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Gis Application in Spatial Analysis of Crime in a Developing Nation: A Case of Ogbomoso, Nigeria

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Abstract

Against the background of astronomical rise in crime rate, the increasing and dynamic sophistication in the strategies employed by criminals and the inability of the Nigerian Criminal Justice System to analyze this social malady with improve technology, the study explored the application of Geographic Information System in the spatial analysis of crime in Ogbomoso South Local Government Area. Within the context of residential densities, police crime records from 1999 to 2003 were analyzed. The geometric data were captured from the township map of the study area. Information from 240 questionnaire administered formed the supplementary data used as the socioeconomic attributes of respondents. The analyses were carried out using ArcView 3.2a and Statistical Package for Social Scientist (SSPS) packages. Spatial analyses such as spatial search, buffering and overlay were done. The study revealed that there is a marked variation in the distribution of crime between and within residential areas. Five hot spots of crime were identified. Further observation was made on areas that may not be sufficiently covered when there is a distress call due to inadequate number of police post or station which is a major security infrastructure that signifies the presence of Government Crime Control Personnel. With this observation the study suggests provision of more police post in areas that are not covered. The study posits that Nigeria Police Authority should be equipped with adequate training and technology in order to enhance a wholesome control of crime within the context of the world's dynamic technologies. This will be effective if other activities within the urban environment are coordinated in order to reduce criminal opportunities.

BACKGROUND INFORMATION TO THE STUDY

The phenomenal rise in crime rate despite all capricious efforts to stymie it constitutes a burning issue in the heart of the governments, researchers, public organizations, criminal justice system as well as the residents. This perhaps calls to mind a serious question- are there no adequate machineries for preventing, managing or controlling the incidence of crime? Perhaps the bodies responsible for maintaining law and order in Nigeria are handicapped or incapable of coping with the dynamic as well as sophisticated weapons and strategies employed by criminals. As Ige et al, (2009) rightly observed, "increasing population both

within cities and their surrounding areas without adequate planning to improve the living condition of the teeming masses and provide amenities and essential services has been associated with increased poverty and crime. While poverty is being addressed by different governmental initiatives and policies, control of crime continues to be demonstrated by occasional increase in the number of law enforcement personnel without proper understanding and analysis of where the various crimes occur with a view to providing the mechanism for controlling and managing them".

One of the sophisticated technologies employed in the analysis (Katamalundu, 2004) and management of crime in the advanced world is the use of Geographic Information Systems (GIS) in the generation of crime information and ultimately a decision support system. Unfortunately, in Africa, especially in Nigeria, the use of GIS as a tool for the police in crime control and management is very rare (Adejumobi et al, 2009). This is partly due to inadequate funding of police organization that makes procuring of GIS tools difficult and more importantly dearth of GIS experts in the police force in the less developed countries. Society is advancing in technology and the law enforcement agencies, like any other organization have to adapt to the new challenges of the environment they are in, and move with the trend or they will not be able to meet the demands of the society becomes obsolete and irrelevant (Ige, 2008). The correct use of Geographic Information System is a very critical success for optimum functioning of an organization, and in order to make better-informed decisions, to present crime information in geographic context there is a need to deploy GIS technologies in crime management in Nigeria. There exists a positive correlation between the quality of information and the quality of decision making (Paresi, 2000).

Until recent time most applications of GIS have been concentrated on studies like site selection, cadastral and infrastructure management rather than criminal investigations. The past studies include the work of Alamu and Ejiobih (2002), Kufoniyi (2002), Akintoye and Oguntimehin (2002). Crime analysis in the past has been through the use of hardcopy maps or analogue method. "Historically law enforcement agencies and other organizations used hardcopy pin maps to chart criminal activity; but these maps were static and difficult to maintain" (Stoe et al 2003). With advancement in computer technology leading to increasing development in quick and user friendly software, manual pin mapping has given way to computerized crime mapping in the developed parts of the world. This powerful technology enhances the capability of researchers and practitioners to discover problem areas and target scarce resources to such zones.

In the recent time, crime-related studies are taken a new dimension with the application of Geographic Information System (GIS). A GIS represents a collection of hardware and software for creating/inputting, managing, manipulating, displaying and analyzing spatial information (Chrisman, 1997). According to Murray et al (2001) GIS is seen as a particularly important tool with intrinsic characteristics for studying the occurrence of crime. One of the salient features of GIS is its relative ease of cartographic display of information. This offers a 'starter' analyst a wide range of facilities to efficiently produce self-explanatory and illustrative crime maps and visually display crime occurrence. A commonly used aspect of GIS for displaying the location of crime occurrence is popularly known as crime mapping (Alex and Kate, 2001). The use of GIS for mapping of crime allows an analyst to create custom displays focused on particular types of crime in specific areas so as to visually check for trends or patterns. GIS also provides integration and modeling framework for analyzing different components of crime activity although modeling oriented research targeted at identifying major relationships or patterns in criminal activity predate the mainstream use of GIS. It is argued that GIS might be able to

enhance, supplement and extend the quantitative techniques used in the past (Murray et al, 2001). Also, modeling approaches incorporated in or attached with GIS (developed outside the context of crime analysis) may be important in identifying probable patterns of criminal activity. GIS capabilities have been applied to crime research in various ways. For instance Murray et al (2001) explore the use of geographic information systems and spatial analytical approaches for examining crime occurrence in Brisbane, Australia. The study applies pattern detention and geo-statistical techniques in the study of incidence of crime.

Crime does not occur in vacuum but within a geographical space (Ige, 2015), and may indeed be pretty compounded by a wide ranging socio-economic and environmental determinants, summarized in urban residential patterns (Adigun, 2004). It is argued here that environments can encourage and/ or deter crime. The rate of occurrence of crime has a serious effect on the image of a city and the body responsible for security and safety of lives and properties in such city. The ability of the Nigerian Police Force at controlling criminal activities is a major concern to the generality of Nigeria. Perhaps the police are "handicapped" and in need of how best to address the issue, then a study of this nature will prove useful, much more that it is aimed at providing an insight into the existing situation: residents' socio-economic characteristics, the prevalent crime in their area and the methods of combating it. This will be a good basis upon which a modification of the currently employed strategies or others may be proposed. Considering the associated benefits in crime analysis using GIS technology a study of this nature will be a "plus" to efforts in this area especially in Nigeria.

The use of GIS techniques in analyzing crime data and presenting it in form of maps helps the police to understand the significance of where, when, and by whom crimes are committed. Determining the spatial variation in the distribution of crime using Police data will be enhanced by the strong facilities for mapping provided by GIS. Thus updating as well as querying of such data becomes relatively easier. This will then facilitate the deployment of human resources as well as evolvement of residential area-specific intervention in security programme by the police consequent upon the differential social, economic and environmental attributes of residents cum the occurrence of crime. The understanding of the complex interplay in social, economic, demographic and environmental factors inherent in urban residential quarters may assist the urban planner in the planning of towns with a strict consideration for security not just aesthetics.

Spatial variation in crime occurrence has been a topical issue in criminology and criminal justice research, especially in the area of generating early warning systems for preparedness against crime (Ige, 2015). It has been argued that, we can perhaps not find a city where there is no appreciable number of people who are frustrated, impoverished or dissatisfied and ready to vent off their grievances through organized criminality, individually or collectively Ayeni-Akeke (2001). Suffice to say then, that no city in Nigeria, Ogbomoso inclusive is totally rid of crime, though the level may differ. It has been substantiated that delinquencies (juveinile and adults) and violent acts increases as the city grows in population and expands in aerial extent (Herbert 1976). However, the concentration of research efforts on crime pattern in capital cities with unjustified neglect of local government areas, towns and/or lesser cities impedes the search for analytical explanations and effective strategies to eradicate crime in such places; hence this study. Besides this, if Ogbomoso South Local Government Area will ever have a full realization of the dividends of urbanization and perform its civic responsibilities to its urban and the rural hinterlands, crime incidence that threatens the psyche and wellbeing of residents should be addressed. Thus, within the context of residential densities, the study examined the

incidence, and mapped the spatial distribution of crime in Ogbomoso South Local Government Area between 1999 and 2003 using GIS technology. In order to provide insight on the subject, certain research questions were raised as yardsticks to achieve the purpose of the study. The questions include:

- What is the distribution of total crime cases recorded in Ogbomoso South Local Government Area between 1999 and 2003?
- Which locality and residential area has the greatest crime incidence within the period of study?
- What is the prevalent crime type in each locality?
- What are the socio-economic activities noticeable in each locality and/or residential area?
- To what extent are the activities identified above connected with incidence of crime recorded in the area?
- What are the socio-economic attributes of the residents in each residential area?

THE STUDY AREA

The study covers Ogbomoso South Local Government Area in Oyo State, Nigeria. The town is located between longitude 040 12' E and 040 17' E and latitude 080 8' N and 080 14' N of the globe. National population census of 1991 put the population figure of the Ogbomoso South Local Government Area to be 65,958 and the figure was projected in 2004 to 90,924 using 2.5 percent annual growth rate. The local government area is delineated into ten political wards. The study area has the features of the three generally recognizable residential densities i.e. low, medium and high density areas. The political ward delineation does not strictly follow residential area delineation. Some political wards are located completely in the high density residential area while others show the features of more than two residential areas. For the purpose of this research, the study area was delineated into residential densities (Figure 1). This was done, based on field observations using the criteria identified in the literature (Okewole 1977, Onerkerhoraye and Omuta 1985).

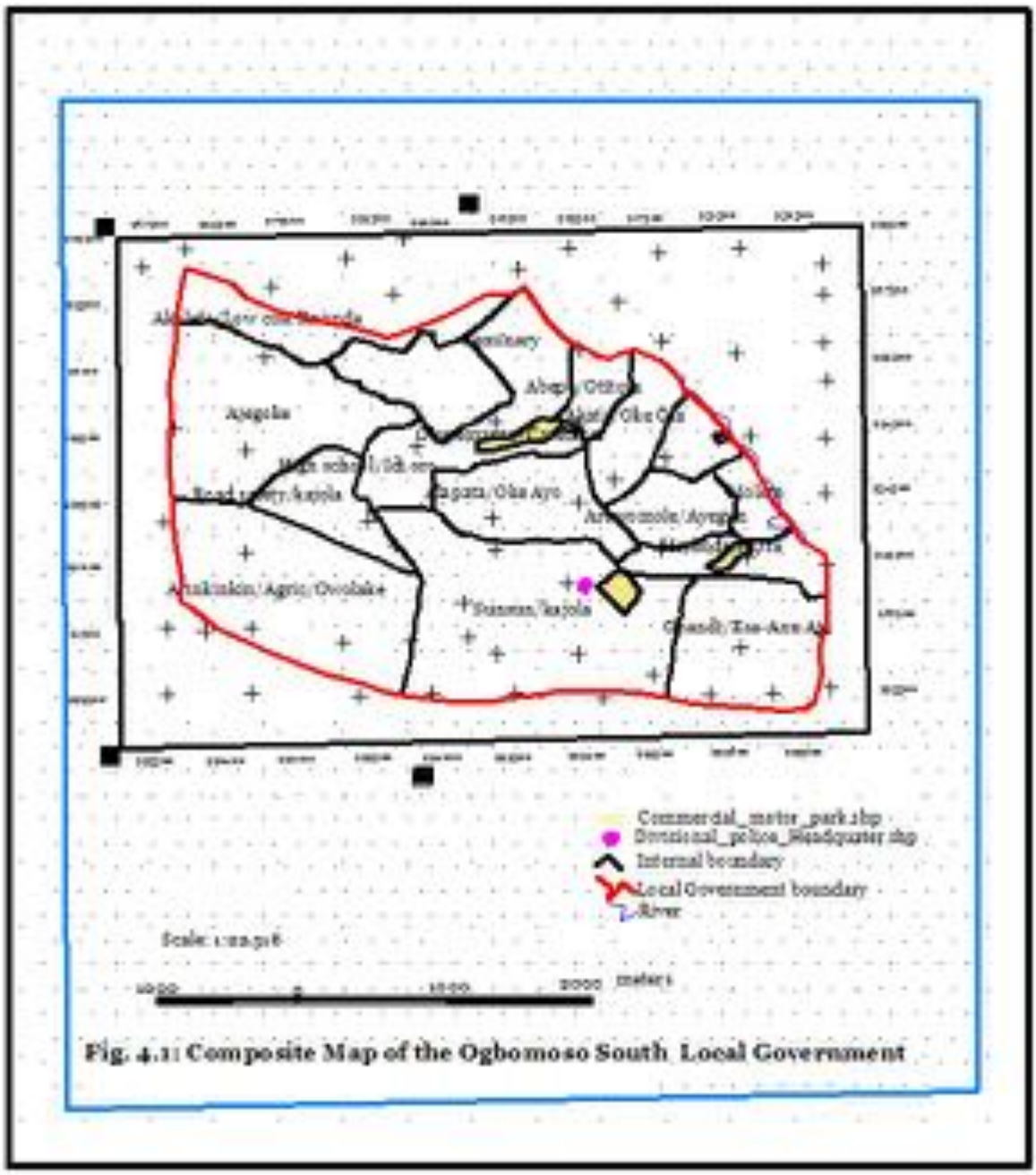


Fig. 4.1: Composite Map of the Ogbomoso South Local Government

METHODOLOGY

This section documents the method employed in carrying out this research. Included here among others is detailed information on data type, source and acquisition; view of reality, conceptual and logical models, physical design and database creation.

DATA TYPE, SOURCES AND ACQUISITION

Attribute Data, Source and Acquisition

The recorded crime data (from 2003 till 1999) used for the study were obtained from the Divisional Police Headquarter at Ogbomoso South Local Government Area. The selection of period of study was borne out of the fact that the period is significant in the history of Nigeria being the third political republic. The dynamic changes in the economic, social and other environmental factors which often accompany political epoch of any nation makes the city of Ogbomoso: a rapidly growing and fast expanding town a source of concern. It is then worth

verifying the occurrence of crime in Ogbomoso in view of these changes. It is also expected that this period of study will be sufficient in drawing a solid conclusion as well as present a definite picture of the spatial distribution of crime within the study area. Three wards were randomly chosen from the ten existing political wards in the local government area, so as to aid easy identification and delineation of various residential densities. A total of 240 questionnaires were purposively distributed based on density hierarchical selection model across three recognizable residential densities using a ratio of 3:2:1 for high, medium and low residential densities respectively.

The delineation of the residential densities was done, based on field observations using the criteria identified in the literature (Okewole 1977, Onerkerhoraye and Omuta 1986). Each residential area was delineated into localities in order to enhance logical comparison of crime zones within the context of residential area, and for good visual impression. In the chosen areas, the first building on each randomly selected street was sampled with subsequent units at interval of every fifth building. To cater for residents in landlocked portions of the high density residential areas (core areas) where buildings cannot be accessed by roads, buildings were selected at a uniform interval of every fourth building off the roads. One household was randomly selected from every selected dwelling unit, and one of all persons aged 18 years and above was purposively interviewed in each selected household.

Source and Acquisition of Geometric Data

The geometric data were captured by scanning and digitizing the township map of Ogbomoso South Local Government Area obtained from the Ogbomoso South Local Town Planning Authority. The scanned map was then geo-referenced for the purpose of obtaining the map layers required for geo-analytical exercises.

View of Reality

After a careful thought of the problems for which the system was required and identifying all entries that took up the spatial unit of interest, the following entities were identified as actual 'reality' i.e. as they exist in the study area. Roads were viewed as roads, locality as locality, local government boundary as local government boundary and police station as police station, residential densities as residential densities e.t.c.

Conceptual Data Modelling (Conceptual Design)

This is the human representation of the various views of reality in a simplified form. The entities identified were laid out and their inter-relationship mapped out by using the extended entity relationship (E-R) diagram. E-R diagram is a modelling technique in the framework of Relational Database Management System (RDMS). Figure 4 shows an example of conceptual design of a crime database using E-R diagram, based on a vector (topologic) data model. In the E-R diagram, rectangle represents entity and diamond represents relationship. Relationships are linked to their constituent entity types by arcs and the degree of relationship is indicated on the arc. It should however be noted that some of the attributes attached to Residential Area in the figure were entered and processed using SSPS 10.0 for Windows. These attributes include residents' income, level of education and occupational status.

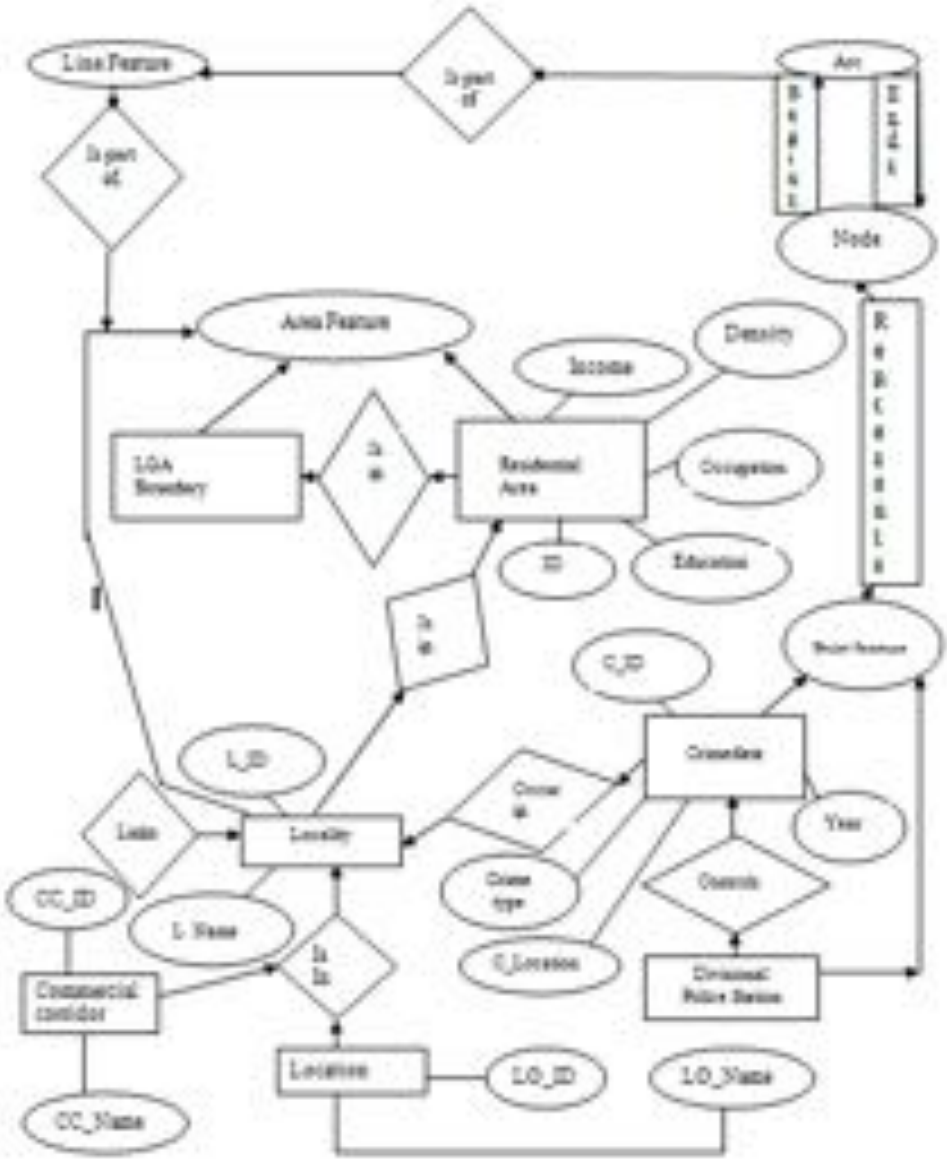


Fig 4: Entity- Relationship Diagram of this Study

Logical design

Here, the conceptual data model was transformed into a data structure (tabular and spatial) upon which the data base system was implemented. The relational data model was therefore used. A relational data model represents the data base as a collection of relations. The logical design stage was defined during physical design.

Physical Design

At this stage, the data structure shown in the logical design was presented in the language of the implementation software. The attribute tabular structured data generated in the logical design stage were actualized in the format of the implementation software. This includes definition of fields (numeric, text and string), record, length and type of record, e.t.c, and setting some integrity rules that must be obeyed before data are acceptable into the records. This aspect also includes the data preparation and actual population of the database software. The implementation software used for the project is ArcView 3.2a.

Database Creation

Following the design phase, the database was created and populated in ArcView 3.2a environment. Polygon, point, line and point themes were created in shape file format for residential area, location, roads and crimedata respectively. These formed individual relations which were then populated with their attribute values.

Collected Dataset and their Format

Feature	Spatial type	Format
Residential	polygon	shape file
Locality	point	shape file
Road	line	shape file
Crime data	point	shape file

SPATIAL ANALYSES, RESULTS AND PRODUCT GENERATION

The section presents the spatial analyses, results and the end product of this application. The major analyses employed in this application include spatial search, buffering, overlay and statistical computations

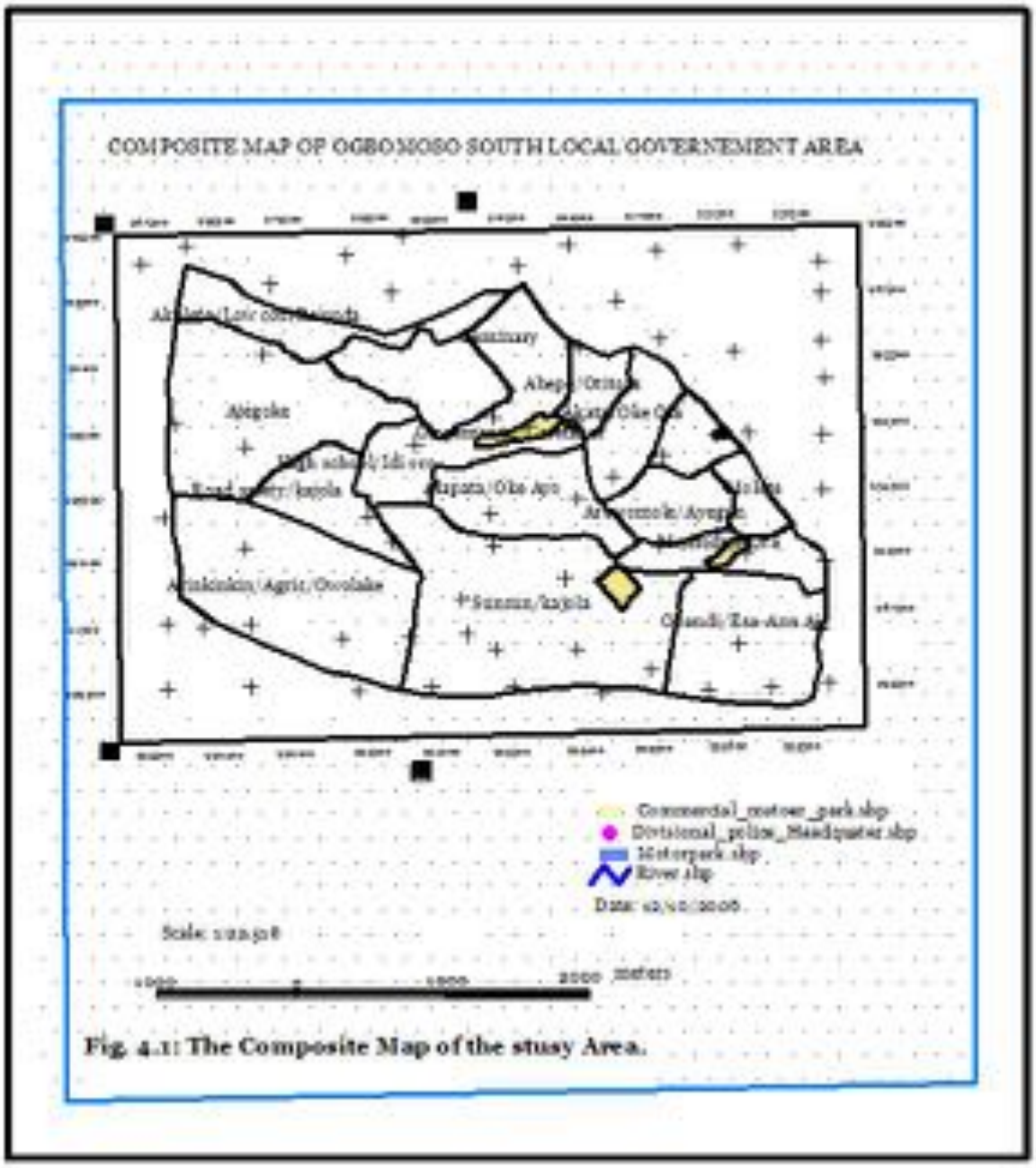


Figure 2: Composite Map of Ogbomoso South Local Government Area

SPATIAL SEARCH

The database developed was queried in order to deduce the spatial variation in the incidence of various crime categories in different localities. The two most prominent crime types (as revealed by the database created) were used for three localities. These are crime of acquisition and aggression. The queries issued to the database and the results are as follows.

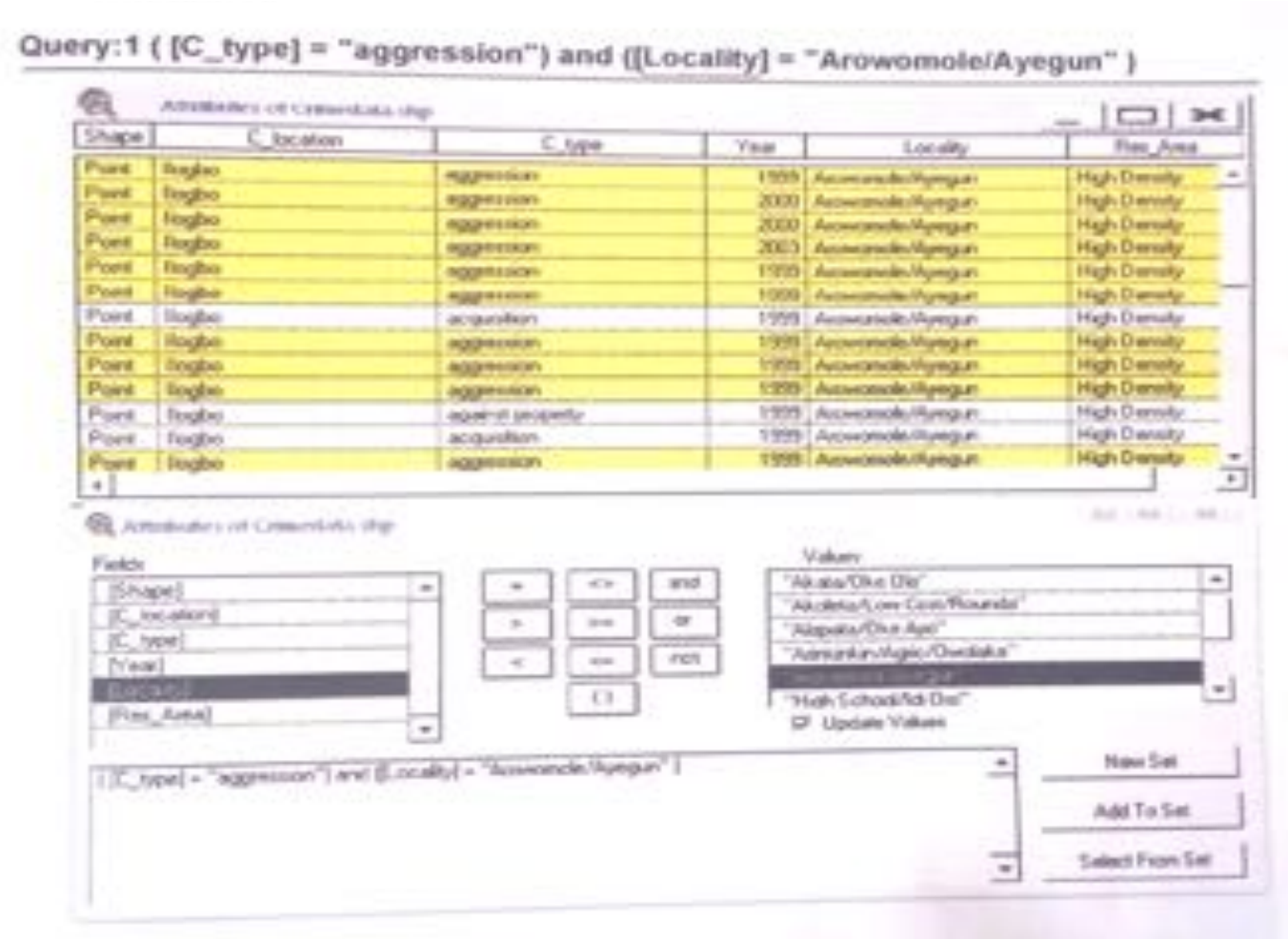


Figure 3:Query1:([C-type] = 'aggression') and ([Locality} = 'Arowomole/Ayegun'
Source: Author's, 2006.

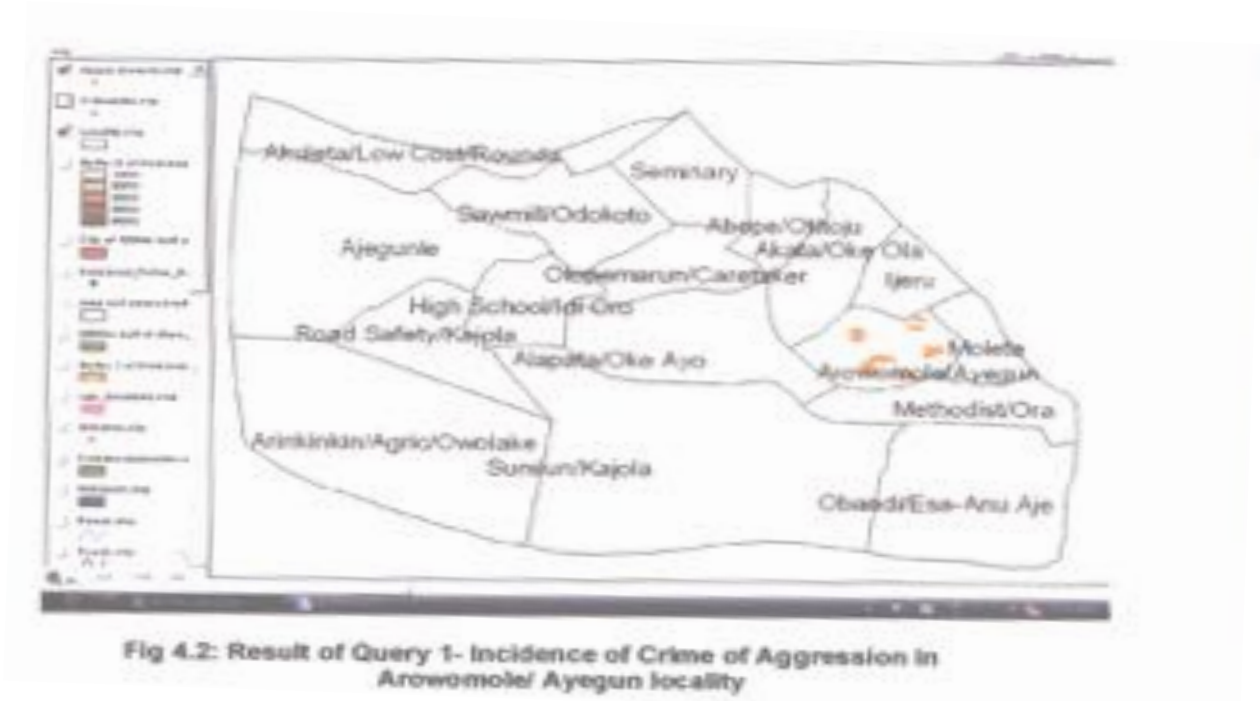


Fig 4.2: Result of Query 1- Incidence of Crime of Aggression in Arowomole/ Ayegun locality

Figure 4: Result of Query1–Incidence of Crime of Aggression in Arowomole/Ayegun Locality
Figure 5: Query 2: ([C-type] = aggression) and ([Locality] = Alapata/OkeAyo)

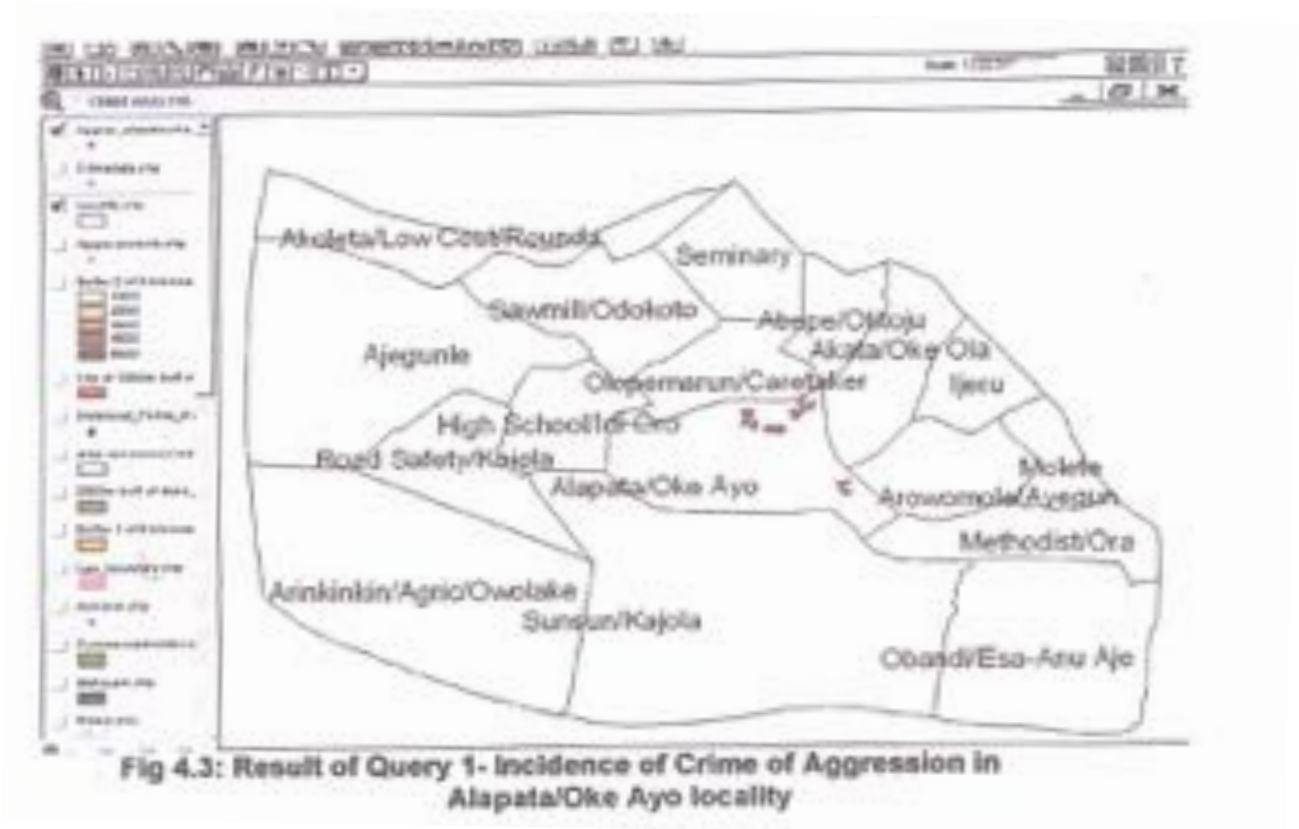
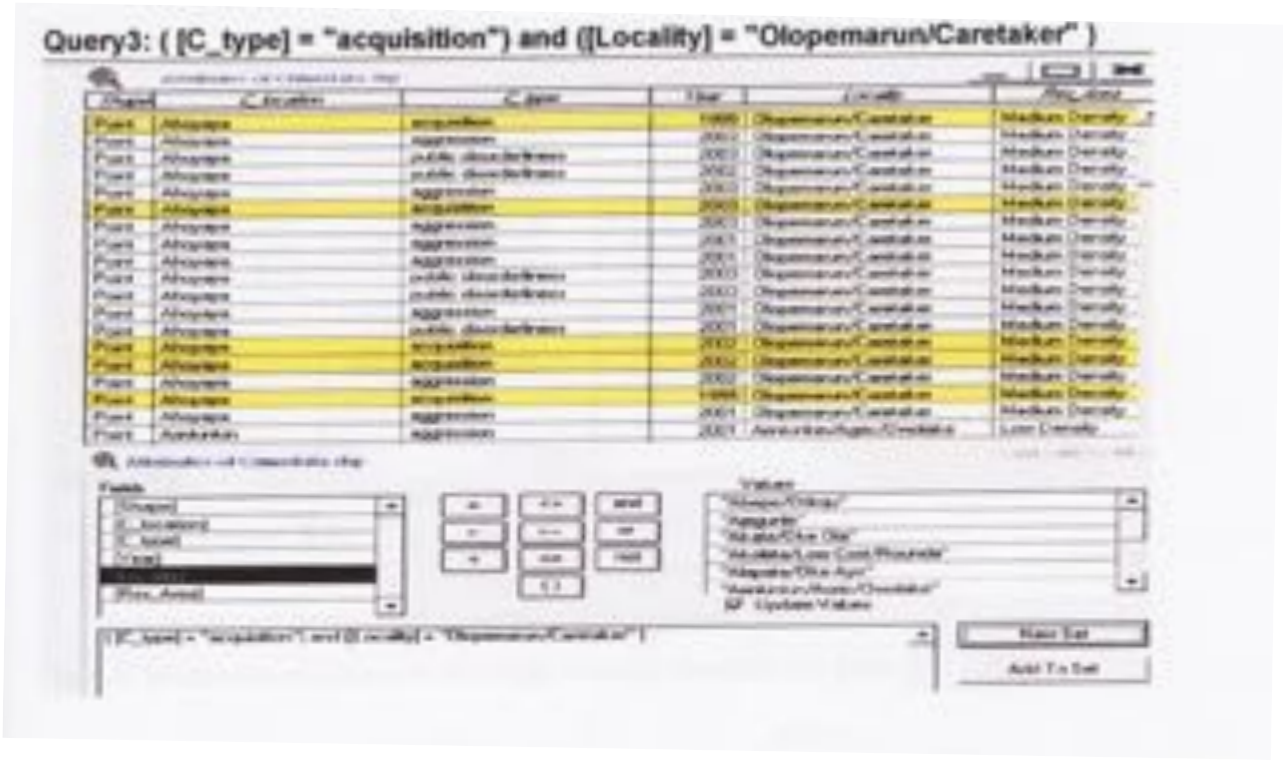


Fig 4.3: Result of Query 1- Incidence of Crime of Aggression in Alapata/Oke Ayo locality



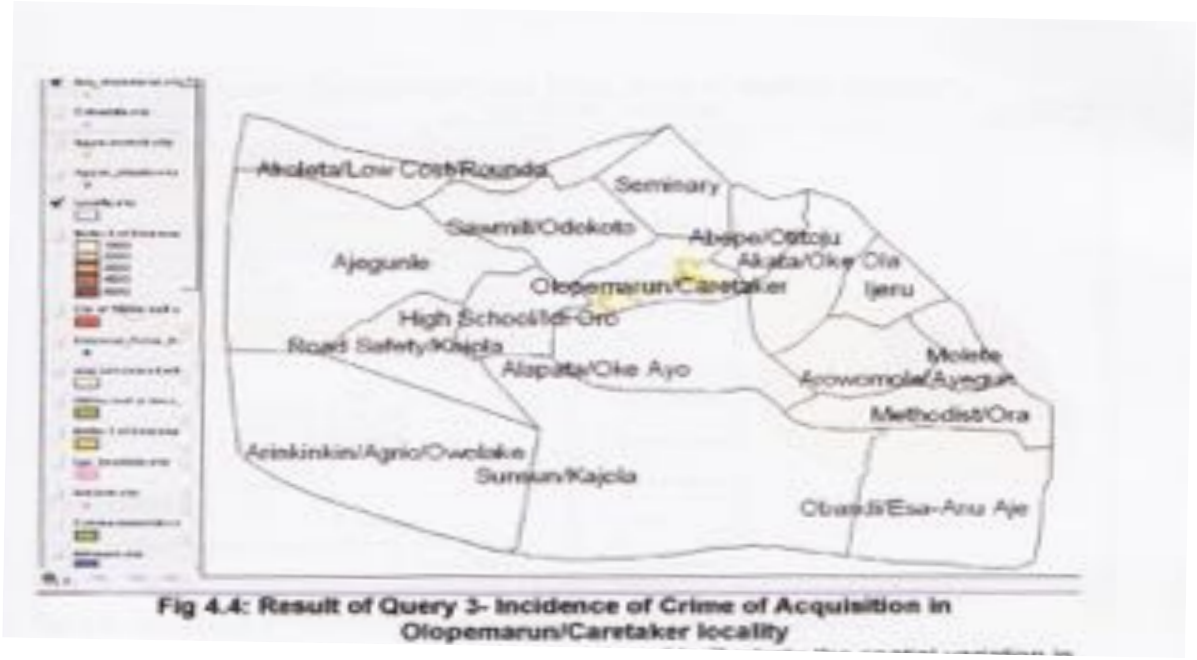


Fig 4.4: Result of Query 3- Incidence of Crime of Acquisition in Olopemarun/Caretaker locality

The second level of spatial search was done on the basis of residential areas and the following queries and results were used to illustrate the spatial variation in the occurrence of crime in different areas

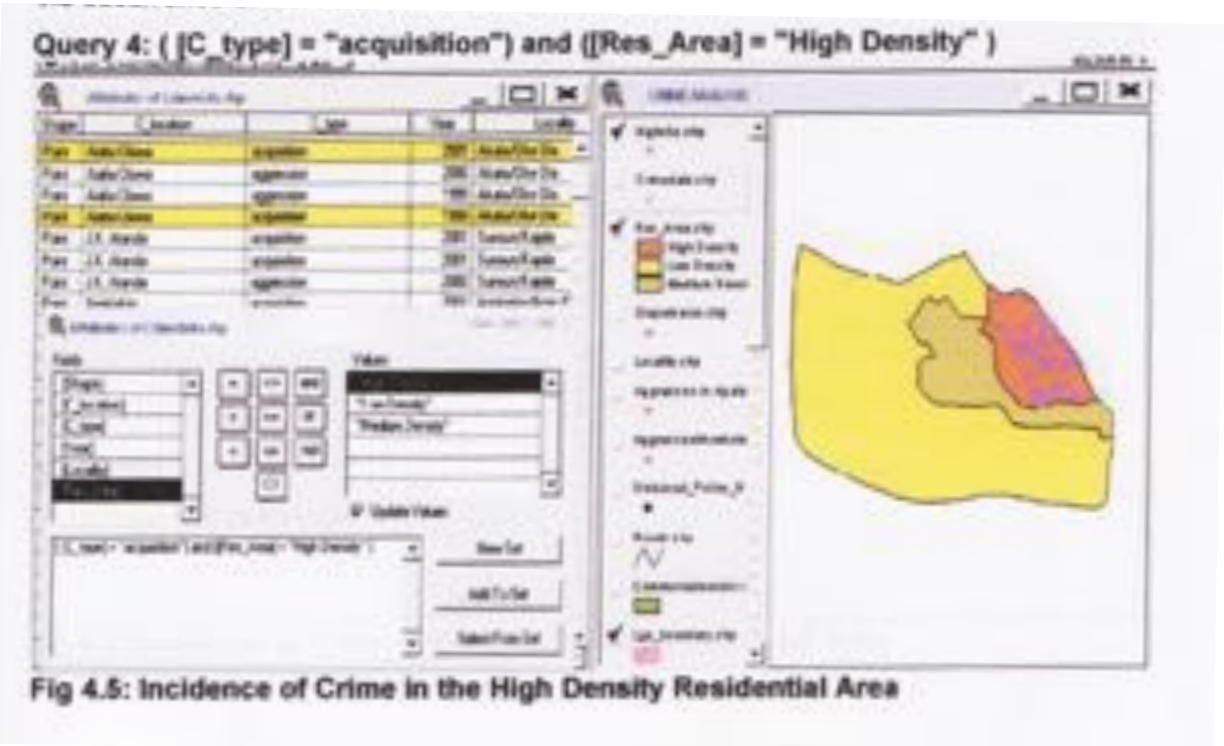


Fig 4.5: Incidence of Crime in the High Density Residential Area

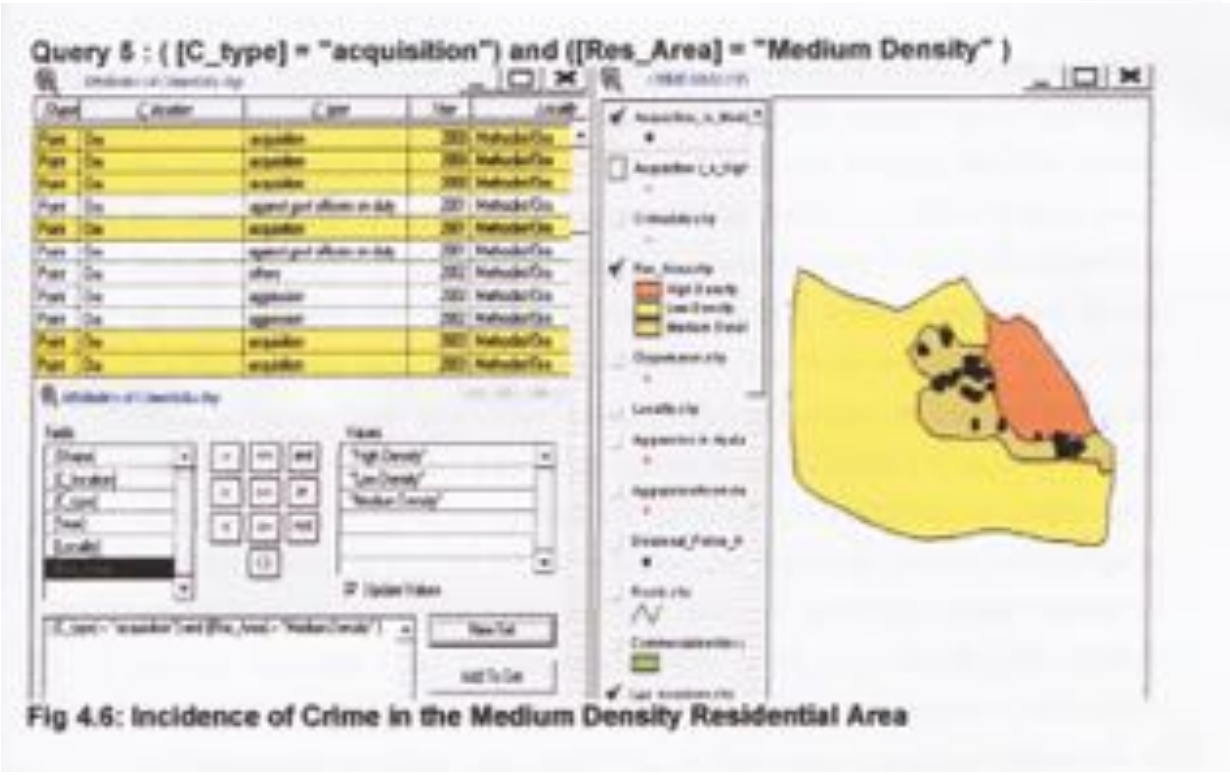


Fig 4.6: Incidence of Crime in the Medium Density Residential Area

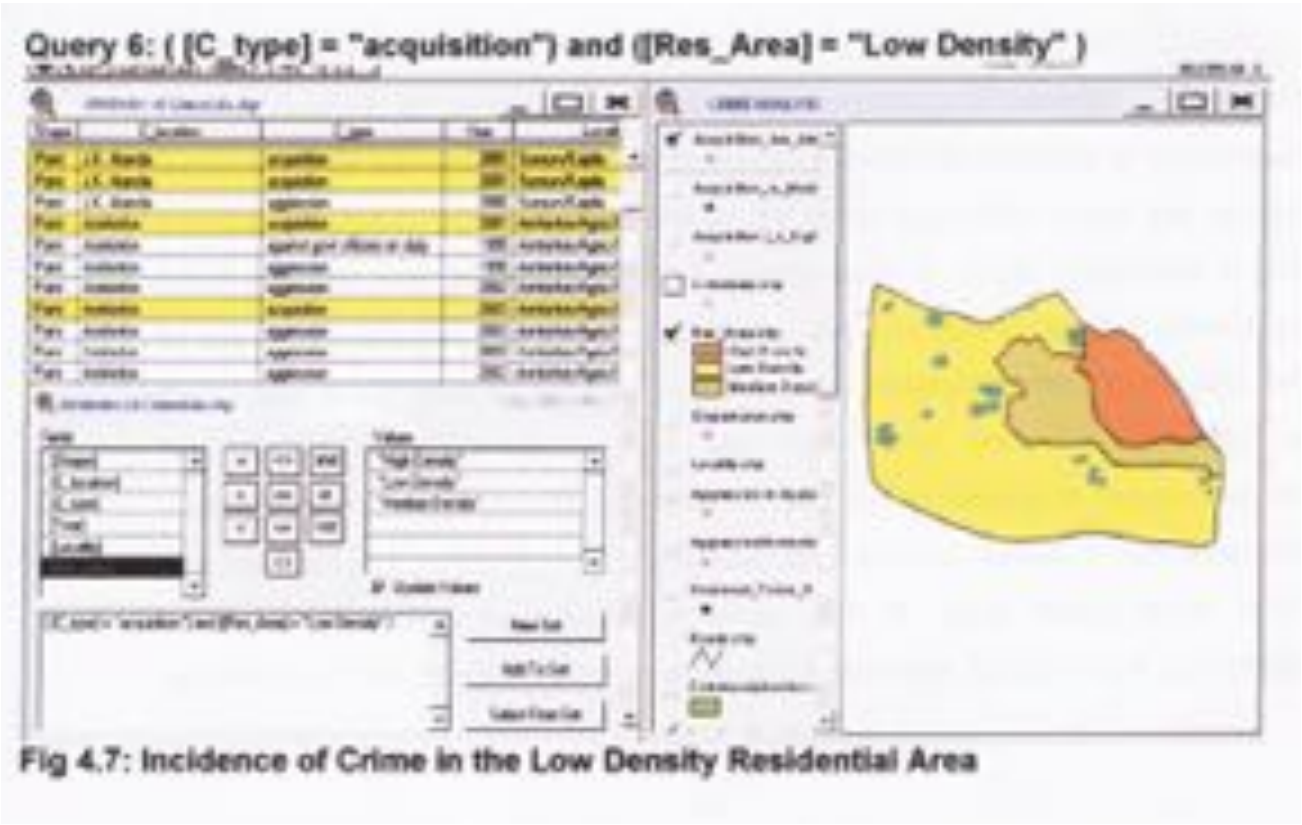


Fig 4.7: Incidence of Crime in the Low Density Residential Area

Incidence of Crime in the Low Density Residential Area

The medium density area of Ogbomoso South Local Government records greater crime cases than the low density area probably due to commercial activities and motorparks located in the area (see fig 4.6 & 4.8) which as commonly observed in Nigeria, places like this are the abode and hideout of touts and deviants. It is not sufficient to show that the incidence of crime varies in space but it is in consonance with scientific reasoning to investigate the causes of such occurrences. Crimes occur not only in space but can indeed be compounded by socio-economic factors prevailing in such area. Among such factors are the attributes of residents studied. This includes level of education, occupation and income. The Chi Square analysis performed shows that these three variables vary significantly in the three residential areas (see tables 4.1-4.3). Their asymptotic values (commonly known as P value) are lower than 0.05 (see tables 4.1-4.3). This implies that calculated Chi square value is significant at 0.05 level of significance. Although the proportion of respondents with higher level of income are more in the core areas but greater percentage of respondents in the same area are also found in two other lower classes of income (see table 4.3a). Significant proportion of the respondents in the medium density area has higher level of education compared to respondents in the other two residential densities (see table 4.1). In same vein significant proportion of same respondents is involved in public service. This has a great implication for the occurrence of crime. There is a great tendency of having the residential portion of this area subtly invaded by thieves under the disguise of patronage of various economic services provided in the area especially when the residents have gone to their places of work. It is very easy to frame anonymity in areas where other people apart from residents are commonly seen. Ghost zone syndrome is not also farfetched in low density residential area especially when the residents must have gone for their daily activities. Poverty and unemployment coupled with low income and overcrowding in residences have the tendency of endangering frustration and tension which if not adequately controlled can lead to outburst of anger and in many cases other criminal tendencies. This is peculiar of high density residential areas.

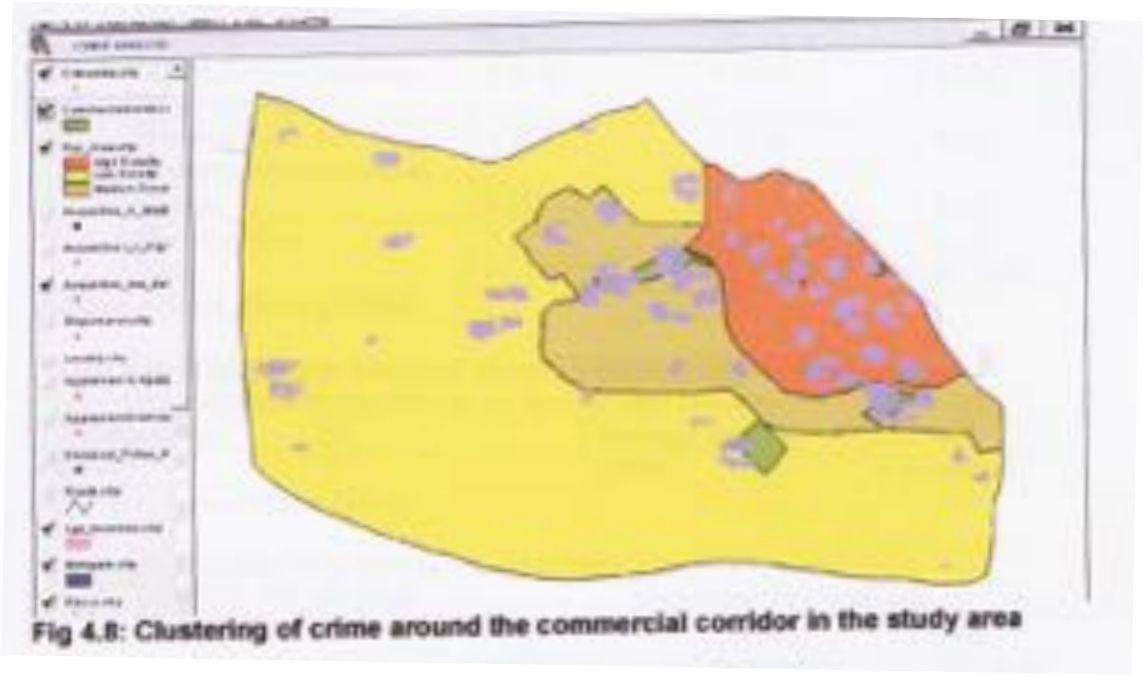


Fig 4.8: Clustering of crime around the commercial corridor in the study area

Table 4.1a: Spatial Variation in Respondents' Level of Education

S/N	Level of Education	Residential Areas		
		High (%)	Medium (%)	Low (%)
1	No formal	26 (28.3)	4 (6.5)	2 (6.5)
2	Arabic	3 (3.3)	0 (0)	0 (0)
3	Primary	26 (28.3)	9 (14.5)	4 (12.9)
4	Secondary	25 (27.2)	17 (27.4)	10 (32.3)
5	Post secondary	7 (7.6)	16 (25.8)	7 (22.6)
6	University	3 (3.3)	11(17.7)	3 (9.7)
7	Postgraduate	2 (2.2)	5 (8.1)	5 (16.1)
	Total	92(100)	62 (100)	31 (100)

Author's Field Survey (2004)

Table 4.1b: Chi Square Analysis showing dependency of Respondents' Level of Education on Residential Density

X^2 Calculated	Df	Asymp. Sig	Remark
44.755	12	0.000	significant

Author's Compilation (2004)

Table 4.2a: Spatial Variation in Occupational Status of Respondents

S/N	Type of Occupation	Residential Areas		
		High (%)	Medium (%)	Low (%)
1	Private sector organized	8 (8.7)	14 (22.6)	4 (12.9)
2	Private sector unorganized	54 (58.7)	15 (24.2)	19 (61.3)
3	Farming	10 (10.9)	2 (3.2)	0 (0)

4	Public Service	2 (2.2)	15 (24.2)	1 (3.2)
5	Retiree/pensioner	5 (5.4)	3 (4.8)	2 (6.5)
6	Student	8 (8.7)	10 (16.1)	5 (16.1)
7	Unemployed seeking employment	2 (2.2)	1 (1.6)	0 (0)
8	Unemployed seeking employment	2 (2.2)	1 (1.6)	0 (0)
9	Clergy	0 (0)	1 (1.6)	0 (0)
10	No response	1 (1.1)	0 (0)	0 (0)
	Total	92 (100)	62 (100)	31 (100)

Author's Field Survey (2004)

Table 4.2b: Chi Square Analysis on dependency of Occupational Status on Residential Density

X^2 Calculated	Df	Asymp. Sig	Remark
48.190	18	0.000	Significant

Author's Compilation (2004)

Table 4.3a: Spatial Variation in Respondents' Level of Monthly Income

S/N	Monthly Income (₦00)	Residential Areas		
		High (%)	Medium (%)	Low (%)
1	<7000	64 (70.3)	31 (50.0)	15 (48.4)
2	7001 – 15000	10 (11.0)	21 (33.9)	1 (3.2)
3	15001 – 23000	4 (4.4)	3 (4.8)	7 (22.6)
4	23001 – 31000	6 (6.6)	4 (6.5)	1 (3.2)
5	31001 – 39000	0 (0)	1 (1.6)	3 (9.7)
6	>39001	7 (7.7)	2 (3.2)	4 (12.9)
	Total	91 (100)	62 (100)	31 (100)

Author's Field Survey (2004)

Table 4.3b: Chi Square Analysis on dependency of Respondents' Monthly Income on Residential Density

X^2 Calculated	Df	Asymp. Sig	Remark
43.165	10	0.000	Significant

Author's Compilation (2004)

BUFFERING OPERATION

The only available police station in the whole study area is the Divisional Police Headquarter located at Sunsun/Kajola locality of the study area. This Divisional Police Headquarter is meant to serve the whole local government area but according to the set standard there ought to be other Police Posts located at a certain distance away from this Divisional Police Headquarter. Their activities will be coordinated by this Divisional Police Headquarter.

The buffering operation used follows the criteria for locating a police post. Cities of the status of Ogbomoso where the study area is located, police posts are to be located at 2000m distance from a police station. The buffer is at 2000m radius from the existing Divisional Police Headquarter (see fig 4.9). This implies that the remaining areas left uncovered are places where police post should be provided for effective surveillance and crime control (see fig 4.12).

Buffering capability of GIS is further used in illustrating localities where Police may not be able to get to within a period of 1-5 minutes in case there is a distress call. The buffering distance used was derived from the stipulated time police are supposed to arrive at any location from where a distress call was made. The stipulated time is between 1-5minutes. Interpreting this period within the context of the allowable speed within urban centers which is between 40-60km/hr, then the distance to be covered will be <=lkm/min (<=1000m/minute). With this stipulated time, a buffering distance of 1000metres was used. The localities that are not within the buffering distance represent the areas that cannot be reached within the period stipulated (figure 4.10). Contrariwise if the maximum time is taken i.e 5 minutes then 5km or 5000metres could be covered. Thus places beyond the township extent of the local government area could be covered (figure 4.11).

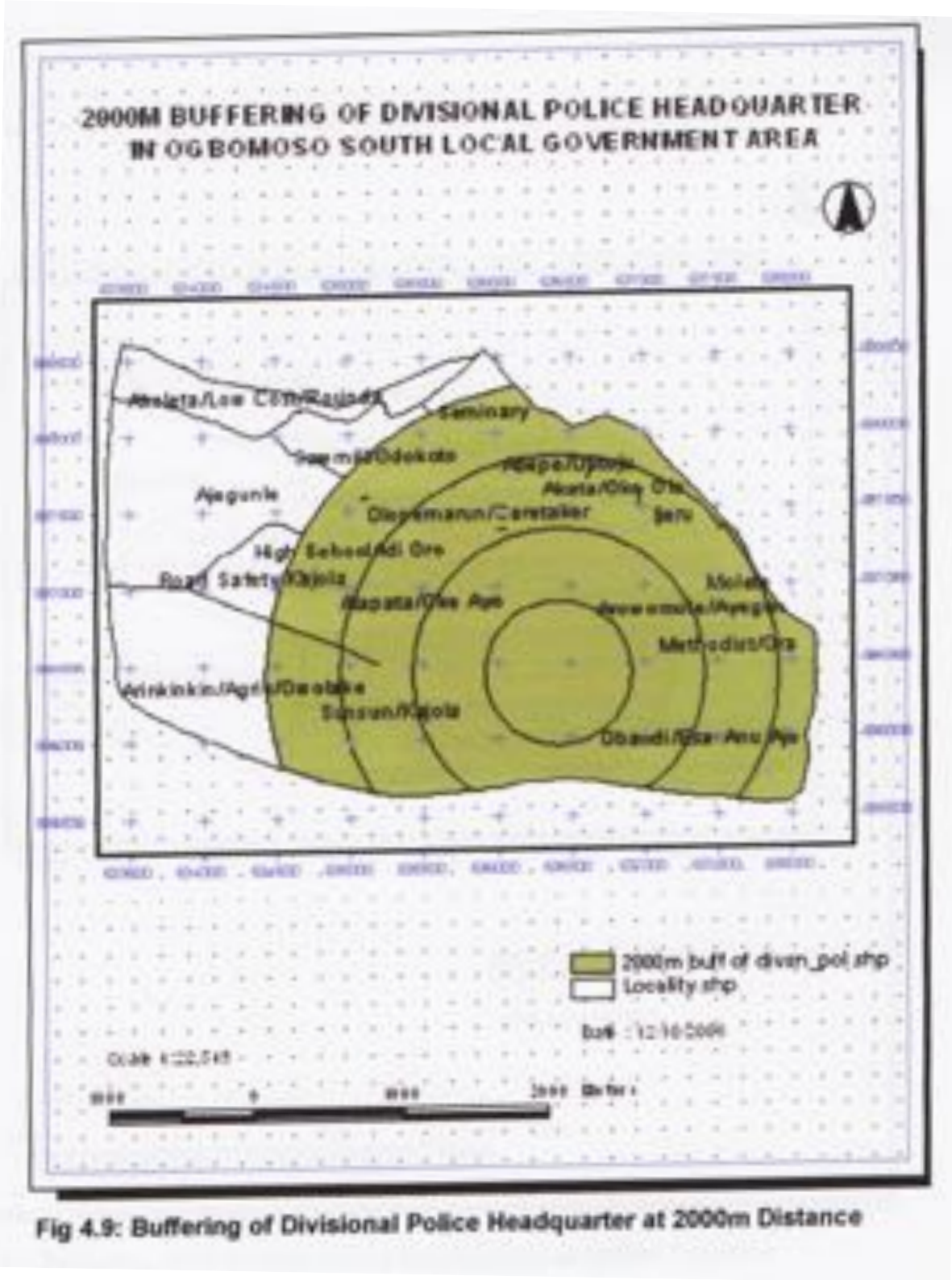


Fig 4.9: Buffering of Divisional Police Headquarter at 2000m Distance

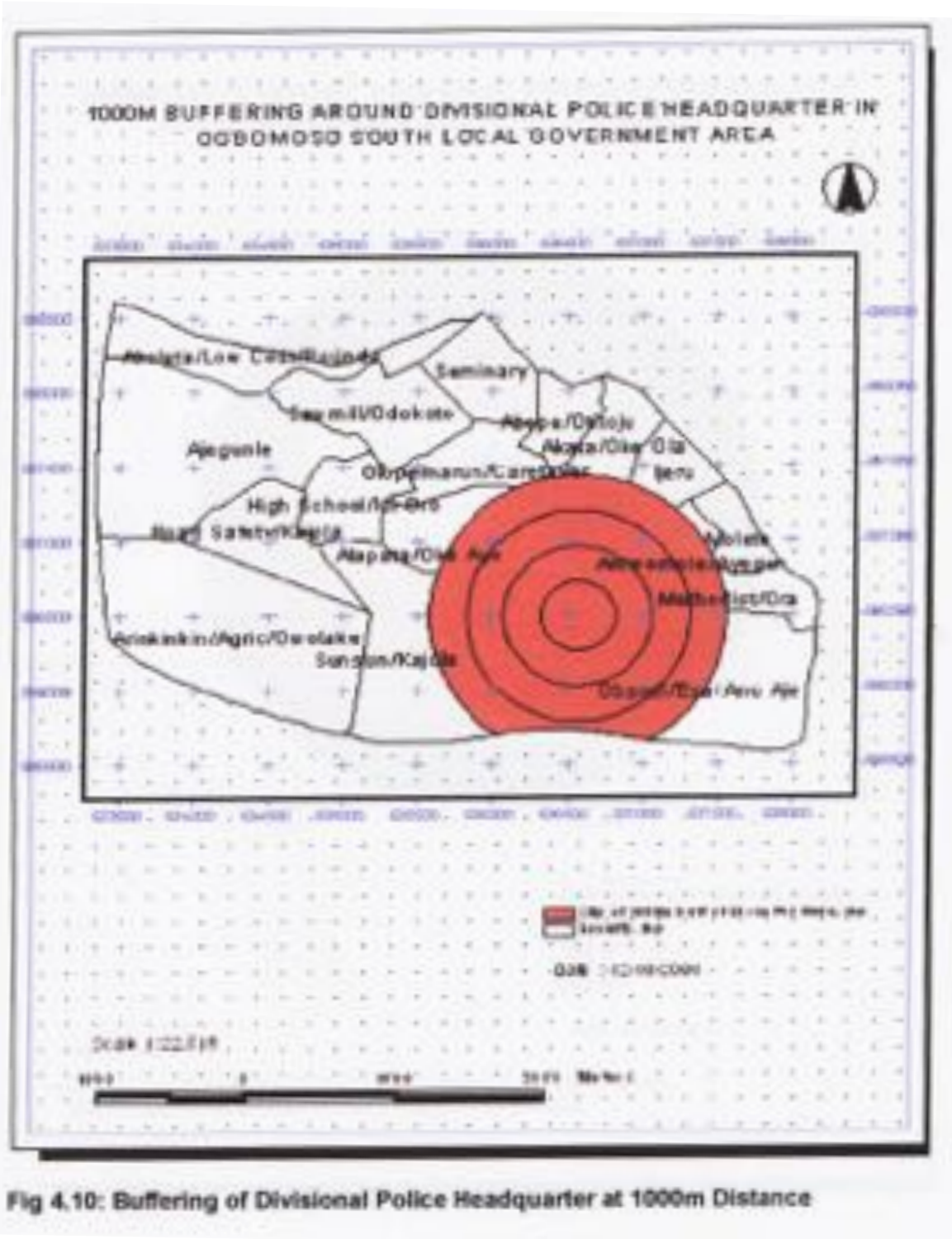


Fig 4.10: Buffering of Divisional Police Headquarter at 1000m Distance

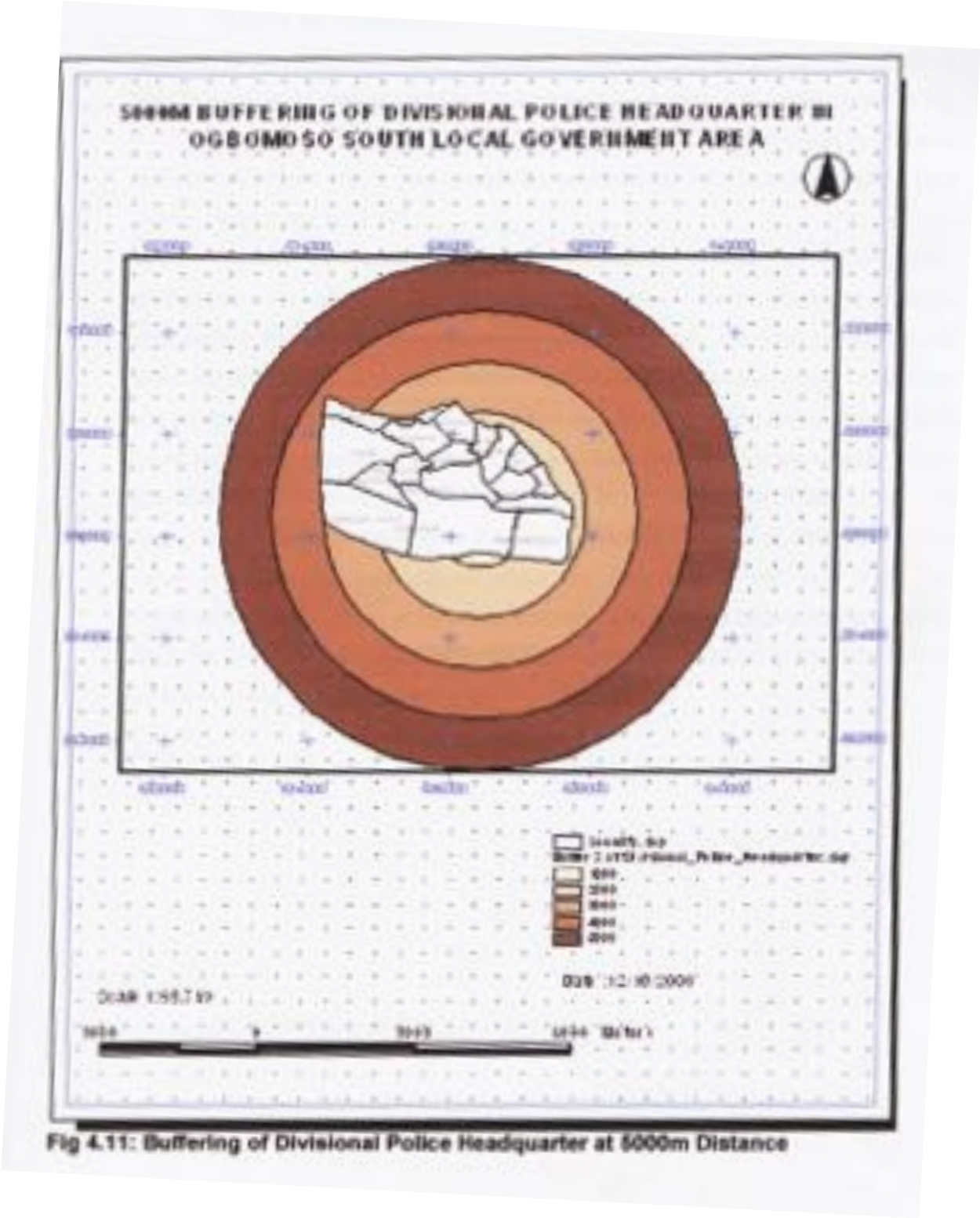


Fig 4.11: Buffering of Divisional Police Headquarter at 5000m Distance

OVERLAY OPERATION

Overlay by intersect was done in order to carve out the areas that are not covered by the buffer done in the preceding section. Using the standard distance for the location of police post (i.e. 2000m) as done above, the areas shown in figure 4.12 are not covered by the buffer. Thus, the remaining areas left uncovered are places where police post should be provided for effective surveillance and crime control (see figure 4.12).

Figure 4.13 illustrates the localities that are not covered by 1000m buffer made round the subject Divisional Police Headquarter. These areas are localities that cannot be reached if

police are to respond to any distress call from such area within 1minute. This submission is made based on the assumption that there are no other obstructions and there is free flow of traffic and the police vehicle is in good condition. However it is a general fact that this may not be realistic within the context of Nigerian cities of this nature. Thus, when any of these conditions is not met there will be delay in travel time thereby increasing the time at which the police could reach any of such places where the distress call was made. The implication of this is that if there are distress calls from localities that are farther than 1000m from the Divisional Police Headquarter, the police may not be able to arrive at crime spots in a good time to rescue the situation.

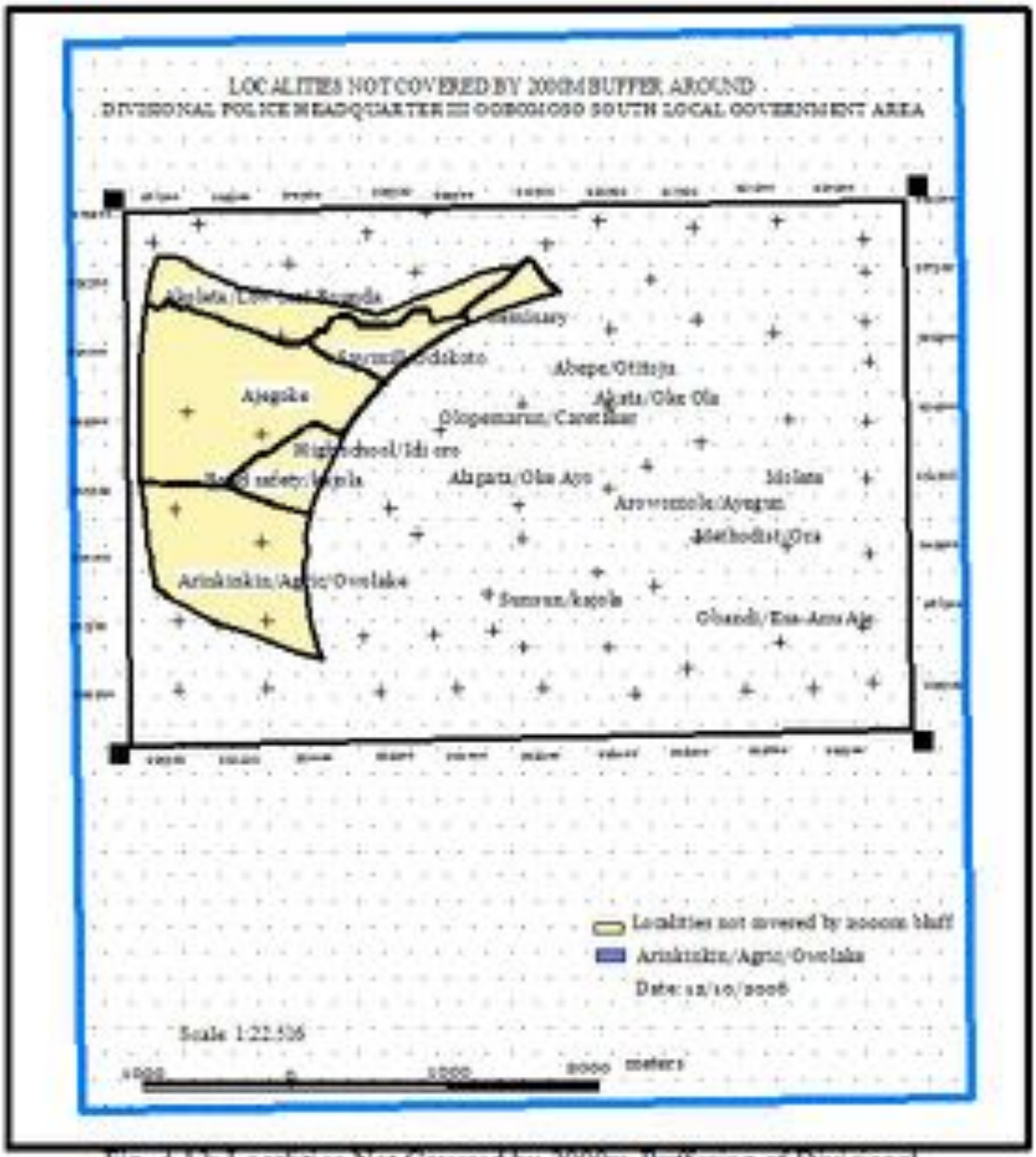


Fig. 4.12: Localities Not Covered by 2000m Buffering of Divisional Police Headquarter

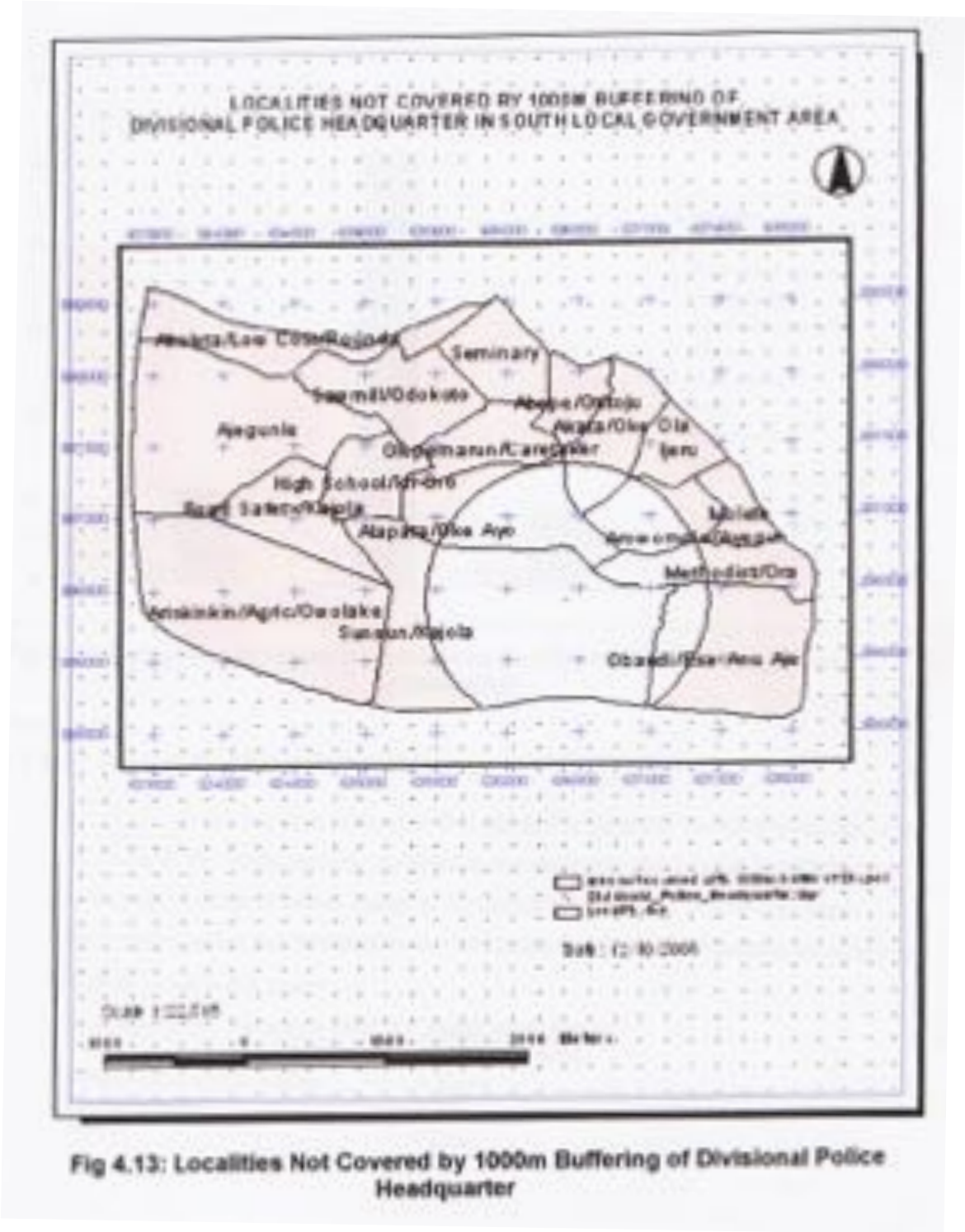


Fig 4.13: Localities Not Covered by 1000m Buffering of Divisional Police Headquarter

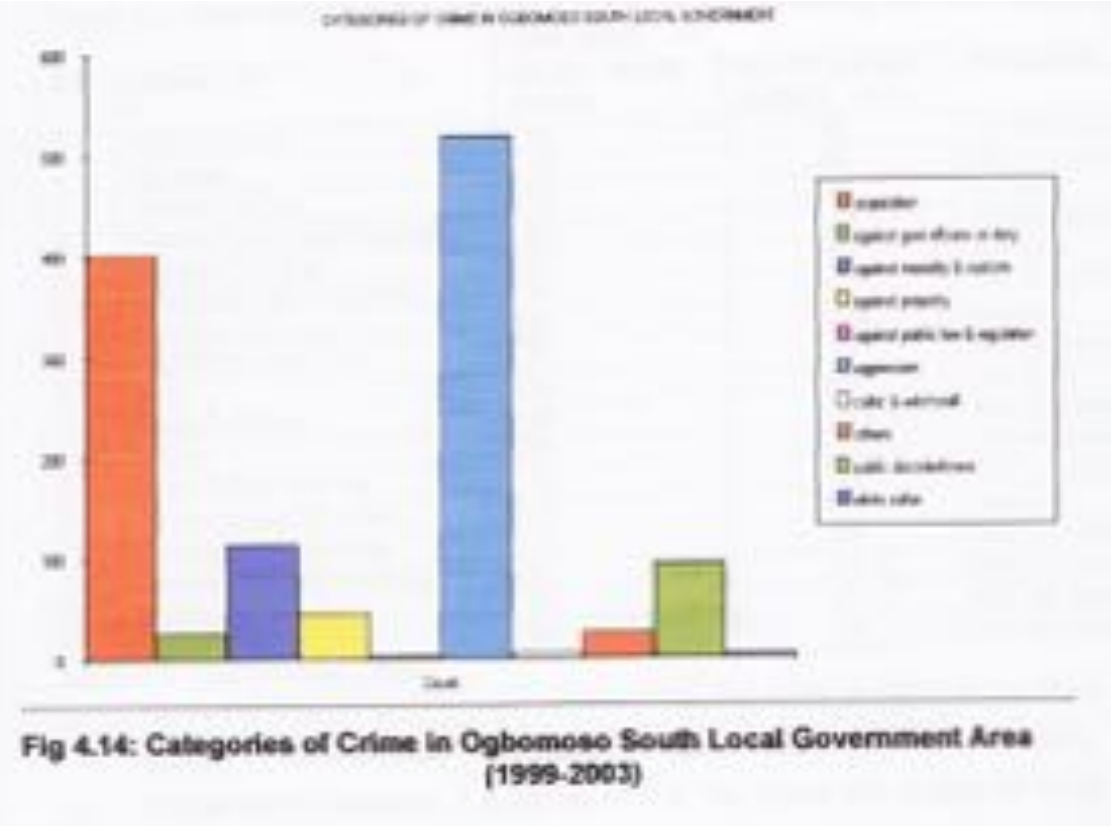


Fig 4.14: Categories of Crime in Ogbomoso South Local Government Area (1999-2003)

HOT SPOTS OF CRIME IN OGBOMOSO

From the data utilized in this study it is possible to identify the hot spots of crime in the study area by comparing the average crime in the whole study area with number of crime cases in individual locality. The total crime cases recorded used in this application is 1243 while its distribution among localities is shown in Table 4.4b.

Average crime incidence (AVC) = Total crime cases / No of locality

Where total crime case = 1243

No of locality = 17

AVC =1243/17

=73

Table 4.4: Determination of Crime Hot Spots of Crime among various Localities (1999 – 2003)

S/N	Locality	No of Crime cases	No of Crime Cases - AVC	Remark
1	Abepe/Otitoju	16	-59	Not hot spot
2	Ajegunle	13	-60	Not hot spot
3	Akata/Oke Ola	113	40	Hot spot
4	Akoleta/Low cost/Rounda	33	-40	Not hot spot
5	Alapata/Oke Ayo	97	24	Hot spot
6	Arinkinkin/Agric/Owolake	30	-43	Not hot spot
7	Arowomole/Ayegun	232	159	Hot spot
8	High School/Idi Oro	92	19	Not hot spot
9	Ijeru	139	64	Hot spot
10	Methodist/Ora	66	-7	Not hot spot

11	Molete	61	-11	Not hot spot
12	Obandi/Esa – Anu Aje	12	-61	Not hot spot
13	Olopemarun/Caretaker	212	139	Hot spot
14	Road Safety/Jesutedo	3	-70	Not hot spot
15	Sawmill Adeleke/Odokoto	52	-21	Not hot spot
16	Seminary	32	-41	Not hot spot
17	SunSun/Kajola	40	-33	Not hot spot

Author's Compilation (2006)

From the foregoing, there are generally five hot spots of crime in the study area, namely Akata/Okeola, Alapata/Oke Ayo, Arowomole/Ayegun, Ijeru, and Olopemarun/Caretaker. It is observed that, the higher the number of crime in an area, the farther the deviation is from the average crime incidence (AVC).

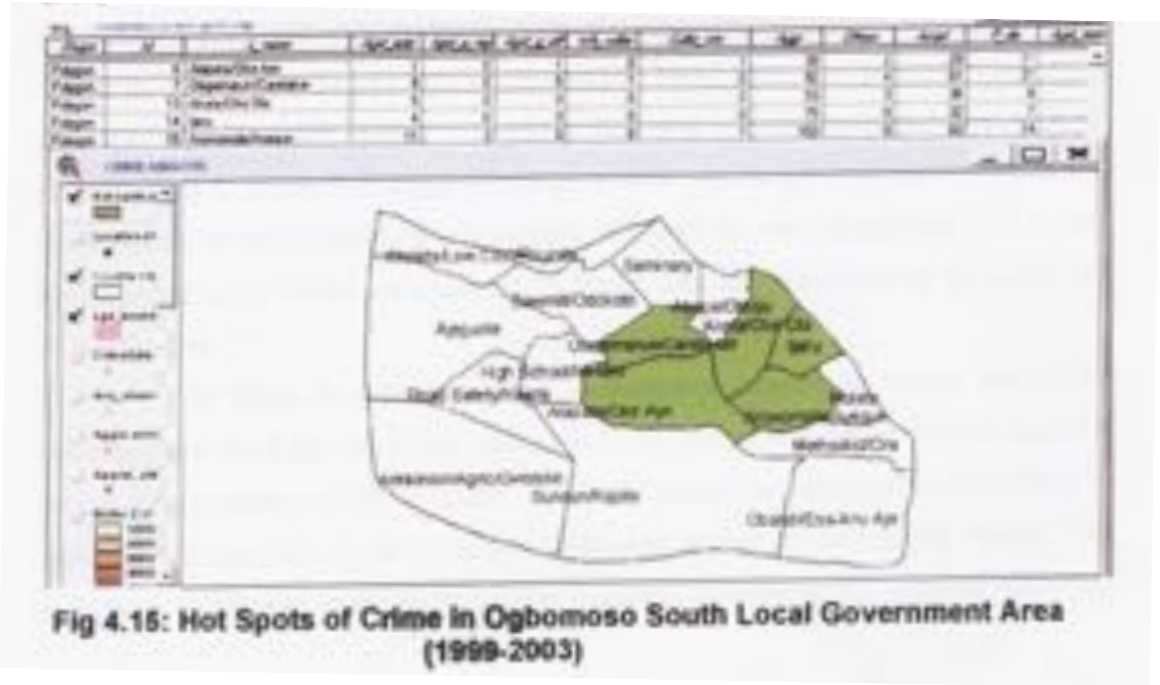


Fig 4.15: Hot Spots of Crime in Ogbomoso South Local Government Area (1999-2003)

CONCLUSION AND RECOMMENDATIONS

The application developed revealed that there was spatial variation in the occurrence of crime in Ogbomoso South Local Government Area within the period of study. Five hot spots of crime were identified. The occurrence of crime was explained in respect of certain socio economic attributes of residents as well as commercial activities in the study area. The result showed that when there is a distress call, the available police station may not be able to effectively address the situation. This is not based on staff strength but on travel distance to cover within safe period at which souls and properties could be safeguarded or delivered. With the identification of areas that may not be effectively covered by the existing security facilities the study suggests provision of more police post in areas that are not covered. Identification of hot spots of crime as done in this study is capable of serving as raw information for policy formulation as well as assist the Police in the deployment of personnel and scheduling of patrol to various sectors of the city.

The dynamic nature of our environment with ever increasing technology and sophistication in crime activities demands an equal level of sophistication in the control of crime. Thus, application of GIS to crime management in Nigeria will go a long way to aid the prevention and

control of crime by enhancing the activities of the criminal justice system to combat crime. The study recommends that distance and population should be taken into consideration in sitting police post or station and that Nigeria Police Authority should be equipped with adequate training and technology in order to enhance a wholesome control of crime within the context of the world's dynamic technologies. This will be effective if other activities within the urban environment are coordinated in order to reduce criminal opportunities.

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