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Research Article

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GIS – Based Crime Prevention: A Participatory Approach to Crime Mapping and Hot spots Analysis in Uyo, Akwa Ibom State Nigeria

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Abstract As essential apparatus in crime prevention, crime mapping and Geographical Information Systems (GIS) are being progressively more accepted by law enforcement agencies. Development in technology and the accessibility of geographic data sources make it feasible for police departments to use GIS and crime mapping. GIS and crime mapping can be utilized as devices to discover reasons contributing to crime, and hence let law enforcement agencies proactively take action against the crime problems before they become challenging. The purpose of this study is to conduct a literature review of Geographical Information System and Crime Mapping in Crime Analysis and to propose policy recommendations regarding the implementation of crime mapping techniques in Akwa Ibom State, Nigeria. To achieve this purpose, first a historical evaluation of GIS and crime mapping will be rendered and then the importance of place will be explained in terms of assessing crime problems accurately.

Keywords Crime Analysis, Geographical Information Systems, Crime Mapping, Hot spots

Introduction

Deciding a policing method is always influenced by some facts of place. Jurisdictions, zones, and incident locations are all related to geography. From pin maps to modern crime maps, mapping has always been an important element of law enforcement. Geographical Information Systems and crime mapping are only a more developed and modernized implementation of traditional types of things that law enforcement agencies have always done. In today's world, police duties are assisted by high technologies such as Geographical Information Systems and crime mapping. Block [1] noted that pin maps have been seen in the police chiefs' rooms since the pin was discovered. Those maps were serving to demonstrate which areas were affected by crimes and in what kinds of places they were occurring at a glance. The developments in computer hardware and software have given further momentum to the use of maps. Many law enforcement agencies use crime maps and GIS thanks to this technology; this enhances the ability of police executives in making reasonable decisions about patrol assignments, better personnel policies, and proactive crime prevention programs. In practice, GIS and crime mapping are used to find out the question "Where?" such as
"Where should we focus efforts to catch a serial killer?" or "Where should we build a new police station to fight the crime problem?" or "Where is crime highest?" By analyzing the data provided from various sources, users at various organizational levels can make observations, conclusions, and policies. Heikkila [2] defines Geographical Information Systems as "GIS is an organized collection of computer hardware, software, geographical data and personnel designed to efficiently capture, store, update, manipulate, analyze and display all forms of geographically referenced materials." GIS not only has the potential of storing the data, but also has the capacity to create a map that makes the data visible. Studies have been done on the role and importance of crime mapping in prevention and reduction of crime in different places such as India [3], the criminals and victims has been explored by some researchers [3].

Crime Mapping Concept

Corbett and Rambaldi [4] narrowed down the concept of applying maps in a community context by describing community maps as a representation of socially or culturally distinct understanding of landscape that includes information excluded from conventional maps. With the very notion of community maps, it could enable communities to represent themselves and their relationship to their physical, cultural, economic, and biological landscapes. Community building, networking and communication are main components of community mapping. Enabling the community will ensure a more beneficial outcome if implemented properly as this reflects the collective process and inclusive process of the whole group [4]. Crime mapping involves mapping incidents to identify hotspots and analyze spatial relationship [5]. To Martinez et al. [3], GIS provides positive payback and continuous possibilities in crime mapping and policing from community and problem oriented policing, detailed relationships between crime, victim, and the offender, demographic and population changes, resource allocation, integration of community and government resources, visualization & analysis of trends, decision & policy formulation, and as effective communication tools [6]. Geographic Information System is an essential apparatus in crime deterrence by assisting police officers to analyze problems through an up to- date and comprehensive data. With the data generated and analyzed, crime patterns are identified. Crime mapping can be more sustainable when the community participates and appreciates the process. However, it is also necessary to look at the readiness of the community in engaging themselves as individual and as a group. Readiness includes assessment of different factors such as resources, skills or capability of stakeholders, powers that be, and assistance of residents, among others. Understanding of crime concentrations in an area is important in planning ways as well as in identifying areas of high risk of repeated victimization [7]. Moreover, crime prevention in its broad sense may even include an initial step describing awareness of crimes. Consciousness of crime and sensitivity of security lead to a healthy and sustainable community
[3].

Participatory Approach

Civic participation geographic information systems broaden civic involvement in policy making through GIS as a medium to attain the goals of community organizations and groups [8]. Schroeder [9] presented some reasons of these community-based organizations in adopting Geographic Information System. The reasons are:

a) for management (e.g., program evaluation),
b) for strategic purposes such as the assessment of local or neighbourhood needs,
c) for organizing (e.g., recruitment of members), and
d) for tactical reasons, such as in counter-mapping and the representation of local knowledge.

In addition, one of the aims of PGIS is to empower communities [10]. Pelfrey [11] posited that GIS benefits law enforcers and peace officers in two basic ways. First, by deploying officers in a more intelligent fashion, law enforcement agencies will have more officers available for proactive work (such as problem solving). Second, by identifying crime patterns and inferring where crime is likely to develop, police officers and peace officers alike can engage in preventive work to reduce their future workload.

Crime-Place Relationship and Role of Place in Assessing Crime

Brantingham et al. [12] noted that one of the most important aspects of the crime is the location. The place of a crime and any other geographic information connected with a criminal incident can give a lot of information about characteristics of possible criminals, assist in the design of prevention, assist in the assessment of programs, and help get a better perspective of environmental reasons that may be related to criminal incidents. The sites of incidents are necessary to analysts who are concerned with recognizing regions containing a high level of crime. Even a person who has no education about criminal science knows that crime is not at the same level in different locations. In nearly all cities, there are some high level crime places and low level crime places. This vital fact was realized by some researchers nearly two hundred years ago. These researchers, rather than being concerned with the criminality of individuals, were interested in the high criminality of places such as cities, counties, states or towns. These scholars tried to understand the reasons for crime rate differences in different places and if these differences in levels of crime were because of the individuals who lived in those

areas or because of the features of these places. In this concern, it is believed that the importance of places was discovered a long time ago in criminal science.

Methodology

The paper used a blend of quantitative and qualitative techniques through survey and interviews. The study employed the descriptive method to define the level of awareness of law enforcement officers in communities in Nigeria.

Participants

The respondents were classified in two groups: the law enforcement officers and the Public.

Profile of Respondents

Respondents	Numbers
Law enforcement officers	30
Public	96
Total	**126**

On the other hand, data were gathered from the public by administering questionnaire in selected public areas for two (2) days by enumerators. In here, the respondents from the public grouping are Uyo residents randomly selected along the vicinities of the public places considered in this study. A quota-convenience sampling method was used in the process where each enumerator gathered at least 10 participants per day. The public areas were composed of Idongesit Nkanga Secretariat, Unity Park, Ibom Plaza, Urua Akpan Andem and Ikpa Road.

Complete responses from the participants, within the law enforcement officers and the public, were ensured to get a high degree of accuracy in data presentation and interpretation. The total number of respondents was 126 participants, both from the public and the law enforcement combined.

Materials

A self-made survey-questionnaire measured the participants' awareness on crime mapping and crime hotspots. The questionnaire which was based on several related literature asked the respondents on what they perceive as the most crime prone in Uyo metropolis among the 15 listed. This specifically looks at the three top crimes in Uyo metropolis based from crime statistics - theft, physical injuries, and robbery. The data generated from the responses was then statistically compared with the actual data gathered. By comparing the discrepancies of the two data, the researchers were able to analyze the awareness of the participants on the crime hotspots, and consequently, the crime mapping program.

Results and Discussions

Perceived and Actual Incidence of Common Crimes: Theft

Public Areas	Percentage (%)
Idongesit Nkanga Secretariat	15
Unity Park	20
Ibom Plaza	35
Urua Akpan Andem	30

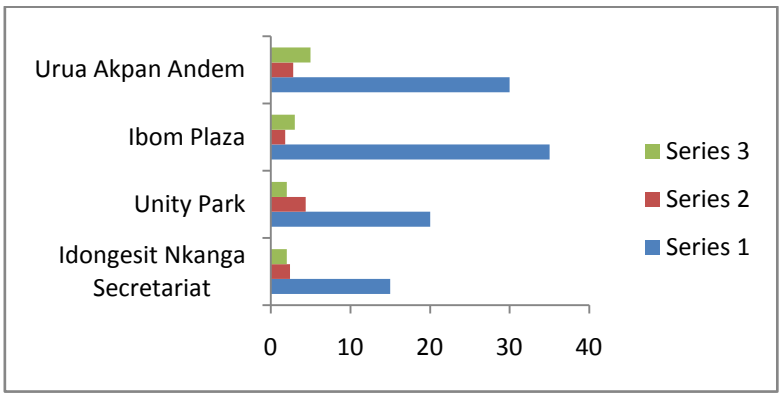

Figure 1: Areas in Uyo with Perceived Prevalent Incidence of Theft (n=126)

Figure 1: shows the bar chart on the prevalence of theft on selected areas comprising the Uyo district. The bar chart compares perceived knowledge of the respondents with actual crime data. The comparison is important in order to determine whether the respondents are able to know accurately the prevalence of theft and existence of hotspots. The result of the comparison shows that the community is able to identify theft hotspots around the city. Moreover, there is a relatively small difference in terms of perception of the respondents as to the prevalence of theft in the different areas.

Perceived and Actual Incidence of Common Crimes: Physical Injury

Figure 2: shows the graphical variation on the respondents' perception of the prevalence of physical injury cases with that of actual data. The chi square statistics between the two was measured to be 12.38 with p-value of 0.05 which is equal to the critical level of 0.05 indicates significant difference between actual and perceived value. The finding suggests that the perceived place of occurrence of physical injury is significantly different than actual data.

Public Areas	Percentage (%)
Idongesit Nkanga Secretariat	20
Unity Park	25
Ibom Plaza	35
Urua Akpan Andem	20

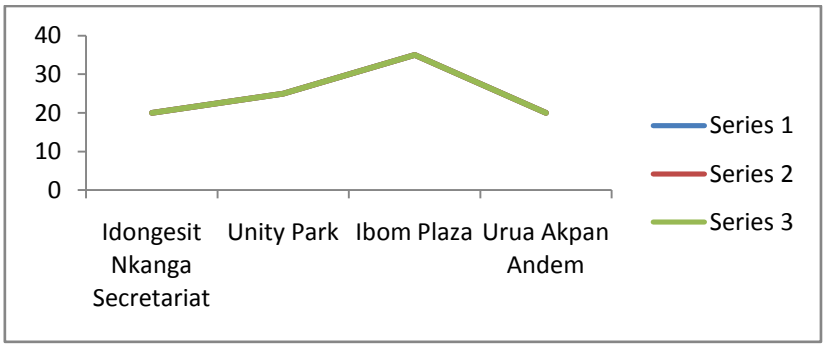

Figure 2: Areas in Uyo with Perceived Prevalent Incidence of Physical Injury (n=126)

Perceived and Actual Incidence of Common Crimes: Robbery

Figure 3: shows the graphical variation on the respondents' perception of the prevalence of robbery with that of actual data. The chi-square statistics computed for the difference between perceived prevalence of robbery and actual data yielded a result of 5.03 with p-value of 0.54. The value is not less than the critical value of 0.05 indicating no significant difference. The result implies differences observed in the line presented in Figure 3 do not constitute significant difference.

Public Areas	Percentage (%)
Idongesit Nkanga Secretariat	20
Unity Park	25
Ibom Plaza	25
Urua Akpan Andem	30

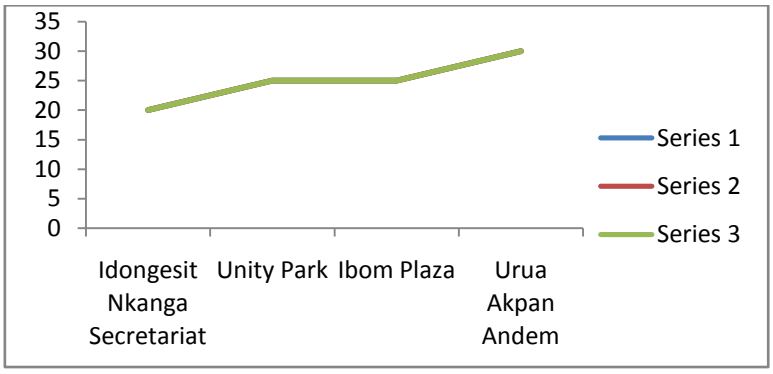

Figure 3: Areas in Uyo with Perceived Prevalent Incidence of Robbery (n=126)

Awareness in GIS and GIS Based Crime Mapping Programs

It is interesting to note that respondents consisting of residents living on those areas in Uyo, and law enforcement personnels are aware of the GIS-based Crime Mapping program. However, on the technology side of it, a low level of awareness exists. For this reason, as shown previously, the respondents' usage of the technology is at the minimum. It is necessary that respondents have hands on learning at least to the extent where they are able to navigate through the site and extract useful information needed to be more effective in their functions as crime prevention agents. Technology dissemination and education among the Uyo residence is needed for the technology to be accepted. The crime mapping initiatives must be implemented at the grassroots level. Effective communication between the law enforcement departments and community organizations can result to implications vastly beyond the project itself. Thus, crime mapping can boost police-community relation which is very important in combating crime and maintaining peace and order. Lubrica [13] also emphasized strong leadership commitment and participant attitude as crucial factors in implementing GIS. Hence, it could be inferred that involving community in web-based crime mapping will not only help improve the project itself but the community's stance against crime as well.

Conclusion and Recommendations

In Uyo City, the web-GIS crime mapping and GIS-based analysis of crime are still gaining popularity. As a result, the respondents exhibited a knowledge gap with the actual data of crime incidences and occurrence, as seen in the results of the study. Because of the relatively low level of awareness of the web-based crime mapping, it is the possible to recommend this study to make a wider dissemination of this system to the communities and public, through appropriate information, education, and communication campaigns. Problems such as lack of internet access, computers could have contributed to the low awareness of the people. It is likewise suggested that more effort in disseminating information on the web-based crime map be made. Also, computers, mobile gadgets and internet access are recommended to be provided to the officials, as well as support for the Local Government Area (LGA), in order for the system and the process to be institutionalized in the communities and the whole city. On the other hand, factors such as capabilities (e.g., skills and tools) must also be assessed in adopting the crime mapping system. These, though, have yet to be addressed and developed as seen in this study. Organizational factor, strong leadership commitment, attitude and infrastructure are needed to assure effectiveness and sustainability of this endeavour. Studies also be done before and after crime prevention to assess effectiveness of the system and efforts for further improvement of crime prevention.

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