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USING GEOSPATIAL TECHNOLOGIES FOR ENHANCING POLICING AND CRIME PREVENTION IN KANO METROPOLIS, NIGERIA

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Abstract
The problem of crime and method of operation employed by the criminals in committing crime has become a problem for our country (Nigeria). The study focuses on examining the contribution of GIS to crime management in Kano Metropolis, thereby supporting more effective policing and strategic decision-making. Hence, the study was guided by these questions; what are the Contributions of Geographical Information System in Crime Management? what are the Types of Crime Detect with Geographical Information System? Routine activity theory was use for the study. The sample size was 317 participants, divided into quantitative and qualitative components; for survey (Quantitative), 300 police officers participated. Selected using School of Postgraduate guidelines for survey research. While Key Informant Interviews (KIIs) with 3 GIS experts: 2 from Police Academy (POLAC), Wudil, and 1 from Bayero University Kano (BUK); and 12 senior police officers from patrol/guard and investigation units across the three divisions, and 2 GIS officers from Zone One. *The study finds that GIS make a* substantial contribution *to crime management in the study area, proving very effective in combating crime. The system supports both operational and tactical police functions by enabling strategic planning, tracking and monitoring of crimes and suspects, as well as revealing patterns of modus operandi. The study reveals that GIS technology is capable of detecting, tracking, and monitoring various types of crimes such as automobile theft, cybercrime, drug trafficking, kidnapping, robbery, theft, smuggling, and related offences. In the digital age, GIS has become even more effective in crime detection because a significant proportion of crimes estimated at over 90% involve the use of a mobile phone or an electronic device connected to a cellular network or the internet. The study recommended that law enforcement agencies should strengthen partnerships with telecommunication service providers and invest in advanced digital forensic tools to enhance the accuracy, reliability, and reach of GIS-based crime detection, especially in cases where suspect information or device signals are limited.*
Keywords: Crime, Management, Effective, GIS and Police

Introduction

Crime continues to be a global problem that threatens social stability, country prosperity, and security. Corruption, terrorism, banditry, abduction, drug trafficking, arms proliferation, cybercrime, and human trafficking are examples of modern crimes that have grown more complex and pose a major threat to nations like Nigeria. Thus, lowering crime rates continues to be a top national concern. GIS enhances criminal investigations through geographic profiling, suspect narrowing, and linking offender databases, demonstrated by successes like the Baltimore County Police auto-dialer system (Groff & La Vigne, 1998; Fahui, 2012). In Nigeria, ICT adoption in policing includes AFIS, CCTV systems, and GIS, though sustainability is challenged by poor maintenance and brain drain **(**Aremu, 2014; Odeyemi & Obiyan, 2018). The Nigerian Police ICT Department oversees digital systems, networks, cybersecurity, databases, and GIS-based crime analysis. Kano State's Advanced Control Room uses real-time GIS and surveillance to strengthen coordinated policing (Anwar, 2018). GIS supports crime

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management by mapping incidents, guiding patrols, identifying hotspots, and evaluating crime-reduction initiatives (Clarke, 2004; Spencer & Jerry, 2005). In terrorism and crime control, GIS enables suspect tracking, GPS-based surveillance, mapping of high-risk zones, and creation of buffer zones (Umar, 2015). Overall, GIS improves proactive detection, resource optimization, evidence-based policing, and strategic crime prevention (Osborne & Wernicke, 2003; Laycock, 2001).

The use of GIS in crime analysis began in 1967 when Pauly, Finch, and McEwen created early crime maps for the St. Louis Police Department to improve patrol allocation (Weisburd & McEwen, 1998; Harries, 1999). These initial systems were informative but limited in analytical depth (Chi et al., 2005). Technological advances from the late 1970s to the 1990s, microcomputers, improved processing, larger storage, and better mapping software, transformed GIS into an affordable and powerful crime-analysis tool (Vann & Garson, 2003). Crime mapping evolved alongside criminological theories linking crime to place, supported by Jacobs' environmental insights (Jacobs, 1961; Eck, 1998). U.S. federal initiatives such as the NIJ Crime Mapping Research Center and Gore's task force further promoted GIS for public safety and resource mobilization (Travis, 1998; Rich, 1999). In policing, GIS integrates diverse data sources, supports hotspot identification, tracks suspects, and strengthens community participation through public crime-mapping platforms (Johnson, 2004; Clarke, 1997). GIS-based mapping enables public access to crime information, improves patrol strategies, and enhances inter-agency collaboration. It plays a major role in criminal investigations through geographic profiling, suspect generation, and linking crime scenes to offender databases. Nigeria's police have adopted ICT and GIS systems, though sustainability challenges persist, while states like Kano now use advanced control rooms for real-time surveillance. GIS enhances crime management by identifying hotspots, predicting risks, supporting terrorism tracking, and complementing Routine Activities Theory through spatial–temporal crime analysis.

Geographical Information Systems (GIS) have become an essential tool for managing, preventing, and detecting crime as a result. Crime is spatial by nature; it happens in particular areas, includes people who come from recognizable places (such homes, offices, or schools), and frequently follows geographic patterns. Understanding the significance of site in criminal behaviour is crucial, as Spencer and Jerry (2005) point out, since it enables law enforcement organizations to examine where crimes occur, why they occur there, and how they might be successfully averted. GIS is currently widely used in contemporary crime management, much like in Western nations, and its function has grown in importance. Even though sociology and psychology have historically dominated the study of crime, the geographical and environmental components of crime did not receive significant scholarly attention until the late 1970s. The geographical aspect of crime has long been acknowledged by law enforcement. In the past, police officers represented crime scenes and locations using straightforward techniques like pins on wall maps. But early research by Chicago School researchers, especially Shaw and McKay (1931), showed that crime is strongly correlated with neighborhood contexts and geographic characteristics (Spencer & Jerry, 2005).

Researchers and practitioners started realizing in the 1970s that studying the spatial distribution of crime can help us understand it better. As a result of this change, methods for determining crime trends and hotspots, examining the connections between crime, the environment, and socioeconomic variables, and assessing spatially focused enforcement tactics were developed. Geographical Information Systems (GIS) emerged as a useful analytical tool for crime mapping, prediction, and management as a result of the combination of various spatial techniques. Research has shown that crime does not happen in a vacuum; rather, it happens within certain geographic areas and is frequently impacted by a variety of environmental and socioeconomic elements that are directly related to residential patterns (Adigun, 2004). Many people believe that the social and physical surroundings can either encourage or deter criminal action. Nigerian cities' reputation is badly impacted by high crime rates, which also pose a problem for the security services in charge of protecting people and property. In light of this, the study's main objective is to investigate how GIS helps Kano Metropolis manage crime, enabling more efficient law enforcement and strategic decision-making.

Research Questions

The study was guided by the following research questions:

i. What are the Contributions of Geographical Information System in Crime Management?

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ii. What are the Types of Crime Detect with Geographical Information System?

Methodology

The study adopted survey research design as a method of gathering information from police officers. This is because it involves examination of the role of Geographical Information System (GIS) in Crime Management in Kano metropolis, Kano State. The data gathered from the population was analyzed, describe, record and interpreted. Both quantitative and qualitative methods of data collection were utilized for the study. Probability and non-probability sampling techniques was also used in the study. Police officers and GIS specialists made up the two primary groupings in the study population. While GIS specialists were interviewed in-depth, police officers took part through questionnaires and key informant interviews. Due to the existence of the GIS unit in Zone One, the target population was picked from three police divisions and the Zone One Headquarters in Gwale Local Government Area. Regardless of their gender, race, or socioeconomic status, officers and staff from these divisions who were informed and eager to share pertinent information were among the participants.

Sample Size and Sampling Techniques According to the World Encyclopedia of Police Forces and Correctional Systems (2006), the Nigerian Police Force (NPF) has an estimated strength of 371,800 personnel, with plans to expand to 651,800 officers. Within Zone One, which covers 96,765 km² and a population of 19,254,909 (2006 census) there are 18,358 police personnel, while the Kano State Command accounts for 8,934 officers and men (Department of ICT, NPF, 2019). Hence, the population was drawn from three police divisions and Zone One Headquarters in Gwale Local Government Area, where the GIS unit is located. Each police division typically has about 60 officers, including undercover and surveillance personnel. Both male and female officers who were available and willing to participate were included. The sample size was 317 participants, divided into quantitative and qualitative components; for survey (Quantitative), 300 police officers participated. Selected using School of Postgraduate guidelines for survey research. While Key Informant Interviews (KIIs) with 3 GIS experts: 2 from Police Academy (POLAC), Wudil, and 1 from Bayero University Kano (BUK); and 12 senior police officers from patrol/guard and investigation units across the three divisions, and 2 GIS officers from Zone One. A cluster sampling technique was used for the quantitative study. Gwale LGA contains three police divisions, one outpost, and Zone One Headquarters, making four clusters: *Accidental (convenience) sampling* was used due to irregular duty schedules and officer availability. For the qualitative component, purposive sampling was used to select 4 officers from each of the three divisions (2 from Patrol and Guard; 2 from Investigation); 2 GIS professionals from Zone One; and 3 GIS academic experts (POLAC & BUK). This structured sampling approach ensured the inclusion of key practitioners and GIS stakeholders, blending statistical representation with expert insight for both policing and geospatial crime analysis.

Data were collected using structured questionnaires, Key Informant Interviews (KIIs), In-depth Interviews (IDIs). Data used in this study were obtained from both primary and secondary sources. The primary data was obtained from structured questionnaires administered to police personnel and Key Informant Interviews; while secondary data was obtained from textbooks, journals, reports, newspapers, and other published materials. Quantitative data were analyzed using SPSS version 4.9. Descriptive were used. Qualitative data from interviews were transcribed, translated where necessary, and used to complement the quantitative findings.

Results

What are the Contributions of Geographical Information System in Crime Management?

Table 1: Role of Geographical Information System in Crime Management

The Role of GIS in Crime Management	Yes (%)	No (%)	Total (%)
Identifying high-risk location for crime	229 (90.5)	24 (9.5)	**253 (100.0)**
Analyzing crime data and presenting it in form of maps	231 (91.3)	22 (8.7)	**253 (100.0)**
Deployment of police force in accordance with the geographic variation of crime	225 (88.9)	28 (11.0)	**253 (100.0)**
Aid in command-and-control decisions	241 (95.2)	12 (4.7)	**253 (100.0)**
Assist in investigations	244 (96.4)	29 (11.4)	**253 (100.0)**
Conduct cross-jurisdictional analysis	238 (94.0)	15 (5.9)	**253 (100.0)**

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Others	221 (87.3)	32 (12.6)	**253 (100.0)**

Source: Fieldwork, 2022

The table show overwhelming agreement among respondents on the major roles of GIS in crime management. Most (90.5%) reported that GIS helps identify high-risk crime locations, while 91.3% indicated it is used to analyze data and present it through maps. Additionally, 88.9% noted its role in guiding police deployment based on geographic crime patterns, and 95.2% emphasized its importance in command-and-control decision-making. A further 96.4% identified assisting investigations as a key function, 94.0% cited its role in cross-jurisdictional crime analysis, and 87.3% mentioned other roles such as monitoring law enforcement. These results show strong consensus that GIS is vital to crime management. Supporting this, the Head of Patrol and Guard Unit, Gwale Division, explained that GIS enhances both operational and tactical planning by helping track suspects, analyze crime patterns and hotspots, examine the link between slum areas and crime, and assess distances between police stations and hotspot locations. Again, an interview with the Head of GIS in Zone One Headquarters affirmed that:

> *…GIS Unit has several roles to play in providing human security by capturing and analyzing, presenting visual to unravel the spatial nature of crime and its suspect; assessing ICT needs of end users/field officers; deployment and maintenance of Local area Network (LAN), Metropolitan Area Network (MAN), Wide Area Network (WAN) both Intranet and Internet connectivity(cable, wireless radio, satellite and optic fibre technologies) in all police formations during operation; ensuring the integrity, security and management of police through the use of ICT; manage and maintain the tracking and interception system for the police; field support to field officers (Patrol officers, administrators, strike force etc.). It's also provided a link to unlikely data sources on common geographic variables as well as to produce maps that help to communicate for analysis (KII with the Head of GIS in Zone One Headquarters, 2021).*

On the response on how Geographical Information System software works, GIS professional in Zone One Headquarters narrated that, in case of human tracking for instance, some one used phone to called with hidden number to threaten an individual that he/she is going to be pick for ransom (kidnapped), with the GIS software, it requires the victim number, duration of the call, and time of the conversation for just 30 second. With those variables the software will pop-up the unknown number, get the IEN number of the phone, alternative number if use, and the software will get the criminal's, his/her exact location. The exact location gives the coordinate (the longitude and latitude), and in some cases they will have the originated longitude and latitude (i.e where criminal start calling) and terminating longitude and latitude (i.e where the criminal end his/her call), it is easily if the suspect use same mast to communicate to the victim. Therefore, the coordinate depending on the mast; the customized software analyzed the coordinate using the circumferences at the angle of 360^0 due to the angle of circumferences, the software will be analyzing moving from radius at the center to the east; if the target is not found, it move to south, west and north using the four cardinal point until the suspect is found. In an interview with GIS Professional in Zone One Headquarters, explain that:

> *…GIS unit deals with tracking analysis, given geographical location (Geoloc) of individual and object that are crime suspects. Some of the functions of GIS are to provide human security: to track high profile criminals, track electronic devices like phones using IEN (international Equipment Number) number which contained 15 digit and varied from phone to phone; to track the cell phone getting the target (i.e the information about the criminal we are looking for) and sub-target (i.e the information about his/her relatives, friends or those who he/she communicate with), pop-up his/her alternative number, if a different SIM card is been used in that very phone. Also, we use GIS to stalk suspect and car tracking. In car tracking we have a device that will we mounted in the car that can navigate via a system, software called 'Car tracking GPRS' we dial a number to stop the car using stop-engine-navigator and the vehicle will stop, also if you want it to continue moving we resume it. With the software, we can get the exact location of the vehicle, the kilometer cover, coordinate and the movement of the vehicle (KII with GIS Professional in Zone One Headquarters, 2021).*

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What are the Types of Crime Detect with Geographical Information System?

Table 3: The Types of Crime Detect with Geographical Information System

Types of Crime Detect with GIS	Yes (%)	No (%)	Total (%)
Automobile theft	247 (82.3)	53 (17.7)	**300 (100.0)**
Terrorism	271 (90.3)	29 (9.7)	**300 (100.0)**
Cyber crime	273 (91.0)	27 (9.0)	**300 (100.0)**
Drugs trafficking	254 (84.7)	46 (15.3)	**300 (100.0)**
Kidnapping	263 (87.7)	37 (12.3)	**300 (100.0)**
Others	215 (71.7)	85 (28.3)	**300 (100.0)**

Source: Fieldwork, 2022

On the types of crime detect with Geographical Information System, table 4.19 clearly shows that 82.3% of the respondents are of the view that automobile theft is the main type of crime detect with Geographical Information System and 90.3% said it is terrorism; while 91.0% said Geographical Information System detect cybercrime only and 84.7% stated that Geographical Information System usually detect drugs trafficking and 87.7% said its use to detect kidnapping. Also, 71.7% of the respondents are of the view that with Geographical Information System technology other crimes such as robbery, theft, smuggling and many others can be detected with GIS technology. However, the Head of GIS Unit in Zone One Headquarters narrated that, in a situation where no internet or mast connected devices are involved or no intel about crime suspects, it's difficult to track and monitor crime, suspect or its method of operation. Hence, it corroborated with an Interview with the Head of GIS Unit in Zone One Headquarters who stated that:

> *With GIS technology, we can be able to trace, track and stalk several form of crime at this global age, because 90% of crimes are committed with something connected to the mast or electronic device that is connected to the internet or mast. During the entanglement, the victim or the perpetrator might have phone, using call "data record" or signal, our software can track or stalk whether those devices are switch off or on, during or after the crime event (KII with the Head of GIS in Zone One Headquarters, 2021).*

Discussion of the Findings

The study finds that GIS significantly enhances crime management in the study area by supporting operational and tactical policing, enabling strategic planning, tracking crimes and suspects, and revealing modus operandi patterns. Despite these benefits, the study notes major constraints, especially the lack of official computers for police officers, which limits effective GIS use. Spencer and Jerry (2005) observe that GIS software offers various techniques for visualizing spatial crime patterns, though capabilities differ across applications, with some providing advanced analytical extensions. The study further shows that GIS is highly valuable in addressing crime, disorder, and antisocial behaviours, simplifying complex data into clear visual formats that improve police coordination, monitoring, and crime detection, as supported by Umar (2015). It also confirms that GIS helps identify crime hotspots, analyze spatial data, guide personnel deployment, enhance command and control, support investigations, and facilitate cross-jurisdictional analyses. Consistent with Adepoju et al. (2014) and Srilekha and Dhanakoti (2016), the study emphasizes that technological advancements, especially GIS have modernized policing by improving suspect tracking, crime pattern detection, and analysis of criminal methods. Ahmed and Maikano (2012) further explain that GIS relies on geo-referenced crime data overlaid on street maps, providing essential spatial context for more effective investigation and resolution of criminal cases.

The study shows that customized police GIS software can detect and analyze crimes such as automobile theft, terrorism, cybercrime, drug trafficking, kidnapping, and smuggling. GIS also supports the detection of robbery, theft, and related offences. Its effectiveness increases when crimes involve digital devices or internet connectivity. Crimes without technological components may limit GIS functionality. Over 90% of modern crimes involve mobile phones or internet-enabled devices. During criminal events, either offenders or victims typically use mobile devices. Also, GIS can analyze call data records (CDR) and device signals for crime detection. Police can track suspect activity even when a device is switched off. This is possible because residual network interactions may still be traceable. Studies by Asongu and Nwachukwu (2019) and Nguyen et al. (2017) support these findings. Their work shows offenders create digital footprints detectable through CDR, GPS, and cell-tower triangulation. GIS-based tools help map these signals to monitor movements and activities. This strengthens evidence-based policing

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and enhances crime prevention. Adewumi and Adebayo (2020) and Kounadi and Leitner (2016) confirm GIS integrates spatial data with digital communication patterns. Such integration is crucial because most crimes now involve mobile technology. Even phones without GPS can transmit approximate location through signal triangulation. Tactical Intelligence Units (TIUs) rely on telecom networks and service providers for this data. Devices used frequently offer more accurate location predictions. Stationary or slow-moving devices require fewer updates but remain traceable. Tracking accuracy depends on situational factors, including how the suspect holds or carries the device.

Conclusion

The study concludes that GIS plays a significant role in crime management by supporting both operational and tactical policing. Through strategic planning, GIS enables police to track and monitor criminal activities, identify patterns of offenders' modus operandi, and accurately apprehend suspects. It also helps in linking crime incidents to their environmental context and in identifying crime hotspots. The study concludes that Geographic Information System (GIS) technology is highly effective in detecting, tracking, and analyzing a wide range of crimes, including automobile theft, cybercrime, drug trafficking, kidnapping, smuggling, robbery, and related offences, especially in today's digital age where over 90% of crimes involve mobile phones or internet-enabled devices. Customized police GIS software can utilize call data records and device signals to monitor suspects' locations and movements, even when devices are switched off. However, the effectiveness of GIS is reduced in crime situations that lack digital footprints, internet connectivity, or sufficient intelligence data.

Recommendations

To enhance the effectiveness of GIS-based crime detection and modern policing, the following recommendations were made:

1. Law enforcement agencies should strengthen partnerships with telecommunication service providers and invest in advanced digital forensic tools to enhance the accuracy, reliability, and reach of GIS-based crime detection, especially in cases where suspect information or device signals are limited.
2. The government and police authorities should invest in adequate ICT infrastructure, including the provision of computers, GIS-enabled devices, and stable digital connectivity across police formations. This will improve officers' capacity to fully utilize GIS tools for crime detection, mapping, and real-time intelligence.

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