GEOSPATIAL MAPPING OF CRIME HOTSPOTS IN GUNDUMI FOREST RESERVE, SOKOTO STATE, NIGERIA

BY

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A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY ZARIA, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE DEGREE IN GEOGRAPHIC INFORMATION SYSTEM AND REMOTE SENSING ((M.SC GIS AND REMOTE SENSING)

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DECLARATION

I declare that the work in this dissertation titled “Geospatial mapping of crime Hotspots in Gundumi forest Reserve, Sokoto state” has been carried out by me in the Department of Geography. The information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this thesis was previously presented for another degree or diploma at this or any other institution.

Abba Safiyanu …… ……

Signature Date

CERTIFICATION

This dissertation titled; “Geospatial mapping of crime Hotspots in Gundumi forest Reserve, Sokoto state” by Abba SAFIYANU meets the regulations governing the award of Master of Science degree in Remote Sensing and Geographic Information System (.RS and GIS) of Ahmadu Bello University Zaria and is approved for its contribution to knowledge and literature presentation.

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DEDICATION

I dedicate this piece of work to my parents and my two lovely children, Nuri and Muhammad.

ABSTRACT

Gundumi is a very large and extensive forest with so many routes linking several villages and towns, which has high record of crime rates on robberies, cattle-rustlings. Murders/assassinations etc. This high prevalence of crimes has been a source of security concern to the general public, especially motorists and other commuters plying these routes. This necessitated for the mapping of crime hotspots in the forest for effective crime control and management. Kernel Density Estimation (KDE) model was used, because the method produces an aesthetically pleasing map from which users can identify hotspots based on contours of densities. Hotspot is an estimate proportion of total crimes at a given location, represented in contours of density. Seven (7) crime hotspot were identified .Two (2) of the hotspots were cascaded into High, Moderate and Low crime densities. Five (5) other hotspots are cascaded into two (2) concentric regions of Moderate and Low crime densities each. And the remaining Four (4) potential hotspots are of low densities only. Therefore, are still in their formative stages, and not yet develop into full hotspots. Findings reveal that all the seven identified hotspots are located along major routes (Roads) in the study area. Therefore, it was recommended that security measures should be reinforced along the affected roads to ensure public safety and security.

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CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND TO THE STUDY

All over the world, threats from terrorism, drugs cartel and organized crimes have been increasing at an alarming rate (Mishral, 2003). It was also stated that high crime rates are not unique features of a few nations, but a statistically normal feature of life all over the world (FajemirokunAdekunle, Oyenusi and Maiyegun, 2006).The global upsurge in crime and criminality has continued to gather momentum such that effort is being intensified daily by concerned individuals and government to combat the menace (Hasan, 1993). Nonetheless, the increasing wave of crime in the society, internationally or locally, calls for concerns and prompt actions on proper, investigation, analysis, documentation and onward prosecution of offenders to logical conclusion. This will provide the needed deterrent and data bank for effective crime policing, aimed at its possible prevention and management.

Microsoft Encarta Encyclopedia (2004), defined crime as a commission or an act of omission that violates the community, as distinguished from torts and breach of contract. According to the Longman Dictionary of Contemporary English (2000), crime is an illegal activity in general. Resulting from the two definitions above, it is a 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.

Crime has a geographical dimension and it is disproportionally distributed across different geographical scales (example National, Regional and Local). Within cities and metropolitan areas, crimes are exceptionally concentrated in a relatively few crime hotspots (Sherman 1992; Weisburd and Green, 1994). Geography has a long history of aiding in the monitoring and

tracking criminals activities (Anselin, Cohen, Cook, Gorr and Tita, 2000). Geographical techniques have been used to map, analyze and provide real solution to crime globally in the last couple of decades. Therefore, geography plays an important role in law enforcement and criminal justice. A popular slogan says 'criminals are not spirits. They move from one place to the other and live in the society just like every one of us' (GIS team 2005).

'Rapid development in satellite technology, especially the bird eye view of satellite, equipped with high resolution sensor and communication satellite with multi transponder has provided critical data sets as well as the necessary communication means to adequately monitor and manage crime in developed countries' (Adepoju,Halilu, Mohammed, Ozigis, Idris, Blessings and Adeluyi 2014). Crime mapping is an integral and essential part of crime monitoring control and management. The success of this is based on development of comprehensive baseline information about dwelling units and other criminal hideouts. It serves as the baseline information and data upon which, security infrastructure is built. Also, it gives an insight into the nature, types, trend, hotspots and time in which all notorious activities take place. It gives information data on the underlining causes, the group that are fully, or partially responsible for different types of crimes in the communities. It also allows for the analysis of vulnerable communities and effectiveness of security's resources allocation. In addition, crime propelled by cross border illegal immigration can also be properly checked by having base – line information and trends.

Geographic Information System (GIS) and Remote Sensing (RS) and other allied technologies have manifested in various forms in the last four (4) decades, particularly since the launch of earth observation satellites. These have provided baseline information for intelligence gathering. The very high resolution images provided by the new generation of satellites have

made the integration of GIS/RS for crime mapping, not only possible but also effective for day to day running and management of many aspects of our lives (Adepoju*et al.* 2014). Geographical Information System (GIS) has become a powerful crime prevention and investigation for mapping and analyzing crime pattern (Shillingford and Grousman, 2010).

However, the potentials of these technologies has not been exploited, utilized or domesticated by various institutions responsible, especially the security agencies in Nigeria, as what is obtainable in many developed countries like the U.S.A. According to Shillingford andGrousman (2010) ‘when snipers terrorized the Washington DC, in October 2002, security agents used GIS to link thirteen (13) separate attacks that occurred over the course of several weeks and in several states. A comp stat program, which made extensive use of GIS technology played a significant role in reducing crime in New York City in the 1990's and is used today in Los Angeles, Baltimore and Philadelphia (Willis, Mastrofski and Weisburd 2003). Moreover, an application of GIS to crime mapping and management has been successful in many developed countries. For instance, information associated with crime in Lima and Columbus (Ohio) was acquired and integrated in a GIS environment, which reduced crime from 1999 to the present. As a result of this, policy formulation and decision making in Lima Police Dept. improved, particularly with the respect to community policing (Ackerman and Murray 2004). The US Department of justice, criminal division has developed an ESRI map objects based spatial crime analysis system. The application, known as RCAGIS (Regional Crime Analysis GIS) was specifically developed to assist police department in analyzing crime on a regional basis (Weisburd, Greenspan and Mastrofski 1998). In an effort to help prevent murders and aggravated battery with firearms, the Chicago City Police Department. (CCPD) developed Operational Centre, deployed GIS technologies to present crime information in geographic context. The idea in

using GIS technologies is to allow officers to make better informed decisions about which area of the city need additional police power. The first six months of GIS deployment, the Chicago City Police Department saw an 18% percent drop in murders compared with the same period the year before (Anne, 2004).

Nevertheless, in the last two (2) decades, crimes have graduated from the common offences (crimes) to sophisticated crimes of mass homicide through suicide attacks and bombing activities as seen in some major Nigeria cities such as Maiduguri, Damaturu, Kano, Kaduna and Abuja. These cities are still experiencing sophisticated crime of terrorist attack of wide dimension (Agbola, 2004). The incident of violence in Nigeria is not only becoming more frequent but also the nature of the crimes is getting sophisticated and dreadful. This is attested by the recent rise in the frequency of high profile criminal activities and the emerging menace of Boko-haram and other terrorist groups in Nigeria (Agbola, 2006).

The growing potential of GIS for supporting policing and crime reduction is now being recognized by all, because GIS is variance of Geo-informatics. It can be employed at different levels to support operational policing, tactical crime mapping, and detection as well as wide range strategic analysis. (Chainey and Ratchiffe, 2005). GIS technology and remote sensing can jointly be used to digitally acquire, store, retrieve manipulate, analyze and present various geo-referenced crime scenarios that can act as decision support tool in crime management plans, policy formulation and combat operation, hence, the rational for its adoption in this study. Therefore, it is against this background that the study is intended to use Geospatial Intelligence Technique (GEOINT) to map out crime hotspots in Gundumi Forest Reserve, Sokoto State.

1.2 STATEMENT OF THE RESEARCH PROBLEM

Crime is ever evolving issue that exists in societies around the world regardless of their geographical location. Lives and properties are no longer safe anywhere in the country and this is not peculiar to a particular socio-economic or cultural group. Both the rich and the poor suffer the same fate. The whole society appears helpless in the face of crime (Agbola 2004; Alemika and Chukwuma 2005).

Ahmed and Salihu (2004) analyzed 'Spatio-temporal pattern of crime using GIS approach in Dala L.G.A of Kano State, Nigeria'. The finding reveals that the spatial pattern of the crime tends to be clustered outside the city wall around Kofar-ruwa and Kurna Quarters. This could be as a result of absence of police stations, even though there are police outposts, but they do not have enough manpower and facilities/equipment for fighting crime. The study also showed that using GIS is a much more compatible means of crime pattern analysis, because of its geographic referencing capabilities.

Jinadu, Morenikeji, Sanusi,Dukiya and Owoyele (2012) carried out a study on 'Digital mapping of crime statistics in Minna'. The study of types and pattern of crimes in Minna reveals that the city recorded varying degrees of crime across the twenty six (26) neighborhoods between year 2000 and 2003. Although, the study observed that the incidence of serious crime like Murder, Manslaughter, armed robbery and rape are not high. The predominant forms of personal and property induced crimes in the neighborhood, which were classified as hot spots and high crime areas constituted a major threat to security.

Bello, Ikhuoria, Agbaje and Ogedegbe. (2013) in the study, 'Managing urban crime with Geo-informatics; a case study of Benin –City, Nigeria' revealed that major crimes in the city were armed robbery (29%), Burglary (22%) rape (19%) pick pocket (15%) Murder assassination (4%)

and other petty crimes (11%). The study was carried out using Geo-informatics methodologies such as ArcGIS and Ilwis Software.

Adepoju, Halilu, Mohammed, Ozigis, Idris, Blessing and Adeluyi(2014) studied 'Geospatial technologies for Nigerian urban security and crime management' which was a study on Abuja crime hotspots mapping and analysis. The study was conducted using proximity analysis to ascertain relationship between crime hotspots, cold spots, police divisional stations, slum settlements as well as various parks and gardens in the study area. The result reveals a significant correlation between slum settlement and crime in the Abuja City. It also showed significant correlation between parks/gardens and crime. It also reveals a positive correlation between slum settlement and crime in the study area.

The Gundumi Forest Reserve is known to be a beehive of criminal activities and house some renowned armed bandits and cattle rustlers that have been terrorizing the neighboring villages, as well as commuters/motorists plying Marnona-Isah Road. The incessant notorious activities of the bandits necessitated in 2012, the deployment of mobile policemen using Armored Personnel Carriers (APC) to disperse the armed bandits, of which many of them were killed. The proximity of the forest to the border line villages such as; UnguwarTabkin-fili, Gidan-Bawa and Yarfako villages (all in Isah LGA) ease the influx of criminals from the Niger-Republic into the reserve due to the porous nature of our borders .Gundumi is very large and extensive forest with so many routes linking several villages and towns. However, with high crime rates such as; armed robbery, cattle rustling, kidnapping, murder/assassination etc. along these routes, there is need for mapping of crime hotspots in the forest, for effective management.

Many studies have been conducted on crimes in different areas such as; (Ahmed and Salihu, 2004; Fajemirokun*et al,* 2006; Jinadu, 2012; Bello *et al*, 2013; Adepoju et *al,* 2014;). However,

the issue of interest here is that none of these previous studies was carried out in the study area. In addition, the current research intends to use GEOINT, which is an all-encompassing platform that allows easy integration of other intelligence components to produce the desired intelligence output. Therefore, it is this gap of knowledge, this study intends to fill.

The study answered the following questions:

i. Where are the crime locations in the study area?

ii. What are the common types of crime in the study area?

iii. What is the spatial pattern of crimes in the study area?

iv. Where are the crimes hotspots in the studyarea?

1.3 AIM AND OBJECTIVES OF THE RESEARCH.

The aim of the study is to map out and analyze crime hot spots in Gundumi Forest Reserve. The aim was achieved through the following objectives:

i. Identify locations of major crime activities in the study area.

ii. Characterize the types of crime in the study area.

iii. Determine the spatial pattern of the crime in the study area.

iv. Identify and map out crime hotspots in the study area.

1.4 SCOPE OF THE RESEARCH

This study is to identify, map out and analyze the crime hotspots in Gundumi Forest Reserve (Sokoto State) between 2009 and 2014.This period was chosen, because crime data prior to 2009 was not available with the police. The researcher had wanted to analyze the temporal component of the collected data (For instance, what times of the day the crimes were committed), however the data obtained from the Police did not have those components. GEOINT discipline

incorporate data from other intelligence disciplines such as Human Intelligence (HUMINT), Signal Intelligence, (SIGINT) Measurement and Signatures Intelligence (MASINT) and Open-Source Intelligence (OSINT). However, the content scope of the research covered imagery, geospatial data collections and processing. While the spatial scope of this study only cover the Sokoto State portion of the Reserve, which covers; IsahRabah, Wurno and Goronyo L.G.As.

1.5 JUSTIFICATION OF THE RESEARCH

GIS can greatly enhance the capabilities of the police department and other law enforcement agencies ability to monitor and prevent future crime. GIS technology can further improve on these capabilities, allowing for crime hotspots to be located and mapped out at both a micro-spatial and macro-spatial level (Ackerman, 2000). Identification of hotspots helps public safety institutions to effectively allocate resources for crime prevention (Illinois Criminal Justice Information Authority, 1993). Once hotspots are identified, it enables security agents and other law enforcement agencies to strategically deploy their scarce resources effectively, in an attempt to monitor and track perpetrators so as to prevent or mitigate future crime growth. A crime hotspot is generally defined as an area containing dense clusters of crime incidents. This simple approach may be good enough to analyze data over a short time period but to analyses data over a year or longer time crime hotspots should be determined not only by the geometrical aspect of event but also by their time characteristics (Anaki, 1997)

Recently, the country has been bedeviled by security challenges, such as terrorism, armed banditry, cattle rustling, assassination etc. These problems combined to make our societies unsafe. It is in the light of these that this study was carried out to uncover the geographical locations of these criminals, as well as other Geospatial intelligence products that could assist in curbing the activities of this criminals hiding in the forest, from where they mobilized and

carryout violent attacks on innocent people.

If this study is successfully conducted, it can be replicated on other suspected criminals safe-haven, such as Sambisa Forest Reserve were it is suspected that the dreaded BokoHaram elements have their camps.

CHAPTER TWO: CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW

2.1 INTRODUCTION

This chapter reviews crime from different perspective, the theories on the causes of crime, crime hotspots, and crime analysis and finally reviews literatures on crime mapping.

2.2. CRIME

The concept of crime involves the idea of a public as opposed to a private wrong with the consequent intervention between the criminal and injured party by an agency representing the community as whole. Crime is thus the international commission of an act deemed socially harmful; or dangerous and the reason for making any given act a crime is the public injury that would result from its frequent participation. The society therefore takes steps for its prevention by prescribing specific punishments for each crime (Edward, 2005).

i. The word 'crime' is of origin viz; 'Crimean' which means 'charge' or 'offence' Crime is a social fact.

ii. The Waverly Encyclopedia defines it as, "An act forbidden by law and for performing which the perpetrator is liable to punishment" (Edward, 2005).

iii. According to the Italian school of criminologists, crime is abnormal in so for as it is atavistic or pathological in its nature (Edward, 2005).

iv. The concise Encyclopedia of crime and criminals, has defined 'crime' thus: "A crime is an act or default which prejudices the interests of the community and is forbidden by law under pain of punishment. It is an offence against the State, as contrasted with loot or a civil wrong, which is a violation of a right of an individual and which does not lead to punishment (Edward, 2005).

v. Crime in international context-"crime is complex, multidimensional event that occurs when the law, offender on target (refers to a person in personal crime and or object in property) converge in time and place (such as a street, corner, address, building or street segment)" (Edward, 2005).

2.2.1 Types of Crimes/Classification of Crimes

All crimes are not the same. There are many types of different crimes. In some crimes, only one individual is involved and in some other crimes there are many persons who are organized for the purpose of crime. There are such bands of criminals working at the national level and even there are bands of criminals whose field of crime is international. It is not only males that are criminals, but there are females and children as well, in criminal acts. So, in order to classify crime we have to consider the personality of the criminal, his purpose and the nature of the crime. Criminologist considers the seriousness of crimes and divides broadly into two types of crimes.

1) Ordinary types of crime, 2) serious types of crime. Crime was also classifies into four main types depending upon their purpose or objective.

i. Monetary crimes: Crimes done to get money e.g. Theft, fraud, forgery, contraband currency, etc.
ii. Sexual crimes: Rapes, homosexuality.
iii. Political crimes: Espionage (international), treachery, treason etc.
iv. Miscellaneous crimes: Crimes other than the above three types e.g. quarrels, fights, kidnapping or addiction to narcotics etc.

Also the crimes are classified on the basis of their antisocial or anti personal aspects as under:

i. Murderous crimes:

It is the prime need of an individual or community to be safe. Any behavior bringing this safety into danger may be called as murderous crime e.g. thrashing, enforcing starvation, causing physical, injuries, inducing some to suicide, victimizing, attempting to murder.

ii. Crimes against moveable or immoveable possessions:

Whether an individual or a community, the property or possessions are important. The basic human needs are food, shelter and clothing on which human welfare, establishment and safety depend. Naturally every community approves the legal ownership of possessions by individuals. Hence, theft, looting, fraud, forgery are crimes regarding possessions. Every human being has the right to protect their possessions. So, getting back the possessions from the criminals and punishing them were considered as personal issues. This tradition is even now found to exist among savage natives. But, this system is not practicable for all the persons and hence not effective always. On the other hand, vengeance and conflict arise and the peace and administration of the community are endangered. Therefore, crime against possessions is considered as logically coming under criminality.

Individual or social welfare depends upon the peaceful running of family. Therefore, any behavior brining the family in danger is positively considered as crime e.g. Negligence of the parents regarding the care taking of their wards, breaking the traditional social concepts of marriages, having many husbands or many wives, extramarital relations, neglecting the helpless old.

iii. Crimes against moral values:

The every organization of each community is based on certain morals and breach of this moral faith by misbehavior is considered as crime. In various communities there are family relations, marital relations are governed by certain moral rules. Going against these rules is condemned. Publicly displaying the nudity and showing openly the love or body, attractions are definitely moral crimes. Lying, tempting for extramarital relation, Dee it, inducing for drug addiction or betting etc. are also moral crimes.

iv. Crimes against public peace and order:-

For the welfare and peaceful life, safety of the people in community is essential. Almost all the communities are alert in keeping their constituent institutes active and therefore they are attentive regarding safety and order within the community. Any behavior against there is considered as crime. Any political party's government basically considers safety and order in the community and any anti-communistic behavior is treated as political crime.

v. Crimes regarding Natural Resources:-

Just as the personal belongings and property are valuable, the natural resources are also very valuable to the community. The resources like, rivers, oceans, forests, mines, birds, cattle and other beasts and also human population are considered as the national property. Any behavior engaged in destroying the above items is considered as crime against national resources.

Considering the criminals in their social status, there are two kinds of criminals.

vi. Criminals of low status:

vii. White collared criminals.

Individuals of low status in society may involve themselves in criminal activities. The reasons

are obvious. Financial scarcity, the favorable crime provoking surroundings, ignorance, illiteracy, uncultured life etc. induce criminality.

White collared people have better financial conditions. They are well-bred and well- educated having good company. Such persons take advantage of their position and commit crimes. Such people are called as white collared criminals. During their professional life these respectable and high class people do commit crimes. Unnecessary, but the increasing unnatural needs and greediness make these people to manhandle the powers vested in them and thus they become white collared criminals. Officers, clerks, professors, teachers, judges, doctors, ministers, public workers, police, advocates etc. are relatively enjoying social status and are respectable. Their duties carry responsibility. In order to carry out their duties they are vested with some authority. But many such people misuse their authoritative powers for their selfish motives. Consequently, the work carried out by such people is not properly done. That means, they commit the crime of not carrying out property their duties. Furthermore, they convert illegal acts into legal acts. So such people commit double crime at a time. E.g. loans to be sanctioned to the needy are not sanctioned.

There might be a person applying for loan for his selfish purposes, and to get the loan sanctioned, he may bribe the loan sanctioning officer. Such examples are experienced more and more in the present days. The persons involved in such crimes are highly educated and managing higher positions. Therefore, they are looked upon with faith because these persons are generally well versed with the legal aspects. They know the loopholes and they have an established relation with higher authorities and politicians. Hence the crimes do not come up or they are suppressed and the involved persons are ready to escape from the crime accusation. Such criminals of the white collared class get a lot of easy money which is in turn utilized for more

luxury like drinking, betting, buying costly furniture and gold ornaments and spending their time in super hotels. These persons involve their money in anonymous investments to get more money. And this surplus money is used again to capture higher positions by bribing. The main aim is to earn more money by corruption. The persons concerned in higher promotions are kept pleased by bribing. The white collared people convert illegal operations into legal affairs by bribing and committing fraud. In addition, such criminal minded people support and help smuggling, corruption, misusing the authority, distributing false licenses or certificates and avoiding income tax or any legal tax. In this way the white collared criminals amass enormous amount of money which is utilized for their luxurious living. Such person doesn't have the social conscience, and there is no effective law to stop these persons, who always keep abusing the powers made available to them. These may be taken as the main reasons of white collared crimes.

2.2.2 Causes of Crime

In this modern age, sociologists have expanded that crime happens in the social structure only. They don't agree that a human being happens to be a criminal by birth. They also analytically put forth many social factors which induce human beings towards criminality by going against the system of social control. Criminologists have proved these reasons leading to crime. Hence, while studying, the reasons for crime, the following factors should be considered.

There are two groups of factors leading to crime

i. Ordinary factors.

ii. Specific factors.

Ordinary Factors:

These factors affect the whole of the society. Further these ordinary factors are divided into four secondary factors. Those are 1) Geographical. 2) Sociological. 3) Physiological. 4) Atmospheric.

i. Geographical Factors:

In the evolution of society the geographical elements play an important role. This has been accepted by historian's torsions and sociologists. A supporter of the school of geographical thinker's tradition, Mr. Huntington states that a child born in winter usually becomes less intelligent. Some of such children become criminals. The geographical elements affect the emotions and behavior of an individual. Many of the French, Italian and German criminologists have tried to show the relation between the features of geographical elements and the proportion of crimes. Criminologist prepared a calendar showing the occurrence of crimes in specific months of the year. According to them, child murders are proportionally more in the period from January to April. In July, murders and total attacks are found to increase. Human needs change according to the changes in seasons e.g. in winter in the European countries, the primary (basic) needs increase and if there are obstacles in satisfying their needs, the individuals have a tendency to criminal acts.

By geographical factors, we mean those factors which are connected with physical environment. The geographical setting governs the form of society. Due to geographical differences we find different types of culture and civilization in different geographical regions. The composition of population is closely connected with geographical

conditions. Social organization always develops in accordance to geographical conditions. Therefore whenever there is any change in the geographical setting there is also change in society."

ii. Sociological Factors:

The number of crimes increases or decreases depending upon how far a society or a community is organized or divided. In a social group where migration, cultural differences, changes in the population and political instability prevail; there a conflict arises regarding the abatement of social rules.

iii. Physiological Factors:

As a living being, man's physique, heredity and the functions of body glands are taken into consideration. In the opinion of Lombroso (a crime specialist) there is abnormality in the body and mind of a criminal right from his birth. Hence he becomes a criminallator in his life. A man of oppressive and bad tempered mentality becomes a criminal. Broadly speaking, an individual inherits some of the organic properties from the parents. We call these as hereditary qualities. This inherited behavioral property is mainly responsible for the criminal attitude. Hereditary weakness and criminal attitude convert a man into a criminal. American criminologist says that the life style of every human being is affected largely by the hereditary qualities. Hence, the consequent circumstances of hereditary qualities cause the future generations to be criminal minded continuously.

Some psychologists say that criminal behavior has its roots in the psychological set up of an individual. During the gradual psychological development of an individual some mental weaknesses take shape. These weaknesses become the causes of criminal

behavior. Mental instability and criminality are closely related. Some psychiatrists have tried to correlate criminality with the abnormality in the nerves. Disappointment, conflict, feeling of criminality, mental shocks etc. one related with the human mental activities and they become responsible for the criminal behavior. Sociologists, Psychologists and Psychiatrists have deeply studied of human behavior. These stimuli are created from eternal circumstances.

Circumstantial Elements:

These are related with the criminality of human beings. The following circumstantial elements may be considered.

i. Family Circumstances:

The family is looked upon as a powerful cause of forming good or bad personality developments. The very important task of a family is to socialize an individual and to impart social rules and to develop the individual culturally, so that the individual becomes a responsible citizen. But, under certain circumstance this family responsibility fails and the members of the family tend to become criminals.

ii. A Ruined Family:

If in a family, the father and the mother are divorced, or dead, or living separately then such a family is in the ruins. The children from such a family turn towards criminality. This has been proved from various researches conducted so far.

iii. The Size of the Family:

A big or a small family is respectively denoted by the number of members in the family. More members make a big family and fewer members make a small family. Usually in a big family there will be difficulties regarding food and management. In such large families, generally children are neglected and such neglected children tend to become criminals. In these matters there have not been researcher showing a definite relation of criminality with the size of the family. Still, in the urban areas, children in the big families generally turn to criminal behavior.

iv. Serial Placement among Brothers in a Family:

Research has been conducted to show the probability of criminality of a brother by his servility among his brothers. Some criminologists of New York have conducted research in 1930 to give the aforesaid conclusions. Generally the brother in the 2nd place of servility tends to become a criminal. The last but one child does not generally have a criminal behavior. The youngest child may turn to criminal behavior as compare with the elder brothers.

v. Discontentedness in the Family:

If the inter-relation between parents and children are not complacent, or instead of love, binding, sympathy, loyalty, c-operation belief, dedication there are conflict, alienation, disbelief, selfishness, unreasonable behavior, rivalry in the family then the members of the family especially the children behave in a dissatisfactory manner. From this, the criminal attitude arises.

vi. Fallen Family:

If the responsible person or persons of a family are involved in drinking, extra- marital relations, polygamy and criminality, the atmosphere in the family is not moralistic and

such a family is known as a fallen family. In such a family, criminality of individuals or specially children is very probable. Such a family is unable to impart civilized life or behavior.

vii. Absence of Orderliness in the Family:

The most important duty of the family guardians is to be attentive towards the socially acceptable behavior of individuals and children in the family. They do not find time as they are involved in their own duties. Further, they do not have desire or they are ignorant and they have undue or over belief in their children. Whatever be the case, if the guardians do nott care for the proper behavior of the children, then they will certainly turn towards criminal behavior.

Living in disorganized company, in congestion and having immoral behavior in a heterogeneous community develop due to cinema. Disorganization breeds crime. Further, in the fast growing cities the increasing population is taken to be one of the prime factors in criminal activities.

Disorganized living under congested conditions, having immoral behavior from movies affect behavior, resulting in criminal acts. That is to say, that the disorganized communities breed crime. Secondly, the increasing population in the urban areas is supposed to cause criminal behavior. Crimes occur more in thickly populated areas than in thinner population of cities. Parents cannot control the children who have to wander along roads. Such children take to criminal acts. Even, homes of too much congestion are regarded to be the causes of crime. In the congested homes it is hard to keep up morality and orderly behavior. Those children, who spend their time on roads in playing, become victims of neglect by the elders and such children turn to criminal behavior. Such pockets

of immoral behavior in communities are said to be responsible for the criminal act. The best examples are houses of cheaper and lower level entertainment and centers of betting games. These convert under age children into immoral acts. The established criminals frequently visit such centers of immoral behavior and here only the companions are naturally selected or here only the criminal professions are started. The society doesn't accept these centers which breed immorality in the individuals.

viii. The Movies:

The cinema houses have become the centers of breeding criminal behavior in children of smaller age. The movies instigate sexual behavior, and getting the advantage of darkness in the theater/theatre the ignorant children are drawn towards sexual acts. Many children commit theft to visit the cinema.

ix. Financial Conditions:

Monitory conditions are taken to be crime breeding reasons in three ways. 1) Difference in social status due to monitory conditions cause criminal acts and the extent of such effect can be studied. Besides, the effects of various professions on criminal behavior can also be studied. Criminologist says that the atmospheric elements are more responsible for criminal activity. He further says that the criminal activity is abundant in a disorganized society. In societies in which the important regulations are broken, the criminal activity forms a firm background. However in many disorganized societies, individuals are found to stay free from criminal activities. And in well-organized societies, some individuals may turn to criminal behavior. It is but obvious that the criminality is more probable in the disorganized societies, than the organized societies.

x. Regional Variance:

The proportionate frequency of criminality and the types of crime change depending upon the region or division of place. The main causal factor of criminal behavior is the structural variety in community. E.g. the judicial and social definitions are different from state to state. The view point of the public towards crime or criminal behavior is different. There are different laws in different areas and they are implemented to control the behavior going against lawful life of a community. The traditional life of communities too tries to curb the criminal behavior. The queer minded persons are of various types depending upon the territorial difference. Even the types of crime are different in different communities of different areas. To illustrate, the border areas of a country may be considered. If groups of advanced class of people have entered the border area, the tendency to breach of law is upper most. The only reason is that there is no established administration of social or political community. Along the political border area there are frequent smuggling crimes. Normally the defense forces on both sides of the border are insufficient and this factor helps criminal's activities. Always there will be people who take advantage of insufficient military forces on the border and they conduct criminal activities.

In cities we find more crimes and child criminals also occur abundantly. Because of the unstable management of communities, the expected moralistic behavior is not extant everywhere. In the deep inner parts of a corporation however the proportion of crime per head decreases. Hence, regional difference shows variant proportion of crime. It is interesting to note that in areas where there is abundance of finance, facilities and conveniences, we find more criminal behavior. Where as in areas affected by natural calamities, scarcity and epidemics, we

do find crime but in lesser proportion.

Class, age, sex, race etc., affect the criminal behavior. For example, the difference of status in a community initiates criminal behavior, and such people come under legal procedures. As these people grow in age, their attitude towards criminality recedes. The criminal attitude is found more in men then in women. Again the reason is that different communities have different views towards women. Generally, the disciplinary control over women is stricter. Further, women have limitations by nature over there physical conditions. They need protection; they are generally called as the weaker sex. Racial or national influence is found on criminality. Especially, in a heterogeneous society these qualities become. In a Nation, the outsiders are given the status of minority and they are looked upon differently regarding criminality. These minority people have different problems to face. Thus, class, age, sex and race have their own impact over criminality and they are important in view of study.

2.2.3 Types of Crime Analysis

The book Exploring Crime Analysis published by the International Association of Crime Analysts (2005) presents a more precise definition for a crime analyst in conducting crime analysis which "focuses on the study of crime incidents, the identification of patterns, trends, and problems; and the dissemination of information to develop tactics and strategies to solve patterns, trends, and problems." In the same book, crime pattern can be defined as when two or more incidents are related by a common casual factor, usually to do with an offender. Trend represents long-term increases, decreases or changes in crime. The concepts of pattern and trend provide an overarching framework to identify relationships of crimes.

By and large, there are five major types of crime analysis conducted on a regular basis by law enforcement agencies: tactical crime analysis, strategic crime analysis, administrative crime

analysis, criminal investigative analysis, and police operations analysis.

i. Tactical Crime Analysis:

Tactical analysis provides information to assist operations personnel (patrol investigative officers) in the identification of specific and immediate crime problems and the arrest of criminal offenders. Analysis data is used to promote response to field situations (Gottlieb, Arenberg and Singh 1994). The goal of tactical analysis is to: (1) identify emerging crime patterns as soon as possible; (2) complete comprehensive analysis of any patterns; (3) notify the agency of the pattern' existence; and (4) work with the agency to develop the best strategies to address the pattern (Bruce 2004). In comparison with all the related crime incidents, it is always possible to identify some commonalities among them. The most significant element in tactical crime analysis is to identify the pattern and that can be achieved in a number of ways, from tabulation comparison to statistical analysis and from simple pin map to automated GIS mapping. This timely qualitative analysis enables the frontline officers to make good use of the available resources for interdicting recent criminal and potential criminal activity and leading to the apprehension of offenders. After all, tactical crime analysis relies totally on the methods however refined and scientific, flexible and intuitive that the analyst can utilize.

GIS has an important role to play in the compilation of tactical crime analysis mapping – a common process of using GIS in combination with crime analysis techniques to focus on the spatial context of criminal and law enforcement activity (Boba 2001).

a) Strategic Crime Analysis:

Strategic analysis is concerned with long-range problems and projections of long-term increases or decreases in crime (crime trends). Strategic analysis also includes the preparation of crime statistical summaries, which are generally referred to as exception reports (Gottlieb 1994). Since there are always changes in the operations of criminal activity, such as spatial and temporal modification, targeting properties and modus operandi. From time to time, resources allocated for tackling will vary according to the crime situation. Exception reports are an effective means to deliver the information for better communication. Strategic crime analysis incorporates two primary functions: (1) to assist in the identification and analysis of long-term problems; and (2) to conduct studies to investigate or evaluate responses and procedures (Boba 2001). After a long-term study, trends can be mapped and tested by repeated hypothesis and subsequently provide a findings of the correlation of a specific crime. From the perspective of the management, these crime projections are useful in the anticipation of crime trends and future challenges and the assessment can assist them to have an insight to initiate strategies, priorities, resource deployment and organizational and planning needs (Baker 2005). Crime trend is the focal point of compiling a sound strategic crime analysis.

b) Administrative/Academic Crime Analysis:

This is different from the previous types of analysis in that administrative crime analysis helps facilitate strategic goals (Baker 2005) and focuses on the provision of economic, geographic, or social information to administrators (Gottlieb 1994). It refers more to presentation of findings rather than to statistical analysis or research (Boba 2001) and it is a broad category including an eclectic selection of administrative and statistical reports, research and other projects not focused on the immediate or long-term reduction or

elimination of a pattern or trend (Bruce 2004). Administrative crime analysis supports law enforcement agencies to initiate special research projects, feasibility studies and questionnaire surveys which ultimately provide additional information to the administration for better crime prevention responses. Its subsidiary outcome may improve and promote public relationships by making available a picture of the overall crime situation for publication to the public.

c) Operations Analysis:

Police operations analysis depicts the review of the organization and operations of a police department. Generally speaking, it involves the measurement of effective allocation of police resources in deterrence of crime and disorder (Bruce 2004).

d) Intelligence Analysis:

The study of criminal organizations and enterprises, how they are linked to crime, which the key players are, helps investigation and prosecution units within police. The purpose of intelligence analysis is to assist sworn personnel in the identification of networks and apprehension of individuals to subsequently prevent criminal activity. Used for:

- Linkage between crime organizations & enterprises
- Relate elements such as companies, agencies, people, times, days, to crimes & places.

e) Investigative Analysis:

Criminal investigative analysis is the study of criminal personality behavior, especially in violent crimes. It involves profiling of offenders, victims and geographical features with a view to linking and solving current serial criminal activity. This is a very specific type

of crime analysis that is primarily carried out by law enforcement agencies (Boba 2001) as it requires professional skills and a high degree of expertise.

2.2.4 Geographic Information System and Crime Mapping

The development of micro-computers in the late 1970's, faster speed of processing power of micro-computer in the 1980's (Boba 2001), larger storage and networking capability of micro-computers in the 1990's (Rich 1999) together with sophisticated mapping software (Rich 1995), has meant that adopting GIS in crime mapping on desktop computer has created a new age of the history of crime mapping. Not only does it become an affordable analytical device, it also provides user-friendly operations in handling complicated queries, higher compatibility in data exchanging (Weisburd and McEven 1998) and better connectivity in sharing of crime information with other agencies (Vann and Garson, 2003).

Mapping crime data is a scientific process and without explicit theory in crime analysis, the value of crime assessment can only rely on the proficiency of the analyst's personal understanding of relations between crime and space (Eck 1998). However, criminological theories of crime and places have been developed along with the growth of computer technology and practical experiences have been shared and integrated crime mapping into law enforcement operations. Crime mapping has become a well-established discipline of science in crime prevention.

The versatility of computer technology and the advance of criminological theory in the past two decades brought the automated crime mapping into being - Geographic Information Systems (GIS). GIS is a computerized mapping system that permits stacking of information layers to produce detailed descriptions of conditions and analysis of relationships among variables (Harries 1999). It also provides a digital representation that enables the user to map crimes

analytically, not just descriptively (La Vigne, 1999). Mapping crime incidents on GIS turns out to be no more a time-consuming and tedious task as it is often confused by a series of possible variables in solving a crime. Its output provides instant analysis for immediate police action that improves the overall efficiency of modern policing. Moreover, GIS is capable of combining data, including temporal data, from various databases, which share common geographic features, and many others from sources outside the police, to perform layering operations for complicated crime analysis. In this way, spatiotemporal study of a crime analysis becomes more viable than before.

Like many computer systems, GIS is a combination of hardware and software. The configuration of GIS basically consists of four major sub-systems: (1) the data input sub-system for creating, importing and accessing data; (2) the data storage and retrieval sub-system for storing and retrieving data; (3) the manipulation and analysis sub-system for performing database management function and analyzing geographical data; and (4) the reporting sub-system for producing visual representation of the data on a computer screen or a map printout. When comparing the advantages of a GIS map with the limitations of a pin map, it is not difficult to find out that a GIS map can overcome all the shortcomings of a pin map and that is the main reason for technological replacement.

2.2.5 Crime Hotspots

In crime analysis, hotspots are always referred to as clusters of crimes. Even though there is no fixed definition for hotspot, a common interpretation recognized by most is that hotspot is a small place where crime occurred repeatedly, such that it becomes highly predictable over a period of one year at least (Sherman 1995). Some criminologists and analysts generally define hotspot as a somewhat larger area in size that even the extended surroundings of a building are

included (Vann and Garson 2003).

In order to determine whether there is a hotspot or no hotspot, the crime data has to satisfy that crimes occurred frequently in an area at least once during a one year period. Initial review of the data set apparently indicated that there are clusters of crime incidents more contagious than other areas in a long span of time. In short, hotspots are detected where the density of crimes is high. The crime data gathered for this study fulfills this basic requirement for crime analysis.

CHAPTER THREE: STUDY AREA AND METHODOLOGY

3.1 INTRODUCTION

This section describes the study area and the methodology employed for the study, which include the types of ata, **s**ources of data, processing and data analysis

3.2 THE STUDY AREA

3.2.1. Location

Gundumi Forest Reserve lies between latitude $12^{o}40'$N to $13^{o}40'$N and longitude $5^{o}20'$E to $6^{o}40'$E. The area has estimated terrain elevation above sea level of two hundred and ninety three meters (293m). The Forest Reserve lies within boundaries of, Isa, Rabah, Wurno, and Goronyo LGAs, all in Sokoto State and Bakura, Bukkuyum, Maradun LGAs, in Zamfara State. It stretches to about one hundred kilometers (100km) between Isa L.G.A and Marnona in (Wurno) L.G.A. (See figure 3.1)

3.2.2 Climate

Gundumi is in the Sahel savannah region with an annual average temperature of 28.3 °C. The maximum daytime temperatures are generally below 40 °C most of the year, and the dryness makes the heat bearable.The hottest periodof the year, in the study area is from February to April, where daytime temperatures can exceed 45 °C.the highest recorded temperature is 47.2°C. The rainy season is from June to October which showers are not daily occurrences and rarely last long. They are a far cry from the regular torrential showers known in many tropical regions. From late October to February, which is the 'cold season', the climate is dominated by the harmattan wind blowing Sahara dust over the land. The dust dims the sunlight, thereby lowering

temperatures significantly and also leading to the inconvenience of dust everywhere in the region. (physical settings of Sokoto2008).

Rainfall starts late and ends early in the year, with Mean Annual Rainfall ranging between 500 mm and 1,300 mm. There are two major seasons in the area, namely; Wet and Dry. The Dry Season starts from October, and lasts up to April in some parts and may extend to May or June in other parts. The Wet Season on the other hand, begins in most parts of the state in May and lasts up to September, or October. During harmattan, a dry, cold and dusty wind is experienced in the region, between November and February. Heat is more severe between March and April. (physical settings of sokoto 2008).

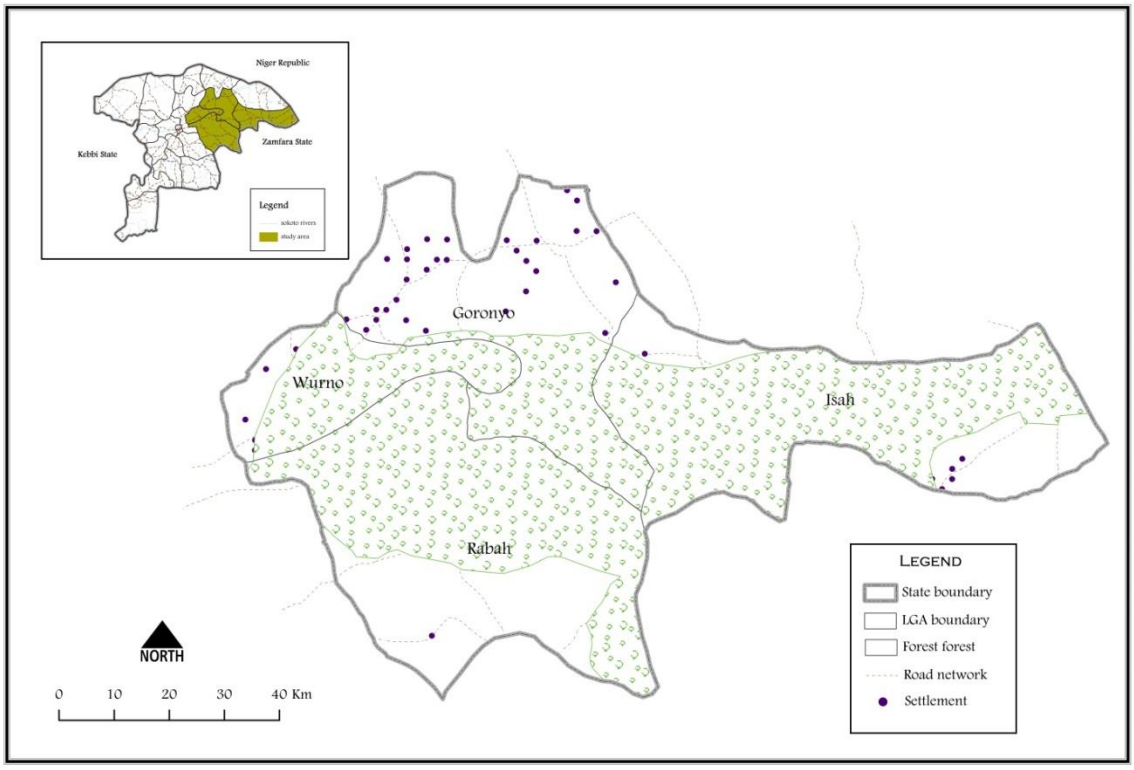


Figure 3.1: Sokoto State showing the study area.
Source: Adapted from the Administrative Map of Sokoto State.

3.2.3 Geology, Relief and Drainage.

The study area is located within Taloka formation, belonging to the Rima group which is part of the extensive Sokoto basin. The Sokoto basin is generally underlain by a sequence of inter-bedded semi-consolidated gravels, sands, clays and some limestone and ironstone of cretaceous to quaternary age resting on pre-cambrain basement complex rocks which outcrop extensively to the East and South of Zamfara State as well to the South of Kebbi State. This basin consists predominantly of a gently undulating plain with an average elevation varying from 250 to 400 meters above sea level. The plain is continuously interrupted by steep sided, flat topped hills with a lower escarpment popularly referred to as the "Dange Scarp". The Taloka formation has a maximum thickness of 180m and consists of fine coarse sand, silt sand, shales and sandstones with many layers of clay/shale within the latter.(physical settings of sokoto 2008).

The topography of the area consists of gently undulating plain dotted with residual hills that are of sedimentary nature with an average height of 285m.The topography is dominated by the famous Hausa plain of northern Nigeria. The vast fadama land of the Sokoto-Rima River systems dissects the plain and provides the rich alluvial soil fit for a variety of crop cultivation in the state. There are also isolated hills and mountain ranges scattered all over the state.(physical settings of sokoto 2008).

The drainage pattern is predominantly radial and populated by ephemeral rivers that drain rain water into rivers *Gawon* and *Gamind* These rivers are only active in the rainy season but their surrounding is moist enough to support small scale market gardening. They also provide clean sand that is used for concrete buildings mostly during the dry season.(physical settings of sokoto 2008).

3.2.4 Soil

The soils in the area are predominantly sandy, ferruginous and light. They are characterized by low level of organic matter, total Nitrogen and Cation Exchange Capacity. They range from moderate to well drain, with a low water retention capacity and a poor structural development. However, there are isolated regions in the study area where the soil is either hydromorphic or lateritic. The hydromorphic soils are found in the low lying, fadama areas and are comparatively higher than the predominant sandy soil in organic matter content, water holding capacity, soil nutrients and bulk density. (physical settings of Sokoto2008).

3.2.5 Vegetation

In terms of vegetation, Sokoto falls within the savannah zone. This is an opentse-tse fly-free grassland suitable for cultivation of grain crops and animal husbandry.It can generally be said that, natural vegetation of sparse shrubs of less than 6m high dominate the area. The vegetation consists of mostly short feathery grasses and some scattered trees most of which are deciduous in character. The tree species are mostly those that can adapt to dry conditions and are fire resistant. The vegetation can be said to be a mosaic of different types but whose pattern of distribution is very largely influenced by human activity though physical factors may assume local importance. Tree species in the area include though not restricted to *Acacia albida, Acacia senegalensis, Khayasenegalensis, Guierasenegalensis, Combretummicranthum, Combretumnigricans, Sennaarereh, Mimosa pigra, Butyrospermumparkii, Parkiabiglibosa, Azadirachtaindica, Adansoniadigitata and Mangiferaindica. The herbaceous species include Sennatora, Borreriaradiate, Eragrotistremula, Commelina Africana, Digitariaddebilis, Cenchrusbifloris, Pennisetumhordeides, Mitracarpusscaber, Ipomeamuricata and Ipomeaasarifolia* to mention but few.(physical settings of sokoto 2008).

3.2.6 Land use.

Land use in the area can be broadly categorized into agricultural, residential and institutional with little commercial use. Agriculture is the predominant human activity in the area and as such, agricultural land use is the major land use. As the area is moderately populated, residential land use also accounts for a considerable proportion of the area. The area has been a center of learning since the jihad period and a predominantly Islamic community. The region's lifeline for growing crops is the floodplains of the Sokoto-Rima river system, which are covered with rich alluvial soil. For the rest, the general dryness of the region allows for few crops, Millet perhaps being the most abundant, complemented by maize, rice, other cereals, and beans.Apart from tomatoes, few vegetables grow in the region. The low variety of foodstuffs available has resulted in the relatively dull local cuisine.(physical settings of sokoto 2008).

3.3 RESEARCH METHODOLOGY

A reconnaissance survey was carried out by the researcher, for the purpose of getting acquainted with the study area All relevant stakeholders, especially the four (4) police divisions in the study area, were contacted in order to assist the researcher gain insight on crime issues in the area.

This study was carried out through adopting the concept of Geospatial intelligence (GEOINT) technique. The GEOINT is an intelligent discipline and trade craft that has evolved from the integration of imagery, imagery intelligence and geospatial information. GEOINT comprises of four (4) fundamental components, which includes;

i. The GEOINT discipline.
ii. The GEOINT data
iii. The GEOINT analytical process
iv. The GEOINT products

3.3.1 The GEOINT Discipline

The term Geospatial Intelligence (GEOINT) can be defined as the exploitation and analysis of imagery, imagery intelligence and geospatial information to describe, assess and visually depict physical features and geographically referenced activities on the earth (GEOINT Basic Doctrine, 2006)

3.3.2. GEOINT Data

GEOINT data refers to any data used to create Geospatial Intelligence (GEOINT), which could be derived from multiple classified or unclassified sources.

3.3.2.1. *Types of data obtained.*

The data obtained for this study include:

i. Topographic Map of the study area (1;50,000)

ii. Crime records from the Police Divisions and DSS Offices in the study area include.

    a) Year the crime was committed.

    b) Type of crime.

    c) Crime scene location.

    d) Frequency of the crime.

iii. Coordinates of the crime scene location.

3.3.2.2 *Sources of data*

The data obtained from two major sources are of primary and secondary nature. The primary data source that was used for the study includes crime scene coordinates that was collected with the use of Global Positioning System (GPS) receiver.

The secondary data obtained for the study include Crime data from the Police Divisions and Department of State Services (DSS) offices in the area. Other secondary data were obtained from

journals, books, publications, magazines and past dissertations.

3.3.3 GEOINT Analytic Process.

While many analytic methodologies are used to create GEOINT, in carrying out this research one of the common analytic methodology known as the Geospatial Intelligence Preparations of the Environment (GPE) was adopted. The methodology originated from a strategic military methodology known as Joint Intelligence Preparation of the Battlefield (JIPB), which was modified so that it may be used for non-military applications such as to deal with problem-set including, law enforcement, investigative work, and threat evaluation. It is also used to deal with natural disasters like hurricane, earthquake, flood, or to even answer a tasking by the President and Commander in Chief.(GEOINT basic doctrine 2006).

GPE is a systematic four (4) component process. The components help ensure analyst consider all information. However it is not a rigid check list. G.P.E provides the analyst with templates for use across the spectrum of intelligence problem-sets with those points in mind. The four components of GPE are described as follows:-

3.3.3.1 Component 1: Define the Operational Environment

This involves gathering of basic facts needed to outline the exact location of the mission or area of interest. Physical, political and demographic boundaries must be determined. The data might include grid coordinates latitudes, longitude, vectors, altitudes, natural boundaries component, ranges, river etc. this data serves as the foundation for GEOINT product.

3.3.3.2 Component 2: To Identify the Environmental Influence

This provides descriptive information about the areas defined in component1. This involves identification of existing natural conditions, infrastructure and cultural factors etc. It also

considers details that may affect a potential operation in the area such as weather, vegetation, roads, facilities, population language and social, ethics, religious and political factors.

3.3.3.3 Component 3: Evaluation of Threats and Hazards.

This involves adding intelligence and threat data drawn from multiple INTS on to the foundation as descriptive information layers (the environment established in the first two (2) stages).The information may include sizes and strength of the threats (enemy), adversary doctrine, the nature, strength, capabilities and intent of the target group. Example, possible chemical/biological warfare attack

3.3.3.4 Component 4: Analytic Conclusions

Integration of all the information from components 1 to 3 to develop analytic conclusions, the emphasis is on developing predictive analytic conclusions. Example, the analyst may create models of likely course(s) of action for the threat or hazard, and then assess the potential impact of the action. In some cases, Components four (4) could include assessment of potential reaction to friendly operations. These courses of action can also be analyzed and visualized by using GEOINT as foundation (GEOINT Basic Doctrine 2006).

3.3.4 GEOINT Products

Geospatial intelligence (GEOINT) products range from (1) Standards geospatial data-derived products such as map and imagery, to 2- specialized products that incorporate data from multiple types of advance sensors and use 4-dimensions.

3.3.4.1 Standard product

This include geospatial data derived product such as maps, charts, imagery and digital raster or vector information. These products may be used alone or with many layers of additional data, such as geographical data (vegetation, culture, language and weather) and intelligence

information the products are 2-dimensional but can be processed into 3-dimensional products (GEOINT Basic Doctrine 2006).

3.3.4.2 Specialized product

Specialized product can provide additional capabilities to standard product to customize them for a special purpose. The product may be developed using sophisticated technology to integrate multiple types of geospatial data, as well as data from other INTS (GEOINT Basic doctrine 2006).

For the purpose of this research work, a standard product in the form of crime map was produced, as the GEOINT products. The objectives of this research work wereachieved as follows.

Objective 1: identification of crime locations in the study area

The objective was achieved by identifying the various crime locations in the study from the records obtained from Security agencies. The coordinates of these crime locations were obtained using a GPS receiver. The coordinates of the various crime locations was then imported into the ArcGIS 10.1 environment, and point overlay analysis (mapping) was carried out.

Objective 2: characterization of the type of crime in the study area

To characterize the types of crime in the study area, Geo-database for the crimes from 2009 – 2014 was created. This was achieved by entering the attributes of all the crimes in Microsoft Excel format and imported it into ArcGIS 10.1 environment. The database was used for hotspot analysis and queries and the result was depicted inform of crime document, crime maps and tables.

Objective 3: Determine the spatial pattern of crime in the study area

This was achieved using Nearest Neighbor (NN) analysis in Arc Toolbox of ArcGIS 10.1. The equation in ArcGIS was used to calculate the average NN value, Z score and P value of the crime distribution in the area. The result was compared with hypothetical random distribution to find out whether the distribution is clustered, random or dispersed.

Objective 4: To identify, analyze, and map-out crime hotspots in the study area

The Kernel Density Estimation (KDE) was utilized in mapping the crime hotspots. Kernel Density Estimation (KDE) is a type of non-parameter density estimator, meaning it uses all the data points to create an estimate (Comaniciu, Ramesh and Meer, 2003) KDE is a good method for using crime data, because it estimates how the density of events varies over the study area. It produces a smooth map in which the density at every location reflects the number of points in the surrounding area (Goldsmith 1999; Gor and Olligschlaeger 1998; Harris 1999). In Kernel estimation we start out by laying a fine grid over the study area. A circular window of constant bandwidth is placed on a grid over the study area. The density is calculated within the window. Points closer to the center of the window are given more weight than points further away (Goldsmith 1999). We use Kernel estimation because the method produces an esthetically pleasing image from which users can identify hotspots based on contours of density.

The mean and standard deviation of the Kernel Density Estimation was used to determine the hotspot and also a raster map will be generated, where the intensity of crimes is represented by continuous surfaces. In most case, lighter shades represent locations with a lower crime density, while darker shades represent locations characterized by the highest crime density.

CHAPTER FOUR:RESULTS AND DISCUSSION

4.1 INTRODUCTION

This chapter covers data presentation and analysis, as well as the discussion of the results.

4.2 IDENTIFICATION AND MAPPING OF CRIMES IN THE STUDY AREA.

To achieve the first objective of identifying and mapping of crime locations in the study area, three (3) major crimes (armed banditry/robbery, cattle rustling and murder/assassination were identified to be most prevalent in the area, on which data/ recsords are available with the Nigeria Police Force (NPF) and Department of State Services (DSS). Therefore, crime data covering fifty-five (55) crime scenes from 2009 to 2014 were obtained from four (4) respective Police Divisions and DSS Offices in Goronyo,Isah, Rabah and Wurno LGAs covering the study area. They are presented in Table 4.1 below :

Table 4.1: Crime Data of the Study Area.

Crime Scenes in the study area	Total Murder/ Assassination (2009-2014)	Total Robbery (2009-2014)	Total cattle rustling (2009-2014)
Boyi 1	0	6	3
Boyi2	0	1	1
Gwaddodi 1	1	16	6
Gwaddodi 2	0	5	8
Maikujera 1	1	4	3
Maikujera 2	0	8	5
Rara 1	0	3	1
Rara 2	0	18	2
Gandi 1	2	11	10
Gandi 2	0	1	5
Gandi 3	0	4	2
Alike 1	3	23	28
Alike 2	3	8	29
D/tasakku 1	2	31	8
D/tasakku 2	3	11	0
D/tasukku 3	6	5	8
Sarwa 1	0	4	0
Sarwa 2	0	1	0
Kubutta 1	1	15	2
Kubutta 2	1	3	0

Kunawa 1	0	5	2
Kunawa 2	0	5	0
Gundumi 1	4	33	12
Gundumi 2	3	14	5
Rafingo 1	0	9	0
Rafingo 2	0	8	0
D/tasakku 4	1	31	3
D/tasakku 5	1	13	1
Gundumi 3	3	39	23
Gundumi 4	2	25	8
Kaeda 1	0	8	2
Kaeda 2	0	2	3
G/sale 1	0	4	1
Kalkailu 1	3	18	6
Girnashe 1	2	6	8
Girnashe 2	1	8	6
Yarfako 1	0	6	27
Yarfako 2	0	2	16
U/Tafkinfili 1	0	3	9
U/Tafkinfili 2	0	14	10
U/Tafkinfili 3	0	3	12
GidanBawa 1	0	3	5
GidanBawa 2	1	6	14
D/Sule 1	0	31	0
D/Sule 2	0	20	0
D/Sule 3	0	13	0
Marnona 1	2	7	2
Marnona 2	0	3	0
Marnona 3	0	9	0
R/Alu 1	0	17	1
R/Alu 2	0	2	0
R/Alu 3	0	9	0
DabaginYari 1	0	8	5
Dinawa 1	0	1	1
Dinawa 2	0	2	1
Total crime	46	565	304

Source: Police Division and DSS.

Moreover, the geographic coordinates of the above mentioned crime scenes were obtained using Android Global Positioning System (GPS) Software called *Mobile Topographer.* The said software is popularized by Professional surveyors as an advanced technology of reading the geographic coordinates of a given place, with lower margin of error, when compared with

normal GPS receiver. The coordinates of the crime scenes can be seen on Table 4.5 and were mapped out in Fig. 4.1

Table 4.5: Coordinates of the Crime Scenes

S/NO	Point:	Latitude:	Longitude:	LGAs	S/NO	Point:	Latitude:	Longitude:	LGAs
2	D/Sule 2	13.2632	5.5761	Wurno	29	Sarwa 1	13.1870	5.8585	Goronyo
3	D/Sule 3	13.2629	5.5753	Wurno	30	Sarwa 2	13.1882	5.8679	Goronyo
4	Marnona 1	13.2137	5.5072	Wurno	31	Kubutta 1	13.1886	5.9031	Goronyo
5	Marnona 2	13.2125	5.5073	Wurno	32	Kubutta 2	13.1801	5.9290	Goronyo
6	Marnona 3	13.2122	5.5077	Wurno	33	Kunawa 1	13.1674	5.9777	Goronyo
7	R/Alu 1	13.2709	5.6024	Wurno	34	Kunawa 2	13.1606	5.9878	Goronyo
8	R/Alu 2	13.2690	5.6001	Wurno	35	Gundumi 1	13.1555	5.9943	Goronyo
9	R/Alu 3	13.2658	5.5953	Wurno	36	Gundumi 2	13.1479	6.0040	Goronyo
10	DabaginYari 1	13.2678	5.4624	Worno	37	Rafingo 1	13.1966	5.6210	Goronyo
11	Dinawa 1	13.2381	5.4400	Worno	38	Rafingo 2	13.1807	5.6559	Goronyo
12	Dinawa 2	13.2306	5.4400	Worno	39	D/tasakku 4	13.1787	5.7172	Goronyo
13	Boyi 1	13.0300	5.6010	Rabah	40	D/tasakku 5	13.1867	5.7499	Goronyo
14	Boyi2	13.0340	5.6030	Rabah	41	Gundumi 3	13.1481	6.0345	Goronyo
15	Gwaddodi 1	13.0500	5.5700	Rabah	42	Gundumi 4	13.1534	6.0442	Goronyo
16	Gwaddodi 2	13.0480	5.5690	Rabah	43	Kaeda 1	13.1584	6.0648	Isa
17	Maikujera 1	13.0800	5.5330	Rabah	44	Kaeda 2	13.1622	6.0902	Isa
18	Maikujera 2	13.0800	5.5370	Rabah	45	G/sale 1	13.1701	6.1142	Isa
19	Rara 1	13.0200	5.5960	Rabah	46	Kalkailu 1	13.2030	6.2134	Isa
20	Rara 2	13.0170	5.6030	Rabah	47	Girnashe 1	13.2033	6.2450	Isa
21	Gandi 1	12.9640	5.7450	Rabah	48	Girnashe 2	13.1994	6.2764	Isa
22	Gandi 2	12.9650	5.7540	Rabah	49	Yarfako 1	13.3550	6.6770	Isa
23	Gandi 3	12.9710	5.7460	Rabah	50	Yarfako 2	13.3460	6.6650	Isa
24	Alike 1	12.9880	6.0040	Rabah	51	U/Tafkinfili 1	13.3040	6.7080	Isa
25	Alike 2	12.9540	6.0040	Rabah	52	U/Tafkinfili 2	13.3030	6.7020	Isa
26	D/tasakku 1	13.1728	5.8018	Goronyo	53	U/Tafkinfili 3	13.2960	6.6990	Isa
27	D/tasakku 2	13.1726	5.8083	Goronyo	54	GidanBawa 1	13.2390	6.7390	Isa
28	D/tasukku 3	13.1729	5.8179	Goronyo	55	GidanBawa 2	13.2350	6.7270	Isa

Source: Field Survey

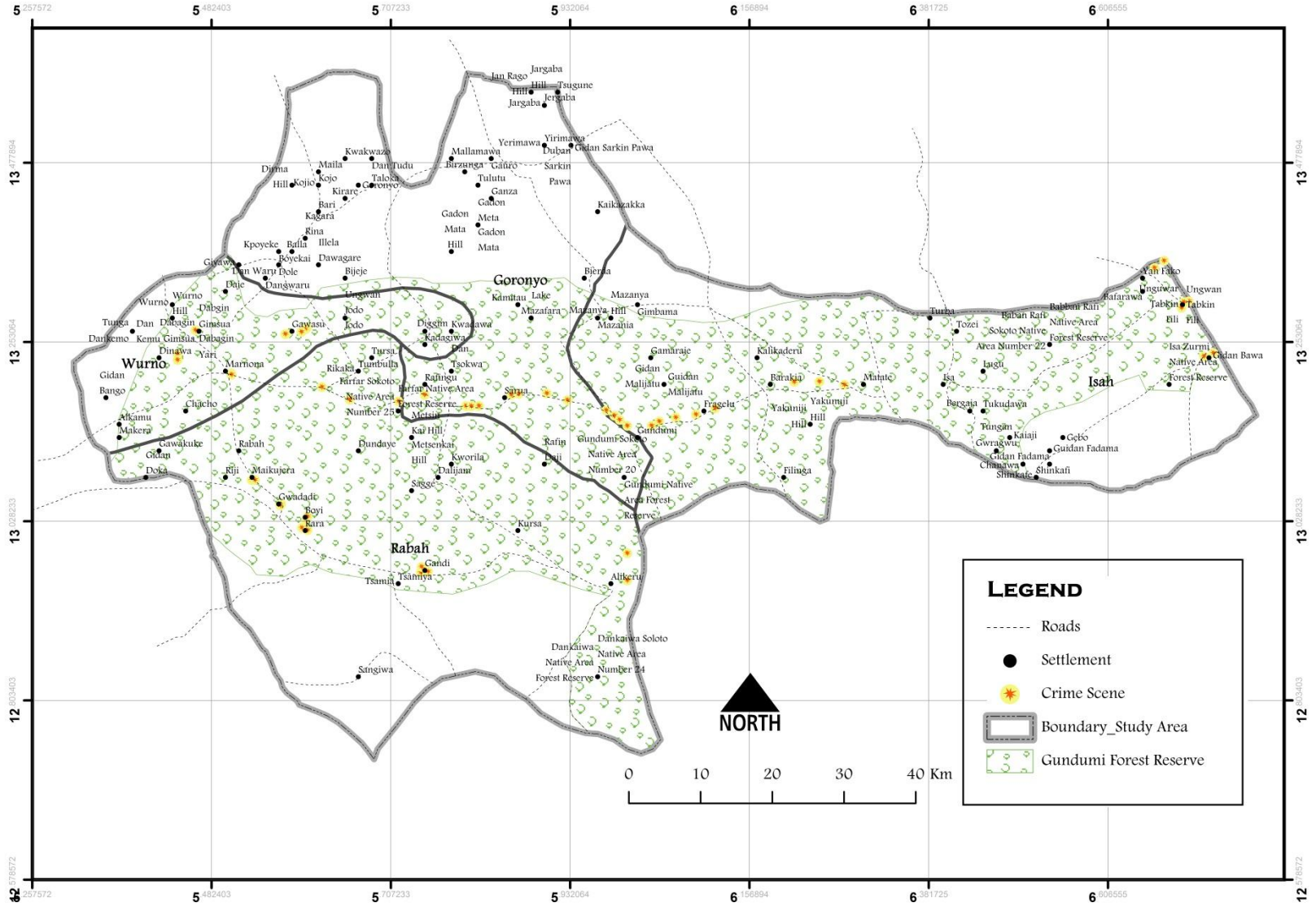


Figure 4.1: Crime scenes map of the study area.
Source: Author's Analysis (2015)

From Figure 4.1 one can observethat most of the crimes occurred along major roads linking several villages and towns. For instance along Marnona – Isa road, villages such as Rafingo, Dantasakku, Kubutta, Sarwa, Gundumietc., are all crime scenes locations. Other major routes with crime locations include; Marnona to Goronyo and Wurno to Marnona Road. It was further observed that other areas in the map, which do not fall along major routes, are mostly located along Nigeria-Niger border such as Yarfako, GidanBawa,Unguwartafkin- fili, all in Isah LGA.

4.3 CHARACTERIZATION OF THE MAJOR CRIMES IN THE STUDY AREA.

This was achieved through creating geo-data base of the crimes from 2009 to 2014. Using the following criteria (fields):

i. Name of the crime scene.
ii. Coordinate of the crime scene.
iii. Type of crime.
iv. Year of occurrence.
v. Frequency of the crime in every year.

The geo data base created is presented on Appendix I and summarized on Table 4.6 below:

Table 4.6: The Total Crime Occurrence in the Study Area.

Study Area	Total Murder/ Assassination	Total Robbery	Total cattle rustling	Total Crimes in LGAs
Goronyo	27	252	72	351
Isa	7	83	119	209
Rabah	10	108	103	221
Wurno	2	122	10	134

Total crimes	46	565	304	915

Source: Field survey.

From Table 4.6 the cattle rustling incidents in the study area, it can be observed that there were three hundreds and four (304) reported cases of Cattle-rustling incidences in the study area during the study period, out of which, Isah LGA has the highest number of cattle rustling incidents with one hundred and nineteen (119) reported cases. The recorded figure represented39.1% of the total cattle rustling incident that happened between 2009 and 2014 in the study area. While Rabah LGA is second with one hundred and three (103) recorded cases, representing 33.9%.Goronyo LGA is third with seventy- two (72) reported cases, representing 23.7%. Wurno has the least incidents of cattle rustling during the period with ten (10) reported cases representing 3.3%.

From the table 4.6,Goronyo LGA recorded the highest number of total crime, during the period under review, with three hundred and fifty-one (351) total crime cases, representing 38.4%. Rabahis second with two hundred and twenty-one (221) total number of crime in the study area, representing 24.2%. Isah LGA is third with Two -Hundred and Nine (209) total reported crime cases, representing 22.8%. The last is Wurno LGA with one hundred and thirty-four (134) total number of crime, during the period between 2009 and 2014, which represented 14.6%

Moreover, from the table 4.6 Robbery incidents is the dominant crime with five hundred and sixty-five (565) reported cases representing 61.8%. The second most prevalent crime in the study area is Cattle- rustling, with three hundred and four (304) reported cases representing 33.2%. And the least is murder/assassination incidents, with forty-six (46) reported cases, representing 5.0%

4.4 DETERMINATION OF SPATIAL PATTERN OF CRIMES IN THE STUDY AREA.

In order to determine the spatial pattern of crime in the study area, Nearest Neighbor (NNanalysis was carried out to determine either the crime distribution in the study area was clustered, random or dispersed. Nearest neighbor (NN) is a test of spatial randomness. It works by calculating the distance from each point in a collection, to its nearest neighbor point. In other word NN analysis measures the distance between features centroid and its neighbor's centroid location. The distances are then compared to the expected mean NN distance for a random distribution.If the z-score falls within --1.96 and 1.96 with p-value of 0.05 distribution is considered random. When the obtained values are greater than the range, the distribution is considered disperse, and when it is less than the range value, the distribution is clustered.

As seenin Appendix ii, the result of the NN analysis showed that the Z-score obtained is -9.99 and P-value is 0.00 for the crime distribution. Therefore, the crimes distribution in the study area is clustered.

4.5 MAPPING OF CRIME HOTSPOTS IN THE STUDY AREA.

The kernel Density Estimation in ArcGIS 10.1 was utilized in mapping the crime hotspots in the study area. The coordinates of the crime scenes were imported into ArcGIS 10.1 and was overlaid as point features. The spatial analysis tool in Arc toolbox was used to generate the crime hotspots. (asshown in figure 4.3) Hotspots are an estimate proportion of all crimes in a given location using contour of densities.

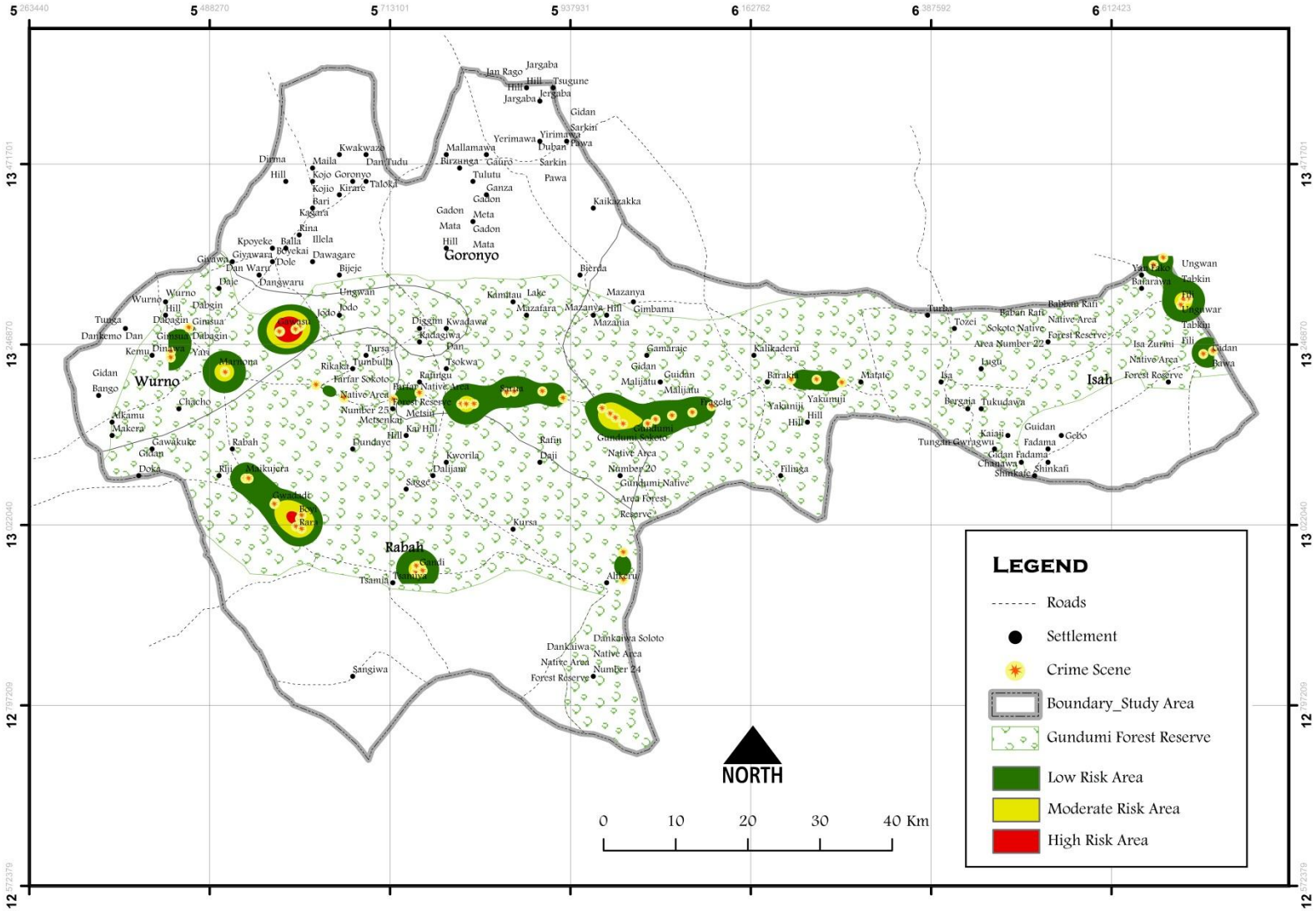


Figure 4.3: Crime Hotspots Map of the Study Area
Source: Author's Analysis (2015)

The crime map in figure 4.3 shows seven (7) distinct crime hotspots, two (2) of which falls under WurnoLGA. The first hotspot in wurno has its nucleus in Marnona village along Marnona – Wurno road. It is made up two concentric regions. The first region which is coloured yellow, represent Moderate Risk Area and it covers three (3) crime scenes under Marnona (Marnona 1, 2 and 3). While the second concentric region is green in colour, representing Low Risk Area. It has crime scenes in Dinawa and Dabagin-yari villages (Dinama 1 and 2 , Dabagin-yari 1). The second hotspot under Wurno LGA has three (3) concentric regions. The first region which represents a High Risk Area is red in colour and covers the 3 crime scenes in Doron-sule village and another 3 crime scenes in RugarAlu (D/sule 1, 2, 3 and R/alu 1, 2, 3). The second concentric region with yellow colour, represent Moderate Risk Area, covering farmlands and cattle routes with no crime scene. The third concentric region which is green in colour covers mostly forest area without crime scene.

Moreover, two (2) hotspots fall under Rabah LGA; the first hotspot has its nucleus in Boyi village, along Marnona – Gandi road. It has 3 concentric regions, the first region which represents a High Risk Area is red in colour and it covers 2 crime scenes in Boyi (Boyi 1and2) and one crime scene in Rara (Rara 1). The second concentric region of the crime hotspot, which has yellow colour, representing moderate risk area covering 2 crime scenes in Gwoddodi and another crime scene in Rara (Gwoddodi 1,2 and Rara 2). The third concentric region with green colour (low risk area) covers 2 crime scenes in Maikujera(Maikujera 1 and 2). The second hotspot in Rabah has its nucleus in Gandi village. It has two (2) concentric regions, the first region which is Moderate Risk Area (yellow colour) covers crime scene in Gandi (Gandi 1, 2 and 3) the second concentric region which is Low Risk Area (green colour) covers some part of Tsamiya village with no crime scene.

While two (2)hotspots fall under Goronyo LGA.The first one has its nucleus in Dantasakku village. The hotspot comprises of two concentric regions, the moderate risk region (yellow in colour) covers the three (3) crime scenes in Dantasakku (D/tasakku1,2and3). The second region, which is low risk area (the green colour area) covers two (2) crime scenes in eachKubutta and Sarwa villages (Sarwa 1and 2 and Kubutta 1and2) all along Marnona-Isah road. The second hotspot in Goronyo LGA is located in Gundumi village and its divided into two concentric regions, the first region which is a moderate risk region (yellow in colour) covers 3 crime scenes in Gundumi, two 2 crime scenes in Kunawa and one (1) crime scene in Kaeda (Gundumi 1,2,3, Kunawa 1,2 and Kaeda 1). The second concentric region, which is a low risk region (green in colour) covers one (1) crime scene in Gidan Sale in Isah LGA (Kaeda 2 and Gidan Sale 1).

The last hotspot falls under Isah LGA, with its nucleus in UnguwerTafkin-fili village. The hotspots comprises of two concentric regions. The first region is the Moderately Risk Area represented in yellow colour, which covers all the three (3) crime scenes in UnguwarTalkinfili (Tabkinfili 1,2 and 3), The second concentric region, which is a Low Risk Area (green in colour) covers 2 crime scenes in GidanBawa village and 2 crime scenes in Yarfako village (GidanBawa 1,2 and Yarfako 1,2).

However, apart from the seven (7) hotspots discussed earlier, there are also four (4) concentration of crime scenes (flash points), which are yet to developed into hotspots, but have the potential to be one in nearest future if not tackled. Two of the flash points are located in Goronyo LGA The first flash point is located in Rafingo village (Goronyo LGA) and covers the two (2) crime scenes in the village (Rafngo 1 and 2). The flash point was evaluated as low risk area. The second flash point is located outside Dantasakku village, and

it covers two (2) crime scenes; Dantassaku 4 and 5. The next flash point concentration is in Alike village (Rabah LGA) the concentration covers the 2 crime scenes in Alike village. The flash point was equally adjudged as low risk area. The last but not the least is the flash point along Kalkailu-Girnashe road in Isah LGA, it covers the two crime scenes in Girnashe (Girnashe 1 and 2) and one (1) crime scenes close toKalkailu village.

4.6 FINDINGS.

At the end of data presentation and analysis, the following findings were observed:

i. The study reveals that Gundumi is an extensive forest with so many routes linking several villages and towns that are associated with high crime rate, of which three (3) major crimes were identified to be most prevalent (armed robbery, cattle rustling and murder/assassination). After mapping the crimes, it was observed that most of the crime scenes are located along major routes/roads in the study area. Those that do not fall under the major routes are located along borderline. (Example, GidanBawa, Yarfakoetc).

ii. From the analysis, it was observed that 915 crime incidences were recorded on the three (3) major crimes that happened between 2009 and 2014 in the study area. Out of this, 304 recorded cases, representing 33.2% are cattle-rustling incidences recorded during the period. Armed robbery incident has 565 recorded cases, representing 61.8%. While murder/assassination incident recorded only Forty-Six (46) cases, representing 5.0%.

iii. Findings from the hotspot analysis reveals that seven (7) hotspots of crimes exist in the study area, out of which two (2) cascade crime scenes into three (3) concentric regions of high, moderate and low risk areas, while the remaining five

(5) hotspots cascade crime areas into two (2) concentric regions of moderate and low risk areas. Therefore, the high risk areas in Gundumi Forest Reserve include concentric regions around three (3) crime scenes in Doron-sule and three (3) crime scenes in RugarAlu, all in Wurno LGA, and another concentric region that cover two (2) crime scenes in Boyi 1,2 and a crime scene in Rara 1 all in Rabah LGA. Therefore, the High Risk Areas in the study area are located in Wurno and Rabah LGAs.

iv. The moderately risk areas in the map are marked with yellow colour, they include three (3) crime scenes in Marnona (Wurno LGA), two (2) crime scenes in Gweddodi 1,2 and Rara 2, all in Rabah LGA. Another moderately risk area in Rabah LGA is concentric region covering three (3) crime scenes in Gandi (Gandi 1,2,3). The moderate risk areas in Goronyo LGA include concentric regions that covers three (3) crime scenes in Dantasakku (Dantasakku 1,2,3) and another concentric region covering Kunawa 1,2 and Gundumi 1,2,3,4. The moderate risk areas in Isah LGA, covers three (3) crime scenes in Unguwartabkinfili 1,2 ,3 and one (1) crime scene in Kaeda 1. The moderate risk area is spread across all the four (4) LGA in the study area.

v. The low risk areas, which are marked with green colour on the map, are also spread into the four LGAs in the study area. In Wurno LGA we have DabaginYari 1, Dinawa 1, 2. In Rabah LGA the low risk areas are; Maikujera 1,2, Alike 1,2, and Rafingo 1,2. In Goronyo LGA, the low risk areas include Dantasakku4,5, Sarwa 1,2, Kabutta 1,2. In Isah LGA, the low risk areas

include;Kaeda 2, Gidan-sale 1, Kalkailu 1, Girnashe 1,2, Yarfako 1,2 and GidanBawa 1,2.

CHAPTER FIVE: SUMMARY CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

This chapter summarizes the study, the methods usedand discusses the results. It also contains recommendations that could assist in curtailing the prevalence of crime in the study area.

5.2 SUMMARY

The aim of this study is to map-out and analyze crime hotspots in the study area. The crime data to carry out the study was obtained from the four (4) Police Divisions and the Department of State Services (DSS) offices in the study area from 2009-2014. The crimes records obtained contains information on, type of crimes, the crime scene locations, the frequency and year the crime was committed. .

The map of the study area was extracted from the Administrative Map of Sokoto State, and the coordinates of the crime scenes of all the 55 locations covered in the study, were recorded using *MOBILE TOPOGRAPHER* Software used in Android Global Positioning System (GPS) which recorded the point coordinates and save them in CSV format readable in ArcGIS environment.

The coordinates of the crime scene locations were imported into ArcGIS 10.1 software and mapped out locations of the crime scenes in the study area. It was observed that most of the crime scenes are located along major roads in the study area, and few are located along border areas in Isah LGA. The Average Nearest Neighbor analysis was employed to carry out pattern analysis. The result of the pattern analysis shows that crime distribution in the area overtime is significantly clustered.

The Geo data base of the three (3) major crimes in the study area for the year between 2009

and 2014 was created to characterize crimes in the study area. It also assisted in carry out risk assessment of the crime scenes in the study; using Kernel Density Estimation (KDE) model. The model categorized the crime scene areas into High, Moderate and Low risk areas.

The high risk areas in the analysis include concentric regions around three (3) crime scenes in Doron-sule and three (3) crime scenes in RugarAlu, all in Wurno LGA. The second high risk area covers two (2) crime scenes in Boyi 1,2 and one (1) crime scene in Rara 1 all in Rabah LGA. Therefore the high risk areas in Gundumi forest reserve include parts of Wurno and Rabah LGAs.

The moderately risk areas include three (3) crime scenes in Marnona (Wurno LGA), two (2) crime scenes in Gwaddodi 1,2, and Rara 2, all in Rabah LGA. Another moderately risk area in Rabah LGA is concentric region covering three (3) crime scenes in Gandi (Gandi 1,2,3). The moderate risk areas in Goronyo LGA include concentric regions that covers three (3) crime scenes in Dantasakku (Dantassaku 1,2,3)and another concentric region covering kunawa 1,2 and Gundumi 1,2,3,4. The moderately risk area in Isah LGA covers three (3) crime scenes in Unguwartabkinfili 1,2 ,3 and one (1) crime scene in Kaeda 1. The moderate risk area is spread across all the four (4) LGA in the study area.

The low risk areas spread in the four LGAs in the study area. In Wurno LGA we have Dabagin-Yari 1, Dinawa 1,2. In Rabah LGA the low risk areas are Maikujera 1,2, Alike 1,2 and Rafingo 1,2. In Goronyo LGA the low risk areas include Dantasakku 4, 5. Sarwa 1,2. Kabutta 1, 2. In Isah LGA the low risk areas include Kaeda 2, Gidan-sale 1, Kalkailu 1, Girnashe 1,2, Yarfako 1,2 and GidanBawa 1,2

5.3 CONCLUSION

After mapping the spatial distribution of the crime scenes in the study area, it was observed that mostof the crime scenes are located along routes linking villages and towns. The Nearest Neighbour Analysis revealed that the crimes pattern distributions in the study area are clustered. It was further observed thatincidents of Murder/Assassination aredecreasing, while Cattle-rustling and armed- robbery are on the increase. Finally, the hotspot analysis using Kernel Density Estimation (KDE) model identifies 7 major hotspots and four (4) new potential hotspots.

5.4 RECOMMENDATIONS

i. It is recommended that security be reinforced along major roads in the study area, to ensure safety and security of commuters and motorists since most robbery incidents are along major roads.

ii. High and moderately risk areas are supposed to be specially treated. Where there is no presence of security personnel, especially policemen, adequate arrangement should be made to deploy them to ensure full security coverage of such areas.

iii. Establishment of security committees by the affected Local Government Councils (LGCs) in all towns and villages bedeviled by criminal activities. The committee should comprises of all security agencies operating in the area, the traditional rulers of such Towns/Villages, local vigilante and other stakeholders. This is to ensure obtaining useful and relevant information and suggestions on the criminal groups.

iv. Local Government and security and peace committees in all the four (4) LGAs in the study area should be resuscitated. And the committee is to meet at least twice in a month to discuss pending security issues that need attention.

v. The Local Government offices of the Nation Orientation Agency (NOA) and the Local government Information Officers (I.Os) should from time to time embark on sensitization campaign, in conjunction with relevant security agencies to enlightened and educate general public on safety and security of their communities, especially on current security issues both locally and nationally.

vi. The four (4) concentrations of crime scenes in Rafingo, Dantasakku, Kalkailu, Girnashe and Alike villages are potential crime hotspots that are recording high crime rates. Therefore, special security attention should be given to them, in order to neutralize the threats they posed.

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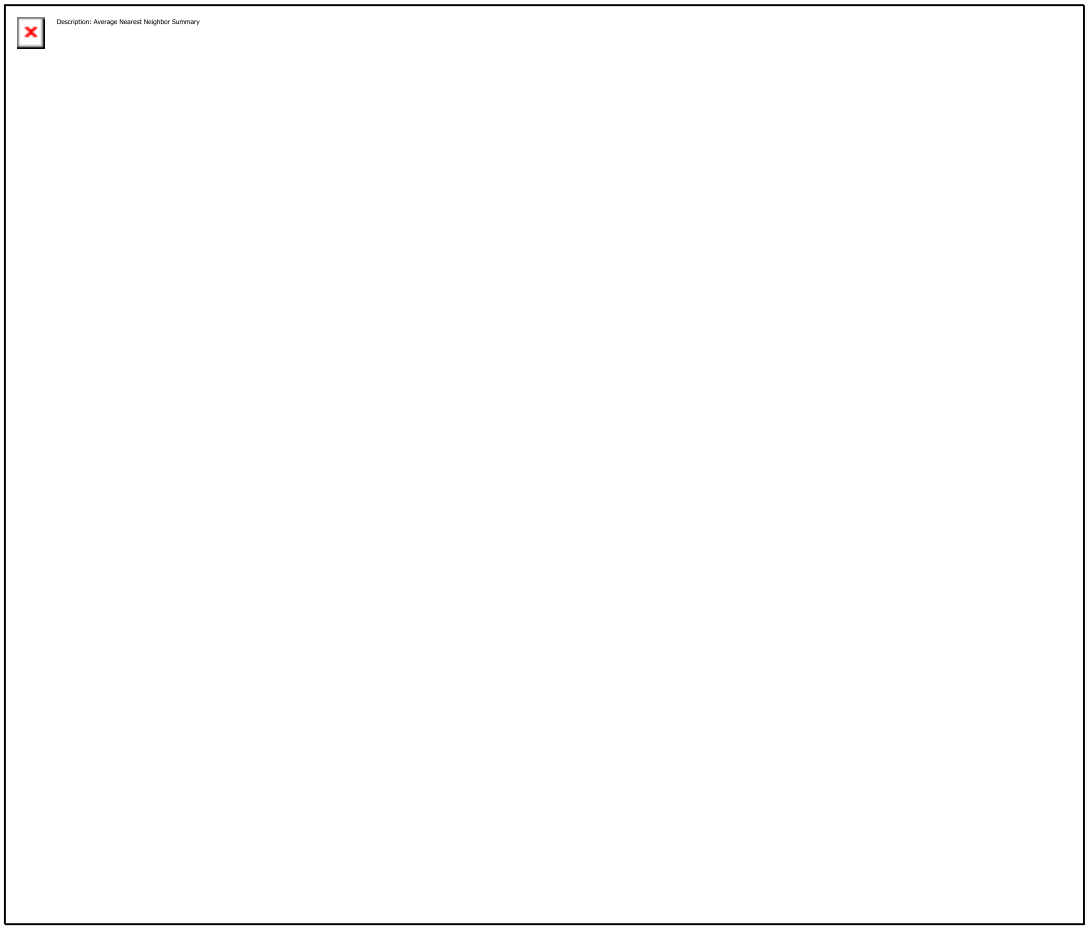
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APPENDIX II



Given the z-score of -9.99, there is a less than 1% likelihood that this clustered pattern could be the result of random chance.

Observed Mean Distance:	0.013458 Meters
Expected Mean Distance:	0.045530 Meters
Nearest Neighbor Ratio:	0.295581
z-score:	-9.994097
p-value:	0.000000