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The Use of Geographical Information System (GIS) in Detecting Criminal Activities in Asaba, Southern Nigeria

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ABSTRACT

This research investigated the use of GIS in monitoring criminal activities from 2004 to 2010 in Asaba metropolis. Crime causes loss of lives and property as well as overwhelming fear of insecurity. These have serious consequences for economic and social development. Geographical Information System is a powerful tool that can aid the Nigerian Police in effective routine and unscheduled patrols using GIS produced maps which not only depicts crime hot spots, but also the fastest route to track down criminals. The study showed that the high density areas in Asaba with high socio-economic interactions coupled with its political antecedents have the highest number and types of crime reported while the traditional areas have less of the crimes reported. However, kidnapping is a very new type of crime that was reported in the area. The analysis of variance used to test the research hypothesis revealed that there is spatial variability in the numbers and types of crimes reported in the different zones in the study area.

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INTRODUCTION

The occurrence of criminal activity in the form of thefts, assaults, homicides, e.t.c is something that takes place every day in almost all reaches of our world. Crime causes loss of lives and property as well as overwhelming fear of insecurity. These have serious consequences for economic and social development. There is a great deal of debate on the cause of crime (Fattah, 1997). Nigeria has witnessed an upsurge in crimes during the past two decades (Alemika, 1997). Increasing incidence of crimes has led to a paralyzing fear which in turn affect economic and social life in Nigeria. Most of the nation's prime economic centres and the densely populated capital cities have recorded disproportionate level of crime rates (Alemika, 1997). As a result of the growing rates and severity of criminality, successive governments in the country introduced diverse crime control measure since the early 1980's but without much success. In many societies that are undergoing transition to democracy, the perceptible rise in violent, crime and increasing social disorder is widespread. Participants at a seminar on crime and policing in transitional societies, organized by the South African Institute of International Affairs (SAIIA) in 2000 echoed this concern when they observed that even though democratic transitions in Eastern Europe, Latin America and some parts of Africa have renewed hope among the peoples of the regions, it has brought in its wake, a surge in crime and disorder before it has the opportunity to

germinate and bear fruits (Chukwuma, 2001).

Similarly, Neild (1999), in a paper entitled "*From National Security to Citizens Security*" draws from her experience of working in Latin America; stated that almost all new democracies manifest an overwhelming increase in common crime and delinquency, including homicide, giving rise to a generalized feeling of fear and insecurity amongst the population. The result, in many cases, is a groundswell of popular sentiment in favour of a return to authoritarian modes of governance and repressive approaches to crime (Neild, 1999). Nigeria's experience in the past twelve years of transitional democracy is not different from this emerging trend. In spite of the government's promises to tackle crime, the rate of armed robbery, political assassinations, ethno-religious killings (BOKO HARAM) and other violent crimes remains extremely high (Carina, 2002). The then Minister for Police Affairs, General David Jemibewon, admitted this much in a paper delivered on his behalf at a seminar in the South African seminar: When Nigeria ... shifted from autocratic military rule to democratic rule on May 29, 1999, Nigerians heaved a sigh of relief. Regrettably, our new-found democracy has, to some extent, become a source of insecurity and lawlessness, as these rights were mis-construed and without exercised restraint. The past eleven years under the democratic administration has therefore seen an increased in crime waves in various parts of the country (Jemibewon, 2001).

The government's response (at both federal and state levels) have come in the form of increase policing capacity, enactment of draconian laws such as extension of Sharia laws to criminal matters, legalization of the activities of vigilante groups and reintroduction of militarized approaches to law enforcement. Similarly, the Nigeria public has not only welcomed repressive approaches to crime control by law enforcement agents but has also resorted to self help measures. These measures include formation of vigilante groups that have made lynching of criminal suspects their stock in trade, due to frustration at the inability of the public service police to bring down the level of crime. Crime is an act or omission that violates the law and is punishable upon conviction (Ratcliffe, 2008). It includes Criminal Code offences against a person or property, drug offences, motor vehicle offences and other provincial or federal statute offences. Crime has an inherent geographical quality. When a crime occurs, it happens at a place with a geographical location. For someone to have committed a crime they must have come from a place (such as their home, work or school). This place could be the same location where the crime was committed or is often close to where the crime was perpetrated (Frisbie *et al.*, 1977; Brantingham and Brantingham, 1981; Rossmo, 2000; Wiles and Costello, 2000). 'Place,' therefore, plays a vital role in understanding crime and how crime can be tackled.

There is no absolutely agreed upon definition of a GIS (DeMers,

1997). A broadly accepted definition of GIS is the one provided by the National Centre of Geographic Information and Analysis which defines GIS as a system of hardware, software and procedures to facilitate the management, manipulation, analysis, modeling, representation and display of geo-referenced data to solve complex problems regarding planning and management of resources (NCGIA, 1990). Geographic information system has emerged in the last decade as an essential tool for urban resource planning and management. Their capacity to store, retrieve, analyse, model and map large areas with huge volumes of spatial data such as crime data has led to an extraordinary proliferation of applications. Geographic Information System (GIS) now combines the maps (in digital form) with the data from all relevant institutions. For instance, instead of having a cadastral map here and a land book there, parcel map and ownership data are combined in one system. Or, instead of using a land use plan on a huge sheet of paper and searching separately for demographic data to find out the best location for a new school, an enquiry can be sent to the computer that directly produces a map showing the location. GIS, therefore, is not only a land management tool. GIS can also accelerate any kind of organization's daily procedures and through quick supply of up-to-date, support decision-making on many important topics while ensuring high quality (Cahill, 2005).

Crime remains elusive and strives to hide itself in the face of

development (i.e. very difficult to curb). As measures and techniques for detecting crimes increases, criminals advance. Criminals also look for means of hiding from these measure-the Internet currently serve as a hiding place for fraudsters who has simply migrated from the streets to an electronic platform offered by the World Wide Web. Different nations have adopted different strategies to contend with crimes depending on their nature and extent. Certainly, a nation with high incidence of crime cannot grow or develop. This is so because crime is the direct opposite of development. It leaves a negatives social and economic consequence (Sylvester, 2001).

The traditional and age-old system of intelligence and criminal record maintenance has failed to live up to the requirements of the existing crime scenario. Manual processes neither provide accurate, reliable and comprehensive data round the clock nor does it help in trend prediction and decision support. It also results in lower productivity and ineffective utilization of manpower. The solution to this ever-increasing problem lies in the effective use of Information Technology (Fajemirokun *et al.*, 2006). Due to inadequate modern technology and sufficient manpower, the Nigerian security agents have not been able to effectively tackle the issue of crime in the country. Also, high fenced walls with earth rod ray tubes and other security probes are installed in most building at exorbitant costs. This has also led to the formation of various

vigilante groups, to combat crimes in some parts of the country. However, these groups have only succeeded in creating other problems instead of solving the existing ones (Fajemirokun *et al.*, 2006). Therefore, the objective of this research is to (i) examine the use of GIS in studying crime from 2004-2010 in Asaba metropolis. (ii) to discuss the types of crimes committed in Asaba between 2004-2010; (iii) to examine the causes of high rate of crimes in Asaba for the period under study. (iv) to discuss the role of the Nigeria Police in crime detection and management as well as equipment available for such purpose in Asaba; and finally (v) to examine the role of GIS as a monitoring tool for crime management in Asaba.

METHODOLOGY

The study adopted the field survey method which involves the direct use of historical/archival data from The Nigeria Police Force Divisional Offices in Asaba. The data collected and used for the research was from secondary source. The crime database for Asaba, Delta State's capital for a period of (7) seven years from 2004 to 2010 was used for the study based on data availability with the Nigeria Police Force which is the law enforcement agent of Government that is in charge of keeping order and crime control in the neighbourhoods. Also the analogue map of Asaba metropolis was obtained from the Ministry of Lands and Survey, Asaba for the purpose of generating other attribute data for this study. The study area was divided into four (4) homogeneous zones based on the

land use types. The sampling technique that was used in the study is the stratified sampling method. Thus, the study area was divided into four zones (A-D). Crime rate and types data was collected from the archives of the Nigeria Police Force Divisional Offices in Asaba by the

researcher. A direct visit was made to their offices to obtain information on crime in the study area covering the period 2004-2010. Data inconsistency was taken care of by methods of extrapolation where necessary.

Zones	Areas
A	Okpanam road, Nnebuisi road, Anwai road, West end and Asaba-Onisha express way
B	Ezenei road, Cable point
C	Umuagu, Isieke, Umuonaje, Ibusa road
D	Direct Labour road, Summit junction road

Source: (Asaba online, 2010)

GIS ANALYSIS

Queries were built to define the crime location or zones and to determine the particular zones or the crime scene. Getis-Ord (G_i^*) hot-spot analysis was used in this analysis to detect significant clusters of crime activities in Asaba. The statistic which is one of the family of exploratory spatial data analysis (ESDA) is used to test whether a particular location I and its surrounding regions constitute a cluster of higher or lower

than average values on a (x) of interest.

The statistic uses this formula:

$$G^*I = - \sum$$

Where s is the sample standard deviation of the x values, and $w_{ij}(d)$ is equal to one if region j is within a distance of d from region i , and zero otherwise. The sum is over all regions, including region i . Also, $w_{ij}(d)$ is a weight matrix element defining neighbourhood relationship between i and j which is measured by the distance (d) between them, and n is the number of observations. In other to

calculate this statistic, a spatial contiguity (first order) weight matrix was generated based on the zonal map of the study area. To determine whether the G_i^* score is statistically significant; it is compared to the range of values for a particular confidence level. At a confidence level of 0.05 a G_i^* score would be set to equal to or greater than 1.65 under a one tailed-test to be statistically significant. Under a two tailed-test, the G_i^* would be set to between -1.96 to +1.96 to be significant. However, in this analysis clusters that fall between the tailed-test normal distribution are considered significant and mapped. The G_i^* statistic was computed with a spatial statistics program for analysis of crime incident locations-CrimeStat version 3.3 which was developed from the office of science and technology, National Institute of Justice Washington, D.C. The 2010 crime report data of Asaba was entered into the CrimeStat as Microsoft Access file. This extracted significant crime clusters corresponding to the various police patrol zones of Asaba. The result

of CrimeStat analysis (G_i^*) then entered into the geo-processing wizard of the ArcGIS version 9.3 developed by ESRI. The significant crime hot-spots were identified within the ArcMap environment. Consequently, the significant local Getis-Ord statistic map of Asaba was generated and this was further used to produce the crime hot-spot map of Asaba, which shows the distribution and magnitude of crime activities.

RESULTS AND DISCUSSION

Types of Crimes Reported in Asaba

The various types of crime committed in Asaba as reported by the Nigeria Police Force for the period 2004-2010 showed that a total of six hundred and twenty eight (628) cases of armed robbery, Eight thousand, one hundred and four (8104) cases of assault on persons, Fifteen thousand, three hundred and thirty five (15335) cases of stealing, Nine (9) cases of kidnapping, Nine hundred and ninety two (992) cases of malicious damages, Fifty five (55) cases of murder. While the rape cases were three hundred and twenty nine (329),

other minor crime were eight hundred and twenty five (825) (See Table 1.1 and Fig 1.1 for details).

Table 1.1: Showing True Crimes Reported in Asaba

Zones	Year	Armed Robbery	Assault	Stealing	Kidnapping	Malicious damages	Murder	Rape	Others	
A Okpanam rd Nnebisi rd West End Asaba-Onithsa Express	2004	20	1020	800	0	27	9	19	51	
	2005	30	306	623	0	81	9	12	42	
	2006	23	670	504	0	20	2	17	31	
	2007	13	224	229	0	42	7	14	15	
	2008	15	227	336	0	48	4	17	13	
	2009	28	75	1000	4	30	6	18	40	
B Ezenei Ave Cable Point Umueze Ahaba Agiri Str	2010	24	63	750	1	24	2	10	45	
	2004	31	600	753	0	25	2	17	50	
	2005	36	201	600	0	72	2	12	45	
	2006	35	600	510	0	27	0	21	31	
	2007	17	215	220	0	38	0	11	14	
	2008	21	220	330	0	40	0	19	10	
C Umuagu Isieke Umuaje Ibusa rd	2009	25	60	1002	0	25	1	15	39	
	2010	23	50	713	1	20	1	6	40	
	2004	10	540	600	0	23	0	5	41	
	2005	19	269	450	0	50	0	7	35	
	2006	20	500	400	0	20	1	15	20	
	2007	21	198	196	0	40	1	9	9	
D DLA, Summit rd, Jesus Saves	2008	23	203	300	0	41	1	9	7	
	2009	21	55	800	0	23	0	5	30	
	2010	25	45	529	0	15	0	4	31	
	2004	19	493	558	0	19	3	10	47	
	2005	21	294	554	0	75	2	8	35	
	2006	25	560	491	0	29	1	10	11	
	2007	27	200	218	0	50	0	11	11	
	2008	21	117	315	0	45	0	14	14	
	2009	20	50	945	1	26	0	6	33	
	2010	15	49	609	2	17	1	8	35	
			628	8104	15335	9	992	55	329	825

Source: Delta State Police Hqter,s Crime Statistics, Asaba, 2010

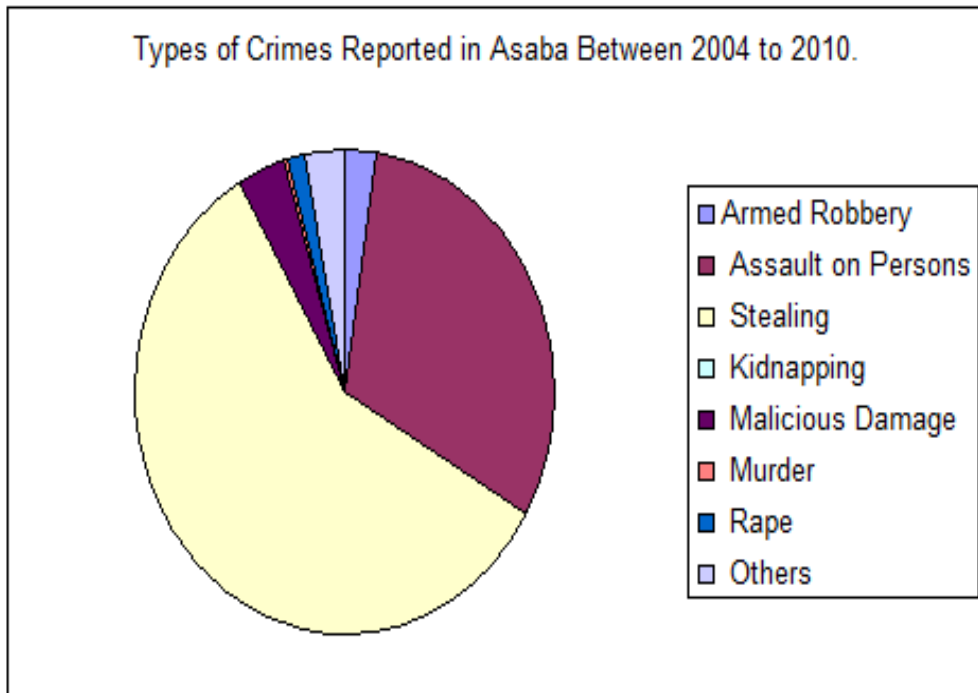
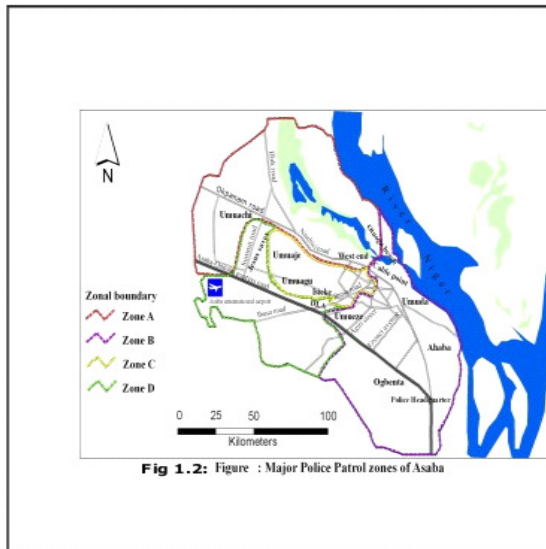


Fig 1.1: Crimes Committed in Asaba
Source: *Author's fieldwork, 2011*

The Role of the Nigeria Police in crime Detections and Control

The Nigeria Police Force is charged with the responsibility of maintaining law and order and protection of lives and properties of the Nigerian citizenry. In a bid to carry out these statutory duties, the law enforcement agent of the Government ensures that there is peace, decorum and sanity in their areas of operation. This is done by routine checks of vehicles on the

roads/streets as well as periodic and scheduled patrols by men of the Police Force to forestall peace, scare, monitor or arrest criminals and other offenders of the law. To effectively carrying out their patrol activities in Asaba, Geographical Information System has been used to map the patrol line (GIS produced Map) for several patrol vans/teams for effective crime control and monitoring in the area. (See Fig 1.2)



The Role of GIS as a Tool for Crime Monitoring (Hot Spot Delineation)

Geographical Information system (GIS) is an effective environmental tool

in crime monitoring through the mapping of the crime hot spots in Asaba (See Fig 1.3 and Fig 1.4)

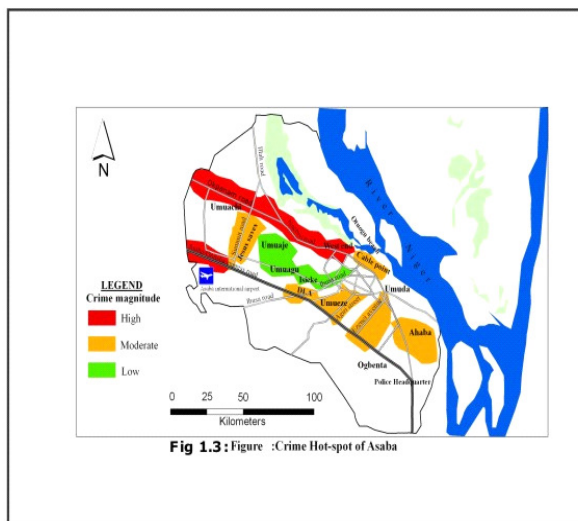
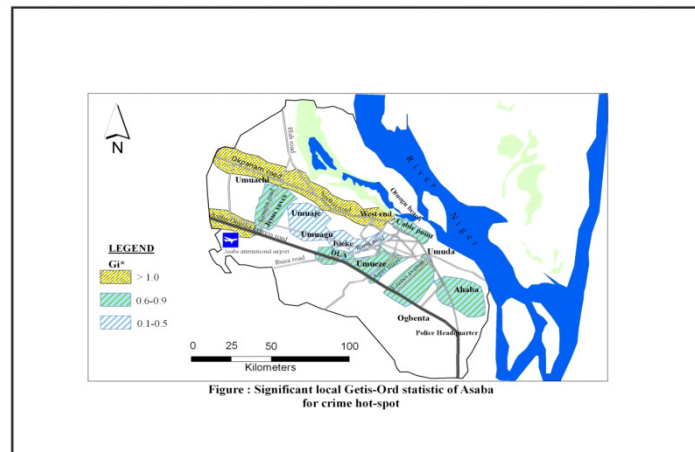


Fig 1.4:



From Fig 1.3 and Fig 1.4 above, it is evident that GIS is a very powerful tool for crime mapping in the study area because it was able to show at a glance where crimes were high (Hot Spots), moderate and low crime areas and as such areas that needs more attentions of the Police Force in terms deployment of their men to monitor these areas to discourage criminal activities in the area under study. From this mapping, the areas of high crimes for the period of 2004-2010 were Okpanam and Nnebisi roads, West-End and Asaba-Onitsha expressway which are areas of high socio-economic activities as well as the political hub of the town while Direct Labour Road (DLA), Cable Point,

Umueze, Jesus Saves, Agiri Street, Ezenei Avenue as well as Summit Junction Roads were areas of moderate crimes. These areas of moderate crimes have markets, and other moderate economic activities. In the low crime category are areas such as Umuaje, Umuagu, Ibusa Road, and Isieke areas which are highly traditional areas with mostly ancient traditional buildings harbouring the indigenes of Asaba.

RECOMMENDATIONS

Management Measures of Crimes in Asaba

According to produced crime maps, resources such as patrols, vehicles and equipment should be concentrated

on high density crime locations. Plans are made in consideration with crime hotspots then patrol routes and timing of patrol services are arranged accordingly. Instead of random patrol services around random neighbourhoods, contemporary understandings of preventive patrols are realized in high crime rated streets within crime occurred peak times by benefiting crime maps.

Command and Patrol

Police executives decide new plans and strategies on crime suffering neighbourhoods with the aid of crime maps produced. These plans are passed quickly to subordinates as memorandums and reports with crime maps attached to them.

Monitoring Displacement and Temporary Changes

Because of strict measures taken as a response to crime hotspots, displacement of crime is a common fact of policing. These temporal changes are monitored on crime maps very easily and new responses are made accordingly.

Public Acknowledgement

Produced crime maps and analysis results are shared with public. Official crime reports acknowledged by the public have positive impact on community-based policing applications and feed-back from local neighbourhoods.

CONCLUSION

Despite the incomprehensiveness and non availability of similar studies, particularly in the South-South geopolitical zone of Nigeria, this research represents a huge success in analysis of general trend, spatial pattern of crimes occurrence over a period of time (2004-2010). The statistical data generated and analyzed in this study were able to identify when and where the crimes occur and the effects on the population as well as the role GIS plays in effective crime monitoring using GIS produced maps. These findings may be needed to assess specific policy, counter measures, and legislation aimed at reducing crime cases in the area. Such

policy and counter measures may include increased road monitoring and road patrol, traffic safety awareness campaign and a more stringent legislation against crime offences.

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