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Managing Urban Crimes with Geoinformatics: A Case Study of Benin City, Nigeria

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Abstract
In recent time, the increase in rural-urban migration has continued to have both positive and negative impact on the receiving urban environment. Social vices such as terrorism, urban crimes, prostitution, drug cartel and urban slums are on the increase and as a result, most infrastructural facilities are been overused resulting to urban blight. In most developing countries like Nigeria, the impact of corruption and act of criminality has equally added to this menace and effort by security organisations to restore urban sanity has yielded little or no result due largely to the use of mundane policing methods. Using Geoinformatics methodologies (ArcGIS and ILWIS software), results of buffering; network, proximity, and crime service area analyses on crime hotspots in Benin City reveals that some areas are more vulnerable than others. Base on statistical analysis of administered questionnaire, the study shows that perceived higher income (33%), employment opportunities (24%), basic infrastructures (15%), quality of life (10%), change of environment (9%) and other reasons put together (9%) are mainly responsible for migration and consequent urban growth. The location of police stations vis-à-vis police-public relations was observed to be very poor. The study also revealed that the major crimes in the city are armed robbery (29%), burglary (22%), rape (19%), pick pocket (15%), murder/assassination (4%) and other petty crimes put together (11%). Combating crime requires intelligent ICT system and a pragmatic intelligent synergy between the public and well-prepared police force. Reducing indiscriminate rural-urban migration through rural infrastructure and police welfare/logistics improvements are recommended.
Keywords: Crime, Geographic Information Systems (GIS), Geoinformatics, Remote Sensing, Urban Environment.

1. Introduction

All over the world, threats from terrorism, drug cartel, and organized crimes have been increasing at alarming rate (Mishral, 2003). Consequently, the events of 9/11 has clearly illustrated that no nation, however politically powerful and infrastructurally endowed it may be, is immune to crime and act of terror. The International Crime Victim Survey (ICVS) has collected data on 55 countries, spread over six major world regions including Africa, Asia, Central and Eastern Europe, Latin America, and Western Europe. Findings showed that for the 1989–1996 period, more than half of the urban respondents reported being victimized at least once regardless of what part of the world they inhabit (Ackerman & Murray, 2004). Also, it was stated that high crime rates are not unique features of a few nations, but a statistically normal feature of life all over the world (Fajemirokun *et al*, 2006).

By definition, a crime is a commission of an act or act of omission that violates the community, as distinguished from torts and breach of contract (Microsoft Encarta Encyclopaedia, 2004) and according to the Longmans Dictionary of Contemporary English, a crime is an illegal activity in general. Resulting from these definitions is the fact that any activity being carried out by an individual or group of persons within a particular time and space, which does not follow the guiding principles of the rule of law amounts to a crime. The global upsurge in crime and criminality has continued to gather momentum such that effort is been intensified daily by concerned individuals and governments to combat the menace. For instance, from Los Angeles to New Delhi, as observed by Hasan (1993) 'urban crimes statistics reveal that not only is the incidence of violence becoming more frequent, but the nature of those crimes are turning out to be heinous'. Given that the protection of the lives and properties of the citizens is the major duty of every responsible government, the increasing wave of crime in the society, internationally and locally calls for concerns, proper documentation, investigation, analysis and onward prosecution of offenders to logical conclusion, as this will provide the needed deterrent and data bank for effective crime policing aimed at possible prevention and management.

The situation is very depressing in developing countries like Nigeria where rapid growth of unplanned cities and population pressure force poor inhabitants to live in overcrowded spaces, thereby undermining social relations and increasing the tendency for conflict, violence and crime. The disorderly growth of urban areas is, in part, provoked by poverty, the breakdown of traditional and legal values, structures and social norms, psychological disorientation, child abuse, street hawking, unemployment and violence.

In recent time, the increase in crime occasioned by indiscriminate rural-urban migration has continued to have both positive and negative impact on the receiving urban environment. However, social vices such as terrorism, urban crime, prostitution, drug cartel and slums are on the increase and as a result, most infrastructural facilities are been overused resulting to urban blight. To Odekunle (2005), there is no doubt that, since the mid-seventies, Nigeria has been experiencing what is referred to in criminological literature as a "crime-problem" i.e. when crime, in terms of incidence and seriousness, passes from the normal or tolerable level to the pathological and becomes a "social problem". To Ikhuoria & Bello (2011), the perceived results of social vices (criminal drug abuse and unprotected sex) such as HIV/AIDS has been attributed to labour migration or diffusion through international mobility of commercial sex workers into Benin City, the study area.

Since crime is a very broad discipline, investigating crime, therefore, requires identification of specific crimes and their location attributes since different crimes will require different resources and logistics. Identifying and analyzing hotspot of crime would help to achieve the needed result (Gupta *et al*, 2012) because effective urban crime control and management requires the collection, organization and retrieval of a variety of data. Multiple types of data such as text (criminal data, property data, gang information, case profile), graphic (photographs of criminals, pictures of crime scenes) and geographic (crime locations, details of the area) need to be accessed when and where such data are needed, especially in time-critical situations.

In most police stations in Nigeria, and in Benin City the study area in particular, the process of handling criminal matter is very poor as complainants are expected to, in most cases, provide the pen and paper to document their complains, these papers are haphazardly collected and content re-entered into another general case file with pen by the police. Thus in the event of fire outbreak or any disaster, the possibility of retrieving any information is zero. This should not be the case in this modern Information Communication Technology (ICT) driven world where computer (hardware and software) and internet facilities together with Global Positioning Systems (GPS) gadgets are available to do same with minimal effort and maximum result. Unfortunately, the problem now is that the existing manual method of documenting, filing and handling criminal cases calls for urgent overhauling as the method and processes are currently at variance with what is obtainable in most developed world like USA. For example, according to Shillingford & Groussman (2010), "when snipers terrorized the Washington, D.C., area in October 2002, police used GIS to link 13 separate attacks that occurred over the course of several weeks and in several states. And, the CompStat program (which made extensive use of GIS technology) played a role in reducing crime in New York City in the 1990s and is used today in Los Angeles, Baltimore, and Philadelphia". (Also see for example, Bruce & Stallo, 2009) where crime is managed using digital means such as Geographic Information System (GIS) and database software methodologies.

The growing potential of GIS for supporting policing and crime reduction is now been recognised by all because GIS, a variant of Geoinformatics, can be employed at different levels to support operational policing, tactical crime mapping, detection, and wider-range strategic analysis (Chainey & Ratcliffe, 2005). GIS methodology and Remote Sensing (the acquisition of geospatial data without having direct contact with the object been sensed) can jointly be used to digitally acquire, store, retrieve, manipulate, analyse and present various georeferenced crime scenarios that can act as decision support tool in crime management plans, policy formulation and combat operations (see for example, Pollock, 2012 & Boba, 2009) hence, the rationale for its adoption in this study.
Using questionnaire, Focus Group Discussions (FGDs), quantitative and geoinformatics methodologies, the specific objectives of the study are to (1) examine the factors responsible for, and impact of, rural-urban migration and urban growth on crime distribution, (2) determine and analyse the types and hotspots of urban crimes, (3) determine the influence of police stations on crime and urban safety, and (4) design a workable Crime Managing Information System (CMIS) as a synergy intelligence system for crime management.

1.1 The Study Area

The geographical coordinates of the study area lies within latitudes $6^0$16'10''N and $6^0$24'50"N, and longitudes $5^0$34'41"E and $5^0$40'40" E (Figure 1). The study area straddles across three local government areas (Egor, Oredo and Ikpoba-Okha). During the past three decades, Benin City has experienced tremendous growth in population and in the structural complexity of its activity mix. From a population of 53,753 in the 1952, Benin City reached

a size of 100,694 in 1963, and has been estimated at 249,437 in 1972 (Omuta, 1984); 314,219 in 1976 (Sada, 1976), 425,000 in 1981 (Ozo, 1981), 801,622 in 1991 (NPC, 1991), 1,085,676 based on 2006 NPC census (Ikhuoria & Bello, 2011). Beginning with the dreaded reign of Lawrence Anini armed robbery gang in 1986, the city has continued to witnessed unprecedented wave of criminal activities ranging from rape, armed robbery, burglary, arson, kidnapping, destruction of government properties, cultism, murder, assassination to mention but a few hence, the need to provide alternative policing approach using geoinformatics. Of particular significance of the study area is the recent killing of Olaitan Oyerinde, the personal private secretary to the state governor of Edo State in May 4, 2012. This and many other recent events necessitate a systematic study and pragmatic overhauling of the security apparatus.

2. Literature Review

Globally, crime and criminalities have assumed different dimensions such that dealing with it demands a lot with respect to ethical dilemmas and decision in criminal justice (Pollock, 2012). While much has been said and observed in criminal matters all over the world, effective gathering of crime data, its analysis and taken informed decision in planning and policy formulation requires a careful application of technological and scientific approach that integrates hard and software with traditional intelligence gathering (see for example, Chainey & Tompson, 2008; Bruce & Stallo, 2009, Gorr & Kurland, 2012). The need for the integration of modern state-of-the-art techniques is informed by the sophisticated manner in which crimes are executed. For example, "in the Western Hemisphere, we have only to look at Colombia—and, of course, at Mexico—to see just how effective drug criminals can be. On the other side of the world, we see authorities in Burma and increasingly in Afghanistan, using the drug trade as vital sources of state income" (Snyder, 1998). The need for efficient and effective application of Information Technology in public safety management is increasing in the present Indian scenario of crime. For example, the capabilities of Kriging as well as weighted overlay analysis were effectively applied to identify the crime patterns in the district of Jhunjhunu on a GIS platform (Gupta *et al*, 2012)

In Africa, the PUNCH newspaper of 28 June, 2006 published that millions of small fire arms are circulating in West Africa, mostly in the lands where rebel activities are going on. It was also reported that there are at least eight million (8m) small fire arms in West Africa, with more than half in the hands of the insurgents and criminals. In addition, it was equally reported that criminal elements in Ghana alone poses some 40,000 small arms. The arms were often sold illegally in exchange for hard currency or goods such as diamonds, drugs or other contraband. The estimate of the black market trade in small arms ranges from two to ten billion a year. Nigeria, Africa's most populous nation with more than 130 Million inhabitants is a significant actor both as producer and consumer of weapons the paper recorded. Similarly, crime rate in South Africa is also worrisome as social misfit parades the street looking for an opportunity to commit crime as social vises such as rape and armed robbery has contributed to the spread of HIV/AIDS in the country (see Capelli, 1998; Ikhuoria & Bello, 2011). In Southern Africa for example, Capelli (1998) remarked that since the end of apartheid, crime in all its various forms has expanded exponentially thus, no one is immune. He argued further that affluent South Africans, tourists, expatriates, business people, and the poor have all been affected by this growing crime wave and affirmed that in 1995 alone, crime drained $7.1 billion out of the South African economy. That amount represents 6 per-cent of the nation's GDP - equivalent to estimated profits of the proposed Cape Town Olympic Games. Many other countries are also caught in this web of crime, although with variations in magnitude and levels of management.

Olnunmelu (2005) noted that "with the population of Nigeria growing at an alarming rate according to statistics, the ability of the existing law enforcement agencies to provide the needed security and the ultimate safety of lives and property in these fast growing commercial cities has become a major source of concern for Nigerian government". This has earlier been observed by Snyder, 1998; Corsun, 1998. This to a large extent necessitates the integration of geoinformatics as an added approach in probing into crime and criminalities. According to Markovic & Stone (2002), without a systematic way to describe crime and public safety concerns, one that both the police and members of the public can understand, there is danger that only the sensational crime of the moment will form an interest.

Geoinformatics approach such as GIS has the digital capabilities to create a single visual output that combines multiple data layers into a meaningful output. In his study, Nelson (1999) concluded that GIS allows integration and analysis of data to identify, apprehend, and prosecute suspects; it aids more proactive behaviour through effective allocation of resources and better policy setting. Likewise, data on surface communication, telephone

communications, and demographic pattern can all be used to predict sensitivity of a locality in relation to a given time (Mishra, 2003). To further boost crime management, increase efficiency and effective delivery of services by security forces, the International Association of Crime Analysts (IACA, 2012) has come up with a robust white paper on GIS Software requirements for crime analysis. In the USA for example, a number of web portals and self-practice GIS tutorial for crime analysis have been developed to provide real time crime events from which the public can carry out analysis themselves just by clicking and moving the tools accordingly. The recorded success in crime fighting by using these methodologies are enormous (see for example Shillingford & Groussman, 2010; Gorr, & Kurland, 2012) hence, their recommendations for adoption in developing countries like Nigeria.

Historically, the first use of computerized crime mapping in applied crime analysis occurred in the mid-1960 in St Louis (McEwen & Taxman, 1994; Coker, 2004). Early contributions came from Lloyd Haring (who organized a seminar on the geography of crime at Arizona State University around 1970) and David Herbert in the United Kingdom (Harries, 1999). Among the most remarkable pieces of research emphasizing crime mapping according to Coker (2004) are Schmid & Schmid's (1972) "crime in the state of Washington", Frisbie, *et al's* (1977) "crime in Minneapolis Proposals for Prevention" Markovic & Stone's (2002) "Crime Mapping and the Policing of Democratic Societies" among others. Sociological literatures establish a clear link between modernization and increasing levels of criminality (Adisa, 1994). The situation is very depressing in developing countries where the rapid growth of unplanned cities and population pressure force impoverished inhabitants to live in crammed spaces, undermining social relations and increasing the propensity for conflict, violence and crime. On the causes of crime, Andrea (1997) opined that poverty, and not race, is the primary cause of spatial crime clusters.

Although the Nigerian Policing approach is becoming obsolete, there is the need to have a viable system for crime reporting, monitoring and control as suggested by a study carried out by Boondao (2003) in Thailand. In this study, the requirements for the modeling of location based services for crime control were derived from questionnaires from a survey of 100 Thai citizens and 100 Thai police between May to July 2003. According to the survey results, more than two-thirds of the respondents regard safety and security issues (emergency calls i.e. on robbery, murder, theft, etc) as the primary reasons for wanting the system. They also want the system to provide information on crime; for example, crime warning messages, news reporting on crimes, report lost property and crime prevention information. Boondao's study sums up the requirement of crime management in a developing economy like Benin City. The implication of this is that urban crime has measurable spatial and temporal distribution that requires urgent attention by the arm of government responsible for maintaining law and order (Agboola, 1997) and this study seeks to reveal these possibilities based on quantitative and geoinformatics approach.

3. Research Methodology

Figure 2 shows a diagrammatical workflow of the methodology adopted for this study. The Global Positioning System (GPS) instrument was used to obtain the coordinates of facilities and crime hotspots: i. Hotspots (33), ii. Police stations (16), iii. Hotels (25), iv. Banks (38), v. Markets (14) and, vi. Parks (42) points respectively. To obtain information on crime pattern in Benin City, questionnaires were also used. One questionnaire for the NPF (addressed to the Divisional Crime Officer), Benin and 300 questionnaires were randomly administered to adult residence above 18 years. Based on systematic sampling method into 15 zones of 20 questionnaires each, 279 questionnaires were retrieved amounting to 93% success rate. The secondary data source includes Benin City route map of 1989 at scale 1/20,000 obtained from the Department of Lands and Surveys, Benin City. This was scanned, georeferenced and digitized using ArcView GIS software. Also, Landsat Satellite imageries of 1987 TM and 2002 ETM+ with spatial resolutions of 30m and 28.5m respectively were subjected to ILWIS Remote Sensing processing for analysis of urban growth. Figure 3 shows the crime Entity Relationship diagram based on the view of reality concept.

4. Findings and Discussion

From administered questionnaires to the public, results shows that all the respondents are more than 26 years of age. Maritally, 23% are married, 61% single and 16% others (separated/widow-widower). Similarly, all the respondents have lived within the area for more than 2 years implying deep knowledge of the study area. In terms of occupation, 49% of the respondents are students mostly in tertiary and informal institutions, traders (29%), civil servant (23%), military/police (3%) and all other occupations put together account for the remaining

4 %. The student respondents is high because unlike in most tertiary institutions all over the world, where students are accommodated in the hostels, the reverse is the case in Nigeria and in Benin City in particular, where most of the hostel facilities built in the 1970s for a specific target population are what are still available for the present students despite the upsurge in population and school enrolment. The majority of them who came from other states, who cannot be accommodated in the hostels, are left to seek alternative housing in the city, thus mixing up with the locals. No wonder most riots and criminal activities reported by the police usually involves some misguided students who are in the business to make a living. This has generated a lot of reactions which the government are yet to find solutions to. Findings from the study also revealed that about half of the respondents are student (BSc, MSc, PhD, technical and informal sector) because the adult (mostly working class and artisans) are scared to provide answers to criminal issues for fear of been victimised by the government or been sold out to criminal gangs hence the disparity observed in the response levels. Also, most of the adult populations are illiterate hence scared of been misquoted. Findings for the entire study are presented below based on the earlier identified objectives.

4.1 Factor Responsible for Rural Urban Migration, impacts and Urban Growth

From administerred questionnaire to the public, the study reveals that in ranking, perceived higher income (33%) and employment opportunities (24%) account for more than half of the reasons for rural-urban migration **(**Figure 4**).** Most of these migrants do not have the necessary qualifications or skills to secure a well paying job, hence in order to survive, they often results to criminal activities. This factor is partly responsible for rural-urban migration, population increase and urban slum in the study area. Figures 5 and 6 shows that, from the 1987 and 2002 multi-dates satellite images compared, the city has grown both in population size and in urban landuse.

The results of the urban growth analyses (figures 5 and 6 respectively) shows that the urbanized landuse has increased in area from 153.989km^2 in 1987 to 340.117 km^2 in year 2002 with an increase of about 110%. Result of projected population shows that population has equally increased with about 105% from 634,603 persons in 1987 to 1,336.225 persons in 2002. From the calculated Population density commonly represented as 'people per square mile' (or squared kilometers).

- *1987 Pop. Density = 634,603/153.989 = 4121 persons per square km*
- *2002 Pop. Density =1,336,225/340.117 = 3929 persons per square km.*

One can conclude that there is a slight decrease in the population density with about 4.7% as a result of urban expansion which is a good sign of healthy urban growth.

4.2 Crime Pattern Analyses (CPA): types and hotspots of urban crimes

On the impact of crime rate on urban environment, Table 1 shows that armed Robbery (42%), Burglary (22%) and Rape (Table 1 and Figure 7) ranks highest while murder/assassination ranks the least with 4%.

4.2.1 Spatial Analysis of Single and Multiple Buffering of Crime Hotspots

A buffer simply means establishing a distance of equal radius around a phenomenon of interest such as crime hotspot (red dots). From the CPA, a distance of 500m (see figures 7 and 8 respectively) was observed for the single and multiple distance buffers to accentuate the immediate areas vulnerable to attack. From Structured Query Language (SQL) query, study reveals that burglary combined with robbery are dominant around Sapele road, new Santana market, Adolo College road and environs in Ugbowo, Iwogban at Ikpoba hill, Etete in GRA, Ugbekun quarters down to Sokponba road and St. Saviour area in Ihinmwinrin quarters, Erumwuse and 2nd cemetery environs, Ogbe quarters near the stadium, and Uwasota area in Ugbowo. Effort should be made by the police to spread their crime search light to these identified hotspots and environs and by this analysis, rapid response can be made as useful information on the overall crime pattern have been made. This analysis will also inform the residents to improve efforts to guide against prevalent crimes in their locality.

4.2.2 Network and Service Area Analyses.

The network and Service Area Analysis (see figure 9) carried out using a robbed bank (formerly Oceanic Bank at Akpakpava, now Access Bank) and the Police Area command revealed (in yellow lines) the best route that could be taken from the Police Area Command at Sapele road to arrive at the robbery scene and the possible area of escape by the robbers (in purple) that requires close monitoring considering the nature and significance of the roads.

4.3 Influence of police stations on crime and urban safety Analyses

From administered questionnaires to the public, the study shows that at least 93% of the respondents are not comfortable with the prevailing level of crime in the community while 7% are indifferent. However, it is still surprising that regardless of the heinous nature of crime and knowledge of the location of police stations, most residents of Benin City (84%) do not report crime incidents to the police because 1) Fear of being exposed by the police, 2) Perceived police apparent insensitivity to duty and, 3) The police lack of arms and logistics to effectively combat crimes. The study also shows that, as an individual, only about 14 % have ever reported crime incident and, as a group only 7% have done likewise. It is not surprising therefore, that effort to curb the menace of crime is still not receiving the needed support it deserves as most crimes are left unreported. The survey equally revealed that from those who have reported crime about 78% agreed that the police sometimes come to their rescue, while 19% agreed that the police always respond leaving only 3% disagreeing with the last two claims. The study also revealed that 42% of the respondents agreed that the police have carried out raids as a way of combating crime while the rest 58% have contrary opinion. With increasing crime rates, and perceived failure of the police to combat crime effectively, 96% of the people have resulted to organized local security outfit known as "vigilante" while the rest have contracted registered security outfits as private guards.

4.4 Workable Crime Managing Information System (CMIS).

From questionnaire administered to the police force, study reveals that the Police measures at combating crime in Benin City includes, but not limited to a) encouraging research into crimes, b) thorough investigation of crimes, c) keeping anonymity of informants, d) periodic publications of crime data, e) stop and search operation, f) road block checking, g) periodic patrol and raid, and h) arrest of suspects. In all these current efforts, there is no application of geoinformatics technology. For effective policing, especially in the 21st century, the integration of geoinformatics (especially GIS/Remote Sensing) is inevitable as previously observed in its successful implementation in the USA by Shillingford and Groussman (2010). This can be implemented following the CMIS developed in this study (see figure 10). The CMIS use case shows the role of the public and the police in crime management. The CMIS adoption is highly recommended for effective and efficient policing based on the findings of this study.

From the developed CMIS (see figure 10), (a) shows the components of crime reporting and documentation and what the public should do and what the police should equally be interested in. (b) shows what the police and the public should both be interested in and how to go about crime management so as to be able to secure life and property and build a viable crime-free society in no distant time.

5. Conclusion, Recommendation and Further Research

Literature shows that crime is a universal problem but management levels vary from one country to the other. While most countries are now integrating geoinformation science and technology such as geoinformatics approach in addition to old methods of policing, most developing countries like Nigeria is still far behind in this techniques. This study examined the application of Geoinformatics techniques in crime control and Management in Benin City metropolis as a result of the increase in criminal activities. It was argued that crime is endemic and heinous in the study area and as such geoinformatics techniques is inevitable as a result of the advantages in digitally acquiring, documenting, retrieving, analysing, manipulating and presenting time variant crime scenarios of georeferenced data. This was demonstrated using the statistical analysis of respondents' information, geographic visualization (buffering, network and service area analysis and SQL queries) of crime events and deductive evaluation of crime report from the police force. This effort formed synergy with GPS data, GIS and Landsat remote sensing data and crime information extracted from administered questionnaires to particularly analyse and map urban crimes. It was observed that that spatial dimension of crime in Benin City metropolis is a function of so many factors. Study reveals that these factors include mass unemployment, urban growth due to migration and population increase, the primacy of the city (state capital) and the hub of socio-economic activities (banking, marketing, transportation/parks, and hotels among others) which makes the city attractive and a destination for rural populace who sees the urban environment as a place for varied life opportunities. The location of police stations vis-à-vis police-public relations was observed to be very poor. The study also shows that armed robbery is the major crime in the city closely followed by burglary, rape, pick pocket, murder and other petty crimes. From buffering, network and proximity crime service area analysis on hotspots, study shows that some areas are more vulnerable to crime than others. Combating crime, therefore, requires a well prepared police force with efficient manpower and a robust logistics and these for now are absent in the force. The

benefits derived from using Geoinformatics/GIS/Remote Sensing techniques in combating crimes are considered enormous hence, its recommendation to the Nigerian Police Force to adopt without further delay. While recommending improvement in rural infrastructure, further research should be advanced in migration, urban growth and crime distribution pattern.

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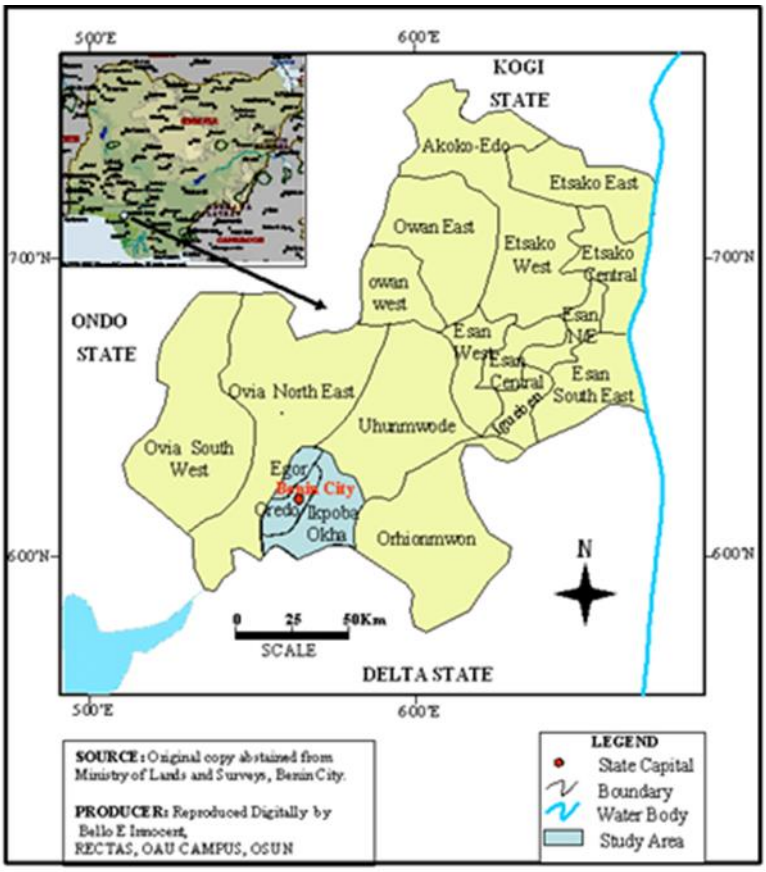

Figure 1. Edo State Map Showing the study area.

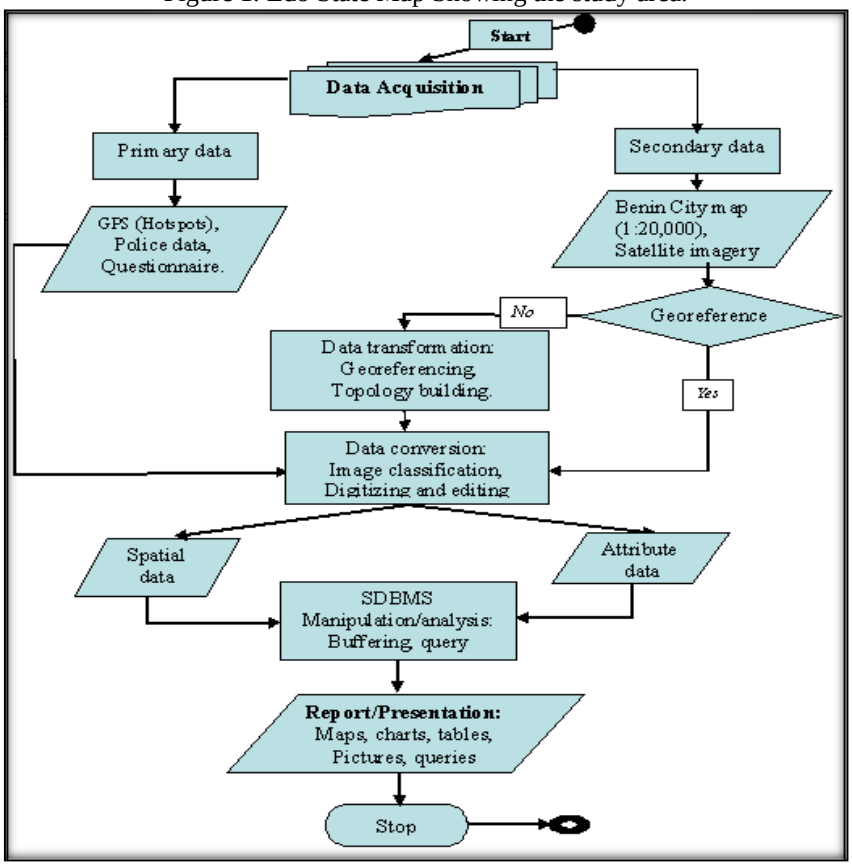

Figure 2. Flow diagram showing methodology for the study

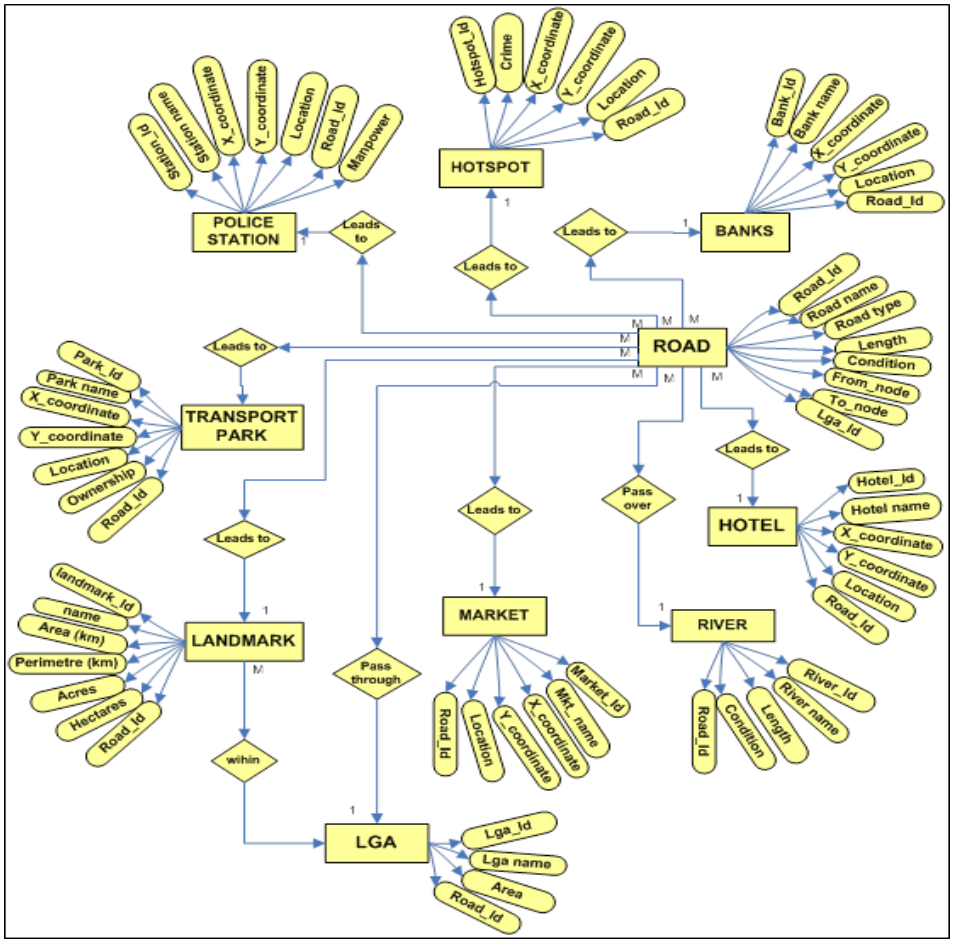

Figure 3. Developed Entity Relationship and Attributes for Benin City Crime Study

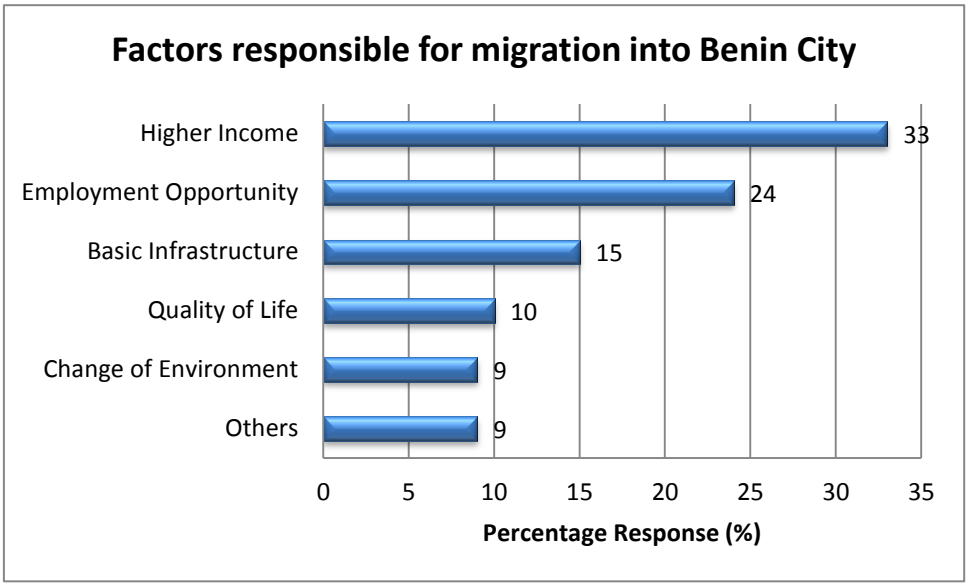

Figure 4. Examined Factors Responsible for Migration into Benin City

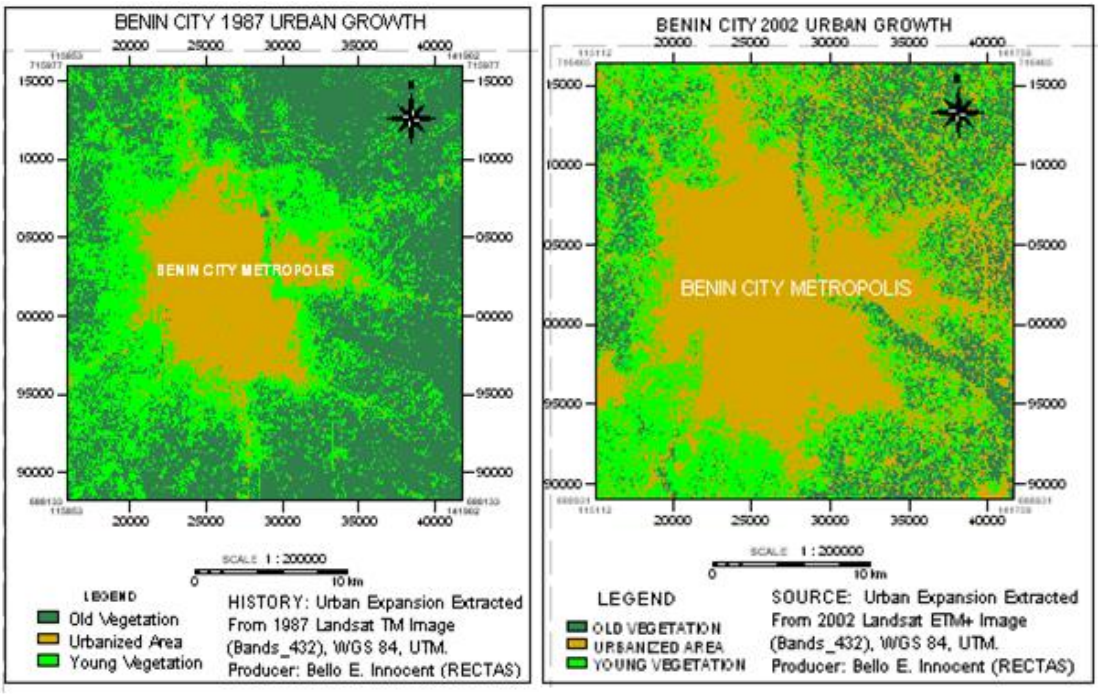

Figure 5. Supervised Classification of Benin City Urban Expansion (1987-2002)

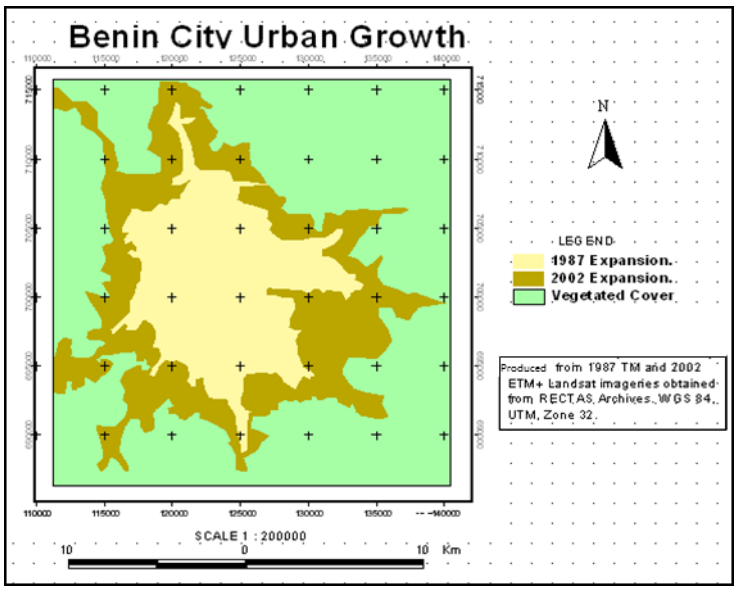

Figure 6. Overlay Analysis of Benin City Urban Growth/Expansion between 1987 & 2002

Table 1. % rating of Crime cases based on public response from Questionnaires

ARMED ROBBERY	BURGLARY	RAPE	PICK POCKET	MURDER / ASSASINATION/ KIDNAPPING	OTHERS
263	201	172	137	35	93
29 %	*22 %*	*19 %*	*15 %*	*4 %*	*11 %*
1st	***2nd***	***3rd***	***4th***	***6th***	***5th***

(Source: Fieldwork, 2013)

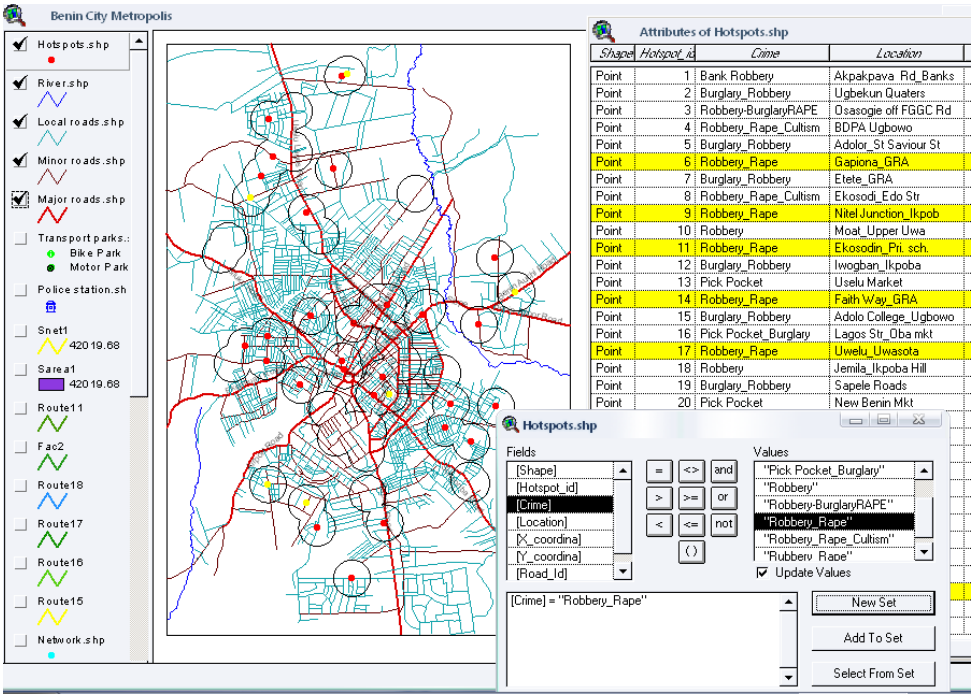

Figure 7. Database SQL Result of Robbery_ Rape Hotspots

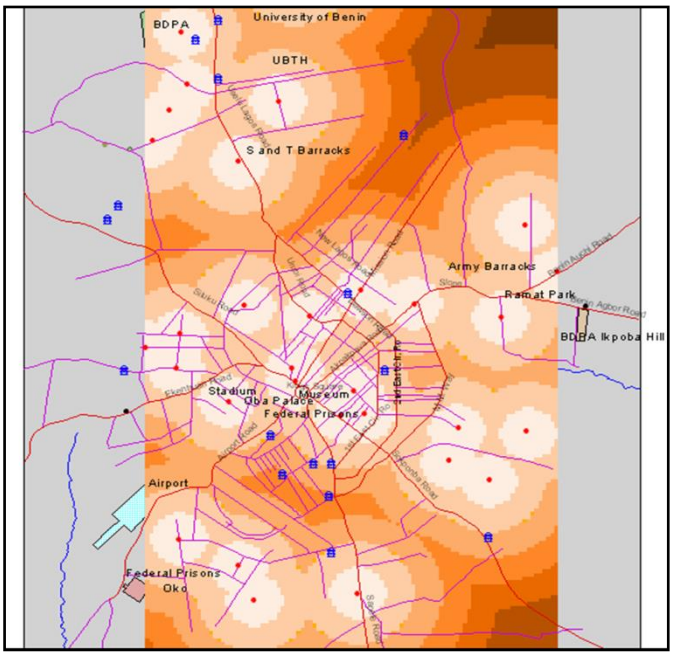

Figure 8. Multiple Distance Buffering/proximity (500m interval) to Crime Hotspots

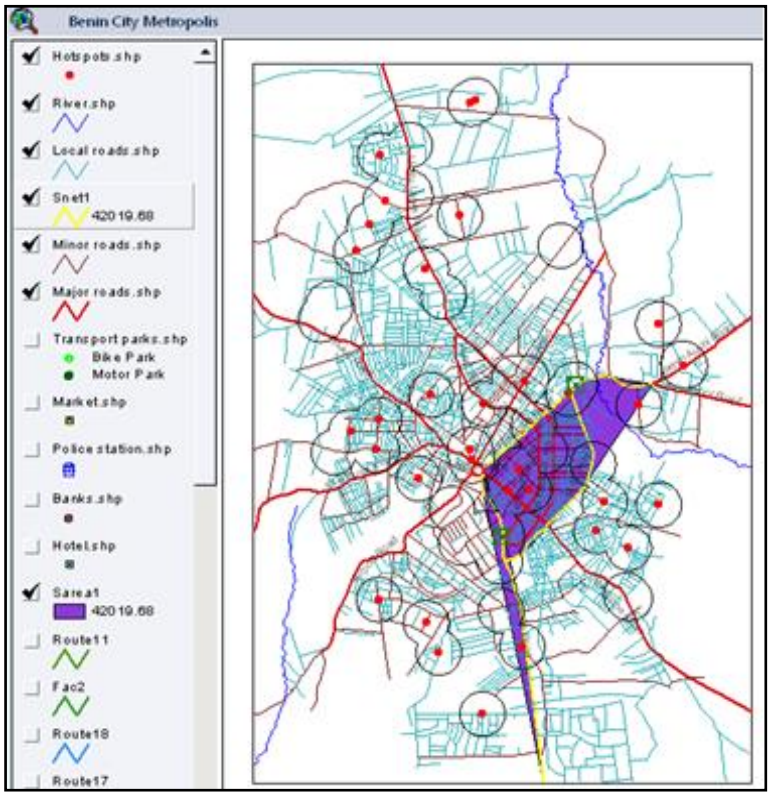

Figure 9. Crime Network and Service area analyses

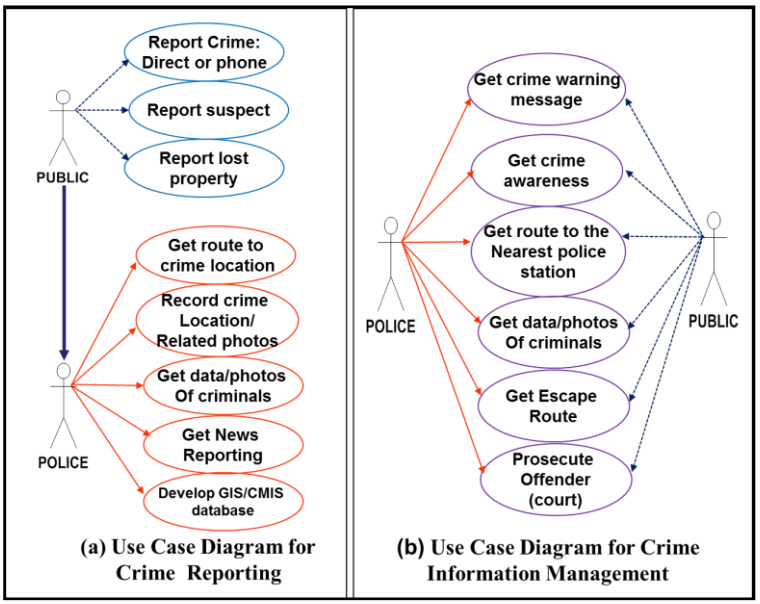

Figure 10. Proposed CMIS Use Case for Crime Control and Management