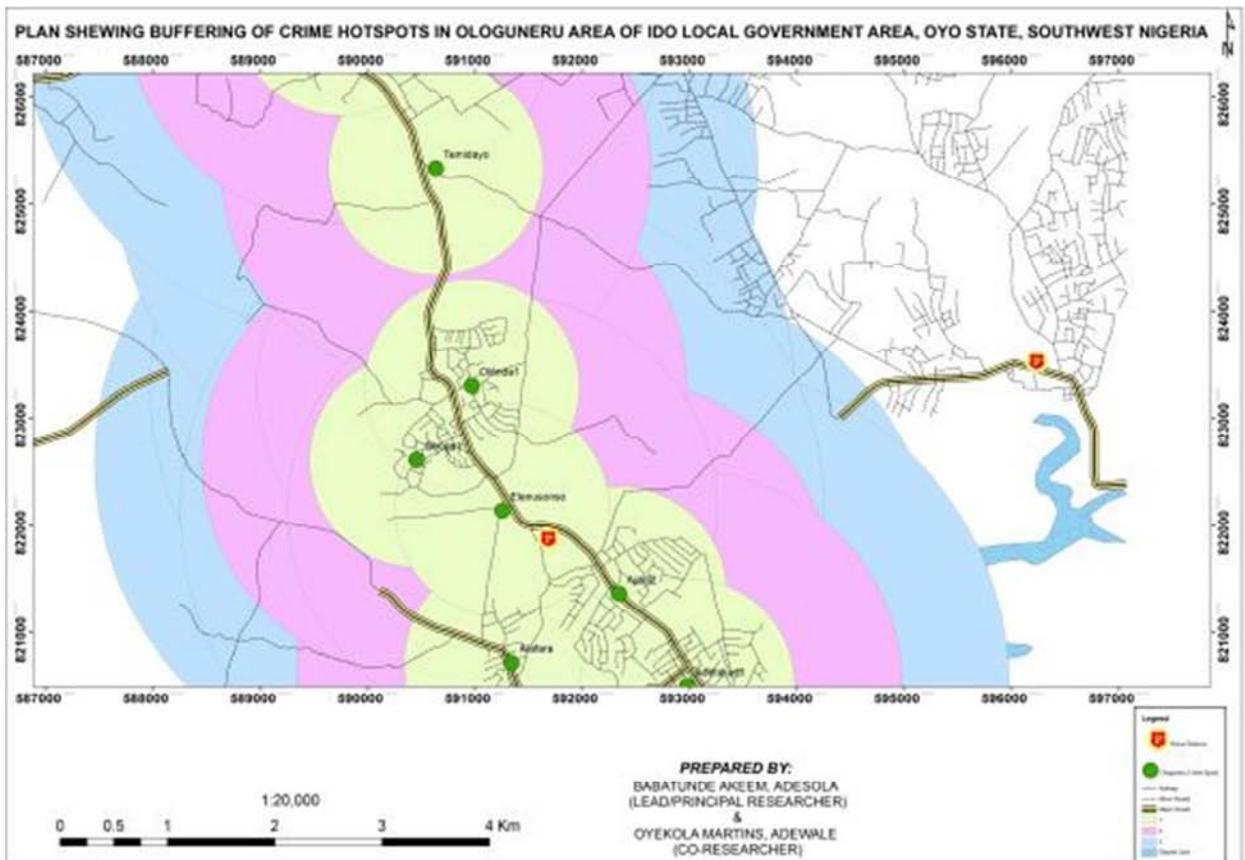


Figure 15. Map showing 1km, 2km, 3km Buffering in Ologuneru area in Ido Local Government.

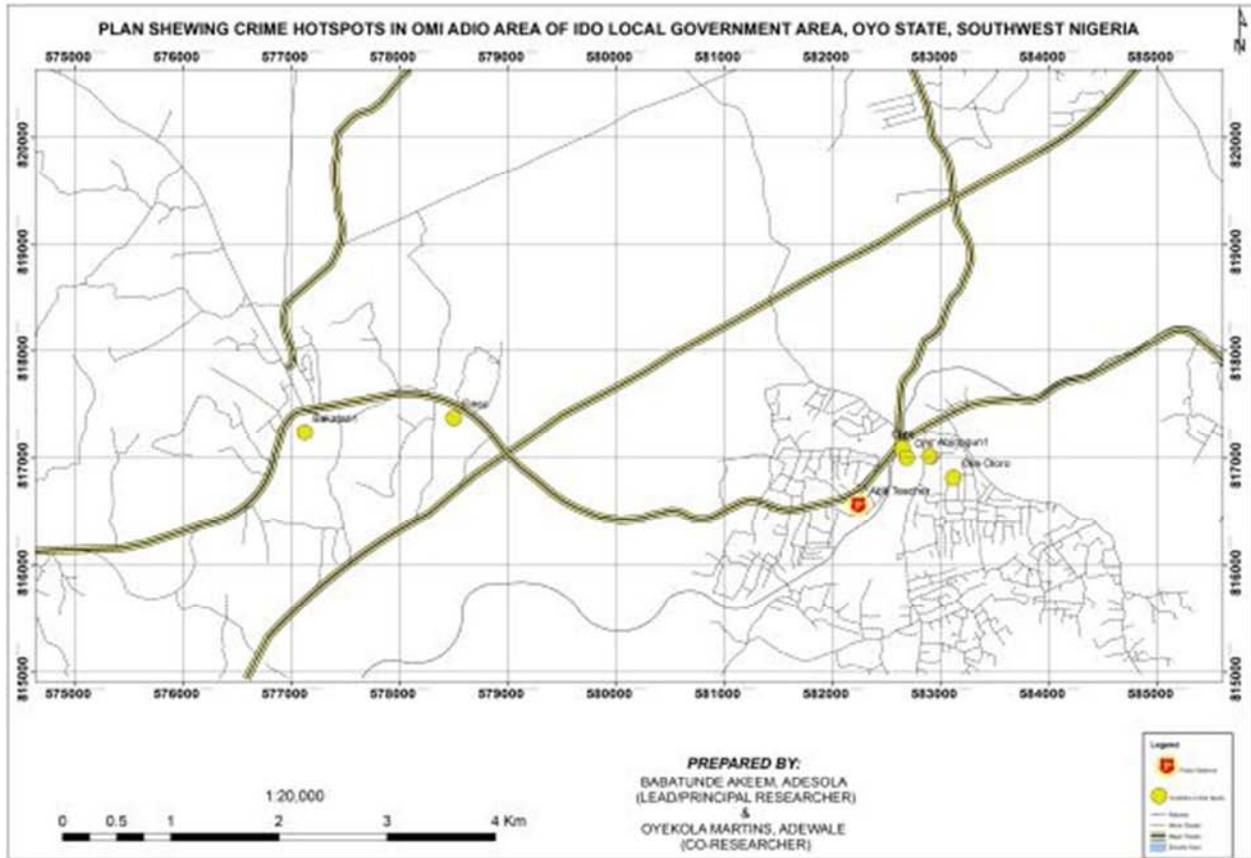


Figure 16. Map showing Crime Hotspots in Omi-Adio Area in Ido Local Government Area.

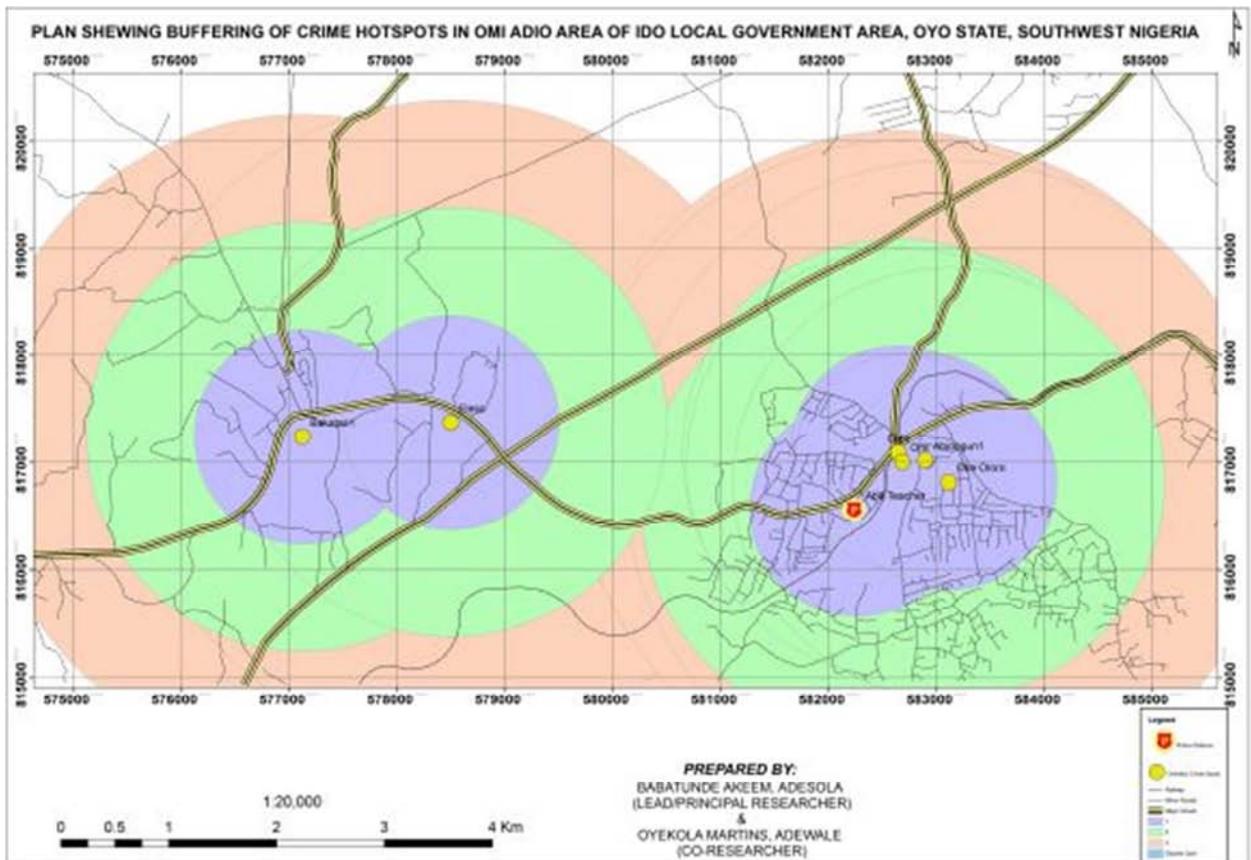


Figure 17. Map showing 1km, 2km 3km Buffering in Omi-Adio area in Ido Local Government.

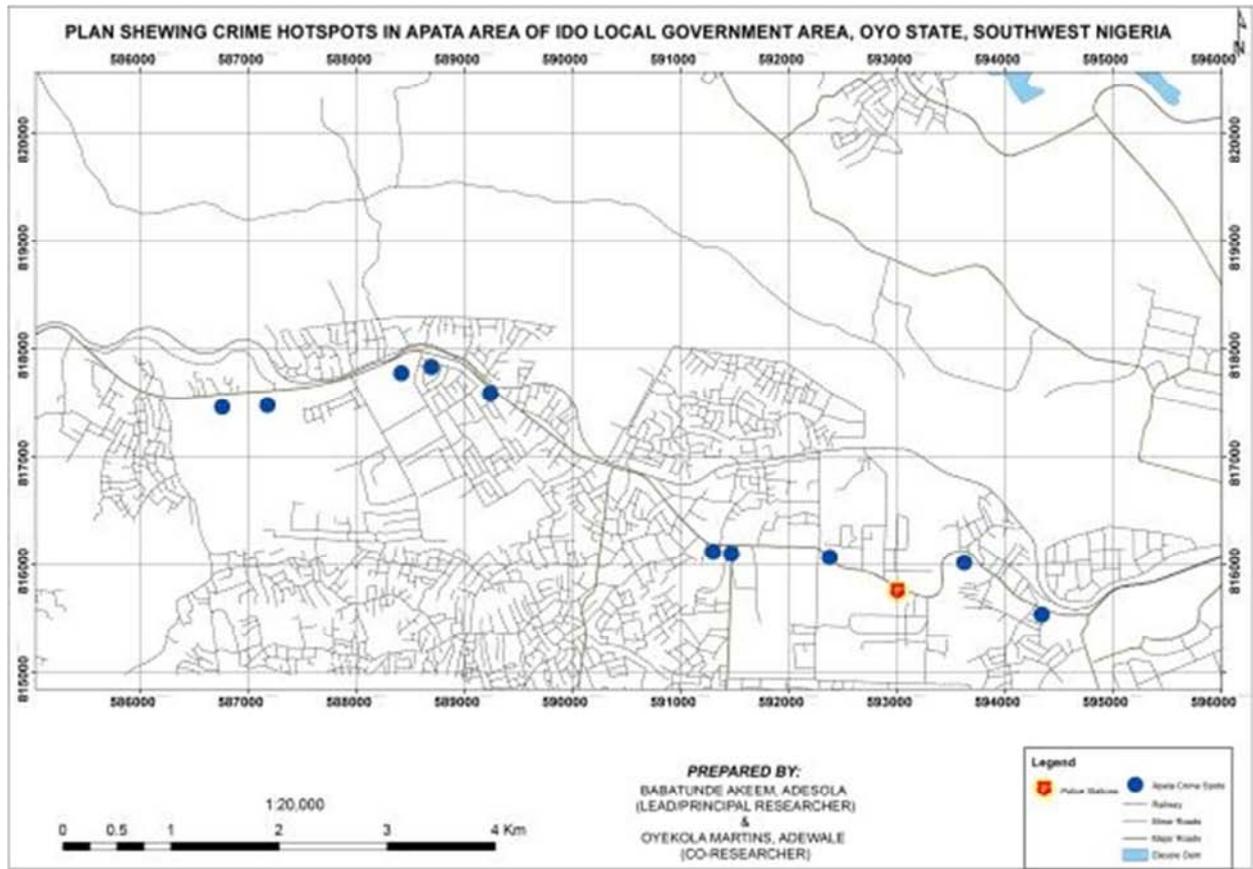


Figure 18. Map showing Crime Hotspots in Apata Area in Ido Local Government Area.

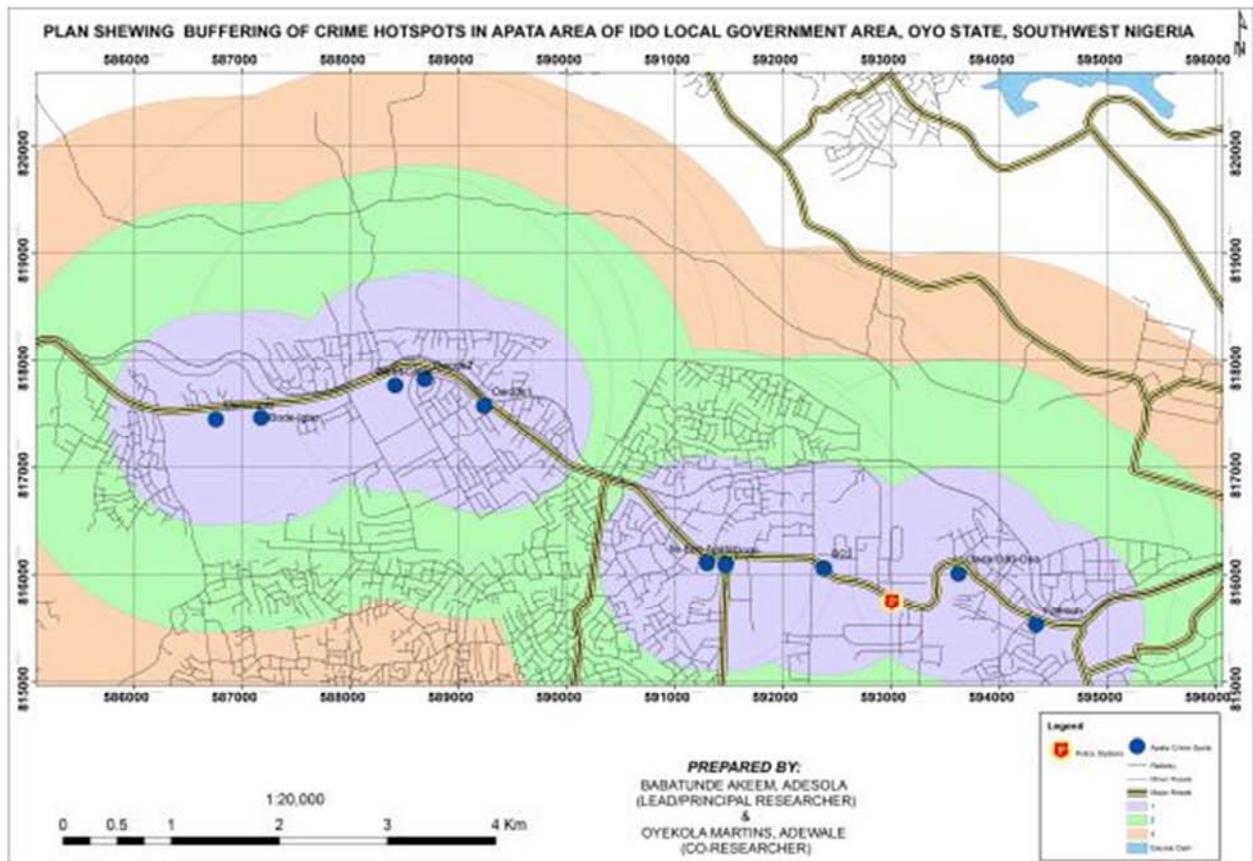


Figure 19. Map showing 1km, 2km, 3km Buffering in Apata area in Ido Local Government Area.

Figure 8 showed all the major crime hotspots in the study area and how closely they are to the police stations. Figures 10, 12, 14, 16 and 18 showed the individual area where crime hotspots exists from the five major area of the study area. From figures 9, 11, 13, 15, 17, 19 above, 1km, 2km and 3km buffering analysis was carried out which showed how close and far of the police station to the crime hotspots. In Apete area, it showed that area like trailer park (3.46km), Oke-Odan (3.29km) are the areas that are too far to the police station while others are close. In Ido area, area like Alako (10.68km) Esaru (4.84km), Idi-Amu (8.53km), Idi-Iroko (5.48km), Koguo (5.91km), Idiiko (7.60km), Tade (4.83km), Ode-Inu (8.64km), and Iloka (6.65km) are those areas that too far from the police while others in Ido area are close but not too close. In Ologuneru area, it showed that only in Temidayo community is very far to the police station while others are close and not too close. In Omi-Adio, area like Bakatari (5.06km), and Eleso (3.71km) are the area that are far from police station while others are close and not too close. Bode-Igbo (6.08km), Command (6.47km), Owode 1 (4.20km), Owode 2 (4.79km).

5. Conclusions

The use geospatial analysis has significance importance in reducing and preventing crime. Most of the police agencies nowadays adopted the use of geographical information system in crime investigations and analysis. The data used in this research is from five divisional police department, field data acquired through surveying methods in Ido local government area of Oyo State, Nigeria. From the finding of this study, the crime data obtained will be depicted on a spatial domain which may be use to show the correlation between each type of crime committed within the five locations studied. Maps produced displayed the locations/hotspots where crimes occurred, and they can be used to help direct police patrols to the places where they are mostly needed. In crime assessment, it showed that there is no direct relationship between crime hotspots and distance to the police stations. Therefore, by increasing the number of police stations and number of police officers/patrol with available facilities required, it is possible to reduce crime rate in the affected areas as well as the study area as a whole. The methodological frame work and the results that was applied in this study presents investigation for crime mapping which have a very promising use in the existing scenario and provides an effective method to law enforcement agencies for crime detection and its prevention within the study area. Hence, the investigations and the results of this study may be used by the law enforcement agencies within the study area for future purposes so as to ensure public safety. Therefore, the security issues in the two areas and in Ido local government area of Oyo State in general requires more attentions by the government, community itself as well as the law enforcement agencies

6. Recommendations

- i. A system for recording crime data based on locations is recommended.
- ii. The use of CCTV and drone should be employed i.e. in monitoring area prone to crime. This will be more effect of cost less.
- iii. Community residents should be encouraged to participate in the overall security of their environment.
- iv. Police should make fund available as an incentives to those who are ready to vital information crime.
- v. Where distances are much, proximity should be enhanced. More police station should be established/created
- vi. Government should provide job/employment so that crime could be reduced.
- vii. Government should establish a vigilante group that will be helping the police in fighting crime. Also, more patrol vehicles should be given to the police within the study area.

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