INSTITUTE FOR SECURITY, DISASTER AND EMERGENCY STUDIES (ISDES)

SPATIAL ANALYSIS OF CRIME DATA: THE CASE OF KASOA IN THE CENTRAL REGION OF GHANA

SETH OKYERE

PG/CRM/21/013

2023

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BY

SETH OKYERE

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Long Essay submitted to the Department of Criminology, Institute for Security, Disaster and Emergency Studies, in partial fulfilment of the requirements for the award of Master of Science degree in Criminology

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DECLARATION

Candidate's Declaration

I, Seth Okyere, hereby declare that this dissertation is the result of my own research carried out at the Institute for Security, Disaster and Emergency Studies (ISDES), under the supervision of Dr. Jones Opoku-Ware. I further declare that no part of this dissertation has been presented for a degree at any University or College.

CANDIDATE:

SETH OKYERE

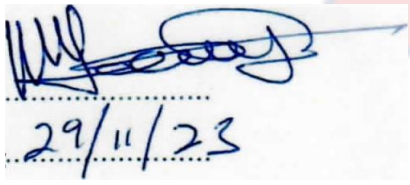
29/11/2023

Supervisor's Declaration

I hereby declare that the preparation and presentation of the long essay were supervised in accordance with guidelines on supervision of a long essay laid down by the Institute for Security, Disaster and Emergency Studies

PRINCIPAL SUPERVISOR:

DR. JONES OPOKU-WARE



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ABSTRACT

Kasoa has long been associated with crime issues in Ghana, appearing in both traditional and digital media. There has been a plethora of efforts made by security agencies to nip the crime issue in the bud. However, in recent times, as there has been the use of advanced technology in the fight against crime in other countries, the lack of it in our part of the world seems to put a strain on the efforts of the police service. This research sought to bring to light the application of technology in crime management. The main goal of this study was to analyze spatial patterns and distributions of crime in the Kasoa Police Division. The study concentrated on five police districts, i.e., Kasoa Central, Awutu Bereku, Senya Bereku, Odupong Ofaakor, and Bawjiase. In order to achieve this objective, secondary data on three selected crimes, i.e., robbery, assault, and fraud, for three study years, i.e., 2017–2019, was obtained from the police, and a dataset containing land uses of the study areas was obtained from the Town and Country Planning Department. QGIS was used to identify hotspots for the selected crimes for each study year. The software was also used to identify the location of frequent activity within the study area. As a result, the study discovered Kasoa Central to be a hotspot for the majority of crime incidences during the selected years, as well as a location of frequent activity. The study concludes that there is a positive correlation between locations of frequent activity and incidences of crime if police visibility is not strengthened. It was recommended that the police must setup GIS departments at all police district offices to help with data collection, ensure that other stakeholders are considered when putting in place measures to help curb crimes, and also encourage community policing to ensure reasonable police visibility.

KEYWORDS

Crime

Geographic Information System

Hotspot

Frequent Activity Space

Spatial Analysis

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DEDICATION

This work is dedicated to my mother, Comfort Manu; my sweet sister, Mrs. Naomi Okyere; and my lovely niece, Madepah Yaa Akyere Badu-Koomson.

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GIS – Geographic Information System

GPS – Global Positioning System

CHAPTER ONE

INTRODUCTION

1.0. Background to the Study

Crime have been with humanity since time immemorial (Bagri, 2016). In our current epoch, the phenomenon has become a worrying feature for countries across the globe. Does this confirm the cliché that "crime is part of human nature?" We must all deal with the reality of crime because it lives with man (Holzman-Escareno, 2009). Crime is one of the most concerning social issues in the world (Ipsos, 2021). Senick (2019) posits that in any population, anywhere in the world, crime is an obvious and unwelcome problem. While sociologists feel that crime is a necessary evil for society's regular functioning (Durkheim & Moynihan, 1998), the current rise in crime is destabilizing and therefore requires attention. Senick (2019) states that a city's negative externality is having a lot of crime. He goes further to add that not only does crime pose a threat to public safety, but it also has financial consequences (Senick, 2019). Jonathan, Olusola, Bernadin and Inoussa (2021), indicates that increased criminal activities lead to decline in the operations of business people which will in effect be a threat to the economic activities of a nation. According to Muscato (2021), crime can change statistics, resulting in a shift in an area's social policies or the designation of a crime region, as well as affecting home market sales. According to Jonathan et al. (2021), “People experience terror and untold agony as a result of crime. Crime frequently acts as a roadblock to society's socioeconomic development, discouraging investment, raising transaction costs, and ultimately fueling

migration, which leads to global economic inequities" (p. 2269). As a result, without a shadow of a doubt, crime must be controlled in order for societies to function efficiently.

Meanwhile, many distinct perspectives have been investigated as probable causes of crime. Multiple unfavorable societal, economic, cultural, and family circumstances may be the probable causes of crime. The age-old question of why people commit crimes, which was formerly a niche discussion among experts in the global North, has recently aroused widespread attention and excitement with no end in sight (Aning, 2006 as cited in Ebu, 2020). As cited in Ayuba, Tanko and Bulus (2016), Murray, McGuffog, Western and Mullins (2001) assert that theft, assault, manslaughter, and other forms of criminal conduct occur on a daily basis in practically every corner of the globe. Murray et al. (2001) stated that there is much dispute over what brings about crime (cited in Ayuba et al., 2016). According to Yaccoub (2017), incidences of crime are caused by "poverty levels; family stability; individual and societal health; social and cultural background; along with geographic, demographic and political considerations" (p. 629). Ayuba et al. (2016) indicate that because crime is such a complicated problem, professionals look into it from several perspectives.

Criminal offenses are not evenly distributed (Curiel, Delmar & Bishop, 2017). To put it another way, one is likely to discover different concentrations of different crime types at different geographic areas (Owusu & Frimpong, 2020). Ayuba et al. (2016) explain that several factors determine where people choose to breach the law, such as the attraction of potential targets and spatial comfort. Therefore, depending on a place's physical and social structure, crime may be encouraged, suppressed, or increased there. Butorac and Marinovic (2017) write that "Geographical approach and an interest for crime

research have significantly increased over the last few decades due to the fact that crime cannot be separate from the offender's natural habitat" (p. 001). It is therefore undeniable that, in order for society to deal effectively with the threat of crime, the aspect of geography, or more specifically, location, must be considered.

When one compares the crime index of Ghana for the past three years, Sasu (2021) indicates that the rate is at a moderate level in 2021 (2019 was 51.95, 2020 was 48.97, and 2021 is 46.98). There have, however, been reports of very violent and cruel crimes at some geographical locations in Ghana. According to the UK government's travel advisory for Ghana in 2021, there has been a noticeable upsurge in cases of robbery, burglary, and severe assault, often involving the utilization of weapons (UK Government's, Foreign Travel Advice-Ghana, 2021, UK Government Website). The statement goes on to say that locations in Accra are high-risk areas, and so travelers should be especially vigilant in these areas (UK Government's, Foreign Travel Advice-Ghana, 2021, UK Government Website). Additionally, the US government advised its people to travel with greater vigilance owing to crime in Ghana (U.S. Department of State- Ghana Travel Advisory Website, 2022). The declaration identified high-risk zones as places like cities and bustling marketplaces, as well as the Upper East and Upper West regions' areas close to the northern border. With location being an important element of the crime problem in Ghana, there is therefore a need for authorities to explore spatial analysis, or more specifically, GIS or crime mapping, to map out and analyze crime distribution in their efforts to fight crime.

Spatial analysis of crime with the use of GIS is increasingly commonly utilized for investigating analysis of crime and to uncover unequal patterns of crime (Yar & Nasir,

2014). According to Zemmouchi-Ghomari (2022) "GIS is used to capture, store, analyze, and visualize data that describes part of the Earth's surface, technical and administrative entities, and the results of geosciences, economics, and ecological applications" (p. 7). Butorac and Marinovic (2017) show that geographic information systems are becoming more common in so-called crime mapping and crime analysis in modern police organizations, and their applications are endless (Butorac & Marinovic, 2017). Researchers and practitioners can use crime mapping to investigate trends in crime, offender mobility, and serial offenses over time and location. (Reid, Tita & Valasik, 2018). The utilization of Geographic Information Systems (GIS) in crime analysis allows for the identification of crime patterns, problem areas, and hotspots, aiding police personnel in effective emergency response planning (Gupta, Rajitha, Basu & Mittal, 2012). There are indeed numerous implications of spatial analysis, or more specifically, GIS, crime mapping, etc., in analyzing crime.

1.1. Statement of the Problem

In Ghana, the print and electronic media are day in and day out flooded with news of reported criminal activities like murder, robbery, theft, and various crimes. Lately, there have been concerning accounts of a significant surge in incidents involving attacks on bullion vans and cases of homicides throughout the nation. A report by Ghana Public Safety and Crime Report indicates that there has been a 20% increase in violent crimes across the country (Bureau of Public Safety, 2021). Countries like the UK and USA have had cause to caution their travelers to Ghana to be extra careful because of recent crime problems in the country. In their quest to curb criminal activities in the country, the Ghana Police Service has started using electronic surveillance and horse patrols to supplement

other traditional measures (Boakye, 2021). The continuation of criminal activities in Ghana, despite the measures put in place by the Ghana Police, appears to agree with the notion of Costanzo and Gerrity, as cited in Ebu (2020), that the policies and regulations put in place by the service are ineffective because they have not been able to match the sophisticated methods used by offenders.

As the world moves at a breakneck speed, Paul (2018) indicates that the population is expanding, technological advancements are accelerating, and criminal activity is also on the rise. The population is expanding, technical advancements are accelerating, and criminal activity is also on the rise. He goes further to add that the era of technological innovations is encouraging police agencies around the world to imbibe GIS in their in their line of duty ensure swift attendance to criminal activities. Sahu and Srivastava (2010) assert that Geographic Information Systems (GIS) stands as a highly influential methodology when it comes to examining the geographical patterns of crime. The ability to observe, assess, and interpret criminal behavior within a spatial framework represents a fundamental advantage of Geographic Information Systems (GIS) compared to conventional methods and tools for crime analysis. To support their stance, they provide evidence suggesting that specific elements within the environment, such as the physical configuration of an area, proximity to different amenities, and land utilization, are probable factors influencing criminal conduct. Consequently, it is imperative to take these factors into account when analyzing crime data. Oyineke, Odedare, Olajoke and Olateju, (2016) also postulate that utilizing GIS technology in crime data analysis aids police in comprehending the relevance of where, when, and by whom crimes are committed. They add that the robust mapping capabilities provided by GIS will aid in determining the spatial

variance in the distribution of crime utilizing police data. Wang (2012) claims that GIS is a potential technology for police enforcement and helps authorities to always forecast criminal activities.

According to Otieno (2018) cited on WorldAtlas, the standard police-to-citizen ratio is 1:450, or around 225 officers per 100,000 people. However, population and housing census indicated that the country's population was 30.8 million (GSS, 2021), with about 25000 police staff strength in the country (Nyabor, 2021 cited on Citi NewsRoom). In effect, the country will be grappling with a ratio of 1 police officer to about 1000 civilians at a time; this ratio is way below the global recommendation, and hence there is a need to put in place measures to mitigate the effect of this shortfall and also look for technological ways to fight crime to ensure efficacy.

Police departments must implement "Smart Policing," which uses GIS technology to track crime, identify hot spots, assign personnel, and profile offenders, while the world experiences "Smart Offenders." Society is progressing in terms of technology, and law enforcement organizations, like any other institution, must adapt to the changing difficulties of the environment they operate in and change with the times, or risk becoming obsolete and irrelevant (Ige, 2008 as cited in Oyineke et al., 2016).

However, less attention has been given to the utilization of GIS in managing levels of crime in Africa, especially Ghana. This is due in part to a lack of funding for police organizations, which makes acquiring GIS equipment difficult, as well as a shortage of GIS professionals in the police forces of developing countries (Oyenike et al., 2016). Olabode (2019) asserts that it may also be because people are unaware of the advantages that GIS offers for managing and reducing crime in the nation. Extensive research has been

conducted on crime analysis in Ghana (Appiahene-Gyamfi, 2005; Owusu, Wrigley-Asante, Oteng-Ababio, & Adobea, 2015; Owusu, 2016; Oteng-Ababio, Owusu, Owusu, & Wrigley-Asante, 2016; Dziwornu, 2021). However, there is a noticeable scarcity of studies focusing on the spatial distribution of crime in the country (Brookman-Amissah, Wemegah & Okyere, 2014; Ebu, 2020; Duffour, Asante & Acheampong, 2022). Moreover, these limited studies only targeted specific areas, such as the Dansoman Police Subdivision, the Sekondi-Takoradi metropolitan region, and La-Dade Kotopon municipality, further highlighting the dearth of comprehensive research in this area. Given the associated benefits of crime analysis utilizing GIS technology, a study of this nature will be a valuable complement to efforts in this field, particularly in Ghana. Against this backdrop, the current research sought to focus on using GIS to map key crime hotspots in Kasoa in order to discover point-based locations of selected crimes like assault, fraud, and robbery, in order to help the police, make informed decisions towards curbing such crimes.

1.2. Objectives of this Study

The study's general objective was to investigate the distributions and patterns of crime in the Kasoa Police Division.

Specifically, the study sought to:

1. To find out the total crime statistics of the selected crimes from 2017-2019.
2. To conduct statistical analytical trends of the selected crimes from 2017-2019.
3. To identify hotspots of the selected crimes in the study area from 2017-2019.
4. To determine the location of frequent activity within the study area.

1.3. Research Questions

The study was directed by the following sets of questions in order to fulfill the specified study objectives;

1. What are the total crime statistics of the selected crimes from 2017-2019?
2. What is the statistical trend of the selected crimes from 2017-2019?
3. Where are the hotspots of the selected crimes in the study area from 2017-2019?
4. What is the location of frequent activity within the study area?

1.4 Significance of the Study

As the world hovers around technological innovations, so must the fight against criminal activities. Inasmuch as police in developed countries are using technology to fight crime, the same cannot be said in developing countries such as Ghana. It has been well established that when a crime is committed, it occurs in a physical location. Someone must have come from somewhere to commit a crime. This location might be similar to the scene of the crime or regularly nearby (Rossmo, 2000; Wiles & Costello, 2000 as cited in Ebu, 2020). As a result, location is critical to comprehending crime and determining how to combat it, and so the Ghana Police Service must show maximum evidence of using spatial analysis of crime, specifically, the utilization of GIS.

Crime mapping aids authorities in quickly identifying crime hotspots as well as evaluating responses. Hot spot analysis helps law enforcement agencies identify high-crime areas (Eck, Chainey, Cameron & Leitner, 2005). Therefore, it is evident that much research is required in this field. However, there is a paucity of research in this field, which is Ghana's fight against crime. As a result, the goal of this study is to visualize the spatial distribution of different crimes. Additionally, the GIS-mapped crime hot spots in this study

enable the police service to identify distribution of crime and prevention techniques, enabling them to make wise and informed policymaking on the control and reduce of levels of crime, specifically with in study area.

1.5 Scope of the Study

The Kasoa Division Police Command provided secondary data for the study, including crime statistics on robbery, assault, and fraud from 2017 to 2019. With this data, the study involved statistical trend analysis of the selected crimes for the selected years to determine whether or not there are significant variations, and found out the total crime statistics for the selected crimes. The study also used the collected data to identify crime hotspots of the selected crimes. In order to locate areas of the research area that are often used for activities, a dataset from the Town and Country Planning department was gathered.

1.6 Delimitations

Inasmuch as this study focused on spatial analysis of crime, it should be noted that, despite the many forms of crimes, this study involved only three types of crimes, i.e., assault, fraud and robbery. Also, geographically, the study focused on Central East Police Region, and more specifically focused on Kasoa Police Division.

1.7 Limitations of the Study

Due to the police's reliance on manually collecting crime statistics, problems with data gathering emerged. As a result, this had a substantial influence on the process' efficiency and caused delays in acquiring the necessary data. As a result, it was discovered that some essential criminal data, such as the geocodes of specific crime scenes, were not

available. The accuracy and efficiency of the hotspot analysis were subsequently impacted by this flaw, which had a significant impact on the entire dataset.

When examining the concentration and distribution of crime at various spatial levels, another consideration is the utilization of reported crime data in a research study. Another limitation that the researcher envisaged was the sole use of Uniform Crime Data. When using this kind of data, it is obvious that the data may not be the true representation of the total crime incidents, since such data only involves reported crimes. With this, the study is only able to do analysis, make conclusions, and proffer recommendations that are representative of the available data.

1.8 Organization of the Study

This research work is organized into five chapters. Chapter one comprises the background to the problem, statement of the problem, research objectives, research questions, significance of the study, delimitations and limitations of the study, scope of the study, and organization of the study. Chapter two entails the review of relevant theories, conceptual review, and review of empirical studies related to this current study. Chapter three outlines the research methodology. It involves the research design, research strategy, research approach, source of data, data collection and analysis procedures. Chapter four covered the presentation and discussion of results. Chapter five includes a summary, conclusions, recommendations, and suggestions for further study.

CHAPTER TWO

LITERATURE REVIEW

2.0. Introduction

This section's main purpose is to situate the current study's research in the context of the body of existing knowledge by providing relevant information about the current study. Theoretical Framework, review of relevant concepts and conceptual framework, and review of empirical studies are the three subheadings under which the review is organized.

2.1. Theoretical Framework

When societal norms and rules fail, ecological theories of crime attempt to explain how criminal behavior can be traced back to external sources in the physical environment (Norton, 2016). To better comprehend the connection between crime and place, this section will examine three ecological theories of crime: the theory of crime pattern, the theory of social disorganization, and the theory of broken window.

2.1.1. Crime Pattern Theory

Crime Pattern Theory delves into the intricate interactions between offenders and their physical and social environments, which significantly influence their target selection (Brantingham & Brantingham, 1993). This theory posits that crime is not randomly distributed across time and space but exhibits discernible clustering patterns (Curiel, Delmar & Bishop, 2017). Several factors strongly shape these patterns, including individuals' residential locations within a city, their motives for navigating urban landscapes, and the social networks that govern their interactions. To gain a comprehensive understanding of crime patterns, it is imperative to consider various aspects of offenders' and targets' activity spaces (Brantingham, Brantingham & Andresen, 2017). This

encompasses the activity spaces of individual offenders, the collective activity spaces of networks comprising acquaintances involved in criminal activities, the geographical locations of stationary targets, and the activity spaces of mobile victims and mobile targets (Eck & Weisburd, 1995). Moreover, fixed targets possess catchment areas that exert a notable influence on crime dynamics. The significance of place within Crime Pattern Theory cannot be overstated. Places serve as not only logical prerequisites for criminal events (offenders must physically be present at a location to commit a crime), but their inherent characteristics also wield substantial influence over the likelihood of criminal activity (Brantingham, Brantingham & Andresen, 2017). This theory underscores the pivotal role of social structures and environmental attributes in shaping crime patterns within specific localities.

This study's focus on the spatial distribution of crime in Kasoa, Ghana, is closely aligned with Crime Pattern Theory's core principles. By analyzing crime patterns in the study area, this current study explored how offenders in that specific geographic area interacted with their environment and selected their targets. This aligned with the theory's emphasis on understanding the connection between offenders and their surroundings. Furthermore, the study aimed to identify crime hotspots, recognize clustering patterns and assess the influence of specific geographic factors on criminal activities in Kasoa. These objectives are directly related to Crime Pattern Theory's focus on recognizing non-random patterns of crime distribution and understanding the role of place in criminal behavior.

2.1.2. Social Disorganization Theory

Social Disorganization Theory explains the connection between the environment and crime rates. Shaw and Mckay developed the theory out of research conducted at the

Chicago School (Shaw & Mckay, 1942). The theory connects the environmental characteristics with respect to the socioeconomic conditions of a location to crime rates. As a result, the theory's central assumption is that geography matters in forecasting criminality. Physical decay, poverty, and greater racial and cultural mixing are among the factors that plague areas with increased levels of crime (Shaw & Mckay, 1942). As a result of the aberrant conditions in the environment, criminality will emerge.

According to the theory, anomalous circumstances will disorganize society, prompting people to engage in unlawful actions. Wickert (2019) indicates that aberrant conditions in the neighborhood inhibit social organization and cohesiveness and hence informal social control of delinquency. According to Shaw and Mckay (1942), disordered neighborhoods were more prone to facing the consequences of delinquent or criminal behavior. The social disorganization theory therefore indicates that in an environment where inhabitants are faced with unaddressed socioeconomic challenges, the said environment becomes disorganized, breeding a lack of social order and collective conscience, pushing people to form subcultures with their own illegal norms, resulting in rampant criminality.

Social Disorganization Theory, which explains the connection between the environment and crime rates, is highly relevant to this study. Just as Shaw and McKay (1942) developed the theory based on research conducted at the Chicago School, this study sought to explore how the geographic environment in the study area influences crime patterns. The central premise of Social Disorganization Theory, emphasizing the impact of environmental characteristics and socioeconomic conditions on crime rates, aligns with the objectives of this study. By examining crime hotspots, clustering patterns, and geographic

factors in Kasoa, this study aimed to uncover how certain environmental conditions may contribute to criminal activities. Moreover, the theory's assertion that aberrant conditions in the environment can lead to social disorganization and an increase in criminal behavior is particularly pertinent to understanding the dynamics of crime in the study area. As this study delved into the spatial distribution of crime in the area, it provided valuable insights into how unaddressed socioeconomic challenges might affect the organization and cohesion of the community, potentially contributing to higher crime rates.

2.1.3. Broken Windows Theory

Broken Windows Theory explains that an orderly atmosphere in a particular environment gives the indication that the area is being watched and that illegal behavior will not be permitted (Wilson & Kelling, 1982). A disorderly setting, on the other hand, communicates the message that the location is unmonitored and that illegal activity is unlikely to be detected (Oscar, 1972). The theory investigates how an unruly environment, such as one with a broken window, or more specifically, one with a limited probability of detecting unlawful activities, can influence crime rates in such an environment.

Anant (2021) notes that the prevalence of unchecked disorder in an environment instills fear in individuals who are then convinced that the said environment is unsafe, leading to a withdrawal from the environment and weakening of social structures that initially prevented people from committing crimes. This leads to a crime-disorder cycle whereby disorder leads to the commission of crime, and crime leads to further disorder and crime (Anant, 2021). BWT advises that environmental signals of disorder be eliminated and evidence of order be provided to offer a positive social meaning and increase community safety perceptions in order to stop the disorder in the environment (Jiang, Mak,

Zhong, Larsen & Webster, 2018). The interventions to stop the disorder must focus on changing the physical appearance of the environment, which can be the site of a police station. Inasmuch as the theory has been proven to be useful, other studies have questioned its usefulness (Taylor, 2001; Gau & Pratt, 2010; O'Brien & Sampson, 2015).

This theory, as proposed by Wilson and Kelling (1982), posits that the perception of order or disorder in an environment can significantly impact criminal behavior. The study aligns with the Broken Windows Theory by exploring how disorderly settings, characterized by a limited probability of detecting unlawful activities, may influence crime rates in the area. Anant (2021) emphasizes that the prevalence of unchecked disorder can create a sense of insecurity among individuals, leading to a breakdown in social structures that initially deter criminal activities. This understanding of the crime-disorder cycle, where disorder contributes to crime and vice versa, underscores the importance of addressing disorder to prevent further criminal behavior. Moreover, the theory's recommendations to eliminate environmental signals of disorder and provide evidence of order align with the objectives of this study. By identifying crime hotspots and patterns, this study aimed to contribute to the creation of a safer environment and enhance community safety perceptions in the study area.

2.2. Conceptual Review

2.2.1 Crime

Taking into consideration the multidisciplinary imaginary of crime, the concept can be seen from diverse perspectives. Crime has been researched from several angles. The definition of a crime differs from one jurisdiction to the next and over time (Owusu & Frimpong, 2020). Acts that contravene generally accepted norms of moral or ethical

conduct are considered crimes from a non-legal perspective (Olabode, 2019). According to Durkheim (2003), an act is regarded criminal if it offends strong and well-defined states of communal conscience. Cummins and Al Bastami (2021) add that a collective conscience is a group of ideas, values, and convictions that are held by many people within a given culture. Okoro (2020) posits that crime may be seen as acts that are harmful to individuals, communities, and states at large.

From a legal standpoint, crime can be said to be an act or omission of it that is a breach of a duty punishable as stated in statute (Isiaka & Okaphor, 2018). A crime is an unlawful behavior that is subject to retribution from either the state or another legal authority (Gupta, 2019). He goes further to indicate that for a person to be convicted for the commission of a crime, there must be existence of Actus Reus and Mens Rea. Milovanovic (2006) notes that in order to convict someone of a crime, the prosecution—typically the state—must establish the convergence of the actus reus and the mens rea as well as the defendant's guilt further than a reasonable doubt. Therefore, a person does not break a law when they have the intention to commit a crime but do not carry out the act or take any actions to do so. However, even if an attempt to commit a crime is unsuccessful, if someone intends to do so and does one, they may still face legal consequences (Ebu, 2020).

2.2.2. Crime Hotspot

The distribution of criminal offenses across space is not even (Curiel, Delmar and Bishop, 2017). According to Eck, Chainey, Cameron and Leitner (2005), crimes cluster in some places while remaining nonexistent in others. Crime can therefore be concentrated at a particular location for some reasons, be it environmental or not. A crime hot spot is

defined as a location with a high density of criminal activity (Buerger, Cohn & Petrosino, 1995). According to Eck, Chainey, Cameron and Leitner (2005), "a crime hot spot is an area that has a greater than average number of criminal or disorder events, or an area where people have a higher-than-average risk of victimization" (p. 2). A plethora of studies agree to the necessity of crime hotspots analysis. Hotspot's analysis is done to better understand crime problems in a given locality (Thompson, Partridge & Shepherd, 2009). Braga, Turchan, Papachristos and Hureau (2019) indicate that the identification of hotspots of crime helps police departments in the prevention of crimes.

2.2.3. Broken Environment

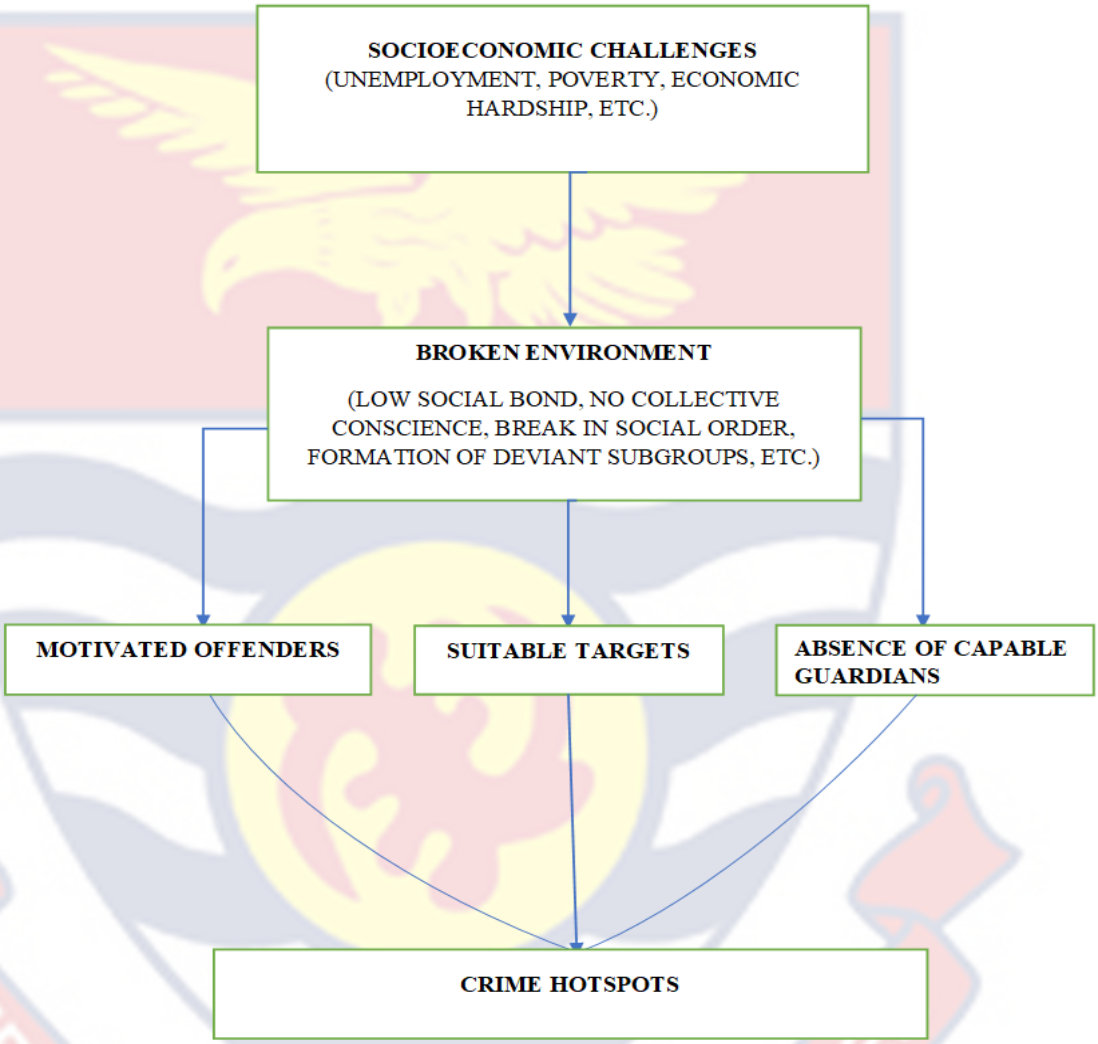
Sampson and Raudenbush (2001) posit that there is indeed a correlation between crime and a disorganized environment. According to the broken windows theory, neighborhood signals of minor crime and disorder that go unchecked can lead to more serious crime (Wilson and Kelling, 1982). A disorderly environment makes crime go undetected, thus, increasing the crime rates in such locality (Jansen, Giebels, Rompay, Austrup & Junger, 2017). Socioeconomic challenges that people go through render the environment broken with disruptions in social order, low social relationships, and cultural transmission of deviant values due to the formation of subgroups, which makes the environment fertile for occurrences of crime. Ramakers, Nieuwbeerta, Van Wilsem & Dirkzwager (2017) posit that the presence of genuine job prospects works as a strong disincentive to potential criminals. This therefore shows that increased unemployment in a given locality opens such an environment up for increased crime rates (Adebayo, 2013; Ajimotokin, Haskins & Wade, 2015).

Shaw and Mckay (1942) as indicated in their Social Disorganization Theory connect the environmental characteristics in respect of socioeconomic conditions of a location to crime rates. Ecological factors like broken homes, lack of jobs, and increased dropping out of schools could lead to high commission of crimes in such localities (Faridi, 2019). Lobonţ, Nicolescua, Moldovan and Kuloğlu (2017) indicate that income inequality, which is a predictor of a broken environment, has an increasing effect on crime rates. According to Shaw and Mckay (1942), these challenges result in a break in social order and collective conscience in the environment, leading to a broken environment (Cohen & Felson, 1979).

2.3. Conceptual Framework

Figure 1 shows how issues in the environment can make it fertile for a high density of crime in such a locality. This framework shows how socioeconomic challenges in an environment can lead to an increased opportunity for crime perpetration.

Figure 1. Conceptual Framework of how conditions in the environment make the environment fertile for high concentrations of crimes.



Source: Researcher's Own Construct based on the theories (2023).

Figure 1 provides a comprehensive framework that centres on the exploration of crime patterns, drawing on the theories of social disorganization, crime pattern, and the broken windows concept. This framework serves as a valuable guide for unravelling the intricate dynamics of crime's spatial distribution and its impact on the study conducted.

This framework delves into the notion that certain environments grapple with unattended socioeconomic challenges, such as poverty, unemployment, and economic hardships. When these challenges persist without resolution, they disrupt the social order within the environment, eroding collective conscience and weakening social bonds. Consequently, this disturbance in the environment can lead to the emergence of subgroups characterized by deviant values, often transmitted culturally, thereby contributing to the creation of a fractured or "broken" environment.

Furthermore, the framework underscores the critical interplay of factors within a broken environment. Specifically, it emphasizes how these conditions motivate individuals to engage in criminal activities. In this context, the absence of capable guardians and the presence of vulnerable, suitable targets make the environment ripe for exploitation by motivated offenders, which influences crime patterns. It is essential to highlight that these environmental conditions often drive away potential guardians, exacerbating the vulnerability of targets and facilitating criminal activities. The synthesis of these theories within the framework provides a robust foundation for understanding the complex patterns of crime in the study area. Through this comprehensive analysis, this study sought to contribute significantly to unravelling the crime patterns that impact the study area, ultimately leading to more effective crime management strategies.

2.4. Empirical Review

This review discusses a variety of relevant empirical studies. The research questions and research objectives that are directing this study were taken into consideration when conducting the empirical review. The empirical review supports the discussion of this study's findings and aids in understanding the diverse perspectives of researchers. This

involves the review of studies based on the following themes: hotspots policing and crime, crime and location, and GIS and crime.

2.4.1. Hotspot Policing and Crime

Crime researchers have highlighted the advantages of concentrating crime control measures on high-crime areas (Braga, Turchan, Papachristos & Hureau, 2019). According to Wallace (2013), hotspot policing is a spatially concentrated policing tactic aimed at reducing violent crime in high-crime areas. He goes on to say that hotspot policing concentrates on enhanced patrols, long-term investigations, and arrests for repeat offenders. According to Braga (2008) "the traditional police response to such trouble spots typically included heightened levels of patrol and increased opportunistic arrests and investigations" (p. 6).

Braga, Weisburd, Waring, Mazerolle, Spelman, and Gajewski (1999) conducted study in New Jersey to evaluate the impact of problem-oriented policing initiatives on the menace of violent crimes in Urban areas. The study's randomization approach made it possible for the researchers to assume that there were no significant disparities in policing action seen between control and treatment groups within that six month before the trial. For the researchers to examine the impact of the interventions meted out by the police on both controlled and treated locations, emergency calls made by citizens and criminal cases reported by citizens were investigated over six months before and after the intervention. According to the study, calls for all types of crimes were reduced to varied degrees in the locations that received treatment relative to the locations that did not. They ended by stating that concentrated police efforts can help to minimize crime and disturbance in high-risk areas.

Tella and Schargrodsky (2003) conducted a study in Buenos Aires, Argentina, focusing on the impact of police presence on car theft following a terrorist attack. They analyzed data from 876 blocks in three neighbourhoods over a nine-month period, starting from April 1, 1994, to December 31, 1994. The study divided the timeline into different periods, including the pre-attack period, an interim period, and the period of police protection.

The findings revealed that blocks receiving police protection experienced a significant decrease in car thefts, with an average reduction of 0.081 thefts per month compared to blocks without police presence. The control group, without police protection, had an average of 0.108 car thefts per block. Thus, the study estimated that police protection resulted in a reduction of approximately 75% in car thefts. These results indicated a localized influence of police visibility on decreasing the rate of car theft and suggested that police visibility in a neighbourhood can contribute to a decrease in neighbourhood crimes.

In Braga and Bond's (2008) study on monitoring crime and disorder hotspots, a randomized controlled trial was carried out. They set out to assess the results of monitoring disruption at crime hotspots in Lowell, Massachusetts. As official indicators of crime, the study employed data from citizen emergency requests for assistance. To gather pre- and posttest information on physical and social incivilities in the treatment and control locations, structured observation methods were used. In this study, 17 pairs of hot spots were formed by matching 34 hot spots, and in a randomized block field experiment, captains were assigned to each pair's member, which was then divided among the treatment

conditions. The study revealed that hotspots policing leads to a significant decrease in crime and disorder calls.

Ratcliffe, Taniguchi, Groff, and Wood (2011) carried out a six-month study in Philadelphia, Pennsylvania, to determine whether foot patrols by the police concentrated in hotspots for violent crime may significantly reduce the quantity of violent crime there. In this study, 120 hotspots were separated into two equal groups of 60, one with two pairs of police and the other with no foot patrol by the police. The results show that foot patrol operations by the police prevented about 90 crimes. The investigation showed that the foot patrol experiment led to a net reduction of 53 offenses, even if it was asserted that 37 of these crimes were relocated to surrounding locations.

Kennedy, Caplan, and Pizza (2015) conducted a quasi-experimental study across five cities to assess interventions meted out by the police targeted at high-risk micro-level situations. The intervention lasted three months in the Glendale, Arizona research, which was focused on robbery. The control street units were located using a Two Nearest Neighbors probit regression matching method. The RTM analysis examined several variables as part of its assessment. These included determining whether the street unit meshed with a high-risk street unit or cell, distinguishing between segments and intersections, considering the concentrated social disadvantage and racial heterogeneity in the surrounding census block group, and taking into account pretest levels of crime and preemptive police activities. During the three-month intervention and post-intervention period, the number of robberies in the treatment and control areas was compared to figures from the previous year. In the target area, there was a 42% decrease in robberies during the intervention relative to the control area (p0.1), but there was a 38% surge after the

intervention. As a result, their findings support earlier claims that tailored policing reduces crime in specific locations.

Kochel, Burrus, and Weisburd (2015) conducted a block randomized experimental study in St. Louis County to investigate the effects of hotspot policing methods on crime, in line with previous studies. Officers were dispatched to 20 home hot spots over the course of five months with the goal of doubling the amount of time spent at each area. In order to be conspicuous, officers were instructed to undertake 11–15-minute patrols during particular "hot times" during the study. Police were instructed to increase their roaming and stationary patrols while decreasing their report writing, traffic enforcement, foot patrols, and community interaction. According to information from automated car positioning systems, officers expended around 3 to 4.5 hours at the treatment areas most of the time during the intervention (AVL). This was a higher degree of patrol than usual. The study discovered that increased police visibility reduced crime since calls for service in directed patrol sites decreased by an average of five per week (a 5 percent reduction).

To ascertain the effect of foot patrol on violent crime, Piza and O'Hara (2014) carried out a quasi-experimental study in Newark, New Jersey. The target area, its catchment area, and two different control areas were the four regions where crime events were measured in the study. Every night, a special squad of 12 police officers and three supervisors was tasked with foot patrolling the target area. It was found after the intervention that the influence of the program on the selected locations outperformed the precinct control area on all crime indicators, with a startling 42 percent decline in violent crimes in the selected locations.

2.4.2. Crime and Location

An important factor in addressing the issues posed by crime is its geography. Location dynamics and the creation of successful crime prevention programs are essential to understand how demographic characteristics interact with crime rates. Lentz (2018) indicates that the environment is a necessary element in determining types of crime that occur at a specific place.

Shaw and McKay (1940) conducted a study to examine the link between population dynamics and crime rates in Chicago. Their study introduced the concept of social disorganization theory, suggesting that crime rates are influenced by the social and structural characteristics of neighborhoods. Shaw and McKay found that neighborhoods with high population turnover, economic instability, and social disorganization had higher crime rates. This supports the notion that population growth, particularly when accompanied by social disorganization, can contribute to increased crime rates.

Kassem, Ali and Audi (2019) explored the relationship between population growth and crime rates in urban areas. Their research focused on the Middle East, specifically Lebanon. They found a positive correlation between population growth and property crime rates, indicating that as urban areas experienced population growth, property crimes increased. This study reinforces the idea that population expansion can be associated with higher crime rates, especially property crimes.

Malleson and Andresen (2016) investigated the impact of population density on crime rates in Vancouver, Canada. Their study revealed a complex relationship between population density and crime. While they found that high population density was associated with increased property crime rates, it was negatively correlated with violent

crime rates. This nuanced relationship highlights that population density can affect different types of crimes in varying ways, emphasizing the need for a detailed analysis of crime subtypes in urban areas.

Anderson (2001) conducted a study to investigate the influence of hot temperatures in a particular location on violence. The study utilized a combination of experimental research, observational data, and theoretical frameworks to explore the complex relationship between temperature and aggression. The research findings suggested that while there may not be a direct, linear association between hot temperatures and violent acts, uncomfortable heat can significantly contribute to increased hostility and aggressive thoughts. The findings of the study suggested that heat may serve as a catalyst, exacerbating underlying aggressive tendencies and making individuals more prone to aggression.

Another study conducted by Jung, Chun, and Griffith (2020) investigated the association between temperature and assaults in South Korea. This study utilized Bayesian model specifications that can cope with both space and time dimensions. The findings of the study indicated that a location with high temperatures and severe heat will have people who are aggressive due to the aforementioned situational factors, leading to increased assaults.

Menting, Lammers, Ruiter and Bernasco (2020) also conducted a study to investigate the influence of activity space and visiting frequency of a location on crime in the Netherlands. The study used an online survey in which 78 offenders reported on their own activity spaces and committed offenses. This study's findings indicate that offenders have a strong tendency to commit offenses near regularly visited activity nodes, such as

residential areas of friends, school, work, and leisure activity locations, and also if these nodes are outside of their own residential area.

Another study was also conducted by Ebu (2020) to investigate the spatial analysis of crime in the Sekondi-Takoradi Metropolis. The study used data from the police and the Town and Country Planning Department in the metropolis. The findings of the study indicated that locations where a lot of people frequently converge to engage in economic transactions have a high propensity for fraud cases.

2.4.3. GIS and Crime

According to Alharith and Samak (2018), "GIS comprises hardware, software and procedural systems, designed to support the capture, administration, manipulation, analysis, modelling and graphing of referenced geographic data and objects, especially to solve questions involving complex planning and management – such as security issues, or issues relating to health care or to the spread of infectious diseases or even to responses to natural disasters" (p. 17). The use of technology, particularly geographic information systems (GIS), gives up new possibilities for crime mapping in order to aid in crime prevention (Mohd Faris, 2006 as cited in Kalang & Valentine Eboy, 2021).

Akpinar and Usul (2004) employed spatial data analysis and GIS to examine what land uses are vulnerable to incidents and why incidents are more common in some areas than others in the Cankaya the Bahcelievler Police Station Zone in Turkey. They analyzed the data using multiple GIS methodologies, indicating that GIS provides a wide range of skills in event mapping and analysis. They went on to say that GIS helps police officers plan effective emergency responses, set mitigation priorities, analyze past occurrences, and

anticipate future events, as well as assist criminal officers in determining prospective incident sites.

Kumar and Chandrasekar (2011) conducted a study to explore the use of GIS technologies to map and analyze. They used information from the Tamil Nadu Police Directorate to conduct their study, which involved crimes like murder, usurpation, burglary, auto theft, and pickpocketing that took place in 2007. The researchers additionally consulted State Institution of Statistics for socioeconomic information, and they also digitized Kernel density Maps purchased in 2007 to gain additional information, such as land use categories. In the study, temporal and spatial distribution of incidents and analyses to determine the relationship between land use and incidents were carried out. The researchers concluded that "GIS allows police personnel to map effectively for crisis reply, determine improvement priority, analyze past events, and predict future events; it helps crime officers to determine possible event locations" (Kumar and Chandrasekar, 2011, p. 121).

Another study conducted by Balogun, Okeke and Chukwukere (2014) used GIS to map crime in Benin City in Nigeria. Data on crimes and their locations, the location and capacity of different police stations, data on drug-related crimes and their locations, housing data and satellite images, and landuse and road guide maps were among the information used in the study. A total of 250 questionnaires were sent out to the general public and 66 were given to the Police Public Relation Officers (PPRO) as part of their study. A step-by-step procedure for using GIS to manage crime using the spatial and attribute data gathered from the field was then put into practice. According to the study's findings, using GIS in crime analysis will make it possible to build a "geo-database" that

will improve the effectiveness of tackling the crime problem. The researchers therefore concluded that "for effective crime control and management in Nigeria, the security operatives should engage in the modern standard of policing by adopting and integrating GIS methodology as this will help the force to be proactive in their operations" (Balogun, Okeke and Chukwukere, 2014, p. 465).

In consonance with the study above, Kedia (2016) examined the use of GIS for crime mapping and its analysis for efficient law enforcement and crime management. Data for the study was gathered by using WhatsApp's location sharing feature, which was provided by the relevant investigation officers. The researcher's GIS software, QGIS, was equipped with Open Street Maps in order to generate maps for the study. For photographic coverage of the hotspot, the researcher employed a digital camera and a handheld high accuracy GPS (GARMIN GPSMAP 64s handheld GPS). It was concluded that "GIS gives us a better synoptic perspective to crime mapping, study, analysis, decision making, better presentation to a layman and thus prevents crime" (Kedia, 2016, Abstract).

Alharith and Samak (2018) conducted a study that concentrated on the use of Geographical Information Systems (GIS) in the Kingdom of Saudi Arabia to prevent terrorism. In their study, a variety of remote sensing methods were used for data gathering. The researchers concluded that, "GIS are not only useful for the exploration of simulated warfare scenarios involving potential attacks at obviously critical sites, such as the telecom industry, the energy industry and the finance sector in particular, but are also an essential aspect of countering terrorism attacks at other less obvious sites" (Alharith & Samak, 2018, p. 29). It therefore indicates that GIS technologies help in fighting crimes, including serious crimes like terrorism.

2.5. Chapter Summary

The chapter discussed the review of literature on the subject of the study. The review was conducted using three different themes: theoretical, empirical, and conceptual. Three ecological theories of crime—the theory of crime pattern, the theory of social disorganization, and the theory of broken windows—were the subject of a theoretical review. A conceptual study of crime, criminal hotspots, and broken environments was also conducted. After that, a conceptual framework was created to show how many environmental factors interact with one another to fuel crime issues. Lastly, an empirical review of studies to throw light on concepts in this current study was done. Here, studies were reviewed on themes like hotspot policing and crime, crime and location, and GIS and crime. It was found that indeed, hotspot policing reduces crime rate, crime has an element of location and also GIS technologies help in dealing with crime situations

CHAPTER THREE

RESEARCH METHODS

3.0. Introduction

A methodology may be described as the systematic methods underlying the conduct of a particular study. It underpins the various principles considered in the investigation of a research problem. The previous chapter evaluated relevant theories, concepts, and empirical research that had been done in the field. The study area, research design, research strategy/approach, and data and its sources are all described in this chapter. It also includes data analysis procedures and consideration of ethical issues.

3.1. Study Area

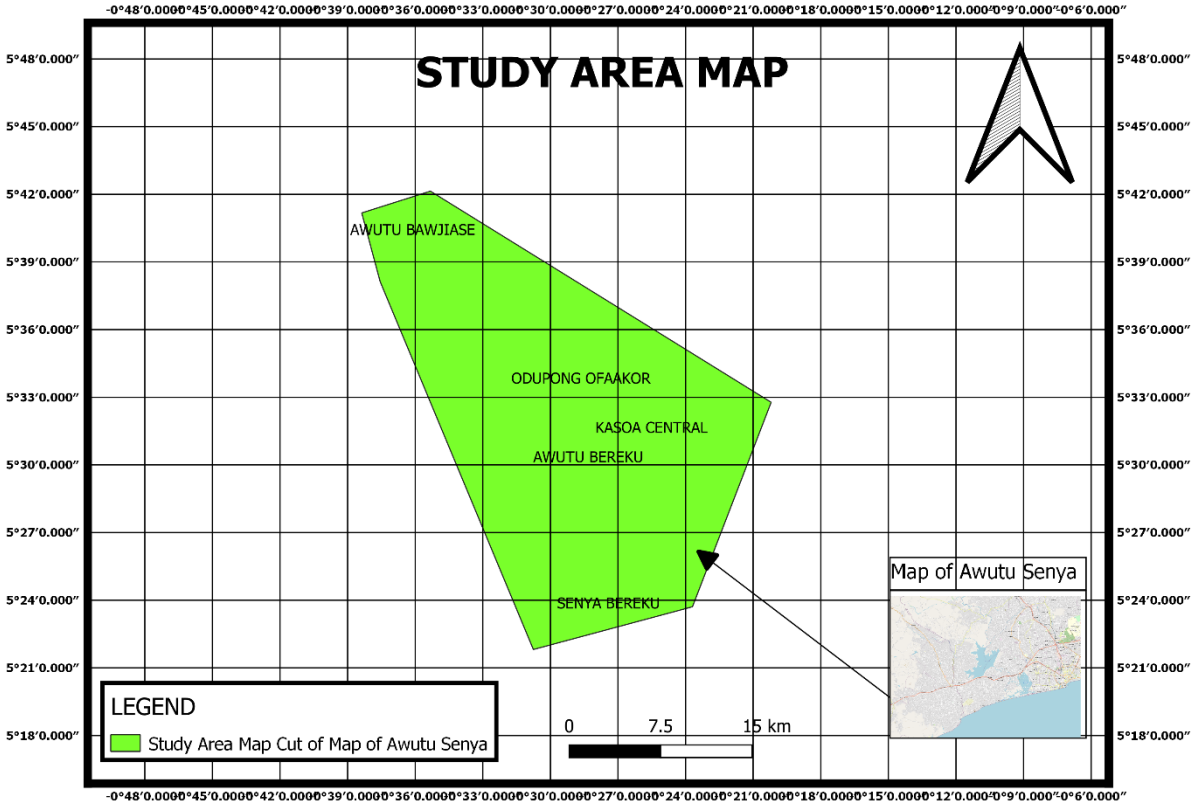
The study area was the area covered by the Kasoa Police Division which has five police districts, i.e., Kasoa Central, Awutu Bereku, Senya Bereku, Awutu Bawjiase, and Odupong Ofaakor. These areas are under the Kasoa Police Division under the Central East Police Region. The research areas are situated in Ghana's Central Region's Awutu Senya East Municipality, specifically Kasoa Central, Awutu Bawjiase, Odupong Ofaakor, and the Awutu Senya West District.

Geographically, the Awutu Senya East Municipal spans about 63 square kilometers (ghanadistricts, n.d.). The population of the area is a total of 236,527 with 115,530 males and 120,997 females (GSS, 2021).

With Awutu Bereku serving as its administrative center, the Awutu Senya West District has a surface area of 237 square kilometers and is situated in the eastern part of Ghana's Central Region (ghanadistricts, n.d.). The area has a population of 161,460 with 78219 males and 83241 females (GSS, 2021).

The study areas are multicultural in character and home to a diverse population of people from various ethnic backgrounds. Markets, bars, clubs, and new residential areas are just a few of the attractions in the neighborhoods. The region has been featured in the headlines because of crime for a while. Therefore, it was necessary for a study like this to be carried out in the area to explore the trends of some chosen crimes and places with a high density of such crimes in relation to police visibility in such areas to aid the police in making informed judgments.

Figure 2: Map of Study Area



Source: Researcher's Own Construct, (2023).

3.2. Research Approach

Research approach may be described as the procedures underlying how a study will be conducted, spanning from the design to be used to the type of data to be employed and its analysis and interpretation. There are basically three research approaches: qualitative, quantitative, and mixed methods. This study's objectives were addressed using the quantitative research approach. Saunders, Lewis & Thornhill (2009) indicate that quantitative research involves the use of numeric data and analyzing it with statistical analysis techniques in order to provide a simple description of the variables involved and also establish relationships between the variables. As noted by Creswell and Creswell

(2017), quantitative research is distinguished by objectivity and the capacity to generalize findings to a larger population, making it especially valuable in studying significant social phenomena and offering empirical evidence to guide decision-making across a range of fields. Trochim and Donnelly (2008) further stress that the use of quantitative methodologies enables the establishment of statistical correlations between variables, which can produce more reliable and repeatable results. The rationale for this choice was that the study sought to describe the trends in crime in the study area and the areas with high densities of the selected crimes, as well as determine the locations of frequent activity space among the study areas, which demanded the use of purely quantitative data.

3.3. Research Design

The strategy that a researcher will use to address the study's research questions is known as the research design (Jongbo, 2014; McCombes, 2019). Sileyew (2019) indicates that giving a study a proper structure is what the research design is meant to do. According to Durrheim (2004), "Research design is a strategic framework for action that serves as a bridge between research questions and the execution, or implementation of the research strategy" (p. 29). It, thus, indicates how data for the study will be collected and analyzed for the purposes of addressing the study problem.

The descriptive research design was used in this study. According to Aggarwal and Ranganathan (2019), "A descriptive study is one that is designed to describe the distribution of one or more variables, without regard to any causal or other hypothesis" (p. 34). It describes variables in their current state. The descriptive element of this study was to seek to find out the hotspots of crime and the crime trends in the study area, explore the

statistical rate of the selected crimes, and determine the locations of frequent activity spaces among the study areas.

3.4. Sources of Data

Persaud (2010) notes that data used in research can be primary data or secondary data. "Primary data is one which is collected for the first time by the researcher while secondary data is the data already collected or produced by others" (Ajayi, 2017, p. 2). Ajayi (2017) indicate that "Primary data sources include surveys, observations, experiments, questionnaire, personal interview, etc. On the other contrary, secondary data collection sources are government publications, websites, books, journal articles, internal records, etc." (p. 3).

Secondary data from the police was gathered for this study. The data included data on three selected crimes, i.e., assault, robbery, and fraud, from 2017 to 2019, which included the total number of cases for each selected crime category with the respective locations and Global Positioning Systems (GPS) coordinates of the selected clustered crime locations. These categories of crime were selected due to their prominence as the most frequently reported crime cases within the study areas, as indicated by the police. This strategic selection allowed for an in-depth analysis of crimes that had a significant impact on the study area and merited comprehensive investigation.

Furthermore, the research design encompassed the utilization of crime data spanning from 2017 to 2019. This deliberate choice of time frame was driven by the intention to explore the dynamics of crime rates during a pivotal period, extending from one year after a national election through to a year before the subsequent national election. By examining these specific years, the study aimed to capture any potential shifts or

patterns in criminal activity associated with political and socio-economic changes, offering valuable insights into the broader context of crime in the study area.

The Town and Country Planning Department's dataset on land uses in the study's study areas was also utilized.

3.4.1 Data Collection Method

Crime data used in crime research may be obtained from, but not limited to Uniform Crime Reports, i.e., from the police, Self-report studies, and the National Crime Victimization Survey. In this study, the researcher sent an introductory letter issued by his school to the District Police Command of the study area. The police were, however, unable to provide GPS coordinates for the individual crime incidents. As a result, the researcher grouped the locations of the crimes under five (5) clustered areas, which was five (5) police districts, i.e., Kasoa Central, Awutu Bereku, Senya Bereku, Awutu Bawjiase and Odupong Ofaakor.

Police provided data on the overall statistics of reported cases for the selected offenses for each research year and their associated clustered study locations. The geo-codes of each of the clustered study locations under the command were retrieved from the police's internal records.

The dataset including details on the land usage of the study areas was received from the Town and Country Planning Department of Assembly. It comprises data on all the locations, including the number of large market centers, hotels, nightclubs, huge truck stations, pubs, game centers, etc., which enables a variety of analyses.

3.5. Data Analysis Procedures

To calculate the overall crime statistics of the chosen offenses for the study years and to identify the crime trends of the study area for the study years, all crime data gathered from the police was imported into Microsoft Excel. The total crime for each cluster throughout the course of the year was included because the data was gathered using a clustered study area methodology. The trend analysis of the different crimes over the course of the three years was created using the Line Chart. This was performed for each year, after which Microsoft Excel produced the statistical patterns. This technique was required because it assisted the researcher in creating a chart that assisted in analyzing the pattern distribution of the selected crime types for the study years.

To digitize data and produce maps that can be used to visually illustrate crime hotspots, GIS software is required. However, in adopting a specific GIS software, a number of aspects need to be taken into consideration, including price, usability, technical support, and the intended purpose. There are a number of options for each type of software, including Esri and MapInfo for proprietary software and QGIS, GRASS GIS, etc. for open-source software. While proprietary software like ArcGIS must be purchased, open-source software is free to the end user.

QGIS Version 3.14 was used in this study. This software is cost-effective, user-friendly, and also has the possibility of achieving the intended purpose. Microsoft Excel was used to enter the data gathered from the police and grouped under types of crime with their respective latitudes and longitudes of the clustered study areas. The data were then recorded in comma-separated values (.csv) file format to enable use in the Quantum Geographic Information System (QGIS). This was done for each selected crime for all the

study years. The .csv files were added into the QGIS software as layers, and the open street map browser in the software was overlayed on the layers, which helped to generate the maps for the study areas. The heatmap symbology in the software was triggered to generate the hotspots, where areas with a deep red heat symbol were regarded as the hotspots. The study area was then cut out of the open street map using the polygon layer in the software in order to generate a true representation of the study area map.

Cagney, York Cornwell, Goldman and Cai (2020) opine that activity space describes a collection of locations that people visit as a result of their regular daily activities. It may therefore be the important location that an individual may frequent. An activity space characterizes the places and spaces a person frequents due to their actions (Golledge & Stimson, 1997 as cited in Smith, Foley & Panter, 2019). In order to determine the locations of frequent activity space among the study areas, the data were added into the QGIS software as a .csv file, where the heat symbology feature was triggered to illustrate the most frequent location in the deep red heat symbol.

3.6. Chapter Summary

The goal of the chapter was to outline the study's research method and design. As a result, the approach established to answer the study's objectives and research questions was explained in the chapter. The methodology of the study explains the research strategy and criteria used, as well as the spatial analysis of a few chosen crimes in the territories covered by the Kasoa Police Division. Additionally, a thorough explanation of the data's source and use, and methodology was supplied It was indicated that the data collected were analyzed using a line chart in Microsoft Excel for the total crime statistics, trend analysis, and QGIS v. 3.14 for the hotspot analysis, and activity space analysis.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0. Introduction

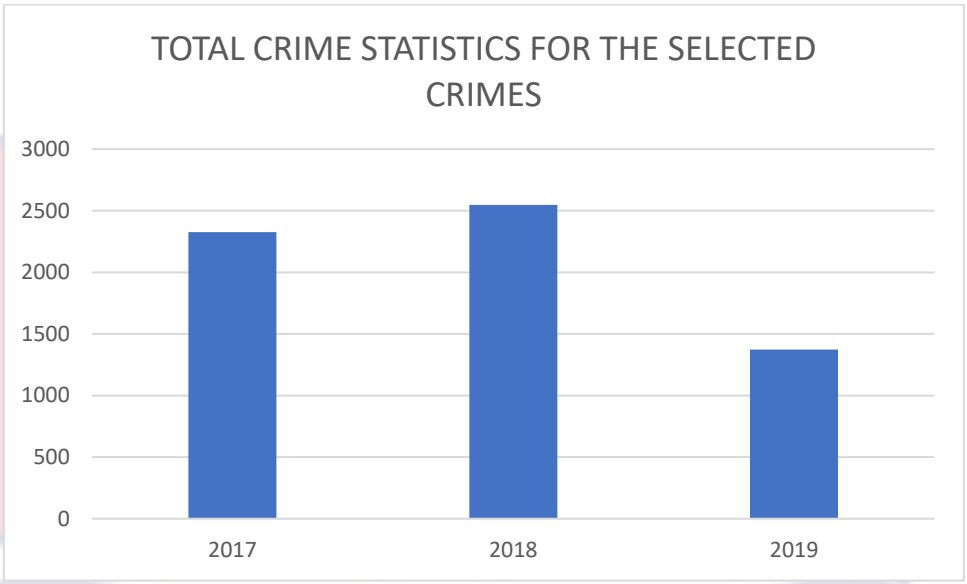
The preceding chapter provided background details about the study area and the methods used to achieve the study's objectives. This chapter is mostly concerned with presenting the findings of the crime data analysis and discussing them. It comprises specifics of the findings broken down according to the overall crime statistics of the selected crimes, the trend analysis of the data, cluster analysis of the hotspots, and the intended determination of locations of frequent activity space within the study areas.

4.1. Results Analysis

4.1.1 Total Crime Statistics for the Selected Crimes

This research objective was intended to examine and calculate the total reported cases for each of the studied crimes, including robbery, assault, and fraud, for the study period, which included 2017–2019. To help with the presentation of the data, it was decided to concentrate on the year with the fewest and most reported crime cases and make inferences. Data on this research objective was analyzed using Microsoft Excel. Figure 1 shows the total crime statistics for the study years.

Figure 3: Total Crime Statistics for the Study Years



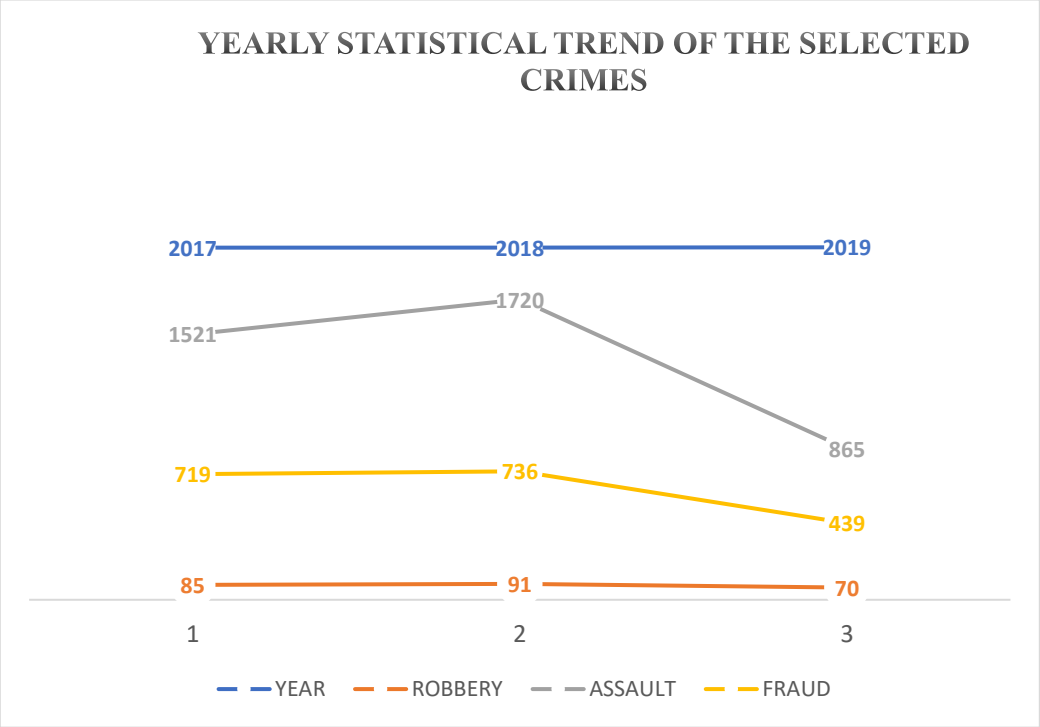
Source: Data from Ghana Police Service, (2023).

The findings observed in Figure 1 indicated that the year 2019 observed the lowest number of cases of crime, i.e., 1374, for the three study years. The year 2018 recorded the most cases of the selected crimes, i.e., 2,547, followed by 2017, which recorded 2,325 cases of the crimes under study. Several factors, including but not limited to police interventions, may account for the fluctuations in the total number of crime cases, but future research may look into them to unearth the true reasons.

4.1.2 Statistical Trend Analysis of the Selected Crimes in the Study Area from 2017-2019

This research objective intended to ascertain how the three study crimes, namely robbery, assault, and fraud, were distributed throughout the study area over the three study years, namely 2017, 2018, and 2019. Data on this research objective was analyzed using the line chart feature in Microsoft Excel. Figure 2 shows the statistical trends of the selected crimes for the study years.

Figure 4: Yearly Statistical Trends of the Selected Crimes for the Study Years



Source: Data from Ghana Police Service, (2023).

In 2017, robbery recorded the lowest cases of crime, i.e., 85, representing 3.7% of the total crime for the year as indicated in Figure 2. As shown in Figure 2, fraud cases for the same year totaled 719, accounting for 30.9% of all reported crimes, with total number assault cases numbered 1521, making up 65.4% of all reported crimes in 2017. In 2018, the number of robbery cases increased to 91, which represents 3.6% of the total crimes for the year. Fraud cases also increased to 736, which represents 28.9%, and assault cases also saw an increase to 1720, which represents 67.5% of the total crime records of the year.

As shown in Figure 2, crime decreased in 2019 compared to the year before (2018); in total, 1374 cases of the selected crimes were recorded. Assault recorded 865 reported cases, which represent approximately 63% of the total crime rate. In addition, fraud was

reported in 439 cases, accounting for approximately 32% of total crime, and robberies were reported in 70 cases making up approximately 5% of total crime.

4.1.3 Hotspot Analysis

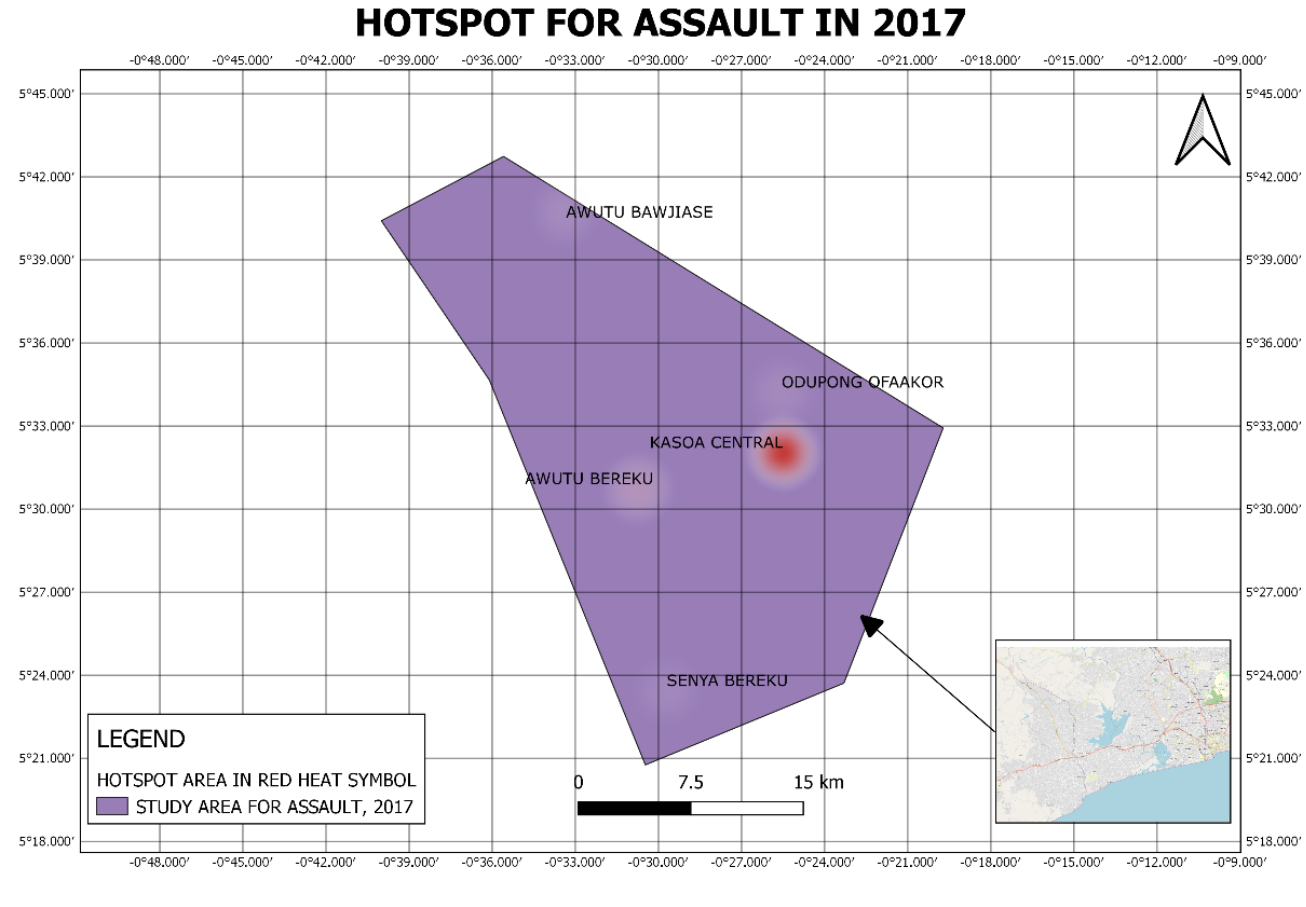
By using hotspot analysis, it is possible to measure how closely the city's numerous crime episodes are related to one another. In this study, the suburbs that are crime hotspots are distinguished from those that are crime cold spots. Lei (2012) opines that hotspots of crime are areas on a map with high intensity of crime, while coldspots are areas with comparatively low intensity of crime. Areas with positive and statistically significant z-scores have a high concentration of high values (Ebu, 2020).

However, in this study, data for the individual geocodes and coordinates for the individual crime incidences were not available from the source, and thus a cluster analysis was done based on the police districts under Kasoa Police Division, i.e., Kasoa Central, Awutu Bereku, Senya Bereku, Awutu Bawjiase, and Odupong Ofaakor, using the QGIS software to unearth the hotspots, which were represented in heatmap symbology. The clustering technique solely considers how the three offenses are distributed throughout the five (5) clustered study areas.

4.1.3.1 *Hotspot for Assault*

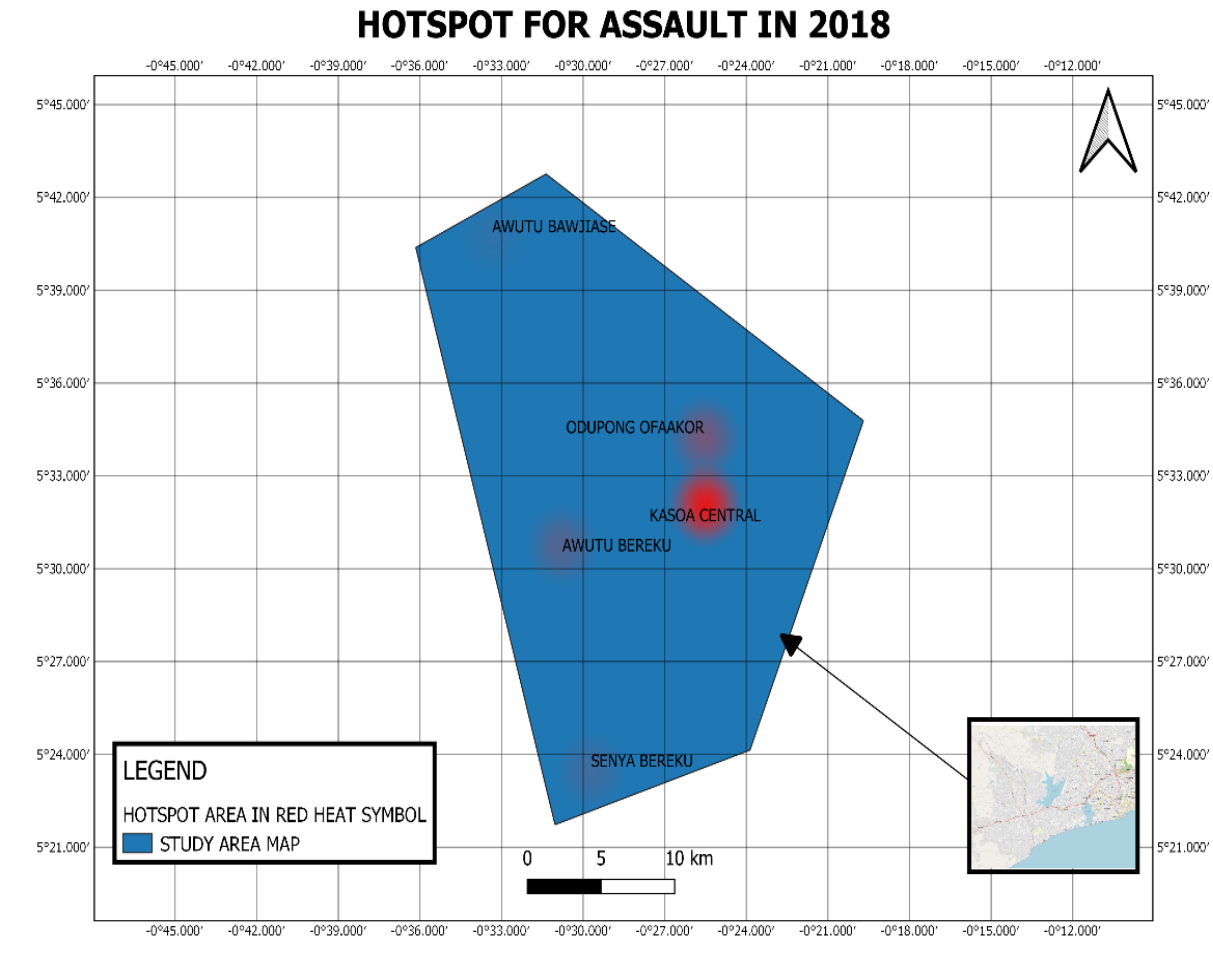
The goal of this section was to identify clustered areas or areas with a high density of reported assault cases over the course of three study years. Data for this was analyzed using the QGIS software. Clustered analysis was employed by presenting the analysis of all the study years as one since the researcher sought to make inferences based on the relationship between the study years. Figures 3, 4, and 5 show the hotspot maps for assault in 2017, 2018, and 2019 respectively.

Figure 5: Hotspot map for Assault in 2017



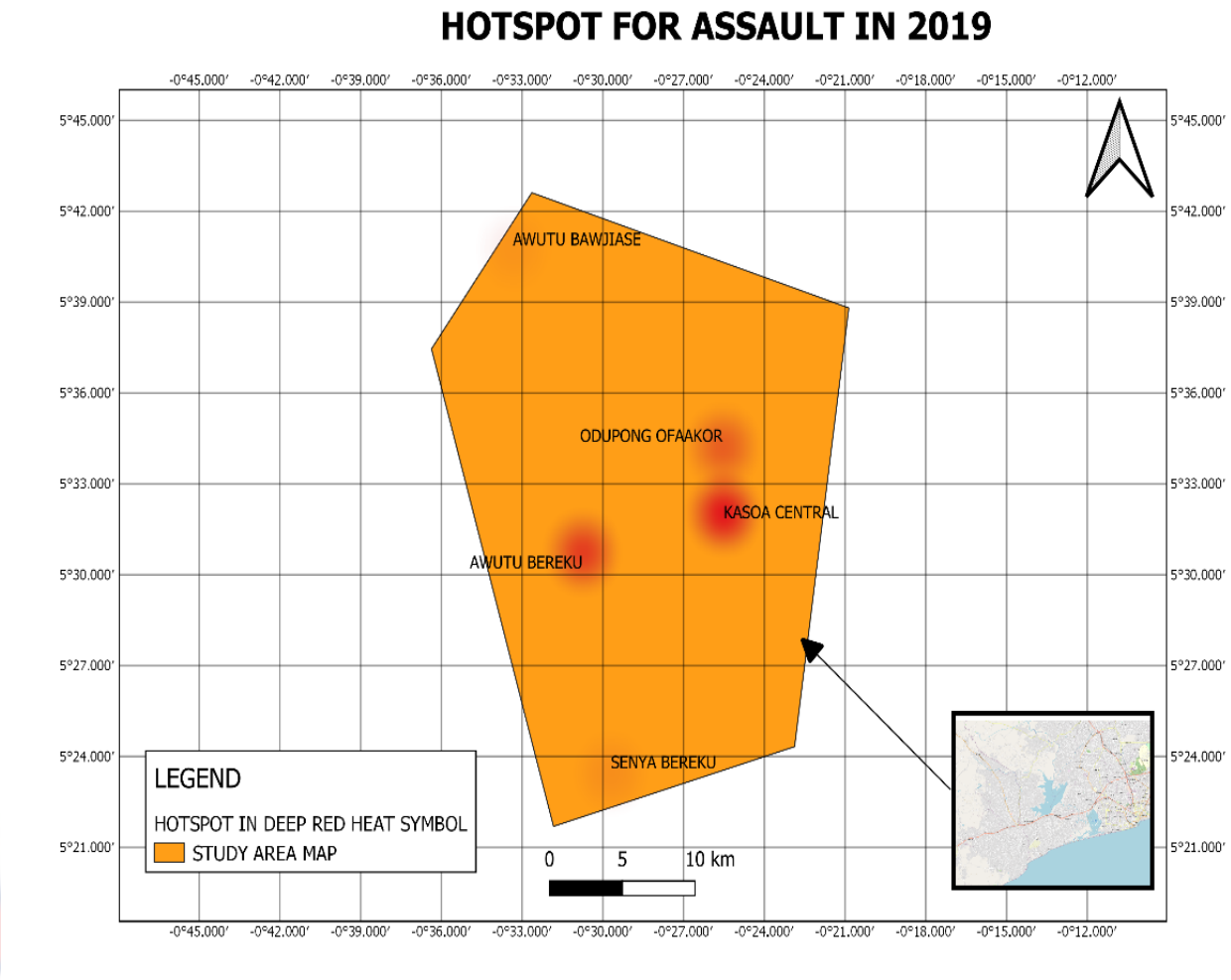
Source: Researcher's Own Construct, (2023).

Figure 6: Hotspot map for Assault in 2018



Source: Researcher's Own Construct, (2023).

Figure 7: Hotspot map for Assault in 2019



Source: Researcher's Own Construct, (2023).

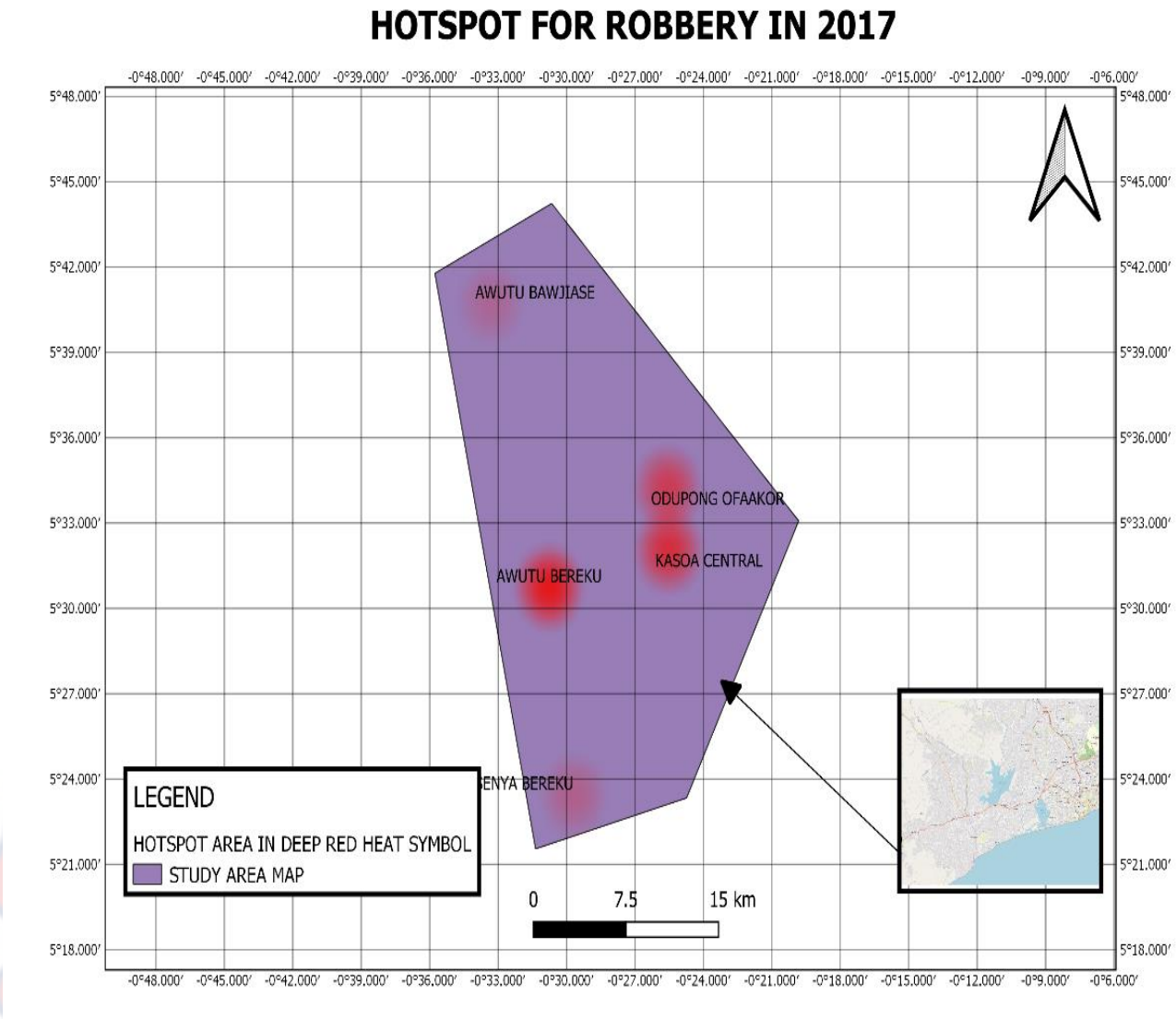
The 2017 and 2019 hotspot maps for assault in Figures 3 and 5 showed that Kasoa Central was marked as a hotspot followed by the Awutu Bereku area. This was not largely surprising since Kasoa Central is a busy area with a lot of people going to and fro coupled with market activities and pubs and clubs, as is the case with Awutu Bereku. Zhang and Peterson (2007) posit that areas with more bars and nightclubs would likely have more cases of assault than areas with fewer such establishments. However, inasmuch as Kasoa Central remained the hotspot for assault in 2018, as indicated in Figure 4, it was

interestingly followed by the Odupong Ofaakor area which was never the case in the other study years.

4.1.3.2 Hotspot for Robbery

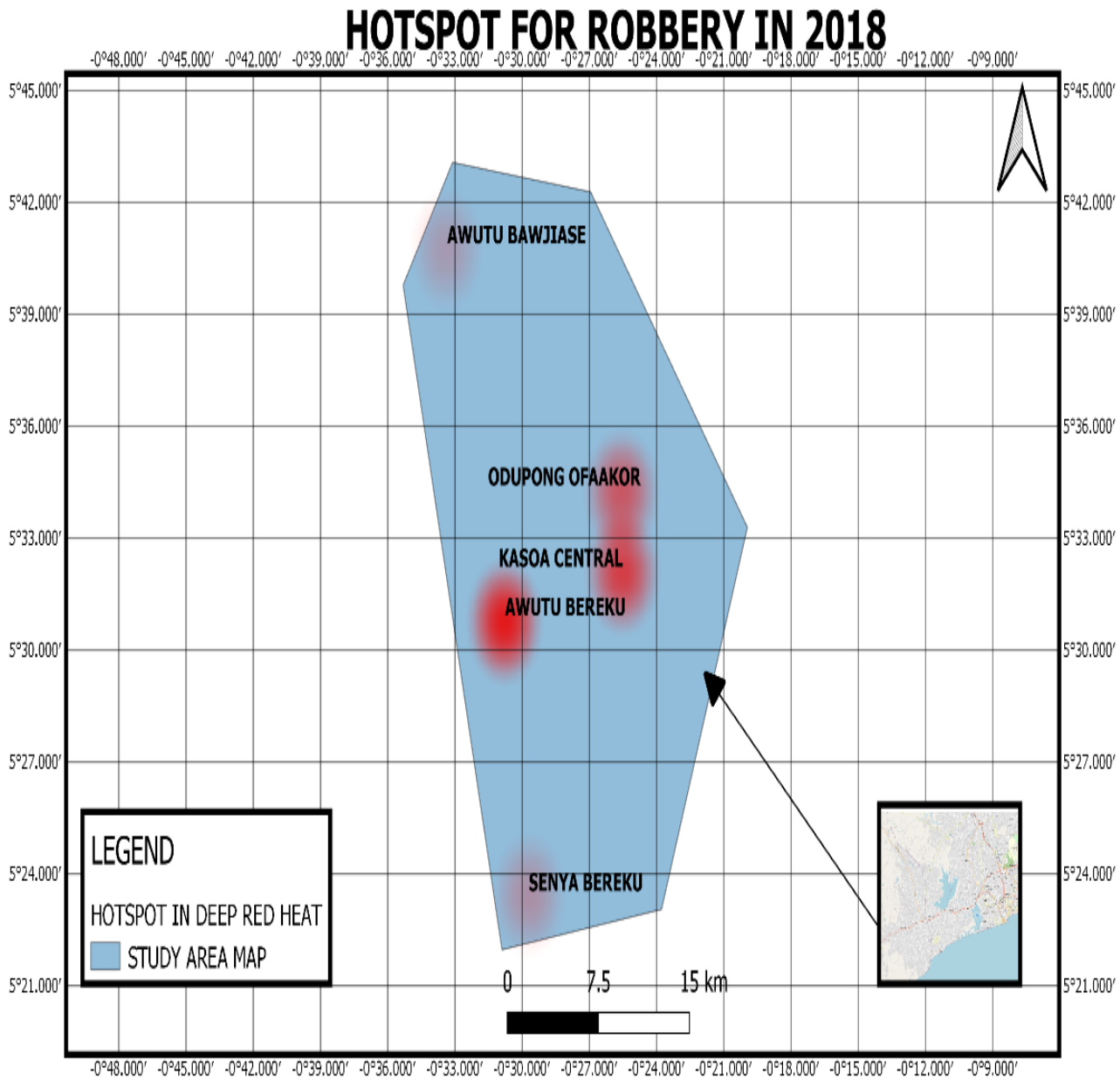
This section's objective was to locate clustered areas that had a high concentration of reported robberies throughout the course of the three study years. QGIS software was used to examine the data for this. Since the researcher wanted to draw conclusions about the relationship between the study years, clustered analysis was used to display the analysis of all the study years as one. Figures 6, 7, and 8 show the hotspot maps for assault in 2017, 2018, and 2019 respectively.

Figure 8: Hotspot map for Robbery in 2017



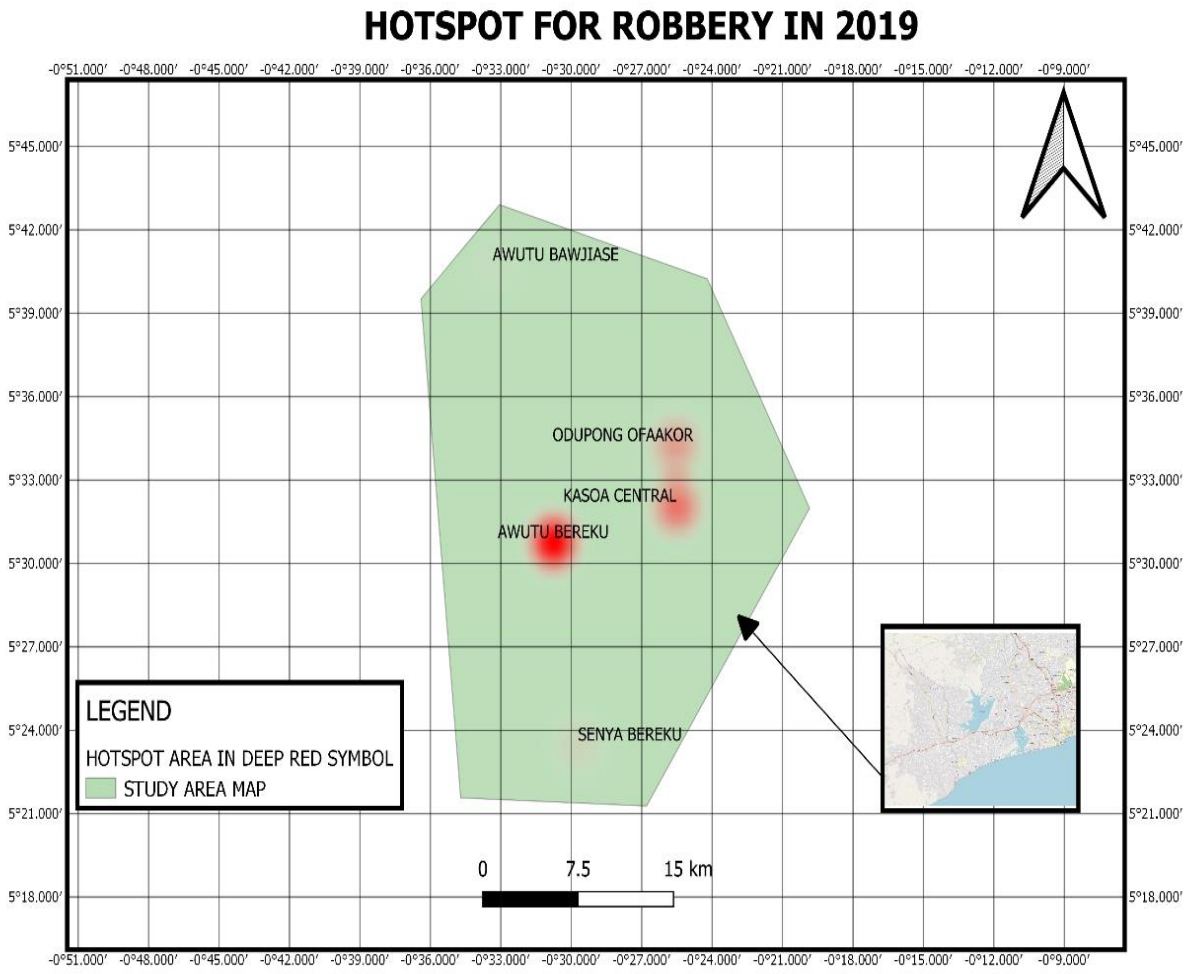
Source: Researcher's Own Construct, (2023).

Figure 9: Hotspot map for Robbery in 2018



Source: Researcher's Own Construct, (2023).

Figure 10: Hotspot map for Robbery in 2019



Source: Researcher's Own Construct, (2023).

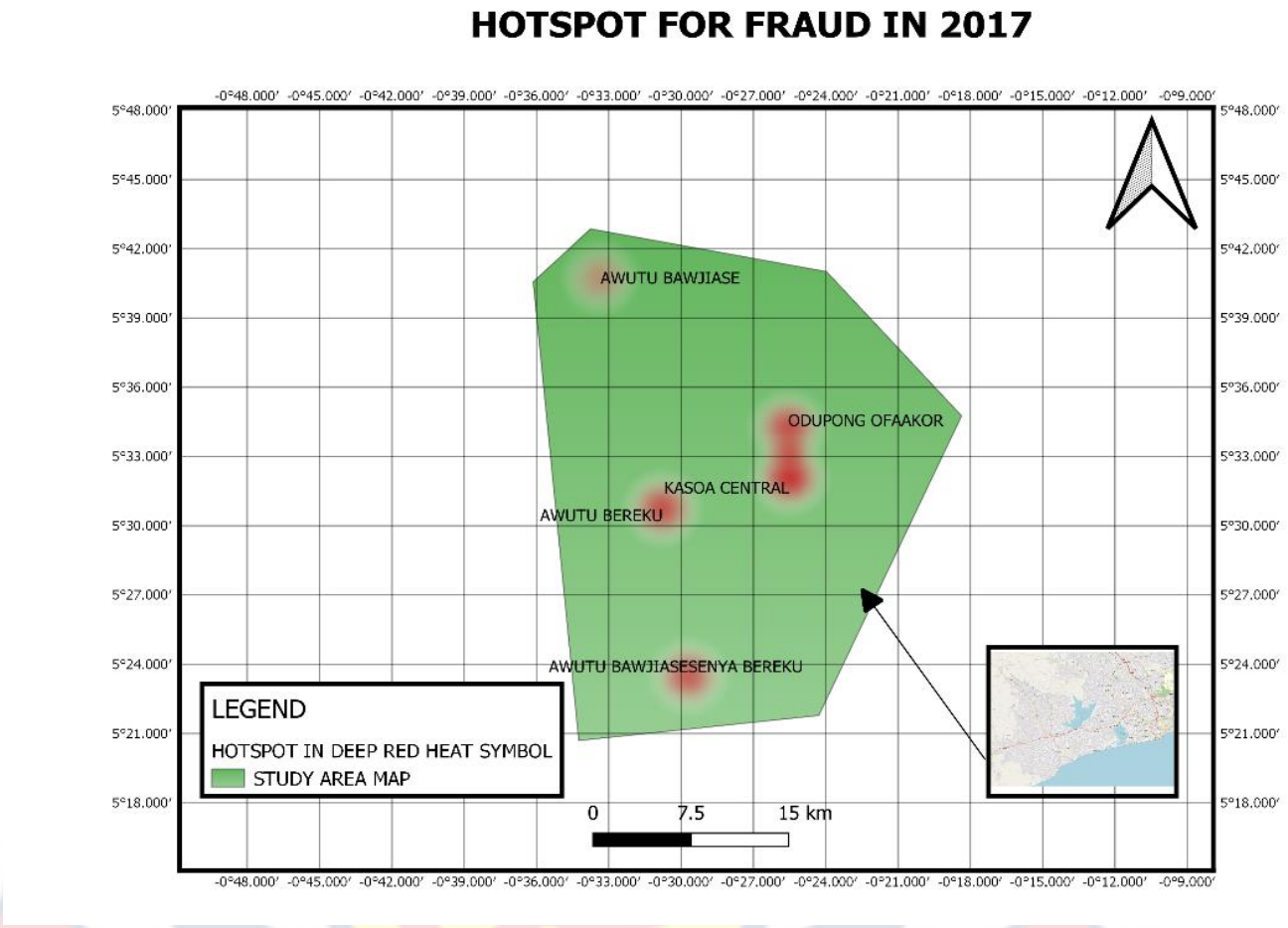
The robbery hotspot maps (Figs. 6, 7, and 8) showed that spatially reported robbery cases were highly concentrated in the Awutu Bereku clustered area. This might be explained by the area's proximity to the section of the Accra-Cape Coast route where robberies are frequently reported. Another explanation could be that the area is more cosmopolitan than many areas in the study area, and thus there is the existence of a refugee camp, for which there have been calls for its demolition since the area is alleged to have been turned into a jungle for criminals. The area is also too densely populated for more

than a handful of police officers to manage criminal activities there, and this could be responsible for the situation. A careful look at the maps indicated that the cold spots were the areas at the periphery, i.e., Awutu Bajwiase and Senya Bereku. This could be in sync with the assertion of Marfo (2016) that economic crimes are usually low in the periphery since economic activities are very low there.

4.1.3.3 Hotspot for Fraud

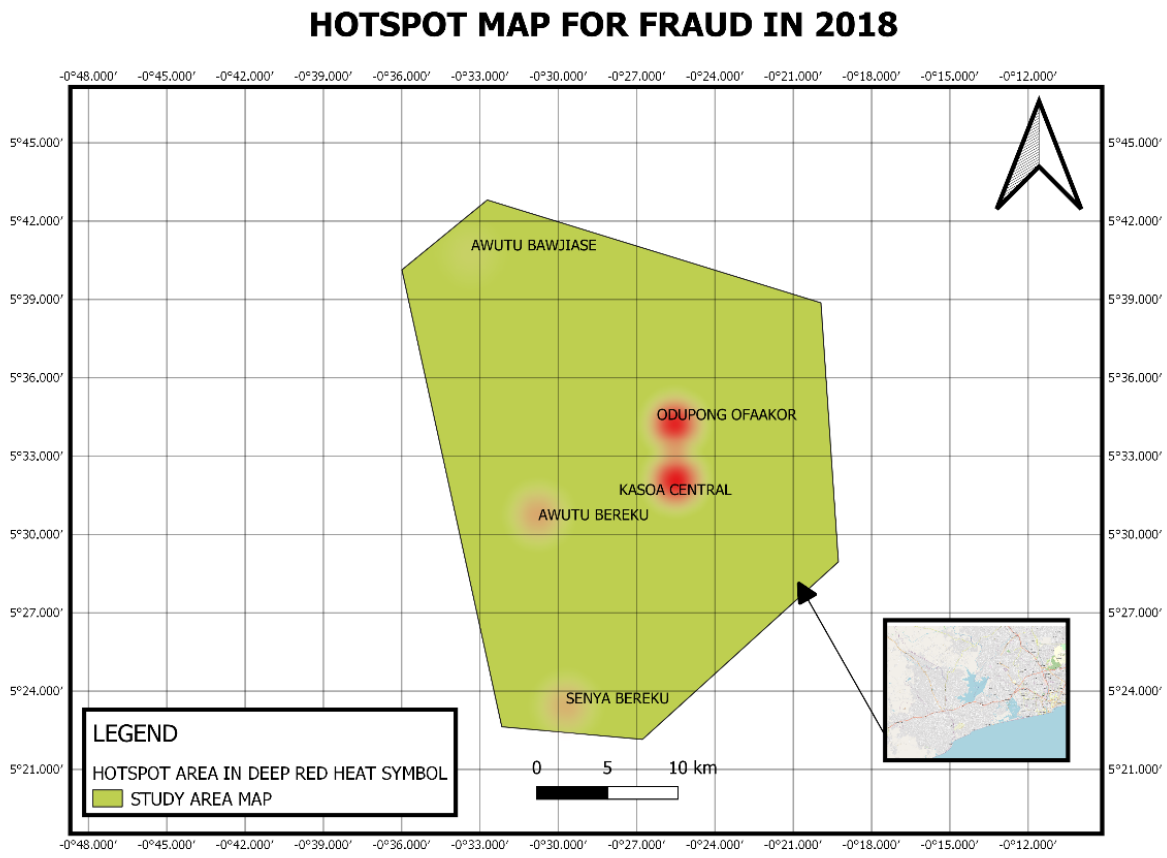
The goal of this section was to identify the clustered areas that, over the course of the three study years, saw a high density of reported fraud cases. Data analysis for this was done using QGIS software. To enable the researcher to make judgments about the linkages between the study years, clustered analysis was employed to show the analysis of all the study years as one. Figure 9, 10, 11 show the hotspot maps for fraud in 2017, 2018 and 2019 respectively.

Figure 11: Hotspot map for Fraud in 2017



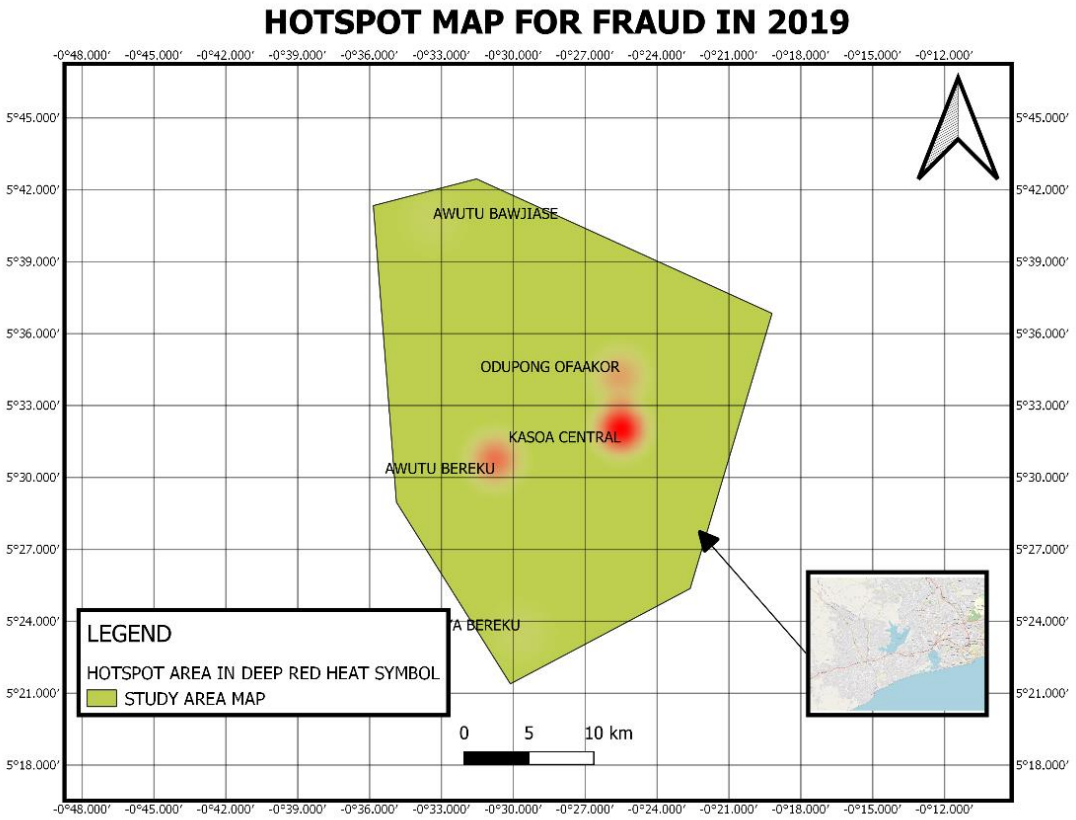
Source: Researcher's Own Construct, (2023).

Figure 12: Hotspot map for Fraud in 2018



Source: Researcher's Own Construct, (2023).

Figure 13: Hotspot map for Fraud in 2019



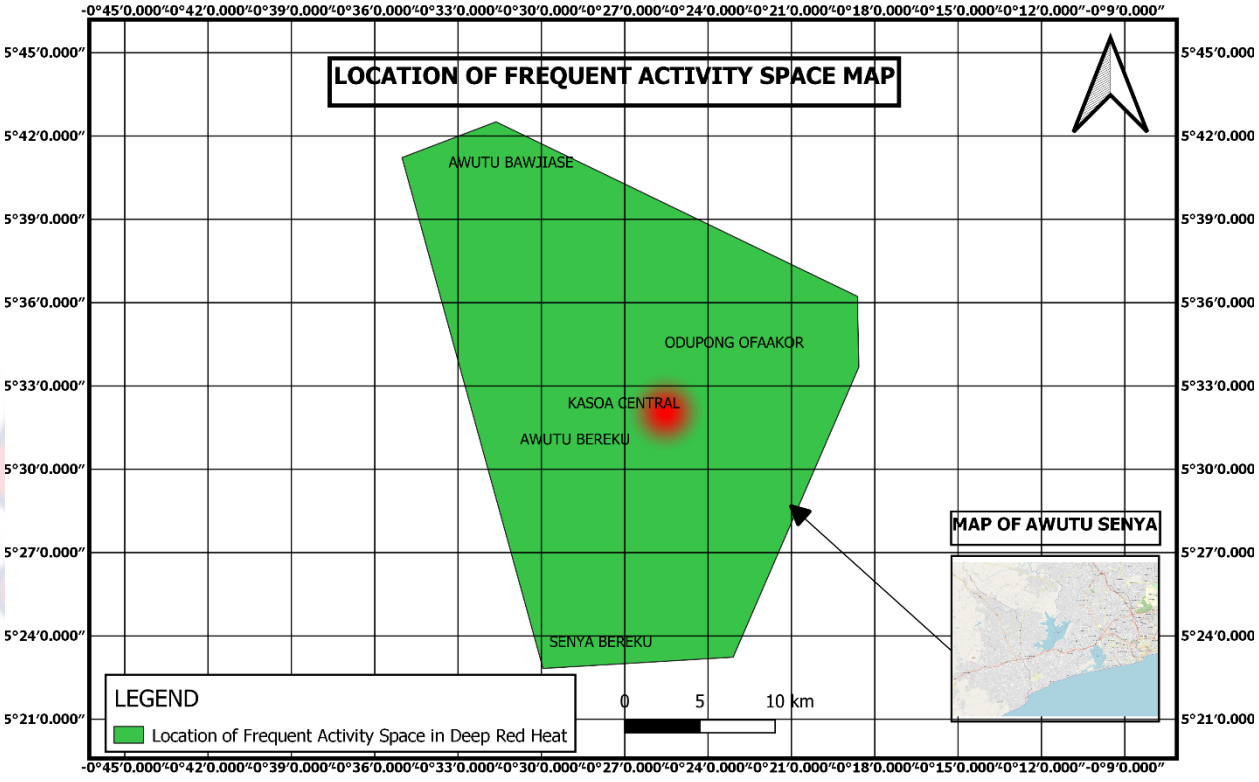
Source: Researcher's Own Construct, (2023).

The findings of the study, as indicated in Figures 9, 10, and 11, showed that Kasoa Central was the area with the highest density of reported fraud cases. This may be explained by the fact that the area includes the market circle, a busy area where many transactions take place, including "Phone Swap," a practice where victims are occasionally deceived. This is in line with Onwudiwe (2017) who posits that fraud rates are typically higher in places with busy markets. The area is closely followed by Awutu Bereku and Odupong Ofaakor, and these point to the fact that those areas are where people are currently acquiring lands for settlement, for which there have been reports of fraudulent transactions.

4.1.4 Locations of Frequent Activity

The last research objective was intended to examine the clustered area which was most frequently accessed as a result of the spatial characteristics of the area. The analysis was done to synchronize the identified area with its propensity to crime. Data on this was analyzed using QGIS software. Figure 12 below shows the frequent activity space map of the study area.

Figure 14: Frequent Activity Space Map



Source: Researcher's Own Construct, (2023).

According to the study's findings, which are depicted in Figure 12, Kasoa C, which houses the central business center, is a popular destination. This is the area with big market centers, pubs, night clubs, lorry stations, etc., which attract the influx of many people day

in and day out. Naturally, people usually frequent areas with such facilities, and it wasn't surprising to observe Kasoa Central being the location with frequent activity space. This lends support to Ebu (2020) that populace attraction occurs in market and entertainment-rich places since these locales become hubs for economic activity.

4.2. Discussion of Findings

In reference to the evaluated empirical literature, the study's findings are discussed. It describes areas where this study's findings support those of other studies as well as any potential contradictions.

4.2.1 Research Objective 1: To find out the total crime statistics of the selected crimes from 2017-2019

This objective aimed to highlight how the study area's demographics could be utilized to explain the alarming statistics—or lack thereof—of the chosen crimes over the study years. All reported crime cases involving the three chosen crimes—robbery, assault, and fraud—for the three research years were summed up for clarity's sake and to meet this goal. Again, to aid in analyses and inferences, the sum for each year was separated. The study's findings showed that throughout the three-year period, there were 6,246 occurrences of each of the three crimes—assault, fraud, and robbery—recorded (2017-2019). According to the study's findings, there were 2,325 total recorded criminal instances in 2017, however, this number rose to 2,547 in 2018, and then fell to 1,374 in 2019.

The study area is an area in Ghana that has currently been experiencing urbanization which goes with the increasing population. It was therefore not surprising to witness an upsurge in the crime rate in 2018 since it is obvious the population would have increased as compared to 2017. The researcher considers the possibility that the dense and

increasing population in the study area coupled with other environmental factors explain the increased number of reported crime cases. A plethora of studies associate increasing population with a daily flow of people, to increasing crime rate (Shaw & Mckay, 1942; Kassem, Ali & Audi, 2019; Malleson & Andresen, 2016). However, increased police visibility and other crime control policies by the police are likely to have been the panacea for the low reported crime cases in 2019. Increased police strength has been found to lead to a lower number of crimes committed (Wallace, 2013; Braga, et al., 1999; Braga and Bond, 2008).

4.2.2 Research Objective 2: To conduct a statistical trend analysis of the selected crimes from 2017-2019

This objective was to highlight how the selected offenses were dispersed over the three study years by using crime statistics. This would help with crime predictions and inform policies. According to the study results shown in Figure 2, robbery incidents were the least frequent of the three crimes over the course of the study years, accounting for around 4% of all crimes committed during that time. Assault cases were the highest, representing an approximate percentage of 66%, followed by fraud, which represents 30% of the crime cases over the study years.

According to the study's findings, as shown in Figure 2, there were 222 more reported cases in 2018 than there were in 2017, which is concerning given that the police institution's main goal is to reduce crime. However, 2019 saw a general decline in crime rates, and this may be attributed to police's visibility during this period as they may have been concerned with the increase in crime rates in the previous year. There is indeed a plethora of research that posits that police visibility either reduces or displaces crime in a

geographic area (Braga, Weisburd, Waring, Mazerolle, Spelman & Gajewski, 1999; Kochel, Burrus & Weisburd, 2015; Kennedy, Caplan & Pizza, 2015). However, the trend continued as assault continued to be the most commonly reported crime in the study area, followed by fraud and robbery.

4.2.3 Research Objective 3: To identify hotspots of the selected crimes in the study area from 2017-2019

There is a need to identify areas with high crime concentrations so that the limited police resources can be distributed as efficiently as possible. This objective aimed to pinpoint locations in the study area where the selected crimes were recorded in high numbers from 2017-2019. The study's findings, as indicated in Figure 3-11, showed that Kasoa Central was found to be a hotspot for assault and fraud for all the study years. The area which is known for big market centers and lorry stations, naturally attracts a lot of people to converge breeding increased temperatures, or better still, uncomfortable heat, which has been found to be a catalyst for the perpetration of violent crimes like assault. This confirms the findings of Jung, Chun and Griffith (2020) who investigated the association between temperature and assaults, and posited that, high temperatures and severe heat are seen as acute situational factors that could eventually make people more aggressive, leading to increased assaults. Jung et. al (2020) posit that increased frustration brought on by severe heat may lower one's tolerance for irritations that one might normally overlook. The study's findings suggested that high temperatures increase the probability of assault. However, interestingly, another study by Anderson (2001) conducted a study to investigate the influence of heat on violence and indicated that inasmuch as the heat hypothesis states that hot temperature may lead to increased aggression, there is no direct

association. Anderson (2001), rather, posits that uncomfortable heat directly increases hostility and indirectly increases aggressive thoughts which may further breed increased assaults.

The findings of the study also showed that fraud was in high density in areas around market centers and areas where there is acquisition of new lands. In general, fraud was seen to be high in Kasoa Central, followed by Odupong Ofaakor and Awutu Bereku. Fraud therefore is in high densities around areas where a lot of people come into contact to engage in various kinds of economic transactions. The aforementioned locations are best known for market centers, and the buying and selling of lands, among other economic dealings. Ebu (2020) posits that fraud is in areas around market centers since a lot of people usually converge to engage in economic transactions.

The findings of the study also point out that robberies were in high numbers in the Awutu Bereku clustered area which covers the stretch along the Accra-Cape Coast highway, and also houses a refugee camp, making the area densely populated. Robberies do have spatial characteristics and thus require the convergence of offenders and targets, along with particular spatial patterns. Kennedy, Caplan and Pizza (2015) opine that the number of residents in a neighborhood directly affects the crime rates there. It can therefore be explained in part that, the densely populated nature of the Awutu Bereku area breeds the development of bad cliques who in turn become potential offenders. Kennedy, Caplan and Pizza (2015) indicate that when an environment is densely populated, it leads to the creation of potential offenders and suitable targets, which in turn increases robberies. On the other hand, the social structure of this area may have had an impact on the increased level of robberies. The area is bedeviled with population heterogeneity, poverty,

makeshift buildings, pubs, and nightclubs, and therefore possesses the semblance of any known socially disorganized environment. The premise of a lot of the research that has already been written about the connection between the characteristics of a neighborhood and crime rates in a particular city is that a disorganized environment encourages more crime (Shaw & Mckay, 1942; Kochel, Burrus & Weisburd, 2015). The population of the area which is difficult for the few numbers of police to manage also has an association with the increased robberies since it will create the opportunity for the perpetrators to operate.

4.2.4 Research Objective 4: To determine the location of frequent activity space within the study area

This objective sought to identify the location within the study area where people frequent and how it could be used to make inferences on the nexus between frequent activity spaces and crime. The findings of the study show that Kasoa Central is the location among the study areas where a lot of people frequent. Interestingly, the area was also found to have a high number of the studied crime types. This proves that areas with high levels of activity are connected with increased crime. In agreement with this claim, a study by Menting, Lammers, Ruiter, and Bernasco (2020) that looked at the impact of activity space and visiting frequency on crime location choice discovered that crime is significantly more common in offenders' activity spaces than it is elsewhere, and the consequences get worse the more they visit. This suggests that areas with high population densities have a confluence of victim and offender activity, which increases crime rates there. However, the association between activity space and crime could be effectively dealt with by exploring how activity space creates crime opportunities.

4.3 Chapter Summary

This chapter's primary objectives were to present the findings and discuss them. It comprised specifics of the findings that were given in the form of overall crime statistics, statistical trend analyses of crimes, and hotspot analyses. It was realized that Kasoa area was where most of the crime hotpots were found, and this could be attributed to how busy the area is. It was found out that the Kasoa Central area which was found to be a crime prone area, also happened to be the location for frequent activity space.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0. Introduction

This chapter presents the study's findings, which sought to address the objectives underlying this study. It provides a summary of the study's findings. Out of this, conclusions were made, coupled with recommendations that were put forward to inform policy decisions and further studies.

5.1. Summary of Major Findings

This study's main objective was to examine the spatial distributions and trends of a few specific crimes (assault, robbery, and fraud) in the areas covered by the Kasoa Police Division. The researcher therefore set out to collect reported crime data from the police over a period of three years, i.e., 2017, 2018, and 2019. The study therefore sought to achieve the following objectives:

5.1.1 To find out the total crime statistics of the selected crimes from 2017-2019.

The study's findings showed that over the course of three years, 6,246 occurrences of each of the three types of crimes—assault, fraud, and robbery—had been documented (2017-2019). According to the study's findings, there were 2,325 total recorded criminal instances in 2017, however this number rose to 2,547 in 2018, and then fell to 1,374 in 2019.

5.1.2 To conduct statistical trend analysis of the selected crimes from 2017-2019.

The findings of the study conveyed that from 2017-2019, assault was the most reported crime in the study area, which was followed closely by fraud. The study's findings also showed that the total number of the selected offenses in the study area was higher in

2018 as against 2017, but rather saw a decreasing trend in 2019. It was also realized that all the selected crimes increased in number in 2018 as against 2017, and they all decreased steadily in 2019.

5.1.3 To identify hotspots of the selected crimes in the study area from 2017-2019.

The results from this study indicate that the clustered Kasoa Area was found to be a hotspot of assault and fraud for all the study years. However, that of robbery was shifted to the clustered area of Awutu Bereku. As a result, it may be inferred that specific regions within the study area were hotspots for the crimes the study looked into due to their spatial characteristics and dynamics.

5.1.4 To determine the location of frequent activity space within among the study areas.

The findings from this study indicate that the Central Business District which happens to be the Kasoa Central area was found to be the location of frequent activity space as compared to the other areas. The place was found to be very routine since it was home to large market centers, large truck stations, and large amusement centers, among other facilities, and as a result, these features were a significant draw for visitors. The area which was also found to be of a high number of reported crime cases seeks to buttress the association between activity space and crime.

5.2. Conclusions

The examination of the selected offenses for the research years revealed a varied tendency, according to the summary of the main findings. A highly populated location is seen as a major pull for the commission of crimes like assault, and thus it was found that assault was on the rise in the research area. Robbery was found to be the least recorded

crime among the crimes chosen for the study years, which is unexpected given the strong economic activity in the study area and the present influx of settlers. Additionally, it may be said that a location's spatial characteristics unquestionably affect the crime rate there. The area featuring market centers, clubs, and pubs, among other things that gather lots of people in one location, was shown to have a high density of assaults. This is in line with Ebu (2020) finding that there is a significant correlation between assault site and demographic characteristics. In areas with a high volume of transactions, fraud was also prevalent. It can be concluded, therefore, that there is a positive correlation between locations of frequent activity and incidences of crime if police visibility is not strengthened.

5.3. Recommendations

On the basis of the research's findings, the following recommendations have been made:

The Ghana Police Service must set up Geographic Information Systems Departments in all police district offices to ensure a robust spatial data collection system to aid crime research. To support this, the Ghana Police Service should provide GPS handsets to all police stations so that spatial data of crimes can be collected at crime scenes. For effective spatial crime analysis to be conducted, it is expected that a researcher obtains and uses adequate GIS data for individual crime incidents in order to ensure efficiency. A robust database that includes the geocodes of all crime scenes must be established by the police to ensure easy retrieval of crime data and prompt response to crime research. Here, adequate funding must be provided by the authorities to equip the police institution with such technical needs. As technology advances at breakneck speed, measures should be put

in place to ensure that police officers are routinely trained and retrained on the use of GIS equipment so that they can keep up with the changing dynamics of some of these technological gadgets.

The police, in collaboration with other organizations, must all be considered when putting in place measures to help curb crimes. It is a well-known fact that increased crime cannot be managed by the efforts of the police institution alone. There are also institutions whose efforts and policies are required to help nip the crime threat in the bud. In part, some of these organizations include the town and country planning department and other institutions, whose institutional mandates all converge to stem the tide in dealing with issues of crime. Institutional measures put in place by these groups would aid in lowering the probability of crime occurring and raising people's fear of committing it. For example, the highway authorities might enhance street illumination in particularly vulnerable sites, and town planners would also support ensuring residential layouts that would limit the establishment of crime-prone locales. Institutional measures put in place by these groups would aid in lowering the probability of crime occurring and raising people's fear of committing it. For example, the highway authorities might enhance street illumination, and town developers would also support ensuring residential layouts that would limit the establishment of crime-prone locales.

The community policing regime should be highly encouraged to ensure reasonable police visibility. The Ghana Statistical Service (2021) indicated that the country's population was 30.8 million, with about 25,000 police staff in the country (Nyabor, 2021, cited on Citi NewsRoom). In effect, the country will be grappling with a ratio of 1 police officer to about 1000 civilians at a time. And this, according to global recommendations,

will not be good for crime prevention since it should have been about 1 police officer to 450 civilians or less. With this, as the findings of the study indicated that crimes are usually on the rise at locations of frequent activity, which overwhelms the few numbers of police officers allocated, the researcher recommends the strengthening of the community policing regime to ensure visibility, which will in effect deter potential criminals. The police should also provide training for stakeholders like watchdogs of towns, market guards, etc., to help manage crime situations.

5.4 Suggestions for Further Research

The study revealed that there aren't many studies on the spatial analysis of crime in Ghana, despite the fact that many have been done in other countries. Meanwhile, the few studies done in Ghana, including this current one, did not delve into why some areas were found to be hotspots of crimes or otherwise. However, to truly appreciate the patterns and distributions of crime at a particular geographic location, the researcher believes that thorough research into the effect of the spatial characteristics of an area on the crime rates is expedient. This would help unearth accurate inferential analysis and predictions.

Specifically, more study is required, especially when exploring the impact of various variables of social disorganization theory on crime rates. Considering neighborhood impacts, using various neighborhood architecture would have produced varied geographic distribution patterns of crime, which might have supported the social disorganization theory. To better understand the causes of crime hotspots and cold spots, the elements of crime pattern and routine activity theory could also be examined against the distribution patterns of crime.

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APPENDIX A

Table 1: Total Crime Data

YEAR	ROBBERY	ASSAULT	FRAUD	TOTAL
2017	85	1521	719	**2325**
2018	91	1720	736	**2547**
2019	70	865	439	**1374**

Data from Ghana Police Service, (2023).

APPENDIX B

Table 2: Crime Data for Assault

CLUSTERED STUDY AREA	2017	2018	2019
Kasoa Central	820	919	312
Odupong Ofaakor	198	412	184
Awutu Bawjiase	90	79	37
Awutu Bereku	302	214	291
Senya Bereku	111	96	41

Data from Ghana Police Service, (2023).

Table 3: Crime Data for Robbery

CLUSTERED STUDY AREA	2017	2018	2019
Kasoa Central	20	22	16
Odupong Ofaakor	18	19	14
Awutu Bawjiase	13	13	11
Awutu Bereku	23	28	21
Senya Bereku	11	9	8

Data from Ghana Police Service, (2023).

Table 4: Crime Data for Fraud

CLUSTERED STUDY AREA	2017	2018	2019
Kasoa Central	247	261	113
Odupong Ofaakor	208	213	94
Awutu Bawjiase	55	48	57
Awutu Bereku	112	115	99
Senya Bereku	97	99	76

Data from Ghana Police Service, (2023).