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Crime Mapping Using Geographic Information System (GIS) Approach In Aba Abia State, Nigeria.

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Abstract **-Aba, Abia state, Nigeria has witnessed activities of criminals perpetuating violent crimes. This necessitated the need for a decision support system that will enhance the mapping of crime pattern .This research focuses on Crime Mapping using Geographic Information System (GIS) Approach in Aba, Abia state, Nigeria. Data regarding to crimes that occurred in Aba was obtained from the C.P.S (Central Police Station Aba). Methodology adopted included the acquisition of GPS coordinates of crime locations, attribute data and analogue map of Aba, Abia state Nigeria, which was scanned and digitized. The GPS coordinates of the crime locations were imported into ArcGIS environment and a database was designed. Queries were also structured to answer basic questions and also demonstrate the effectiveness of the created database. Results showed that the distribution of police stations are not even within the zones in the study area, assaults and theft crimes are the most prevalent in all the zones within the zones amongst other findings. It is therefore recommended that: The results of this study serve as decision support system within the study area; more police stations should be created within Ariaria and Eziama zones to enhance proximity amongst other recommendations.**

Index Terms **- Crime Mapping, Geographic Information System, Spatial Database**

I. INTRODUCTION

Aba is the busiest city in Abia State and is mostly occupied by traders and producers. Crime is a major problem that requires adequate measure to combat and control. The prevalent crimes in the city are stealing, kidnapping, murder, robbery, assault, occasional harm, grievous harm, burglary. As a result of growing rate and severity of crime, successive government in the state introduce different control measures but without much success. In spite of government efforts to tackle crime, the rate of armed robbery, assault, murder, auto theft, kidnapping and violent crimes remain extremely high. The response of the government has come in form of increase for policing capacity, legalization of activities of vigilant groups and re-introduction of militarized approaches of law enforcement. Similarly, the public at large have resorted to self-measures. These measures

include formation of vigilant groups that have lynching of criminal suspects due to the frustration and the inability of police to bring down the level of crime.

The ability to access and process information quickly while displaying it in a spatial and visual medium allows agencies to allocate resources quickly and more effectively. In the mission-critical nature of law enforcement, information about the location of a crime incident, suspect or victim is often crucial to determine the manner and size of the response.

GIS helps co-ordinate vast amount of location-based data from multiple sources. It enables the user to create layers for the data and view the data most critical to the particular issue or.

The rate of crime occurrence has grown sharply in Abia as a result of population explosion, economic inequalities and deprivation, social disorganization, inadequate government service law enforcement, unemployment and social-political conditions. A city with high rate of criminal activities is less attractive to both local and foreign investors. This is the present situation that prevails in most cities in Nigeria and Aba in particular. Most criminal activity depends on spatial information thus having spatial dimensions. Ineffective management of this spatial information affects decision making.

Over the years crime has been manually managed and controlled in Aba, Abia State. This probably is due to the lack of awareness of the benefits of GIS in crime control and management in the state. Records kept in the police stations are manually written in blotters which makes it difficult to make decision for all police stations. Manual process does not provide accurate, reliable and comprehensive data round the clock nor does it help in trend prediction and decision support. Geographic Information System (GIS) is such leading emerging tool which can perform active role in the management of crime since nearly all criminal activities have geographic dimension. It is necessary to put a mechanism in place to identify crime areas and to tackle its problem.

II. STUDY AREA

Aba urban area is situated in southern part of Abia state. It is between latitude 05^0 05’ 40” and 05^0 08 00^N and longitudes 07^0 20’ 00” and 07^0 26’ 00” E (Fig 1.0). Mean annual rainfall over the area decreases gradually from about 4050mm in the south to 2100mm in the north

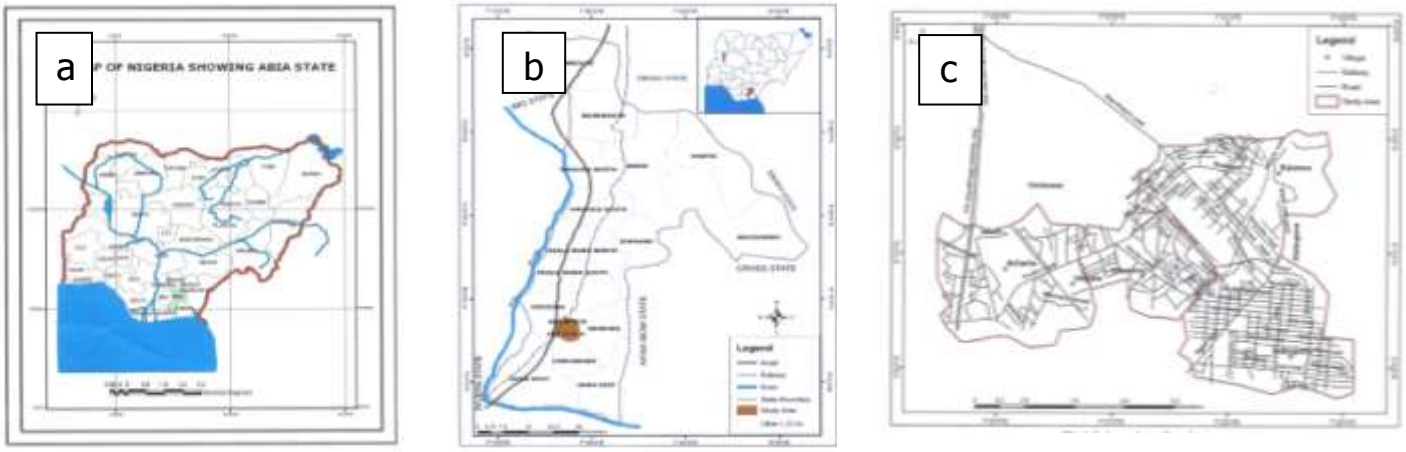

Fig 1.0a Map of Nigeria, (b) Map of Abia State, (c) Map of Aba urban area

III. METHODOLOGY

The methodology was subdivided into various steps such as: Planning stage, Data requirement/acquisition, Digitization/Data conversion and coordinate plotting, GIS database design and creation, GIS analysis and result presentation as shown in the flowchart

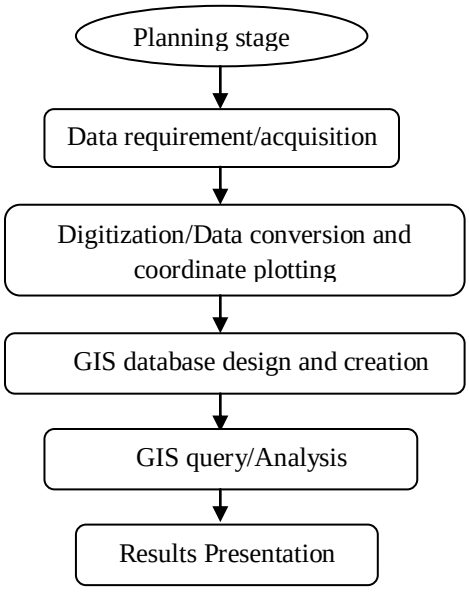

Fig 3.0: Flowchart of methodology adopted

A. Planning Stage

In this phase of the research, a user requirement analysis was focused on what information was presently being used, who was using it and how the source was being collected, stored and maintained. This stage also involved the hardware and software selections.

The necessary information was obtained through questionnaire/interview.

B. Data Requirement

Data used for this research are spatial data and attribute data which included:

i. Administrative map of Nigeria and Abia State showing the study area sourced from Abia State Ministry of Lands and Town Planning.

Acquisition of Secondary Data

The secondary sets were obtained from digitization of available map or data such as:

i. Abia State map showing road networks, towns and location of site of interest

ii. Abia street guide showing the study area

iii. Google earth satellite covering the study area.

iv. Unpublished/published records kept by statutory bodies and organization e.g crime data from police stations and population data from National Population Commission (NPC).

ii. Abia street guide map sourced from Abia State Ministry of Land and Survey.

iii. Satellite imagery of Aba sourced from google map

iv. Crime record statistics (questionnaire and interview) sourced from Central Police Station Aba, Abia State.

v. Population of Abia state sourced from National Population Commission.

vi. Coordinates of police Stations in Abia, and other areas of interest obtained by use of handheld GPS.

C. Data Acquisition

Methods of data acquisition are grouped into primary and secondary data acquisition.

Acquisition of Primary Data

These are data obtained directly from the field:

D. Digitization/Data Conversion

This stage of the research involved the conversion of the topographic map of Aba North and Aba South into a computer based format using A4 scanning device which was subsequently exported to Arc Map environment using Arc GIS 10.1 software. Georeferencing was done and the subsequent digitizing took place.

E. GIS Database Design/Creation

Database design is the process of producing a detailed data model of a database (Hernandez, 2012). The design phase consists of three levels (Kufoniyi, 1998):

I. Conceptual Design
II. Logical Design

III. Physical design

a) Conceptual Design

Conceptual design is the first step in database design where the contents of the intended database are identified and described. It deals with the identification of the basic terrain objects together with the spatial relationship that exist among them. It is human-oriented, often partially structured, model of selected objects and process that are though relevant to a particular problem domain. Conceptual design is carried out independent of the software and hardware to be used to implement the database.

b) Logical Design

This is another stage of the database design in which all the real world entities conceptualized were modeled into the real world using logical design. It is the representation of the conceptual design to reflect the recording of the data in the computer system using a relational database management system (RDBMS) (Effiong and Alagbe, 2012). In this phase, the entities, their attributes and their relationships were represented in a single uniform manner inform of relation in such a way that would be no information loss and at the same time no unnecessary duplication of data.

c) Physical Design

This involves the translation of the real world entities into the computer compactable forms of the chosen structuring model such as relational, geo-relational, network, and hierarchical. For this research, relational (table) structuring method was used due to its easy implementation and management.

All geospatial and non spatial (attribute) data were structured and actualized to form a database in a format acceptable by the implementing software and hardware. Thus, point, line and polygon layers were created for spatial objects on the digital map. Attribute data needs of the database were also structured as shown in the following tables.

This was done such that;

(i) Stored information can be accessed and retrieved at a later date

(ii) Update can be done from time to time.

(iii) Analytical functions can be performed to answer some generic question for the study

ArcGIS 10.1 was used for the database creation for the study area.

IV. RESULTS

Database query involves the retrieval of information stored in the database through the use of certain parameters or criteria based on the researcher's aim in order to aid in decision-making. The following query were generated and discussed: results in the research are presented in figures 4.0- 4.4.,

A. Query, to determine distribution of police stations in the four zones (Ndieogoro, Ariaria, Omuma and Eziama) that make up the study area.

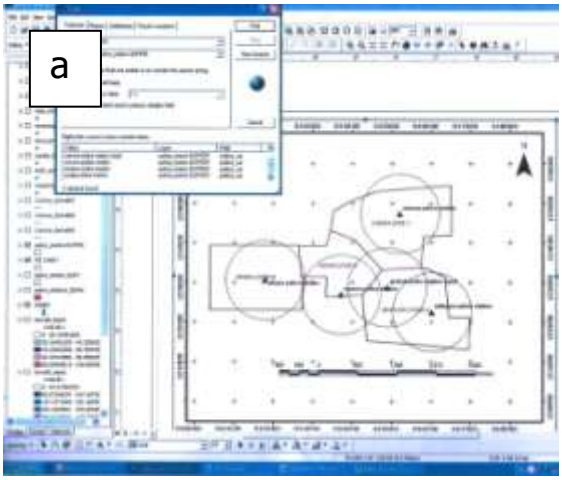

Fig 4.0a: Distribution of Police stations within the study area.

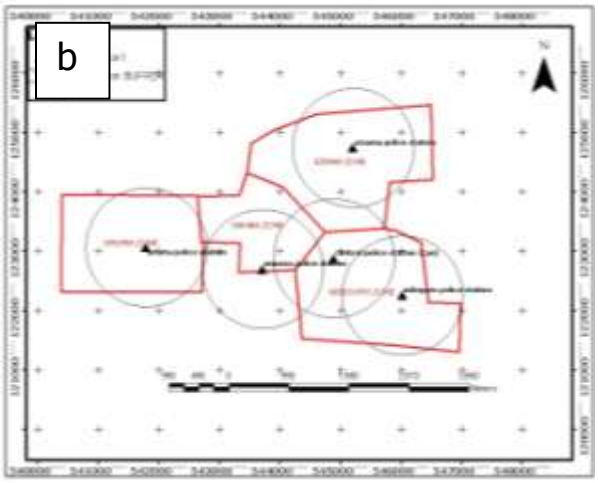

Fig 4.0b: Distribution of Police stations in each zone

The query above determines the distribution pattern of police stations within the study area.

Results, shows that there are two police stations in Ndiegoro zone and one each in the remaining 3 zones. (Fig 4b)

B. Query to determine the total occurrence of assault in zone B from 2007 – 2012.

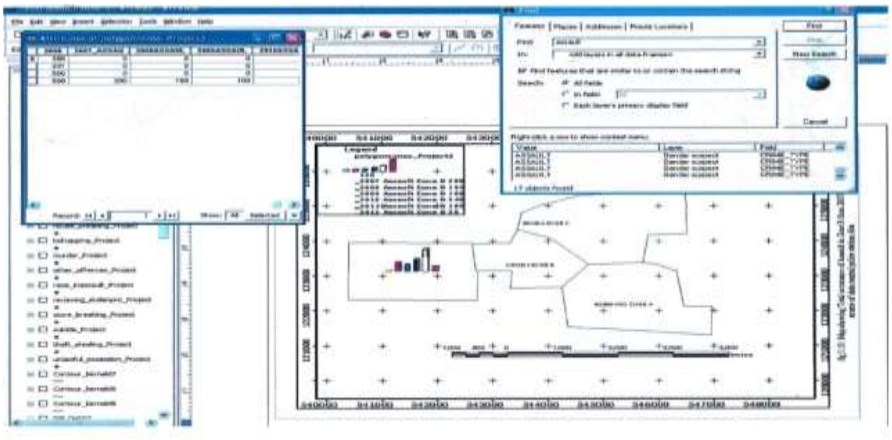

Fig 4.1: Occurrence of Assault in Zone B from 2007 – 2012

Result (fig 4.1) shows that 2007 has the least occurrence of assault whereas 2011 records the highest occurrence of assault in zone B.

C. Query to determine the zone with the lowest reported crime.

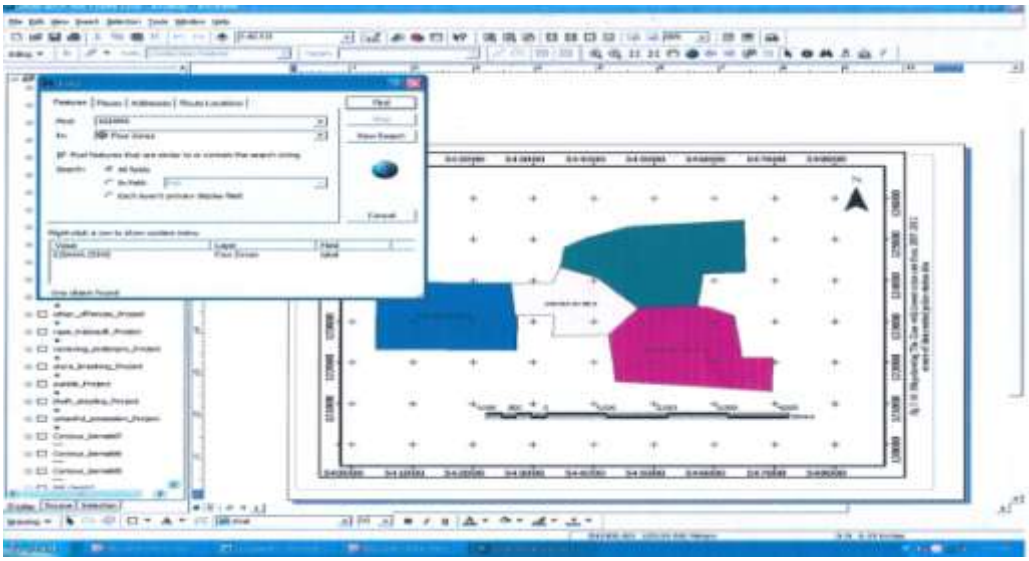

Fig 4.2 Zone with the lowest crime rate from 2007 – 2012

Query results (fig 4.2) shows that, Eziama (zone D) had the lowest reported crime rate in Aba Urban area from 2007-2012

D. Attribute query to determine Crime occurrences in various years (2007-2012) within the study area

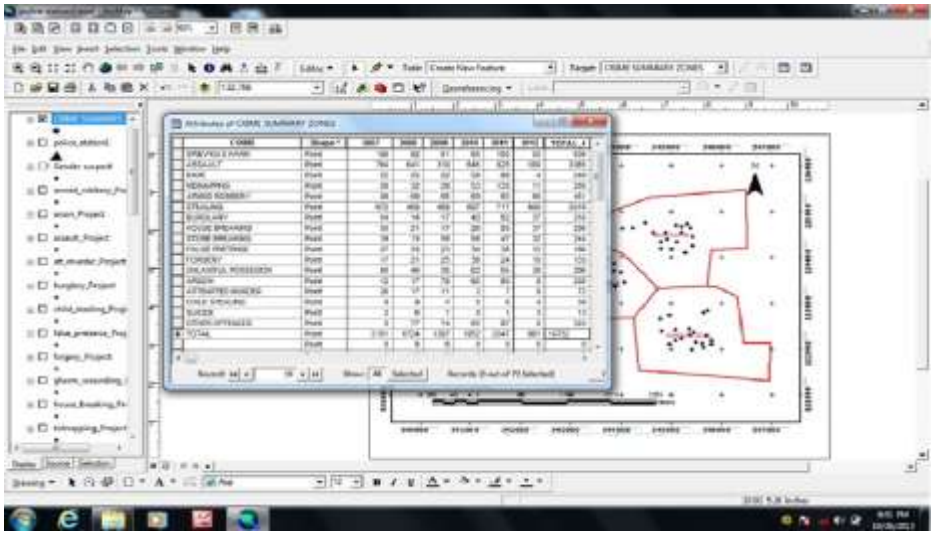

Fig.4.3 shows the summary of crimes in various years.

Results (fig 4.3) shows that in 2007 there was 2161 crime occurrences, in 2008 there was 1724 crime occurrences, in 2009 there was 1387 crime occurrences, in 2010 there was 1952 crime occurrences, in 2011 there was 2547 crime occurrences and 981 crime occurrences in 2012.

Eziama with the record of 1493 crimes was the lowest crime density.

E. Attribute query to determine crime summary in various zones within the study area from 2007-2012.

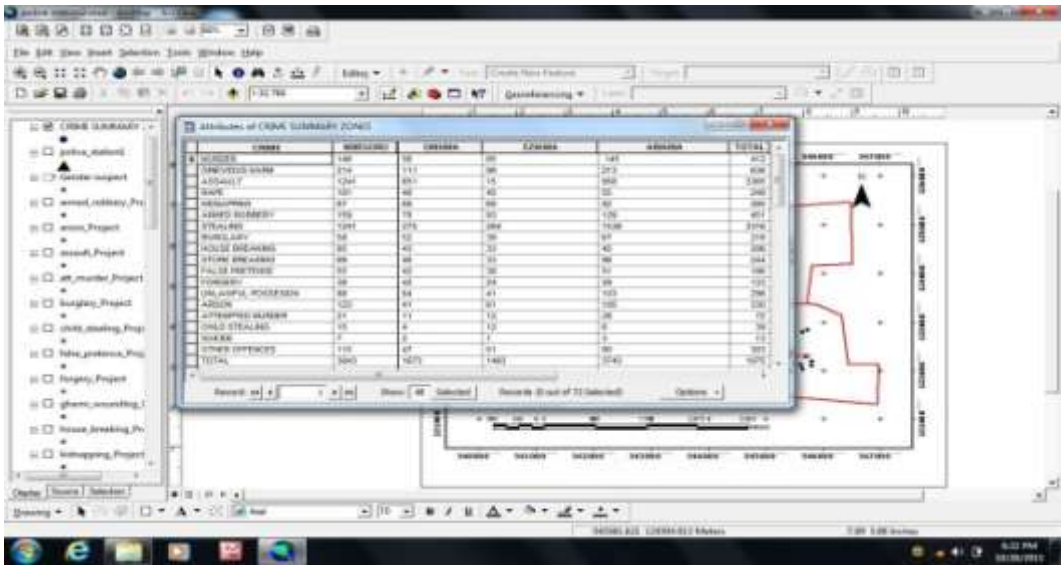

Fig 4.4 Summary of crime in various zone from 2007 – 2012

Result shows that Ndiegoro reported 3843 crime occurrences, Ariaria 3743, Omuma 1673, and Eziama 1493 crime occurrences from 2007 to 2012.

V. SUMMARY & CONCLUSION

Crime statistics obtained from the police stations were used to plot the crime maps using Arc map 10.1 to show the spatial pattern of the Area.

Summarily, it has being proved that high rate of crime in an area is to a great extent a factor of population, structure and social activities within the area and not necessarily the area extent of the zone.

The findings of this research show that GIS is a compactable means of mapping crime. Given the right atmosphere and cooperation from all relevant authorities, GIS is a reliable tool to map and analyze crime occurrences with a view to determining factors leading to such crime and how they can be effectively managed.

With GIS, the police and other law enforcement agencies can produce maps showing the crime hot spots. These maps can be used to forecast crime and map out strategies for combating crime.

The use of GIS is of great benefit to the law enforcement agencies in their effort to analyze crime. With GIS, there would be better information on crime readily available.

VI. RECOMMENDATION

It is recommended that the result of this research serve as a decision support system within the study area.

More Police Stations should be created within Ariaria and Eziama zones to enhance proximity so as to enable the police serve the population within the study area.

Crime data should be made available on the internet for easy dissemination of data.

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