Developing a Crime Mapping GIS System For Law Enforcement: A Case Study of Owerri Metropolis, Nigeria

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Abstract: This paper examines the use of GIS in the development of a crime analysis information system for the Nigeria police. In recent times, criminality has been on the increase with criminals using new and more sophisticated ways to commit crime; resulting to fear and restlessness among the citizens. They police have found it difficult to manage and control these crimes largely due to the obsolete methods and resources they employ in doing so. The purpose of this study is to see how the Nigerian Police Force can adopt the use of crime maps in its operations and reap the benefits. The system will help the police in the analysis of crimes which will lead to crime hotspots identification. Using ArcGIS Software 10.0, we created a digital land use map of crime hotspots in the area and a crime-geospatial database. The results of the spatial analysis and a 500m buffering done on the data shows that areas that are more vulnerable to crime, have no police stations situated around them. This study shows that a GIS based Information system will give the police better insights into crime mapping and analysis which will be a tool to help them effectively manage and combat crime. This study recommends full government involvement in the area of human personnel and infrastructure development for the police to effectively change from the traditional to GIS based ways of combating crime.

Keywords: Crime, Geographical Information System (GIS), Hotspots, Buffering.

1.   INTRODUCTION

The incidence of kidnapping, armed robbery, assassinations, terrorism among other crimes has become a daily occurrence in Nigeria. This increase in crime is attributed to the rising number of unemployed youths and the poor economic situation of the country. The government has allocated billions of naira to curb this rising incidence of criminality without much success.

The police force in Owerri has received massive attention under the state governor's administration in an effort to tackle the rising wave of crime in the state. The government has spent billions of naira in the procurement and distribution of equipment such as utility vehicles, communication gadgets, bullet proof vests, as well and the building and renovation of dilapidated police stations. More so, there has been the introduction of Joint Task Force (JTF) operation; an integration of the army, navy and the police force to join hands with the police to root out crime in the state. Among all these efforts from the government, the police are still not efficient in the

control and management of crime in the city. This is attributed to the old and manual ways they employ in crime fighting.

Irrespective of government's huge investment in the Nigerian police force by way of personnel training and crime fighting equipment, crime has remained the bane of social and economic wellbeing of the people of Owerri-city making the once peaceful city now a heaven for criminals. The means of getting offenders is very much limited and the police force as it appears is yet not fully exposed to modern technologies that will help them combat crime properly. It is therefore with this in mind that this research work is carried out. This research attempts to explore the analytical approach to crime using the GIS technology in Owerri-City. It is hoped that by adopting this innovative approach in combating crime the spate of crime will be drastically reduced.

In today's modern age where computers have become a way of life, it is therefore imperative for Nigeria Police to migrate from the manual system to a digital system in order to reap the associated benefits like crime mapping, crime hotspots identification and GIS analysis of crime. Case files go missing

in manual systems yet this can be eliminated by computerizing the data storage. Storing crime information in a database would lead to more efficient data sharing within the force. This would mean that investigating officers have access to up to date information from any location where there is a computer. This can only be achieved through the use of crime mapping information systems and geographic information system (GIS). Using questionnaire and qualitative data from the Nigeria police, the objectives of this study include 1) To identify the socio-economic factor responsible for crime, 2) To determine the spatial distribution of Crime type based on relevant data from Police stations. 3) To capture and display the location of police stations and crime hotspots using global positioning system (GPS)

A GIS is a system of hardware and software used for the storage, retrieval, mapping and analysis of geographical data. It is a tool for revealing what is otherwise invisible in geographical information [3]. GIS assisted crime mapping is often employed to understand the geographical distribution of crime, identify crime concentrated area, or hot spots, and facilitate deployment decisions regarding the duration and dosage of intervention programs[4]. The early applications of GIS in policing can be traced back to the 1960s, when it was constrained by the limitation of older computer systems lacking memory and speed [5]. The migration of GIS from mainframe to desktop computers provides the law enforcing agencies with a cost effective option for crime control since hardware and software prices have reduced drastically. Methods of data collection available to law enforcement agents include street investigations, informers and undercover operations. GIS would enhance the analysis of the collected data due to its ability to handle spatial data[6].

2. STUDY AREA

Owerri is the capital of Imo State in Nigeria, set in the heart of the Igbo land and is located within Coordinates: 5.485 °N North of Equator and longitude 7.035°E East of the meridian. Owerri consists of three Local Government Areas namely Owerri Municipal, Owerri North and Owerri West, it has an estimated population of about 400,000 (NPC 2006) and is approximately 40 square miles (100 km^2) in area. The Owerri Slogan is Heartland. It is currently referred to as the entertainment capital of Nigeria and is home to an annual beauty pageant called "Miss Heartland". There are five higher institution of learning in the city namely Federal University of Technology, Federal Polytechnic Nekede, Imo state Polytechnic

Umuagwo, Alvan Ikoku Federal College of Education and Imo state University Owerri. Figure 1 shows the map of Owerri city
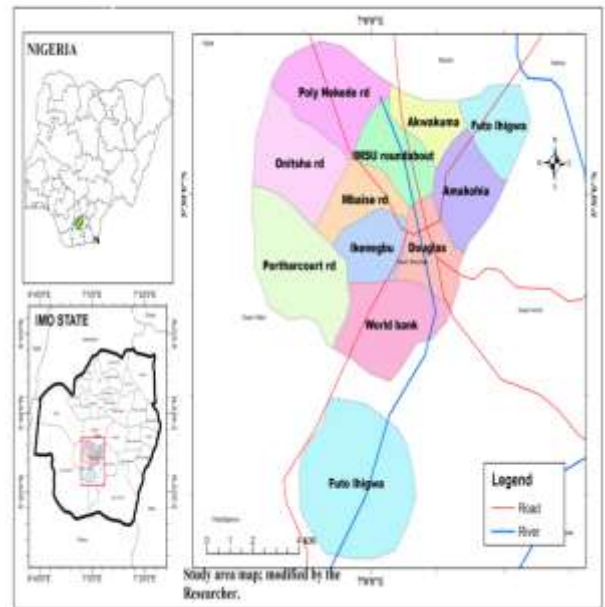

Figure 1 Map of Owerri municipal

3. CONCEPTUAL FRAMEWORK

A crime is an act against a person (for example, murder and sexual assault), or his/her property (for example, theft and property damage) and regulation (for example, traffic violations. Crime is a human phenomenon; therefore it occurs in a place and at a particular time. Crime analysis is important because it helps to identify the different geographic patterns in criminal behavior.

Crime mapping is a procedure using GIS to conduct spatial analysis of crime problems and police-related issues [1]. Crime mapping is a sub discipline of crime analysis which has three main functions. The first one is to facilitate visual and statistical analysis to unravel the spatial nature of crime. The second one is to provide a link to unlikely data sources on common geographic variables and the last one is to produce maps that help to communicate for analysis results [1].A geographic information system integrates hardware, software, and data for capturing, managing, analyzing, and displaying all forms of geographically referenced information [7]. Use of GIS in police departments has proliferated over the past decade. Crime mapping capabilities are useful for police officers patrolling

neighborhoods and investigators trying to solve cases. They can view the recent crime pattern of a neighborhood and query a GIS to search for particular types of crime patterns, such as the location of all recent burglaries within a mile radius of a given intersection[8].

Crime mapping implementation is relatively low in Nigeria. However, numerous examples exist in the developed world eg MAPS (Map-based Analytical Policing System) developed by Rick McKee of the new Zealand police department in the year 2000 to assist his police colleagues in tackling crime. MAPS was predominantly built for and used by Police intelligence analysts to assist in identifying crime patterns and trends, it allowed basic mapping queries to be compiled with a wizard-based formula that could be conducted by all operational police staff. MAPS allow users to build a query, select, display and explore crimes for any location in New Zealand [2]

4.   METHODOLOGY AND DATA

Two types of methods were adopted in this study. The first method is the collection of data using questionnaires. Owerri Municipal has 17 wards of which 8 wards were selected randomly and 15 questions were distributed to each. A list of Police stations in Owerri municipal was also collected from the Police State Criminal investigation department. Ten (10) Police stations were sampled and 2 questions were distributed to each giving us a total of 140 respondents; this is to enable all police stations in the study area to be part of the information gathering and for accuracy purpose. The second method is a step by step process (Figure 2) of how GIS can be employed in the creation and analysis of Crime maps.

4.1 *Spatial data used in this study include;*

a) GPS coordinates of crime hotspots in Owerri City

b) GPS Coordinates of police stations in the study

   area

c) land use and road map of Owerri municipal gotten

   from Ministry of lands and survey,

   New-Owerri secretariat, Owerri.

4.1.1 *Attribute data include;*

- Records of types of crime
- Attributes of police stations in the study area
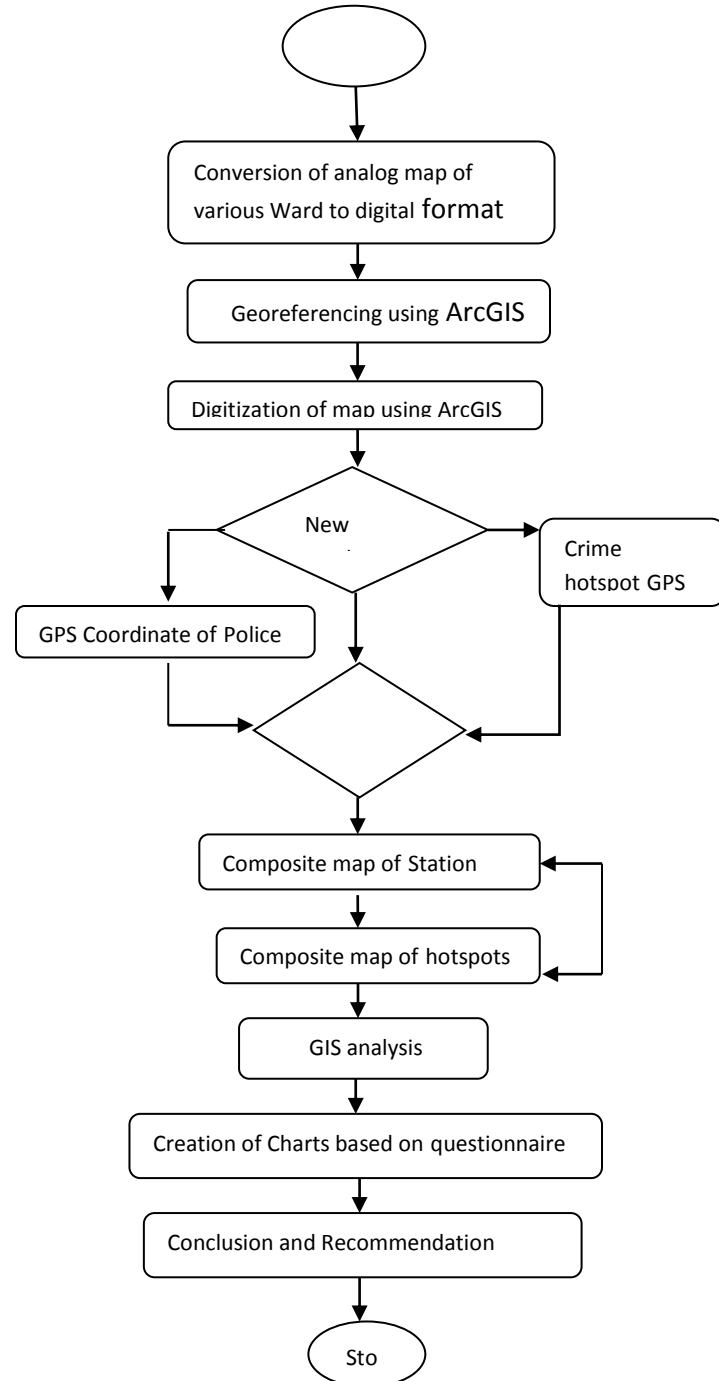- Attribute of crime hotspot

Figure 2 flow chart of GIS map preparation and analysis

5. RESULTS AND ANALYSIS

This study assessed the spatial distribution of crime in Owerri municipal. Data gotten from field work and other relevant sources were analyzed to answer the objective of the study. 140 questioners were distributed, 90% of the respondents are above 27 years of age. All the respondents from the public have lived In Owerri for more than 21 years and they are mainly indigenes which makes them aware of the happenings within the study area.

5.1 Methods employed by police in crime detection

Figure 3 show that the police still rely on the old method of crime detection in the area. 43 of the respondents opined that the use of patrol is commonly used by the police to combat crime, sometimes with patrol van or on foot without uniform, and followed by road block where peoples and car are checked to gather information that may lead to arrest. According to them informant also notify the police from time to time about criminal hide out and crime occurrence.
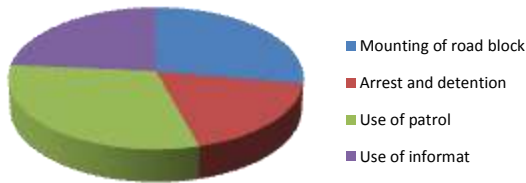

■ Mounting of road block
■ Arrest and detention
■ Use of patrol
■ Use of informat

Figure 3 chart showing method employed by police in crime detection

5.2 Crime types and pattern

With GIS, it is possible to map crime by type and to show which crime is prevalent in a particular area. Figure 4 shows the crime record collected from the police headquarters which aided the analysis; From the chart it is very evident that Assault rank the highest type of crime been committed in the city, followed by rape, burglary etc. This is important for police officers because different types of crime need different strategies in controlling and preventing them. For instance, to reduce chances of murder being committed, assault cases must be controlled or prevented. This type of information guides police officers in making decisions on how to allocate specific resources for specific crimes.
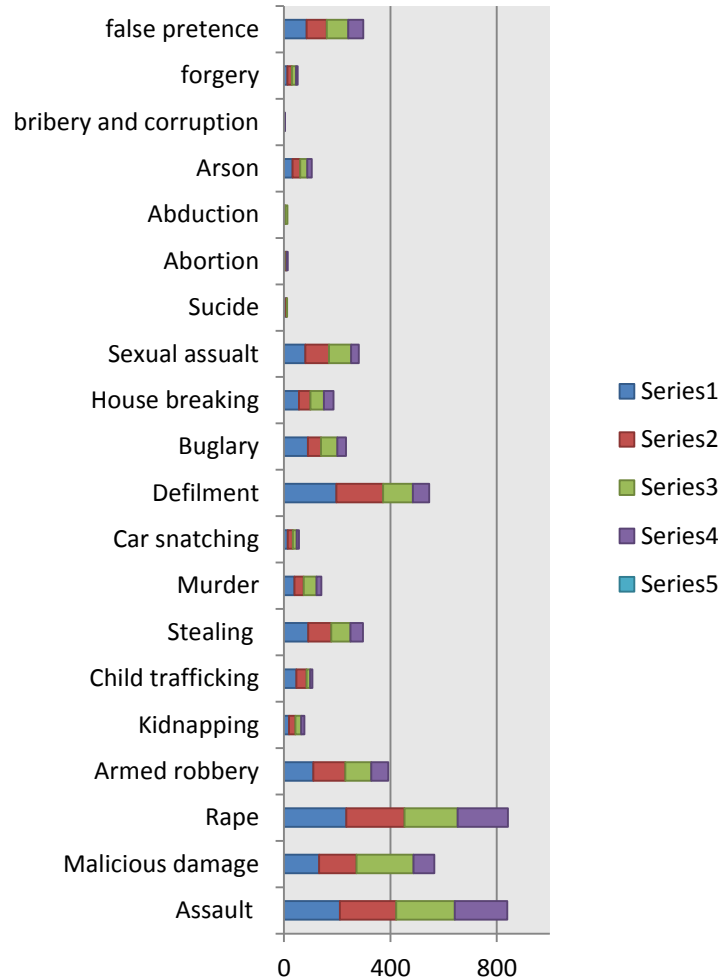

Figure 4 chart of different types of crime

5.3 Socio Economic factors responsible for crime in Owerri

From the public respondents, it was gathered that unemployment, poverty, use of illicit drugs etc are the most common factors responsible for crime in Owerri. Unemployment rank the highest, this is because the youth population which falls between 25-40 years of age is very high while employment is low, jobs are hard to come by, there are few firms in Owerri which are willing to hire the youth, while others who hire often retrench their staff due to poor economy. White collar jobs are readily available in the city, Therefore the only alternative is to indulge in crime to keep body and soul bus

5.4 Crime analysis

This analysis is done in relation to the four basic objectives of the research work. The crime record from police station was obtained from the police headquarter and list of police stations in the city was equally obtained which aided the capturing of the distribution of police station and crime hotspot with the use of global positioning system in the study area. The findings reveals that there are ten police stations in the study area, twelve crime hotspot and several types of crime been committed in the study area of which this will aid the police agency to spread their search and adopt the use of modern technology such as Geographic Information System and Goggle Maps to combat crime and apprehend criminals in the city.

5.4.2 Crime hotspots

GIS helps law enforcement agents plan for crime control. Police officers are able to know where crime is concentrated and focus resources in turn. With GIS it is not only possible to give statistical summaries of crime events per given area but also to visualize the location of crime on a map. Figure 5 shows crime hotspots location indicated with a red circle within the study area. These are the various places in which there are high rates of crime occurrences. Figure 6 shows the GIS analysis result of the crime hotspots. Figure 6, Imsu roundabout, futo Ihiagwa, okigwe road and douglas road has a higher incidence of crime. This is indicated by the yellow color on the map. Crimes are higher in these places because of the location of Owerri main market and the concentration of university students living around these areas. These students belong to cult groups and due to the non location of police station around this area, they find it easy to commit crime and go scout free.
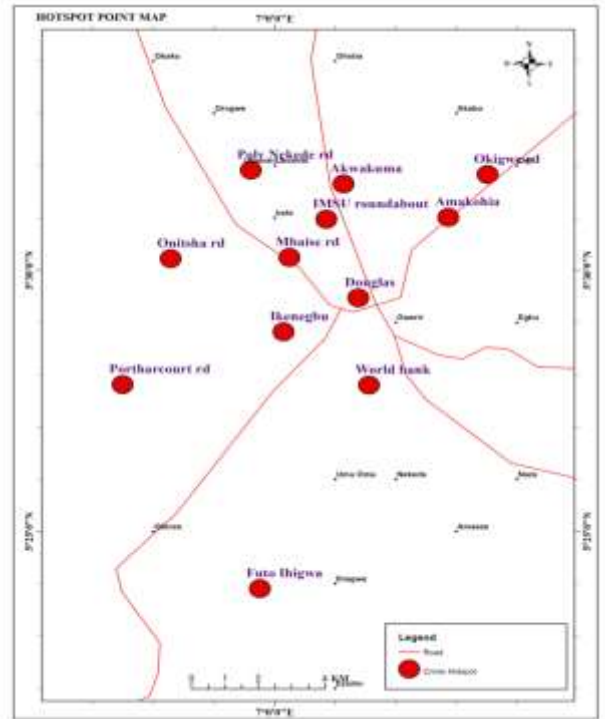

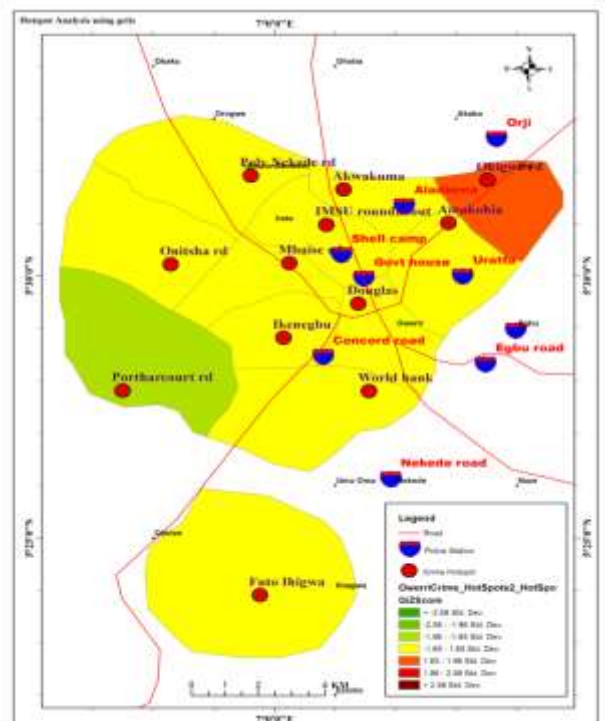Figure 5 GPS coordinate of Crime hotspot was converted into a point Map and overlaid on the study area Map

Figure 6 Crime hotspots analysis result

6. CONCLUSIONS

Based on the response from the field survey, it was gathered that the Police force has heard of geographic Information System but are yet to incorporate it into their daily routine, this was very evident from my visit to the state headquarter of police in the city of Owerri. There were few computer system and no single global positioning system (GPS) Tools seen anywhere in all the offices not to talk about the various divisions, all method of handling data were done manually, that is the reason why combating of crime has remained traditional over the years without improvement. There is need therefore to incorporate geographic information system tools into their structure for better performance. More so, crime hotspots are far from Police stations this is the reason why pattern can be predicted and some areas experience repeat victimization. Furthermore from the statistics of crime gathered assault, rape and robbery are the highest in the city. This is as a result of Institutional and commercial land use of which the youth are mostly involved, this is due to unavailability of jobs and as the adage goes an idle mind is the devils workshop. The solution to all these increasing problem lies in the hand of the government and various recommendations has been proffered below

6.1 Recommendations

The government should establish GIS/ICT sections in all the police quarters and procure all the needed tools, and annually train the police force on GIS usefulness in crime detection and how to use the various tools. Police stations should be cited in areas close to crime hotspot. A map of all the hotspots and photographs of suspects should be stored in GIS tools to increase the knowledge of the police in GIS and aid planners in decision making. More so the police force should have a website where citizens can easily alert them on crime scene, suspect and their photographs at will and an accurate GPS coordinates of all roads network should be stored in the GIS tools in order to provide routine instruction to direct patrol vans to crime scene. The use of GIS can assist the police to improve their traditional method by acquiring information on land use and the socio-economic factors that affects crime. Finally, government should make drastic effort to create jobs by empowering the youths who are more associated with crime from time to time.

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