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**Addis Ababa University**

**College of Social Sciences**

**Department of Geography and Environmental Studies**

**Crime Mapping and Analysis Using GIS Technique in Lideta Sub-city, Addis Ababa,  
Ethiopia**

**By**

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June, 2019

**Crime Mapping and Analysis Using GIS Techniques in Lideta Sub-city, Addis Ababa,  
Ethiopia**

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June, 2019

## **Declaration**

I, the undersigned, hereby declare that the Thesis entitled, Crime mapping and Analysis using GIS techniques in Lideta Sub-city, Addis Ababa, Ethiopia, is my original work under the guidance of **Dr. Asnake Mekuriaw** and the Thesis contain no material previously published by any other person except where proper citation and acknowledgement has been made. I do further confirm that this Thesis has not been presented or being submitted as part of the requirements of any other academic degree.

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## Approval Sheet

This is to certify that the Thesis prepared by **Yeshimar Yigzaw Kebede** entitled: " Crime Mapping and Analysis Using GIS Technique in Lideta Sub-city, Addis Ababa, Ethiopia." is approved for the degree of Masters of GIS, Remote Sensing and Digital Cartography.

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## **List of Acronyms and Abbreviations**

<b>AA</b>	Addis Ababa
<b>ACRR</b>	Annual Crime Rate Report
<b>BOFED</b>	Bureau of Finance and Economic Development
<b>CAD</b>	Computer-aided Dispatch
<b>CALEA</b>	Commission on accreditation for Law Enforcements Agency
<b>CCE</b>	Criminal Code of Ethiopia
<b>CCIAA</b>	California Crime Analysis Association
<b>CSA</b>	Central Statistical Agency
<b>DBMS</b>	Data Base Management System
<b>DMAP</b>	Drug Market Analysis program
<b>DNA</b>	Deoxyribonucleic Acid
<b>ECJP</b>	Ethiopian Criminal Justice Policy
<b>EFPC</b>	Ethiopian Federal Police commission
<b>ESRI</b>	Environmental Science Research Institute
<b>FAO</b>	Food and Agricultural Organization
<b>GPS</b>	Global positioning System
<b>LEJ</b>	Law Enforcement Journal
<b>POP</b>	Problem Oriented Policing
<b>PC</b>	Property Crime
<b>M</b>	Meter

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## *Abstract*

*Crime is an act of commission and omission that is prohibited and punishable by law. Crime mapping is not started yet in national level as well as the study area. This study was conducted in Lideta sub-city, Addis Ababa, Ethiopia. The objective of this study was to map property crime and to analyze its pattern and trend. The study employed both quantitative and qualitative approach of data collection and analysis. The study employed explanatory sequential research design. Structured questionnaires and key informant interview guide were administered in data collection. Property crime records were collected from Lideta sub-city police officers. To analyze the property crime in the sub-city, GIS techniques such as interpolation and point map were used. High and low crime areas were identified. From both low and high crime areas 100 respondents were selected from each area by using non-random sampling technique. The key informants selected by using purposive sampling techniques. Secondary data from annual crime report were used and analysis was done by using ArcGIS 10.5 and SPSS version 20 software. The findings indicated that the trend of property crime was being increased through time in Lideta sub-city. The distribution (pattern) of property crime was high in the northern, north-western and central part of the study. Crime severe places are open spaces, commercial centers, hotels, pensions and grocery, roads that have no street light and areas with rivers, streams and waste disposal tubes. The result shows that high crime was committed during day-tour condition. We found that socio-demographic factors such as income, education, participation of the resident in community policing, police patrol, seasonal variation, police tour condition and the time and family status determine the level of property crime committed in the area. Generally, this study will create a new era for police institution about the practice and development of spatial technology.*

**Key words:** *Crime mapping; Crime analysis; Property crime; Hotspot area; Crime pattern*

# Chapter One

## 1. Introduction

### 1.1. Background

Crime is an act practiced by the community through violating the rules, regulations and social values that are punishable where the court has found the crime proving and deserving of punishment (ECJ, 2004). According to Balogun et al (2014 ) crime is an action practiced against person, property and violations of social norms and values. A crime is a misbehavior which is prohibited and made punishable by law (Kang & Kang, 2017). The act of crime is the commission of what was prohibited or omission what is prescribe for all legal, material and moral ingredients are present (ECJP, 2004).

Criminal activities are concerns in the public safety of a contemporary society. In current time many countries are challenged with high levels of offences and crime rates in both developing and developed nation (Leitner, 2013). Similarly, crime has become a prevailing social problem in the Ethiopia context (Jibat & Nigussie, 2015). Major property crimes in Ethiopia are looting, theft, aggravated theft, check misappropriation, vehicle part theft, robbery, cyber-crimes, bribery and corruption, money laundering (ECJP, 2004).

Global and local crime has a great impact on nation development, citizen's security at spatial and temporal scales. In this regard, crime analysis mapping is important for nations development either in developed and developing economic, social and security issues through computerized spatial analysis (Natarajan et al, 2016). According to Braga et al (2012) the substantial grouping of crime in small places, or hotspot that generate crime in all criminal events.

Analyzing and monitoring the rate of criminal activities is the responsibility of the law enforcement agencies. Crime analysis involves selecting and prioritizing crime prone areas, and also analysis of patterns and trends in crime and disorder (Saravanakumar & Revathy, 2016). Crime analysis, a general term for a relatively amorphous group of analytic procedures relating to crime and criminal behavior (Petherick, 2015), plays a role in creating results to crime problems and voicing crime prevention strategies. For this purpose computerized crime mapping systems is highly recommended by the police department (Hall et al, 2012).

Crime mapping and analysis is the process of indicating crime areas and its distribution in space by using the Geographic Information System(GIS) techniques (Lama & Rathore, 2017). It helps polices to precisely state the characteristics of criminal cases and also to determine the site where the action can be taken (Weisburd et al, 2009). GIS has become an essential technology for crime prevention and investigation purpose (Sivaranjani, 2016). The accessibility of geographic data makes it practicable for police departments to use GIS (Chamikara, 2016).

Crime detection and control have been analyzed by using spatial data recorded by the police institution. Today, applied science and computer-based technologies are rapidly used for exploring, visualizing and explaining the natural event of criminal activity. GIS integrating and accessing large amounts of location based information and produce crime maps (White, 2012).

According to Beteika (2015), crime maps demonstrating the crime location or the area that trends of criminal activity, high-density areas, and temporal information are important for policy makers and police effective activities. GIS and crime mapping output determine policing method to decide based on the facts of place in implementing of law enforcement agencies that have always done and today's world, police duties are assisted by such high technologies (Beteika, 2015). Crime maps protecting police workload, upgrade community knowledge about crime may increase community participation and cooperation, increase public awareness of neighborhood problems, facilitate firms with researchers and other agencies (Ratcliffe 2002). Crime mapping help to solve wide variety of problems and used for spatial decision-making applications in crime, crime patterns and crime locations and suggest the opportunity to police departments to utilize a larger amount of information more intelligently and allowing the analyst to look for patterns and develop maps of certain problem areas (Saravanakumar & Revathy, 2016).

However, police crime record in Ethiopia is still manual and the data is non-spatial. One of the biggest obstacles in crime analysis and the use of GIS in the Ethiopian police institution does not understand the technology behind it. This determines the police force practicing and using spatial technology over the ever-increasing technology sophistication of the criminals in Lideta sub-city police office. Based on this background and justification of the crime with dynamic change of the criminal activities this study has a vital importance in order to implement the spatial

application and technology as well as for better police law enforcement based on the output and spatial information. In addition, the study contributes for further research input.

## **1.2. Statement of the problem**

Criminal activity is characterized by several striking empirical features. It is subject to considerable temporal variation, it is geographically concentrated, and it exhibits wide dispersion across communities that possess ostensibly identical economic characteristics.

There is a high crime rate in the cities of developing countries which are known for their high rate of rural to urban migration, high youth unemployment rate, extreme poverty, high inequality and poor social services. According to Ethiopian Federal Police Commission (2016), Addis Ababa is only second to the Oromia National Regional State in terms of crimes committed annually. In the same budget year, the Addis Ababa City Administration Police Commission reported that 47,890 crimes have been registered. Property crimes of theft, robbery, fraud and breach of trust were the most frequently committed crimes (EFPC, 2016).

The 2011 Ethiopian Criminal Justice Policy (ECJP) at number 1.4(d) clearly stipulates that studies on the causes of crime are the bases of crime prevention strategy (ECJP, 2011). Therefore, in line with the requirement of the policy, the researcher attempted to investigate the nexus between urban poverty and property crimes which are enacted under the 2004 the Criminal Code of Ethiopia (CCE) in greater depth and comprehensibly.

In Lideta sub-city the police institution still is not computerized for effective record keeping. In the study area crime data is not easily retrieve and store for managing and adequately use the crime data. At national level based on spatial technology crime related researches are not done. In Addis Ababa, crime was recorded in attribute form of manual paper. As an entity, crime has spatial characteristics, i.e. location, time and process. In essence, accessibility and rapid access to timely and up-to-date spatial information about crime-susceptible areas, to the law enforcement agencies, will no small way contribute to effective policing of the entire state (Oguntunde & Ojo, 2018).

In the Ethiopian police institution, crime analysis based on spatial data is not started yet in the nation level, except recorded in the manual way of personal information without the spatial data

of the area. For effective crime prevention and police activities, place of the crime is important to protect the area from crime for attracting the deployment of personal and resource in the crime hotspot area. Based on the Addis Ababa police commission crime statistics the amount of crime record in 2014, 2015, 2016, 2017 and 2018 was about 51679, 45060, 47890, 47640 and 50794 respectively (see annex 5). Such crime record does not have a spatial reference and the police commission do not use spatial information and perform crime analysis. This study aims to map crime hotspot areas and pattern of crime by using GIS techniques.

### **1.3. Objective**

#### **1.3.1. General objective**

The general objective of the study is to mapping and analyzing crime and to identify impact of built up environment on crime incidents in Lideta sub-city, Addis Ababa, Ethiopia.

#### **1.3.2. Specific objectives**

- 1) To map spatial pattern of crime in the study area using GIS techniques;
- 2) To identify property crime hotspot areas;
- 3) To examine crime events distribution over space and time;
- 4) Analyze the relationship between crime and socio-demographic characteristics.

### **1.4. Research questions**

To achieve the research objective of this study, the following research questions were formulated:

- 1) What is the crime trend from 2014 to 2018 G.C in the study area?
- 2) Which places experience a lot of crime than others places experience?
- 3) How are crime events distributed over space and time?
- 4) Is there relation between crime and socio-demographic in study area?

### **1.5. Significance of the study**

The findings of the study will inform law enforcers and stakeholders about the hotspot area of crime. This would have enormous significance for the stakeholders in devising peculiar circumstances and implementing case specific intervention plans. This research is also important to minimize the fear of crime among the societies by providing supportive information for police deploy line officers. Moreover, the study will add knowledge in Ethiopian police institution about the importance of GIS techniques for crime analysis.

### **1.6. Scope of the study**

There are different types of crime that classified based on the type of injuries such as crime against person, violence crime, political crime and property crime (Mookiah et al, 2015). According to the Addis Ababa police commission report (2018) the property crime is the most problem in Addis Ababa including the study area. Thus, in this study we focus on property crime.

### **1.7. Limitation of the Study**

While the study was conducted data, compilation was the main problem in the police office because the crime record data exist in a manual format. Besides, literatures with regard to crime mapping analysis in the study area were not available. These was minimized by employing data collector and by reviewing different articles done by both developing and developed countries.

### **1.8. Operational definition**

**Crime** –Crime is an exercise performed by an individual or a group of persons which is unethical, harmful and unsocial to the society (Kanna 2016). In this research crime is any interference with property and economic rights or rights capable of being calculated in money forming a part of the property of another.

**Crime analysis**- It is a set of systematic, analytical processes directed at providing timely and pertinent information relative to crime patterns and trend correlations to assist operational and administrative personnel in planning the deployment of resources for the prevention and suppression of criminal activities (Stenton, 2009). In this research crime analysis systematic and

analytical analysis of the property crime by displaying in map on the tactical and strategic crime analysis type.

**Hotspot-** Hotspots in crime analysis are regions that require attention from law enforcement, perhaps through increased allocation of resources or location-specific patrolling custom-made to hotspot features( Ballera and Gonzales.et al2018). In this research hotspot is the occurrence frequency or rate of property crime in place and time.

**Human landscape-** Human landscape is the service sectors that are built by human for service. This built-up environment of the area expressed human landscape (Wang & Hofe, 2008.). In this research human landscape includes schools, police station, street light, Road and health center that are related to crime factor.

### **1.9. Organization of the Study**

This Thesis is organized into five chapters. The first chapter is an introductory part. It introduces background of the study which gives insight on crime mapping and analysis base for the study. Statement of the problem answers why this research conducted. General and specific objectives of the study are also included in this chapter based on the research questions. Significance of the study which is about who will be benefited from the finding of this research is also part of this chapter. Scope and Limitation of the study also included in this chapter. Chapter Two present a review of literature that could be gathered from both conceptual and empirical literature source. Chapter Three present research methods and materials. In this chapter data collection tools and techniques, research design, sampling methods, data type and sources and data analysis and interpretation techniques were discussed. Chapter Four presents the results and discussions of the data, and Chapter Five presents the conclusions and recommendations of the research.

## **Chapter Two**

### **2. Literature review**

#### **2.1. History and development of crime mapping and analysis**

The crime analysis discipline was started in 1829 by Robert Peel as a modern police force (Stevenson, 2013). The drive for crime analyses is the discovery of significant heterogeneity within smaller spatial units of analysis: innocent places within bad neighborhoods and risky places within good neighborhoods (Michael, 2013). In crime analysis discipline employment opportunities has not been created for long time, individuals have been performing crime analysis and have been analyzing behavior for decades.

Following the industrial revolution, London was experiencing through the top crime rates as populations in urban areas rapidly raised. With increasing populations, slums spread quickly throughout the city spinning it into a lawless, dirty and violent area. In the past time citizens prevent crime into their own hands by forming their own disorganized groups, designating individuals to serve as watchmen (Stenton, 2009).

The focus of crime mapping transferred from the traditional focus of the criminal offender, towards focusing on the actual criminal event and its physical and social environments that helped to create the opportunities for crime in the late 1960s and through the 1980s (). In the early 1980s, client server technology enabled many departments to upgrade their experiments with crime mapping. A project known as Drug Market Analysis Program showed how GIS tools could be used to control crime(Stevenson, 2013). Commission on Accreditation for Law Enforcement Agencies (CALEA) was created in 1979 for the better application of crime analysis. Many police agencies were requiring an accreditation, to have crime analysis capabilities and because of the large desire for accreditation, the likelihood of a department having such capabilities was significantly increased.

The modern policing pioneer, Goldstein (1979) created the term problem-oriented policing. As opposed to the standard model of policing which incorporates rapid response to calls, increased numbers of police officers and reactive arrest policies among other things, problem-oriented policing takes a very proactive approach to policing. Also, rather than trying to reduce crime by

just responding to incidents and making arrests, police shift focuses to identifying, understanding, and responding to problems (Michael, 2013).

The police departments utilize formal analysis in order to achieve effective problem solving to gain a comprehensive understanding of the problems they are facing and to develop ways of addressing these problems and evaluate what went well and what needs improvement (Stenton, 2009). The California Crime Analysis Association what is now currently the largest state crime analysis organization in United States was founded in 1989 (CCIAA, 2012).

Beginning in the early 1990s, police and researchers were significantly improved their works by using computer technology and police data systems, making electronic crime mapping a much more practical tool. GIS attributed to advances in computer memory space and processing speed making police data on crimes, arrests, and incidents available electronically(Stevenson, 2013).

The 1980s and 1990s were a time when much focus was placed on strategic crime analysis and as part of this, providing police agencies with statistics of long-term trends and ways to combat crime trends (Stevenson, 2013).

## **2.2. Trends of crime analysis in Ethiopia**

In Ethiopia, crime analysis starting point is not known. In the past customary practice of criminal selection and investigation used. Ethiopian police force has its own origin of practicing crime prevention and investigation. The techniques “Afersatta or Auchachign” (communal inquiry) and “Lebashay” (most commonly and widely exercised methods). In addition, there is other methods of crime investigation like tenkway (sorcerer) and Sebat masdefat (Crime investigation, (n.d)).

Procedurally, Afersatta was a very participatory crime detection method. When crime is committed by unknown culprit, the people of that locality were made to be gathered in an open field or in an enclosure before the king’s functionaries and confess confidentially under oath. The “Qagn wonber”-which is to mean the judge, was used to address the purpose of the gathering saying: “Until you had discovered the offender; Infants at the breast shall not suck milk, oxen and herds shall not neither drink nor eat, and husbands and wives shall not inhabit their houses.” The elders known as “Mirtoch”-the chosen, sat beside the king’s functionaries and

recruit the “wofoch”-the birds, from the crowd confidentially. The wofoch are confidential informants combined among the people to listen and inform what the people in the crowd were talking about the topic under investigation (kassaye,19747).

The other prominent figure of the Ethiopian criminal detection was “Lebashay.” It is traditional mode of detection in which a young boy would be given a powerful drug and let loose in the neighborhood. On the procedure, the unfortunate owner of the house where the boy collapsed would be declared the culprit. Lebashay is originated in Shoa around the 18<sup>th</sup> century. This method was in effect until it was abolished by Emperor Haile-Silassie (Kassye,1974).

In Ethiopia, the police organization was officially established in 1942 under the Ethiopian proclamation 1942/06 as an autonomous institution with the responsibility of preventing and investigating crime incidents (Mesfin,1999). In 1966 the police institution was put under the then Interior Minister. Since, the police organization structure prolonged to the lower administration unit the police responsibility increase (Mesfin, 1999).

Due to the new constitution adopted in 1994, the Ethiopian government has been exercising federal political system and hence both the structure and authority is changed accordingly. According to proclamation No.1 article 50, regional governments are duly responsible to establish all the necessary administrative levels in their respective region. As a result, Addis Ababa Police Commission has become responsible for maintaining law and order in its respective region together with other concerned agencies. Prevention and investigation of crime, police make use of earlier crime reports and data as an input for the design of crime prevention policies and strategic plans (Wilson, 1977).

In the city of Addis Ababa, specially, Lideta sub-city which is the focus of this study, there is high poverty level, high unemployment rate, inequality, pouring of migrants from the four corners of the country and poor social services. According to Ethiopian Federal Police Commission 2015/16 Annual Crime Rate Report (ACRR), Addis Ababa is only second to the Oromia National Regional State in terms of the number of crimes committed annually. Crime costs the society its life, property and person.

### **2.3. Crime analysis mapping**

Crime analysis is a career and procedure where in a hard and fast of quantitative and qualitative strategies are used to research records treasured to police businesses and their groups (Boba, 2001). Crime and criminals, victims, disorder, quality of life issues, traffic issues, and internal police operations are assessed by crime analysis, and its results are used for criminal investigation and prosecution, patrol activities, crime prevention and discount strategies, problem solving, and the assessment of police efforts (Oguntunde & Ojo, 2018). All activities performed in police agency are analyzed by crime analysis, with the exception of evidence (including DNA) analysis and some administrative analysis related to budgeting, personnel (e.g., overtime, sick and vacation leave, salary), and equipment( White et al, 2014). Mapping and GIS can show detailed relationships between the crime, victim, and the offender (Chamikara, 2016).

In crime and justice crime maps are becoming significant tools for law enforcement work. The development of information technology and GIS increase the opportunities for the implementation digital mapping in crime control and prevention work of the law enforcement (Alex and Kate, 2001). Crime maps are basic application in the study ecology and locational aspects or characteristics of crime. Maps visualize areas of hotspot that occurrence of crime frequency varies. Crime mapping is a pictorial representation of results having more or less complex spatial data analyses and used for further analysis and decision making (Sharifi, 2001).

### **2.4. Geography of urban crime**

The world are living in a dynamic urbanization (Zhao & Tang, 2006). According to the United Nations prediction, by 2050 about 64% of the developing world and 86% of the developed world will be urbanized (Zhao & Tang, 2006). Urban crime may develop on the background of existing city planning in which physical environments, socio-economic settings, accessibility and urban layouts play a role (Harries, 1999).

Crime and disorder events are not distributed evenly throughout a city; on the contrary, certain places experience higher crime levels than others. Urban safety has been addressed using different theories within criminology, architecture and urban planning. Some theories focus more

on social aspects, while others rely on different environmental aspects to explain variations in crime (Saravanakumar & Revathy, 2016). Traditionally, a high crime rate had been seen as a phenomenon of city centers. The residential density determines crime occurrence rate, the presence of more persons per unit, area will serve to produce more crimes (Harries, 2006). When a crime occurs, it happens at a place with a geographical location (Chainey, 2005).

## **2.5. Place and time of the crime**

Ethiopian criminal code, article 25, crime is committed at the place where and at the time when the criminal did or unsuccessful to perform the act punished by criminal law (ECC, 2011). An attempt is committed at the place where and at the time when the criminal performed or failed to perform the preliminary acts: which constitute such an attempt. When non-instantaneous crimes where act and criminals result do not match, the crime is deemed to have been committed both at the place of the illegal act and that of its effect. Similarly, an attempt is deemed to have been committed both at the place where the criminal attempted the crime and the place, he intended the result to be produced. For the purposes of prosecution, the jurisdiction of the place where the result was achieved is subsidiary to that of the place of commission.

When crime occurrence frequency of criminal acts is an element of an ordinary or aggravated crime as provided under Article 61, or when the act is pursued over a period of time, the place where and the time when the crime is committed shall be the place where and the time when one of the combined or repeated acts or part of the acts pursued is committed.

## **2.6. Crime theories**

Due to the day to day activities of the people crime levels vary over space and time that present regular in patterns. These are guided by time of the day, the season, and the day of the week (Marzan & Baculo, 2017).

### **2.6.1. Rational choice theory**

In this theory when offenders assess situations, their own personal risks and benefits play a role in the decision of whether or not to commit the offense (Clarke, 1997). Thus, the environment plays an important role in creating opportunities for crime, as certain features of the environment

may contribute to different risks for the possible offender, such as being seen and apprehended (Clarke, 2004). According to the researcher knowledge crowded or well-guarded location may deter an offender from committing a violent crime because the potential risks are too high. On the other hand, a crowded location may increase the benefits for an offender willing to committed a theft, due to the availability of many targets and the inherent difficulty of surveillance in a crowded location (Wortley & Mazerolle, 2008).

### **2.6.2. Crime opportunity theories**

Criminals commit crime on their most familiar areas work on crime opportunities they face that crimes could occur (Almanie et al., 2015). This theory assumes that analysts give high emphasis on concentrations of crime targets, rather than concentrations of offenders or the absence of social controls. For example, a dense urban neighborhood with no off-street parking will have many cars parked on the street. Such an area may become an area hotspot for thefts from vehicles (Cohen, 2006). Since their property is unprotected the area becomes burglary hotspot in addition , several layers of hotspots can exist simultaneously (Cohen, 2006). Within area hotspots, streets with even greater numbers of burglaries, and some of the homes on these streets may be broken into multiple times(Zhao & Tang, 2018)

### **2.6.3. Routine activity theory**

Routine activity theory suggests that for a crime to occur, the motivated offender and a suitable victim need to be at the similar place at the same time in the absence of guardians (Wortley & Mazerolle, 2008.). A known concentration of people (suitable victims) in a small, accessible location may create an easy crime opportunity for a motivated offender. A transport node could be one such location (Marzan & Baculo, 2017). In this theory potential offenders and criminal opportunity explaining the role of place in encouraging or inhibiting the crime effectively (Anselin et al., 2000).

According to Andresen & Malleson (2015) routine activity theory explains crime in terms of crime opportunities that happen in daily life. At the time of crime committed criminals should converge time and space for a crime opportunity about a motivated offender, a suitable target or victim, and the absence of a skilled guardian. This theory is expanded by the addition of the

fourth element of “place manager” who has the capacity to take nuisance abatement measures (Michael, 2013).

#### **2.6.4. Crime pattern theory**

Crime pattern theory is to understand why crimes are committed in particular areas. The pattern of crime in area is not random, it is either planned or opportunistic(Zhao & Tang, 2018.). According to this theory, crime occurs when the victim or target meets with that of an offender in the activity space. Crime pattern theory has three main notions node, path and edge. Node is a specific area of activity that an individual use frequently. Path is the route that the individual takes to and from typical areas of activity in everyday life. Edges are the borders of an individual’s cognizance space (Wortley & Mazerolle, 2008).

#### **2.6.5. Broken windows theory**

The broken windows theory is an area theory of crime with attention leading area. Wilson and Kelling (1982) argues that in most well-function neighborhoods, small misbehaviors of social norms result in social weights to bring the offending group into compliance. Once a place becomes victimized by criminals, it undermines the willingness and ability of residents to enforce social order. Consequently, resident’s loss enforcing neighborhood norms, which permits further deviancy to occur. According to Skogan (1990) social network is weak for evidence (Harcourt, 1998) show that the theory is seriously defective (Taylor, 2000, Zhao & Tang, 2018).

#### **2.6.6. Social disorganization theory**

This theory suggests that the usual ability of people to regulate deviancy in their neighborhoods is reduced in some areas by constant residential turnover and net-outmigration (Gonzales et al, 2005). These changes either disrupt social networks or prevent such networks from forming. According to social disorganization theory when an absence of social network, residences leads to higher levels of deviancy (Michael,2013). Other factors, such as poverty and racism, also have been identified as undermining social networks (Zhao & Tang, 2018).

## **2.7. Crime and human landscape**

Crime goes together with social life from its very beginning and happens in every society and in every stage of nations development (Pieszko & Ph, 2016). The structure and rate of crime are affected by different factors such as the degree of income level, socio-political system practiced in a given country, the level of industrialization and urbanization, transformations in social structure which are age-related to members of the society and finally, migrations (Pieszko, 2016). The wealth difference in an area leads to an increase in income variation between people. The greater differences between the wealth level of social groups, the bigger possibility of social nervousness and dissatisfaction.

There is no one cause of crime. Crime is a highly complex phenomenon that changes across cultures and across time (LEJ, 2009). Crime and the fear of crime are related to socio-demographic and other social variables. The level of crime in a community is meaningfully related to its members' education, income, racial makeup, age, and length of residency (Schweitzer et al, 2010). Crime is more sensitive in areas where residents have lower levels of education and income, are young, and are highly mobile (Schweitzer et al., 2010).

Diverse land use, arguing that neighborhoods with different functions, that is, residential, commercial, institutional, and leisure, may be safer than single functional areas. When the land use type increases in an area, it attracts a continual movement of people throughout the day and evening (Schweitzer et al., 2010).

The demographic variables were self-reported by each respondent for his or her household and included income, education, age, race, length of residency on the block, and homeownership. Individual responses for each of the demographic variables were aggregated to obtain crime occurrence measurement (Balthazar, 2012).

## **2.8. Crime hotspot**

Hotspots, places with an increased intensity and frequency of crime of an investigated phenomenon, are one way of analyzing concentration of phenomena in space (Braga et al., 2012). From the perspective of crime, these concern areas with an above-average amount (statistically,

these are significant areas) of acts in an investigated area, in which the occurrence of crime is higher form spatial clusters (Eck, 2005). The hotspots viewpoint suggests that police can reduce crime by focusing their limited resources on the small number of places that produce a majority of crime problems(Braga, 2006).The precise identification of crime concentrations (hotspot) is complex and various conceptualisations suggest different analytical methods that may be useful for evaluation (Goldsmith et al., 2000). Hotspot maps are a traditional method of analysing and visualising the distribution of crimes across space and time (Gerber, 2014). Policing crime hotspots has become a common police strategy for reducing crime and disorder problems(Braga, 2006).

Methods of hotspot analyses identify high-risk areas on the basis of localized data. Used is the property of crime that the acts are not evenly distributed in an area, and their occurrence is influenced also by other factors (Michael, 2013). That means that in areas where offences have been taking place repeatedly, such trend will most probably continue. Therefore, it is important to consider the sufficiency of the data, methods and setting of functions which specialized tools for creating hotspots offer (Perry, 2013). Hotspot analyses tend to be the first step law-enforcement agencies take when identifying risk areas where resources will be targeted(Chen et al , 2004). There are a number of techniques used for hotspot analyses. According to Chainey et al (2005), among the most frequently used are spatial ellipses, thematic mapping of geographic boundary areas, grid thematic mapping, and kernel estimates using the kernel-density function. Crime hotspot detection (mapping) is a spatial mapping technique focusing on the identification of the concentration of crime events across the urban (Reno, 1999). Spatial patterns of crimes show their territorial distribution and their dynamics in space and time (Beteika, 2015). Lochner (2004) suggests the role of education as a human capital investment that increases future legitimate work opportunities, which discourages participation in crime.

## **2.9. Socio-economic and demographic aspects on crime**

Crime driving factors has been investigated in a variety of areas and methods worldwide. Researches attempt to explain crime by examining socio-economic and demographic aspects such as age, sex, geographic location, and income status among others (Weisburd et al., 2014; Eck, Clarke, & Guerette, 2007; Groff et al, 2010; Johnson & Bowers, 2010; Badiora 2012;

2016). However, these variables change slowly over time and may not be able to effectively explain short-term variations in crime rates. Furthermore, most of these analyses generally focus on long periods of time, considering units of analysis such as daytime, weekdays, months and years. With all these inadequacies, scholars believe that one aspect of the physical environment which in addition to socio-economic and demographic aspects that may have well clarification of crime occurrences and major effect on social behaviour is the weather condition of our social and physical environments (Jacob, Lefgren & Moretti, 2007).

Selecting possible symptoms of crime is one step into developing social policies that will help lower the vast social costs of criminal activity. Theories explain crime (strain theory, social disorganization theory, and economic theory) links between socioeconomic factors and crime rates to provide evidence that inequality and family instability has significant factor in determining property crime rates (Jacob, Lefgren & Moretti, 2007). The study of crime is not limited to only one factor, and the links between crime and various socioeconomic variables are analysed.

## **2.10. Crime hotspots in time**

The pattern of crime is not random in time and space (Newton & Felson, 2015). At a changed temporal scale of resolution, there have been a number of investigations that have considered the daily temporal variation of crime within small areas (Townsend, 2004).

Just as hotspots can be described geographically, they can also be defined using time-related criteria. An important question is: How long is a hotspot “hot”? The answer requires defining an incident accrual rate within the spot, based on units of time. Related decisions are needed to determine whether the hotspot’s “temperature” is measured according to all confirmed crimes, all calls for service, specific crimes, or other conditions. In a GIS framework, hotspots (and/or incidents within hotspots) can be color coded or otherwise symbolized according to their age (Reno, 1999). For the commission of crime, a motivated offender and suitable target must meet in time and space with the lack of a capable guardian. Therefore, this can be perceived as the presence of crime’s geodiversity, i.e., where there is more opportunity, there is more crime (Frank et al., 2014).

Three-tour system is commonly used in many police departments. Each day or twenty-four hour periods classified into three tours: (1) the day tour, which generally falls between the hours of 8 A.M. and 4 P.M.; the evening tour, which generally falls between 4 P.M. and 12 midnight; and the night tour, which generally falls between 12 midnight and 8 A.M. Shifts or tours do not necessarily have to fall between these exact hours; they can be between any hours, as long as all twenty-four hours of the day are covered. Similarly, patrol operations are based on a three-shift system basis, almost in all Addis Ababa Police Departments (Crime prevention function and road traffic safety, (n.d).

### **2.11. Applications of GIS for crime analysis**

Geography of crime is a discipline of human geography, which describes with reference to space the study of criminal, the incidence of crimes and characteristic of victims (Yar & Nasir, 2016). Technological advances are essential to recent analytical advances in the methods available for analyzing place-based crime data (Anselin et al, 2000).

In recent years, crime mapping and analysis has used for spatial data analysis techniques that add statistical validness and address inherent limitations of spatial data, including spatial autocorrelation and spatial heterogeneity (Yar & Nasir, 2016). Spatial data analysis helps one analyze crime data and better understand not only why a crime occurs but also where crime is occurring (Sharman, 2009).

Spatial analysis of crime, with the support of a geographic information system (GIS) and spatial statistics, is now widely used for analyzing mass behaviors of crime events to reveal uneven distributions of crime risks and spatial interaction between crime events (Yar & Nasir, 2016). From the earliest civilization, maps have been used to portray information about the earth's surface, navigators, land surveyors, town planners, military, architects, geologists, geographers use maps to show spatial distribution of important geographic features (Ojiako et al, 2018).

Whether the problem is tactical, strategic, or administrative, any data containing location information can be displayed and analyzed using geographic information system (GIS) technology. GIS is an essential part of a crime analyst's toolkit (Mubi et al, 2018). According to (Boba, 2005), Crime mapping is a procedure using GIS to conduct spatial analysis of crime

problems and police-related issues. Crime mapping is a sub discipline of crime analysis which has three main functions.

GIS is an important tool for the identification of suspicious events, for which further investigation is required, supporting trend and pattern analysis, implementing various policy methodologies for reduction of crime, integrating all (Sheikh et al., 2017). GIS helps in analyzing, understanding and building solutions to problems, helpful to understand events and dynamics of crime hazards, persons, and events, identification of risk factors for crime control (Fajemirokun et al., 2016). And also, GIS and remote sensing application is important for analyzing crime trends over time, rapidly relocating resources and configuring beats, locating regional/seasonal hotspot localities of crime and developing plans for crime reduction. The application used by different organizations for administrative crime mapping, crime patterns and series observations by analyzing crime data, provision of investigative leads by aggregating data from a variety of sources (Shafique et al., 2018). Using spatial tools and techniques for forecasting of future crime locations, support to operational plans and clarifying ideal deployment locations, spatial queries, analysis and visualization are key functions of GIS, which is very helpful for critical decision making (Muhammad et al., 2014).

## **2.12. Theoretical framework**

Crime analysis theories are pillars that are important in crime mapping because they are used in the interpretation of data and provide direction for most appropriate actions. Therefore, considering how crime theories value for hotspots is critical. Different theories of crime and disorder concentrations (hotspots) exist. Crime theory describes diverse types of crime activities that occur at different geographic levels. Each level needs different elements of analysis for the things being inspected (Braga et al., 2012).

Urban crime has a quantifiable spatial and temporal distribution that requires imperative attention from the specific arm of government responsible for preserving (maintaining) law and order, which is usually the police and the judiciary. Knowing “what” is “where”, “where” is “what” and “when”, is the task of GIS, the need for which therefore cannot be overemphasized. Crime (what) is a spatial phenomenon which has a spatial location (where) and a time (when) it was committed.

GIS has the capability of integrating spatial and non-spatial data, various crime prone areas can be visualised to provide timely and up-to-date information that is infinitely superior to the normal paper records of events by the law enforcement agencies. Crime is a socio-demographic phenomenon; therefore, its pattern in space is uneven (Balogun , 2014).

Crime analysis used for the law enforcement to identify the different spatial patterns in criminal behavior. GIS software can generate a single visual output that associates multiple data layers into a meaningful output. The analysis between crime and other factors, for example roads, housing, police station, and other structures, can lead to the knowledge of place and crime relationship based on the conditions considered (Sureshababu, 2014).

GIS can integrate and analyse of data to identify, apprehend and prosecute suspects; it supports more proactive behaviour through effective resource allocation and better policy making. For example, crime maps used to predict probable sensitive points/areas in hotspot area(Lama & Rathore, 2017). GIS is universal in its use, extending from identification of illicit cultivation of poppy seeds in Afghanistan with satellite imageries to measuring the geographic displacement of drug offenders and monitoring the effects of law enforcement strategies on nuisance bar activity(Ahmadi, 2003).

### **2.13. Conceptual framework**

Crime is misbehavior of the society against the social value and things that prohibited doing by the law of the land. The justice institution crime analysis was based on different parameters for the best judgment, especially for police crime prevention and investigation technique. Crime analysis focus on the location of crime, that is the place and crime relationship where the crime rate is high in time and area. In addition, the trend of crime also analyzes for future prediction of crime rate and the police crime prevention and investigation mechanism. These crime analyses attain the result by using the application of GIS and remote sensing. Geographic information system is a tool used to analyses the spatial data by using different application tools and extension tools. This application was highly used for crime analysis mapping to indicate the network of criminal and crime, the journey distance of patrol officers, identify the crime hotspot area, show the trend of crime in a time series, identify the best site for police station, analyses the

spatial correlation and use as a decision support system for higher officials for human and resource deployment (Figure 1).

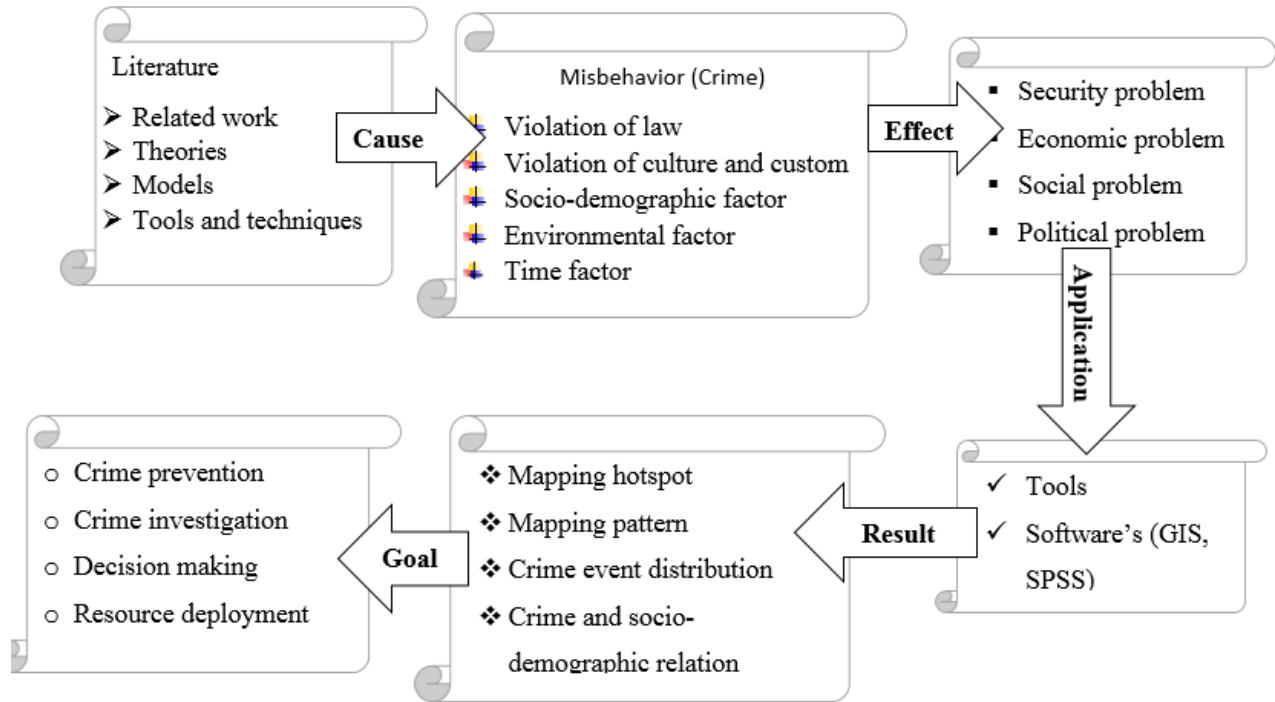


Figure 1: Conceptual framework (source: own survey)

## Chapter Three

### 3. Methods and materials

#### 3.1. Description of the study area

##### 3.1.1. Location

The study area, Lideta sub-city, is located south west of Addis Ababa (Figure 2). Geographically the study area lies between  $8^{\circ} 59'35''$  to  $9^{\circ} 01'50''$  N and  $38^{\circ} 42'32''$  to  $38^{\circ} 45'20''$  E. The total area of study area is about  $9.2 \text{ km}^2$ .

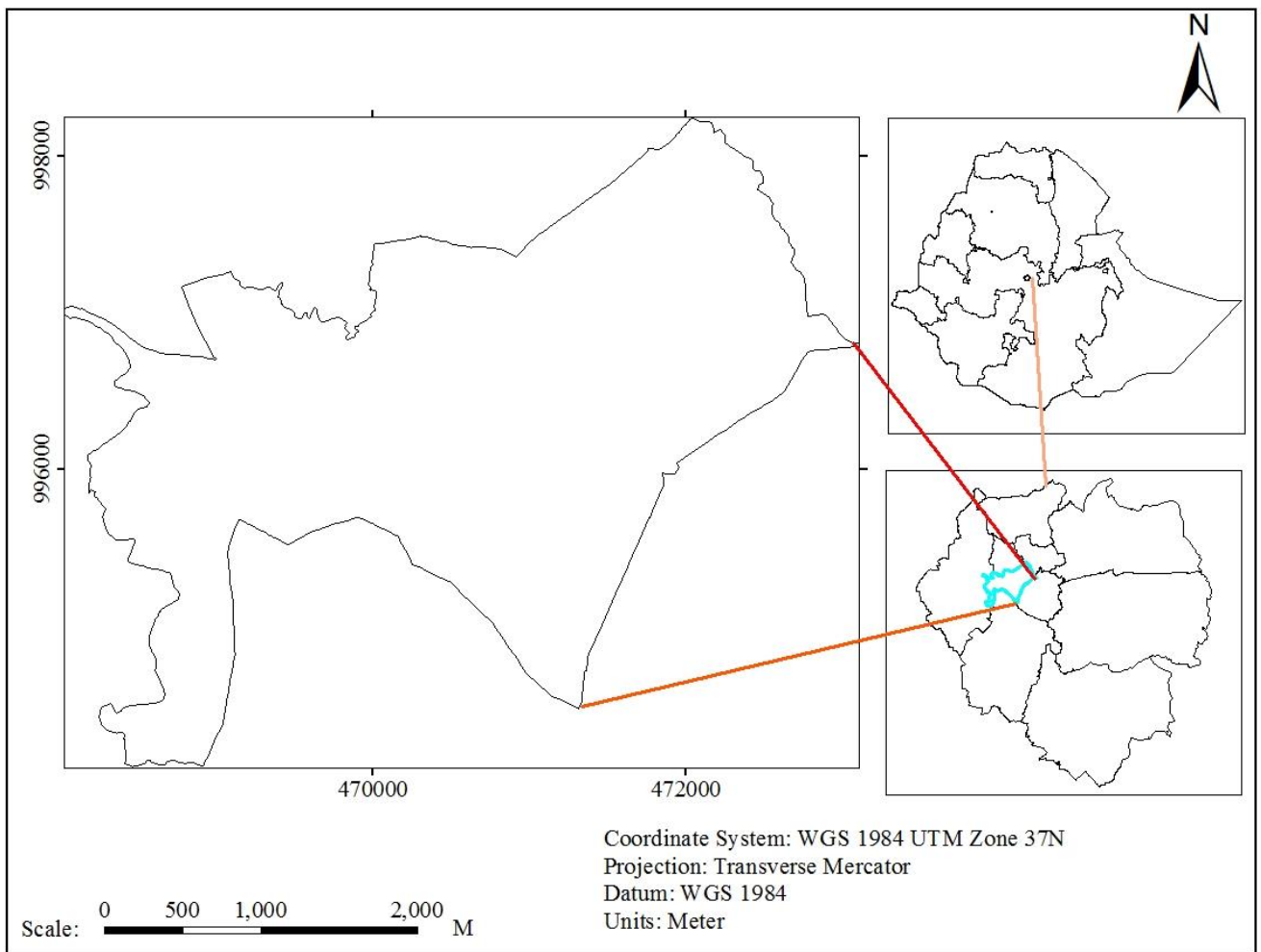


Figure 2: - Location map of study area (source: AA city administration)

### **3.1.2. Population**

Understanding of the human population dynamics is very important for the analysis of crime in the study area. According to the demography department of Addis Ababa (2010 year), the Lideta sub city has a total population of 214,769 (102,513 males and 112,283 females).

### **3.1.3. Economic activities**

According to the state of Ethiopian Cities (2015) report, Addis Ababa share in GDP accounts for 29% of the total urban centers. The city's main economic problems are high unemployment and underemployment. Despite reductions in unemployment, Addis Ababa's unemployment rate is 21 percent. This rate is high in absolute terms and relative to other urban areas in Ethiopia, where unemployment averages 16.9 percent (CSA 2016). This indicates that, while education and human capital levels are improving, there is still an issue with the city's ability to create enough jobs and matching labor skills with employer's needs. According to the 2018 annual report of Lideta sub-city unemployment rate is 23% out of the total population in Lideta sub-city.

## **3.2. Research design**

The research approach used in this study is mixed research approach (qualitative and quantitative). The crime mapping and analysis uses both qualitative and quantitative data. Qualitative data refer to non-numerical data as well as the examination and interpretation of observations for the purpose of discovering underlying meanings and patterns of relationships. This is most typical of field research, content analysis, and historical research. Quantitative data are data primarily in numerical or categorical format. Crime analysis employs both types of data and techniques depending on the analytical and practical need. For example, crime data can be used in various ways, both quantitatively and qualitatively. The information such as date, time, location, and type of crime is quantitative in that statistics can be used to analyze these variables. On the other hand, narratives of crime reports are considered qualitative data in that a large number of narratives are nearly impossible to analyze statistically and are primarily examined to determine general themes and patterns. Due to this and data type this research used explanatory sequential mixed method research design.

### **3.3. Sampling techniques**

The study area, Lideta sub-city, was purposively selected due to the availability of recorded crime data. In addition, the researcher knows this area, which is very important for validation. After having crime data recorded during five consecutive years (2014 to 2018), nine days from each month (day 1,3,8,11,13,18,21,23 and 28) were selected by using lottery method. In each day different types of crime may happen with different weight and frequency. After identifying the spatial location of each crime, hotspot areas and low crime areas were selected based on the frequency of crime events. Then to analyze the relationship between crime events and socio-economic characteristic representative crime areas were selected from high- and low- crime areas by using stratified random sampling techniques. Sample areas were selected from 2018-year hotspot map. Representative crime places were selected from hotspot and low crime areas by using random sampling techniques. From each sample areas, respondents were selected using non-random sampling techniques (availability sampling). Qualitative data is collected from key informants. The key informants are senior police officers, 5 of them were selected by using purposive sampling.

### **3.4. Sample size**

From high and low crime area a total of 100 respondents were selected by using Yamane, (1967) formula:

$n = \frac{N}{1 + (N(e)^2)}$ , n= sample size, N= population, e= error

e=10%, N=54200,  $n = \frac{54200}{1 + (54200(0.1)^2)}$

n=99.95=100

Therefore, 100 respondents are taken from sampled high and low crime hotspot area.

### **3.5. Data collection tools**

Both primary and secondary data were collected. The primary data was collected through open questionnaires and key informant interview from Lideta sub-city police institution and sub-city residential. From hotspot and low crime area open ended questionnaires distributed to the respondents. Key informant interview is organized and interview senior police officers by using

interview guide questions. Secondary data was collected by document analysis of five-year Lideta sub-city police office crime record.

### **3.6. Data type and source**

With the voluminous data being handled by the law enforcement officials, crime analysis is a powerful methodology to analyze the crime data. Majority of crime analysis intended to extract hidden predictive information from large sets of data and encourage law enforcement agencies to make use of it in order to suppress criminal activities. Crime is a human phenomenon, generating data for it requires the integration of the people and the existing security outfits (police) within the study area where the study is carried out(Balogun , 2014)

In this study, both primary and secondary types of data were used. The primary data was the response of the residentials and key informants. Both spatial and non-spatial types of data are important. Secondary data such as Lideta sub-city shapefile, crime record (attribute) data of non-spatial data was used.

The source of primary data was the residential and police officers. The secondary data sources are Ethiopian central statistics authority whereas, crime occurrence places are from Google Earth and ground control points by using hand held GPS. The five year (2014 to 2018) non-spatial data was collected from Addis Ababa police commission, Lideta sub-city police office.

### **Field Observation**

Field observation was taken to know the land cover of the study and to collect the crime place latitudinal and longitudinal values. Some crime occurrence place records were not identified in Google earth. Due to this, recorded crime was fixed with their respective X, Y coordinate by using hand held GPS. The other crime occurrence places of X, Y coordinate was collected from Google Earth with the support of senior police officers.

### **3.7. software's used**

In order to analyze the data, the study used ArcGIS10.5.1 for spatial analysis and SPSS.20 for non-spatial data analysis.

### **3.8. Data analysis techniques and presentation**

The collected data was first geocoded in order to create longitudinal and latitudinal values in the study area with respect to their appropriate places. After creating their spatial value, we used different GIS techniques. In this study point map technique for crime pattern mapping, geo-statistics for hot-spot crime area selection, descriptive statistics for the purpose of analyzing relationship between crime and human landscape. The collected data arrange and the number of crimes committed in the area is given to the specific location. The amount of crime in the area taken as the value and this used to produce the hotspot area. Different researchers analyse crime by hotspot analysis through interpolation techniques. An increasingly popular method for visualising the distribution of crime and identifying hotspots is one that creates a smooth continuous surface to represent the density or volume of crimes distributed across the study area (Chainey et al., 2002; Eck et al., 2005). These types of methods are commonly referred to as interpolation techniques and include inverse distance weighting and kriging. These types of techniques use an intensity or value taken from sample locations to estimate values for all locations between sample sites (Eck et al., 2005).

The occurrence of property crime is not considering the ups and downs rather the advantage of criminals in the opportunity and routine activities. In order to consider the smoothness rather than the topographic variation IDW is used to identify and visualize the property crime hotspot area. By using this technique, the property crime hotspot area and crime sever places were identified.

With crime data we do not necessarily have sample sites where there is an intensity value, and neither are we trying to estimate the number of crimes that may have occurred between these crimes point locations. We should therefore avoid methods that aim to create estimated intensity values in the gaps between our points. Instead, surfaces that we wish to create to represent the distribution of crime should tell us something about the density or clustering of crime points at all locations in our study area. This research used interpolation techniques (Invers distance weighted method). Generally, the study used interpolation, point pattern map and descriptive statistical analysis.

### **3.9. Ethical Consideration**

The informed consent of all participants was obtained before starting the study. Respondents were given a clear explanation about the nature of the study and advised that they are free to withdraw from the study at any time. In addition, participants were informed about data collecting procedure. The secrecy of the subjects protects and guarantee by preventing to write their names and providing clear instruction. Furthermore, the information obtained thorough the aforementioned procedure used only for the research purpose and the confidentiality is maintained.

## Chapter Four

### 4. Results and Discussions

#### 4.1. Crime mapping and trend analysis

From 2014- 2018, property crime committed in the study area was presented in Figure 3. At a point of place, crime was recorded in different years. The figure indicates that 70, 79, 189, 170 and 179 crimes were committed in 2014, 2015, 2016, 2017 and 2018 respectively.

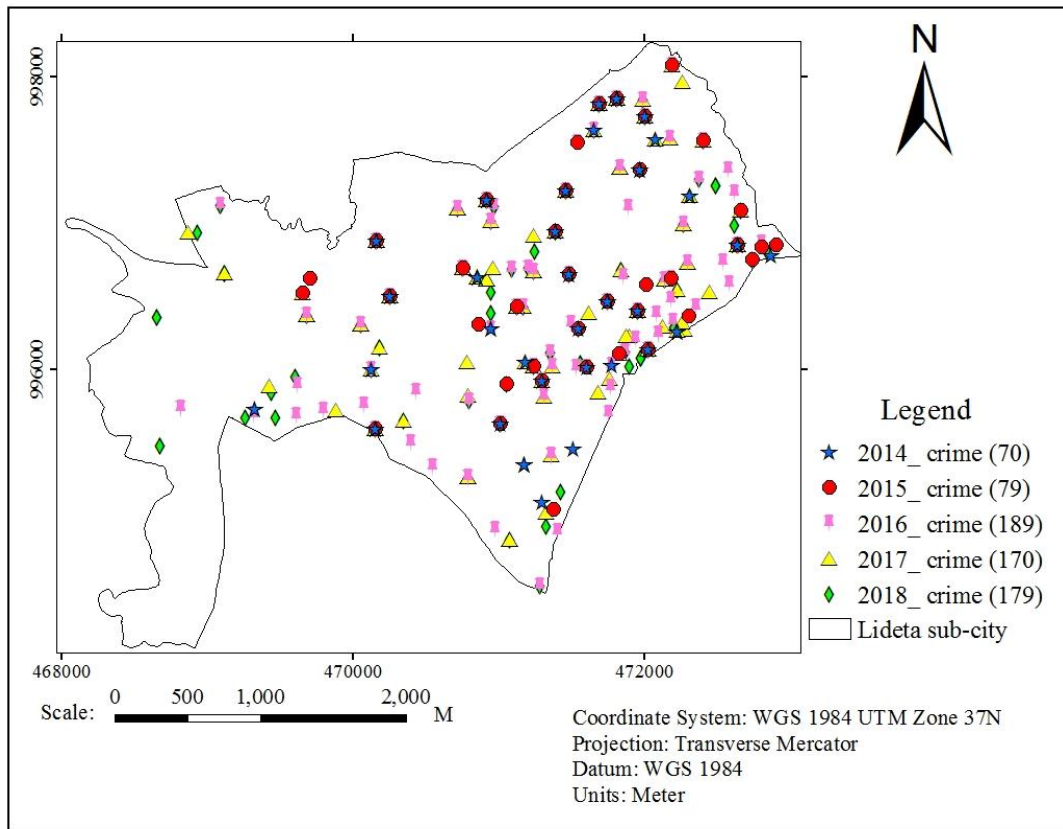


Figure 3: Property crime distribution map (2014-2018) (*Source*: Own data survey June, 2019)

Property crime distribution is high in the southern, central, northern and western part of the study area. However, as can be seen in Figure 3, the eastern part of the study area is almost safe from property crime. According to the key informants the main reasons for this are availability of defense camp and international organizations (e.g., African Union) in this part of the study area.

#### 4.1.1. Property crime pattern (2014-2018)

In order to display the distribution and spatial pattern of property crime in the study area we used point pattern analysis because it is ideal to compare and describe patterns. In line with this, O'Sullivan and Unwin (2003), Bivand et al., (2008) and Cressie (2015) argue that a point pattern analysis is suitable for crime mapping because it clearly shows the locations of crimes within a bounded region.

The property crime committed in the year 2014 shows high distribution density in the central, western and north-western part of study area (Figure 4(a)). In eastern part of the study area property crime pattern is low due to the defense force camp area and availability. On the other hand, in 2016 property crime pattern is high in southern, central and north-western part of the study area (Figure 4(b)). In 2017 and 2018 the pattern of property crime was distributed in central, western, northern and some southern part the study area.

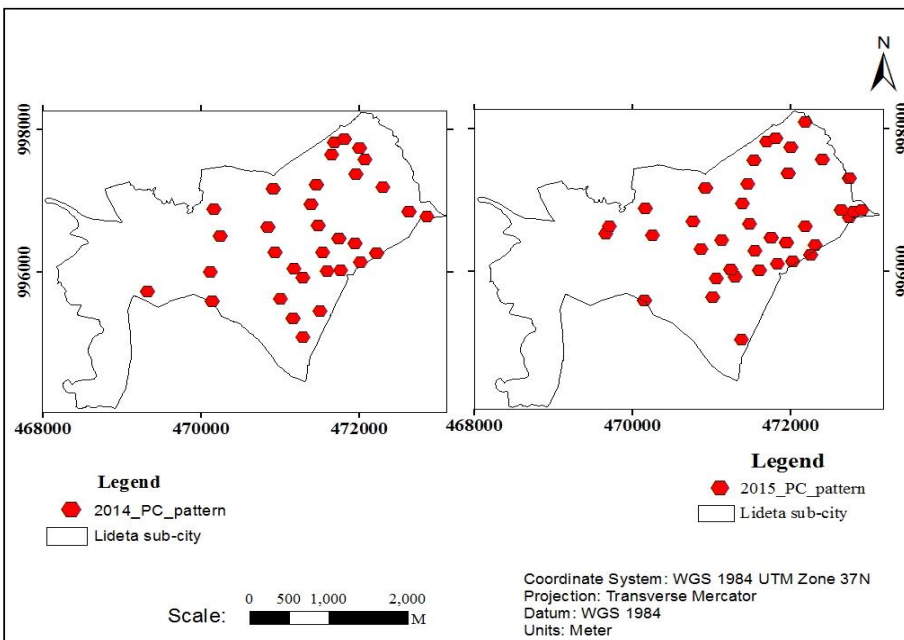


Figure 4(a): Property crime pattern of 2014 and 2015 (Source: Own data survey June, 2019)

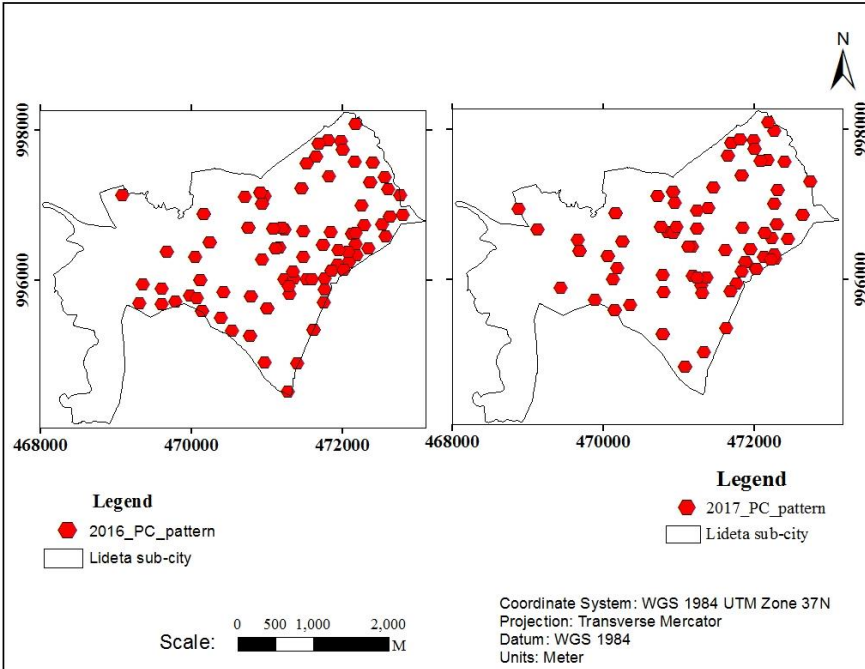


Figure 4(b): Property crime pattern of 2016 and 2017 (Source: Own data survey June, 2019)

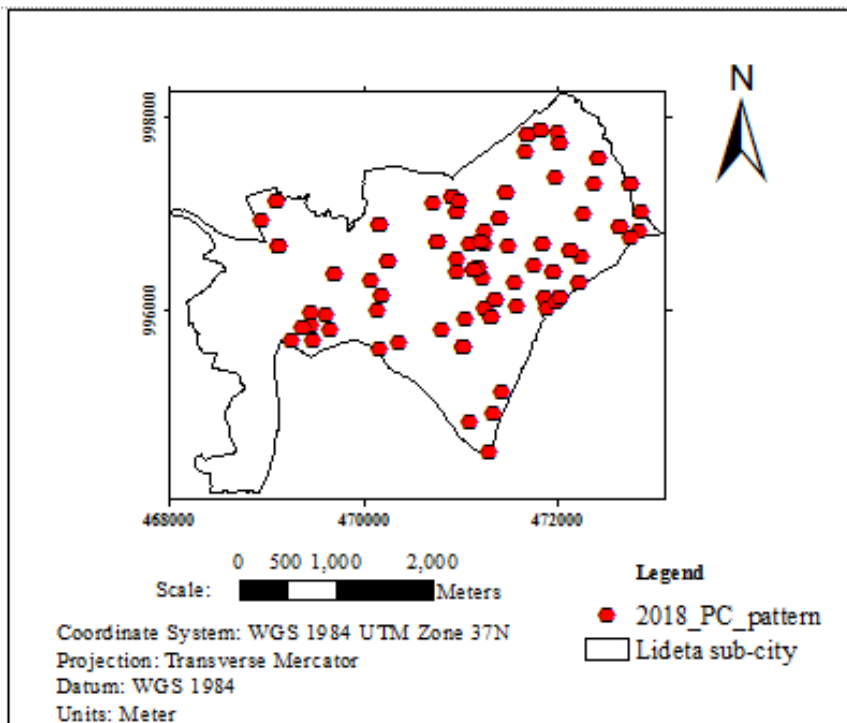


Figure 4(c): Property crime pattern of 2018 (Source: Own data survey June, 2019)

The trend shows that in the study area property crime record increases through time (see Annex 4 and 5). Between the year 2014 to 2018, property crime pattern was high in the northern, southern, and central part of the study. It was quite different from time to time and place to place. High pattern density occurred in 2016, followed by 2017 and 2018.

The result also shows that high property crime rate was recorded in 2016 followed by 2017 and 2018 (Table 1) and Figure 4(a), (b) and (c). The highest rate is 89 recorded in 2016 and the lowest is 34 recorded in 2014. In the study area, the occurrence as well as the trend of property crime is increased after 2015. Although the trend of property crime increased from time to time, its spatial density was different across the study area. For example, the density was very high in northern, central and north western than the other parts of the study area. The central part of the study area has highest crime distribution, followed by north-west and northern.

Table 1: Lideta sub-city property crime record (2014 to 2018) (N=687)

Year	Crime /years.	No crime record	Total record	Population	Crime rate
2014	70	31	103	214769	33.5
2015	79	43	122	214769	36.8
2016	189	20	210	214769	88.5
2017	170	30	200	214769	79.2
2018	179	24	203	214769	83.3

*source: Lideta police station crime record*

Between 2014 and 2015, property crime slightly increases, whereas from 2015 to 2018 property crime increased highly in the study area (Table 1).

The difference of spatial extent and time variation determine the occurrence of property crime. The signature of the crime varies in place and time based on different factors and extents. In spatial-temporal crime pattern analysis, the problem is how to identify patterns from the dynamic interplay between space, time and crime (Leong & Sung, 2015).

#### 4.1.2. Seasonal pattern of property crime

##### 4.1.2.1. Seasonal property crime pattern in 2018

Property crime is not distributed similarly in different seasons. In Lideta sub-city the property crime distribution varies from season to season. As can be seen in Figure 5(a) and (b), during summer and winter season a total of 94 amount of crime (47 in summer and 47 in winter) property crimes were committed in the study whereas, during autumn and spring season 43 and 42 property crime were committed respectively.

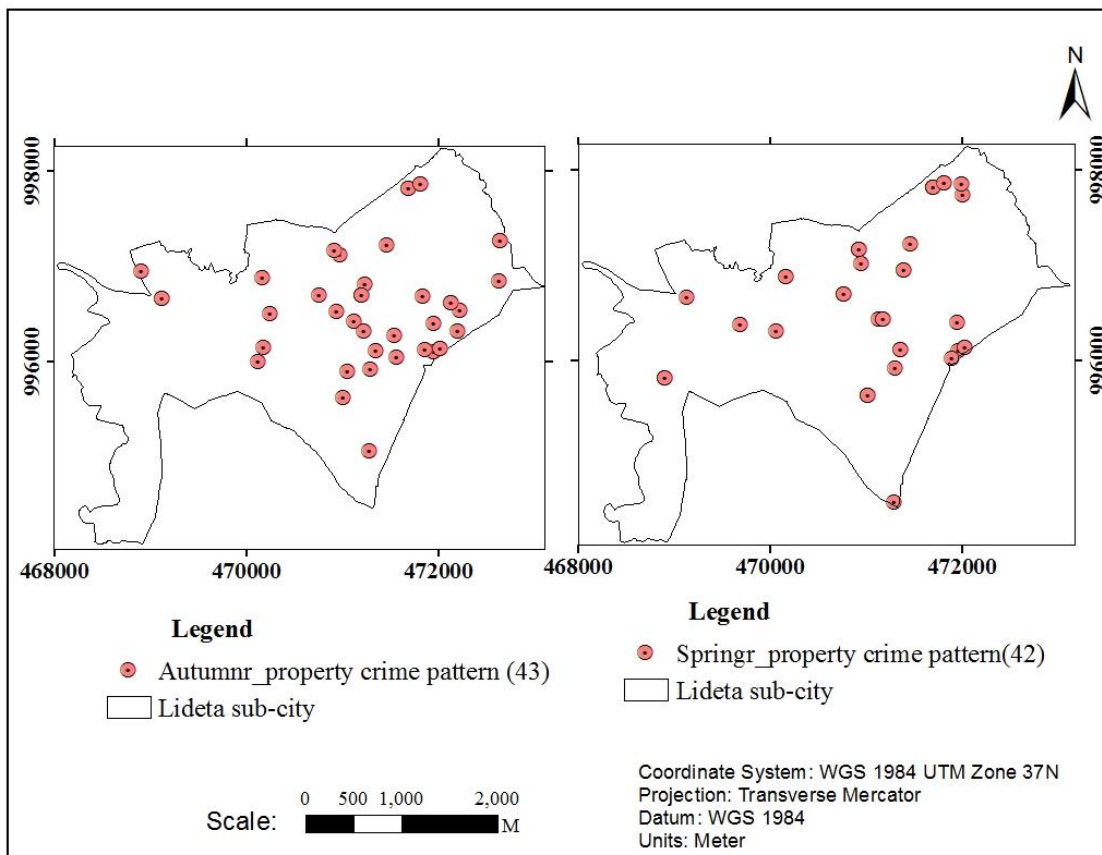


Figure 5(a): Seasonal property crime pattern of 2018 (*Source: Own data survey June, 2019*)

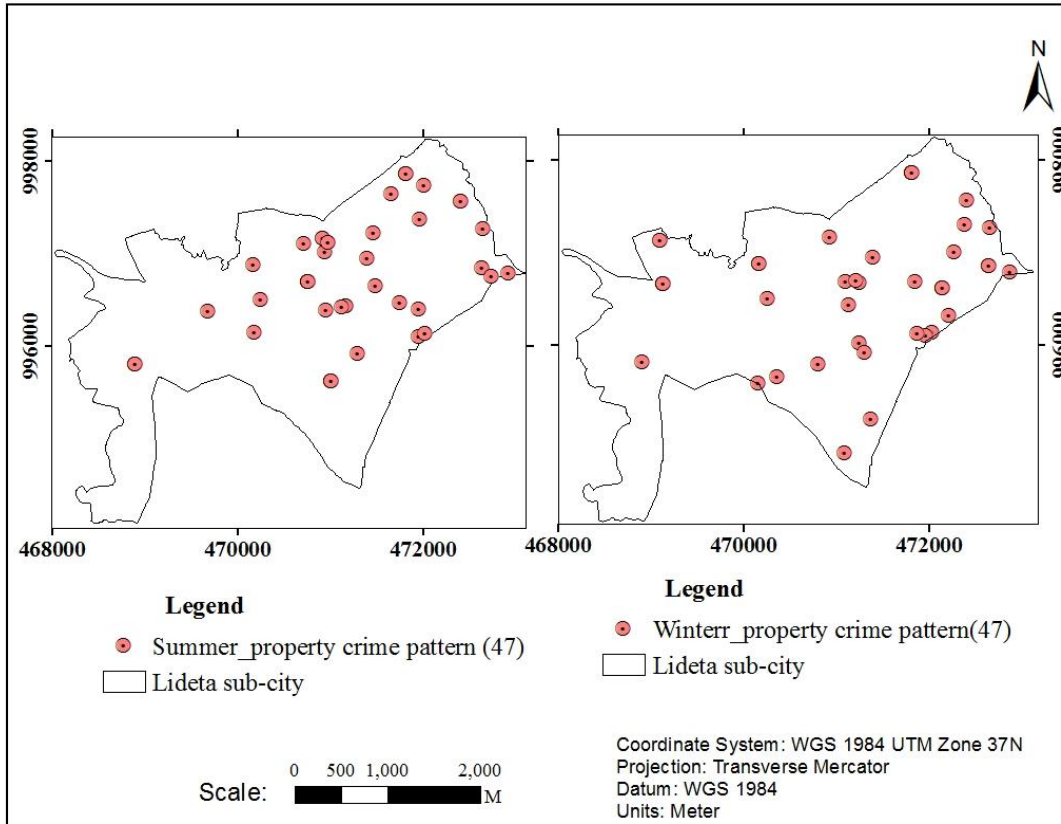


Figure 5 (b): Seasonal property crime pattern of 2018 (*Source: Own data survey June, 2019*)

The distribution of property crime is varying throughout the season with some value. But the pattern is high at the central part of the study area in all season. This is due to high commercial center and lack of street light. In autumn season the heterogeneity of place on the occurrence of crime is high. During summer, winter and spring property crime distribution is almost occur in homogeneous places.

Crimes are not evenly distributed over space, and possible clusters of crime can be detected when large concentrations of incidents are present in a certain limited space. For the investigation of the homogeneity of spatial point patterns for different seasons of the year, spatial crime patterns must be employed.

#### 4.1.2.2. Seasonal property crime pattern in 2017

In the year 2017, 53, 34, 51 and 32 crimes were record in summer, spring, autumn and winter seasons respectively. High property crime pattern and distribution was found in summer and autumn season of the year. According to the key informants property crime high in summer due to power fluctuation and weather factor.

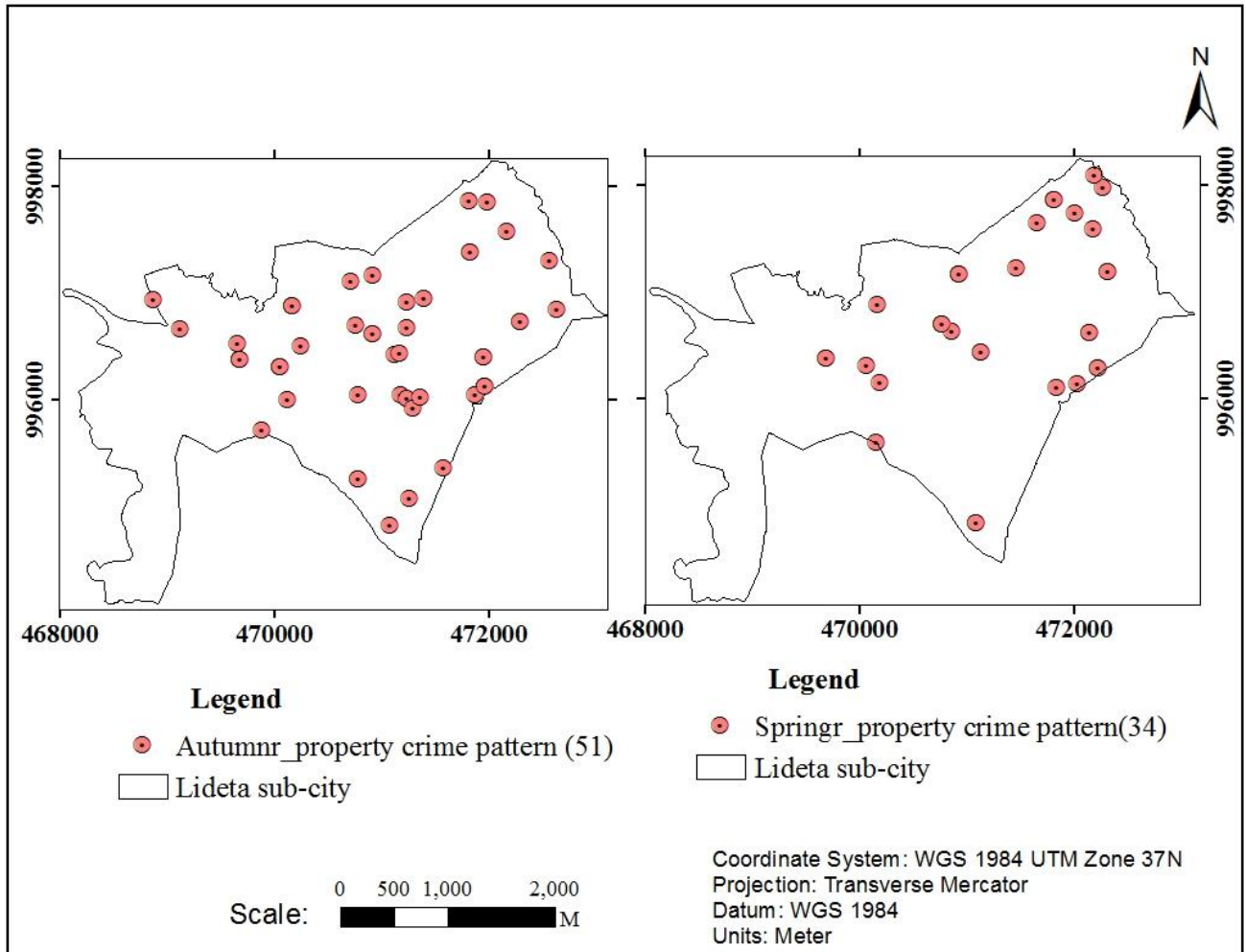


Figure 6 (a): Seasonal property crime pattern of 2017 (Source: Own data survey June, 2019)

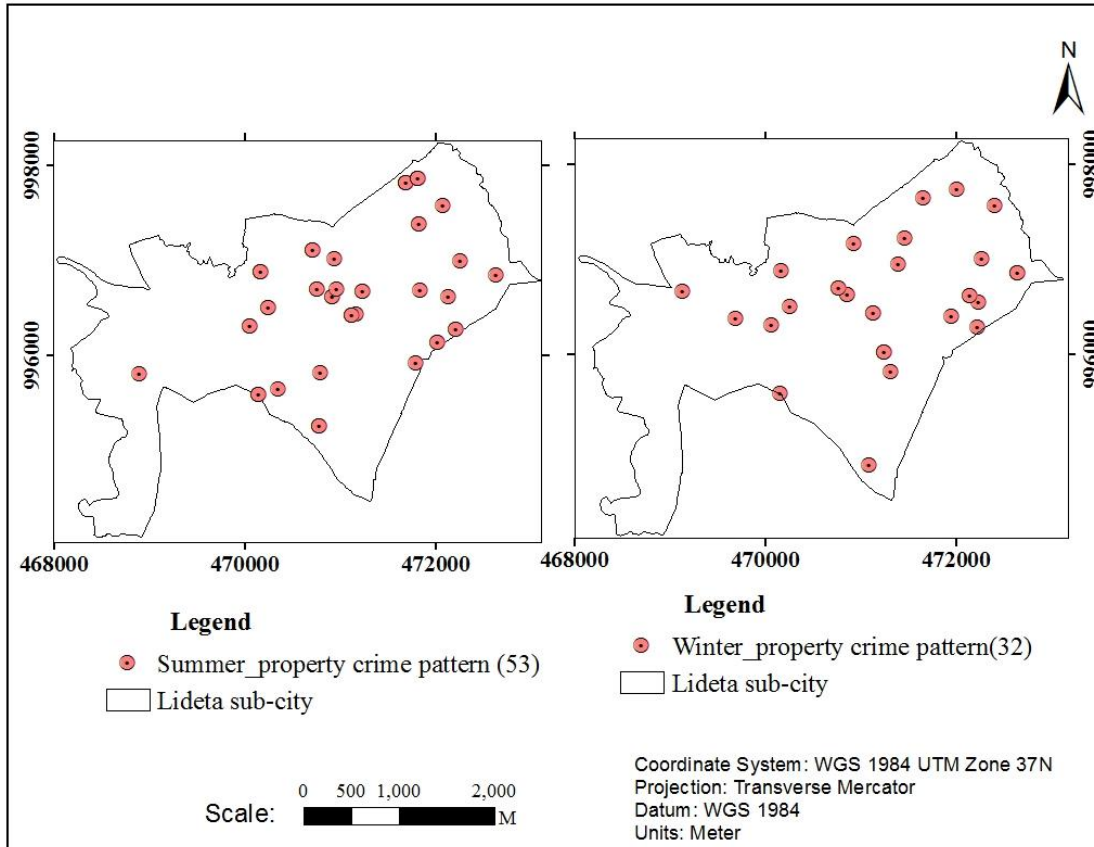


Figure 6(b): Seasonal property crime pattern of 2017 (*Source: Own data survey June, 2019*)

During 2017 seasonal property crime distribution is high in summer followed by autumn, spring and winter. As shown in Figure 6, property crime distribution is high in central part of the area in summer and autumn season. In spring and winter season the pattern of property crime was high in the north and evenly distributed in all parts of the area.

Property crime spatial events generally are not distributed evenly across the study area. They cluster in some areas and are absent in others. Similarly, Lim et al (2014) and Brantingham et al (2009) reported that crime can form very different patterns at different scales.

#### 4.1.2.3. Seasonal pattern of property crime in 2016

In 2016, 68, 59, 35 and 27 crimes record in spring, summer, winter and autumn respectively (Figure 7(a) and (b)). High property crime pattern and distribution was found in spring and summer season of the year.

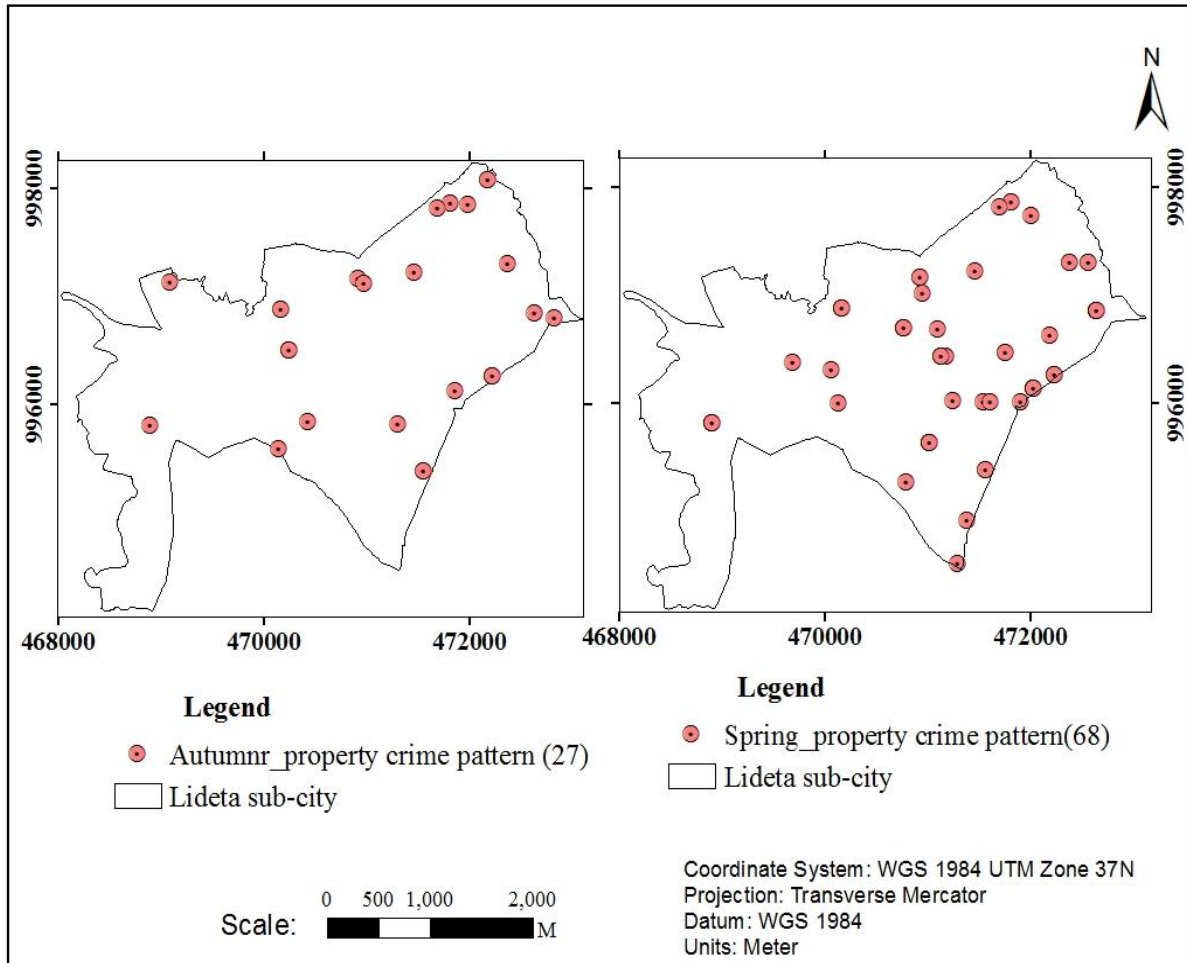


Figure 7(a): Seasonal property crime pattern of 2016 (Source: Own data survey June, 2019)

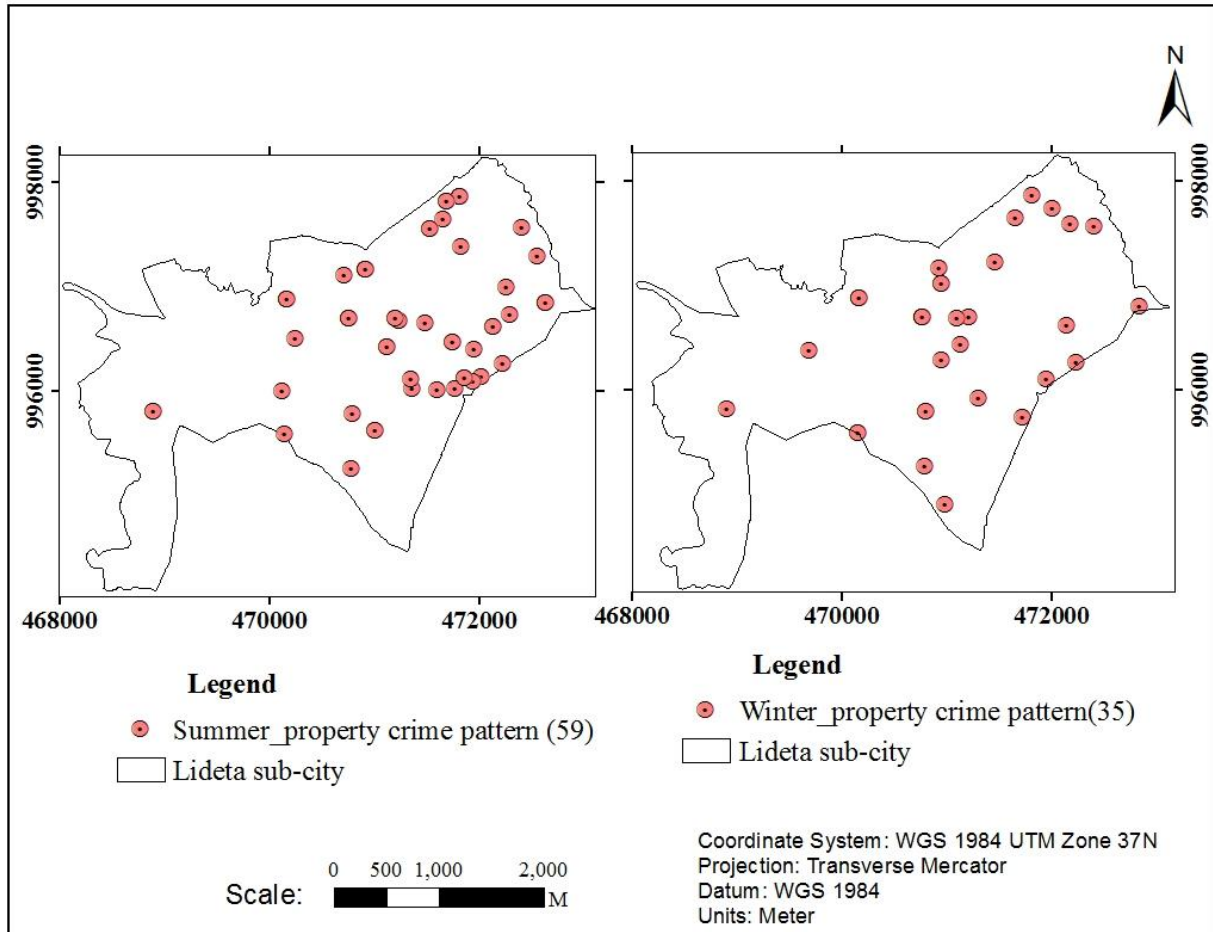


Figure 7 (b): Seasonal property crime pattern of 2016 (*Source: Own data survey June, 2019*)

During 2016, seasonal property crime distribution is high in spring followed by summer, winter, and autumn. Property crime distribution is high in northern, central and southern at summer, in central, northern, southern and western at spring, in northern and some part of southern at autumn and in northern and central part of the study area at winter (Figure 7(a) and (b)). Property crime spatial events generally are not distributed evenly across the study area. They cluster in some areas and are absent in others.

Generally, spring and summer season is the highest crime occurrence season, and the northern and central part of the study area practiced high crime pattern and distribution.

#### 4.1.2.4. Seasonal pattern of property crime (2015)

In 2015, 22, 18, 19 and 20 crimes occur during summer, autumn, spring and winter respectively (Figure 8 (a) and (b)). High property crime pattern and distribution was found in summer and winter.

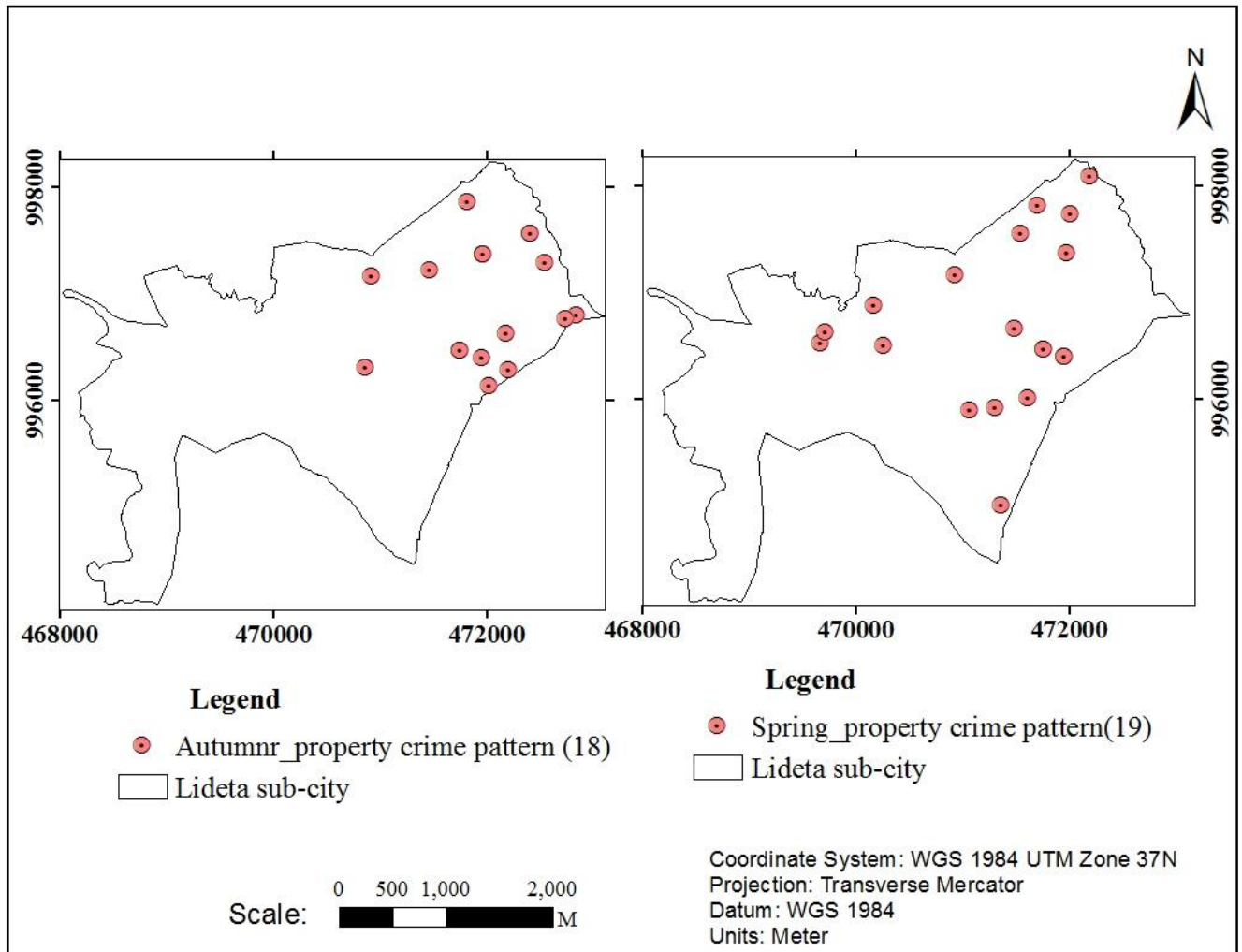


Figure 8(a): Seasonal property crime pattern of 2015 (Source: Own data survey June, 2019)

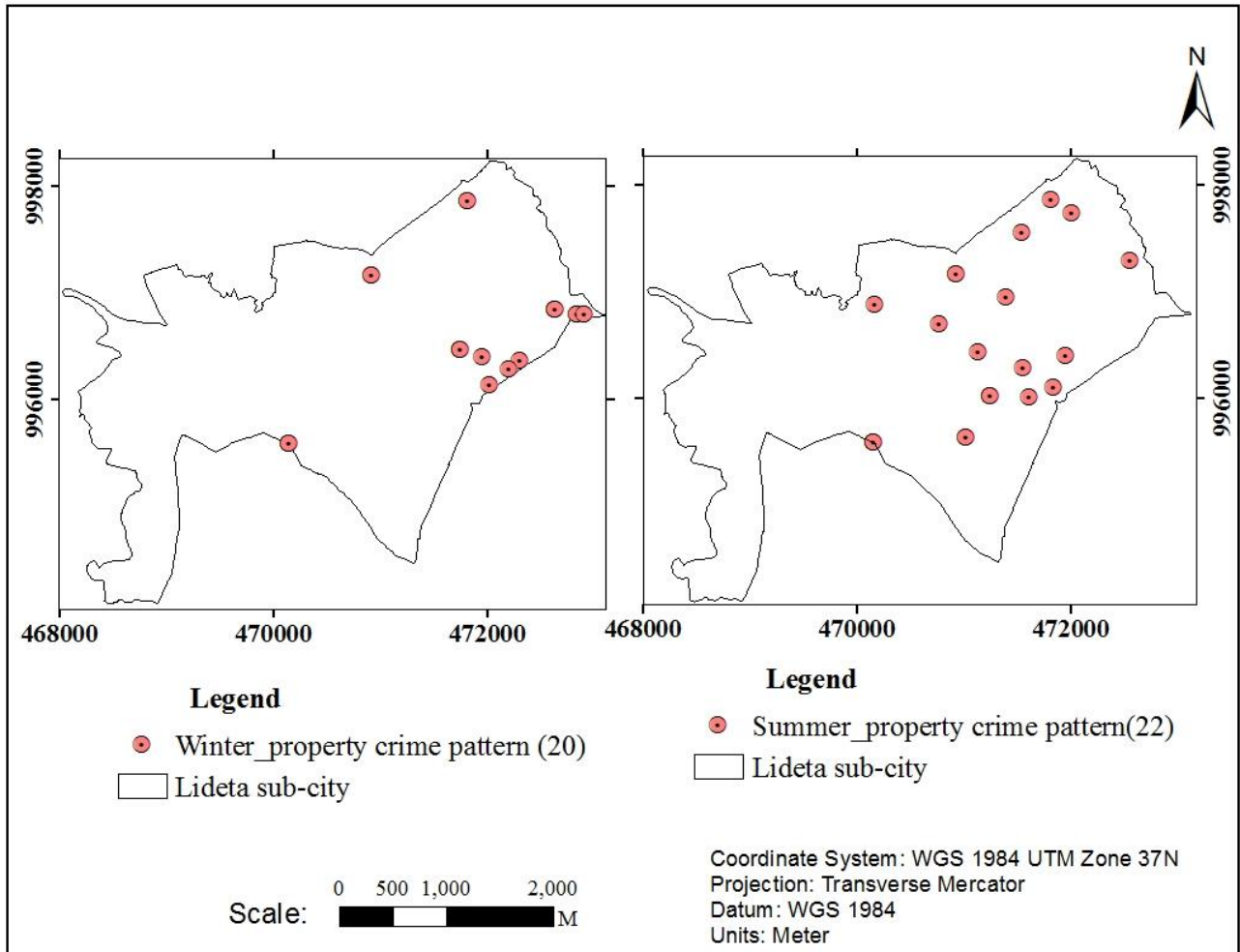


Figure 8(b): Seasonal property crime pattern of 2015 (*Source: Own data survey June, 2019*)

During 2015, property crime pattern is high in winter and summer season followed by spring and autumn. Except winter the other seasons high property crime distribution was found in northern and central part of the study area.

#### 4.1.2.5. Seasonal pattern of property crime (2014)

In 2014, 22, 7, 19 and 22 crimes were committed during autumn, summer, spring and winter respectively (Figure 9(a) and (b)). High property crime pattern and distribution was found in autumn and winter.

During 2014, seasonal property crime distribution is high in autumn and winter followed by spring and summer (Figure 9). As shown in Figure 9 summer and autumn is a high pattern of property crime. Winter is less crime severe season during 2014.

Generally, season determine the crime occurrence rate in the study area. As shown in the year 2018 (Figure 5), 2017 (Figure 6), 2016 (Figure 7), 2015 (Figure 8) and 2014 (Figure 9) the pattern of property crime shows high in summer followed by autumn and spring. From 2014 - 2018 the highest property crime pattern location in these five years were located in central, northern and north western of the study area. From five-year seasonal property crime pattern eastern part is low distribution.

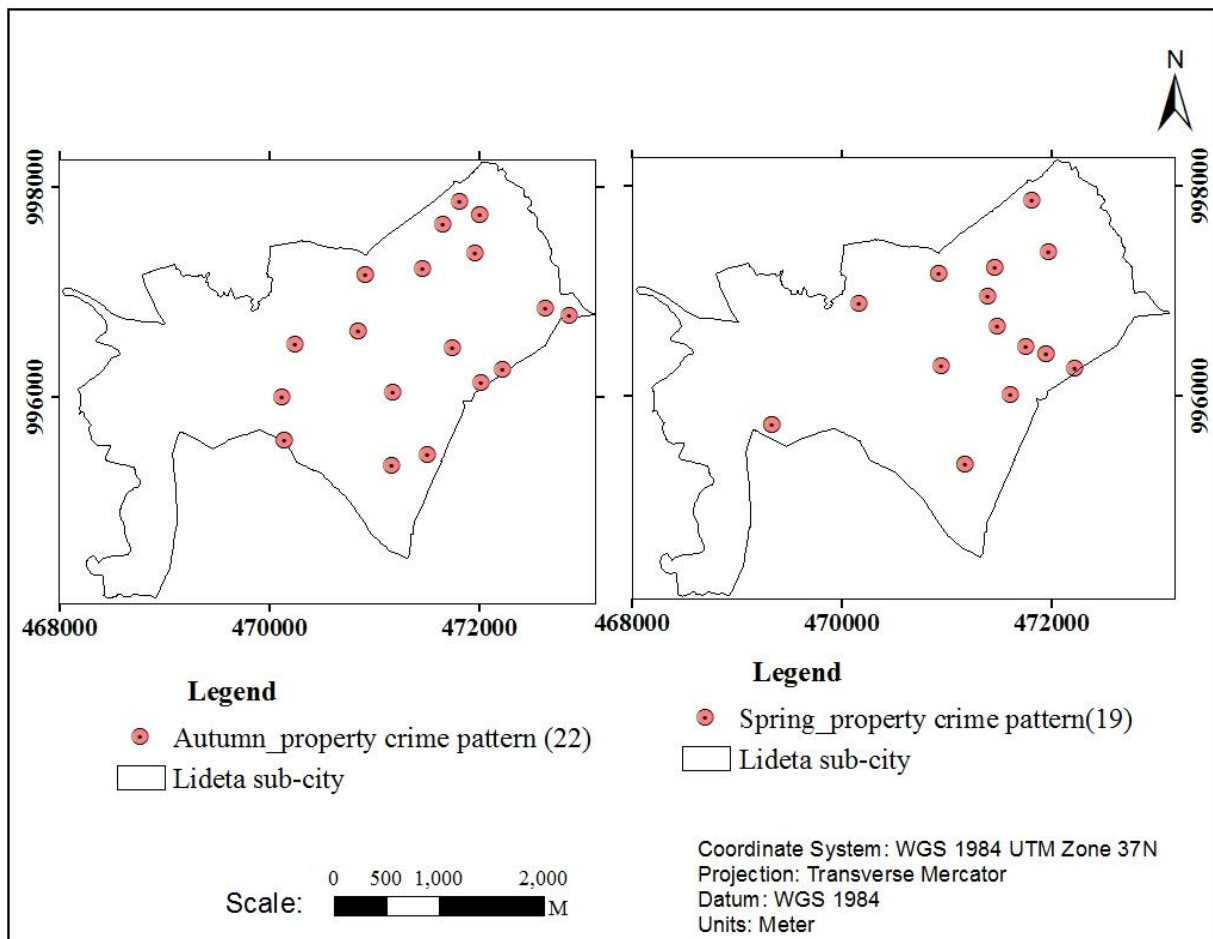


Figure 9(a): Seasonal property crime pattern of 2014 (Source: Own data survey June, 2019)

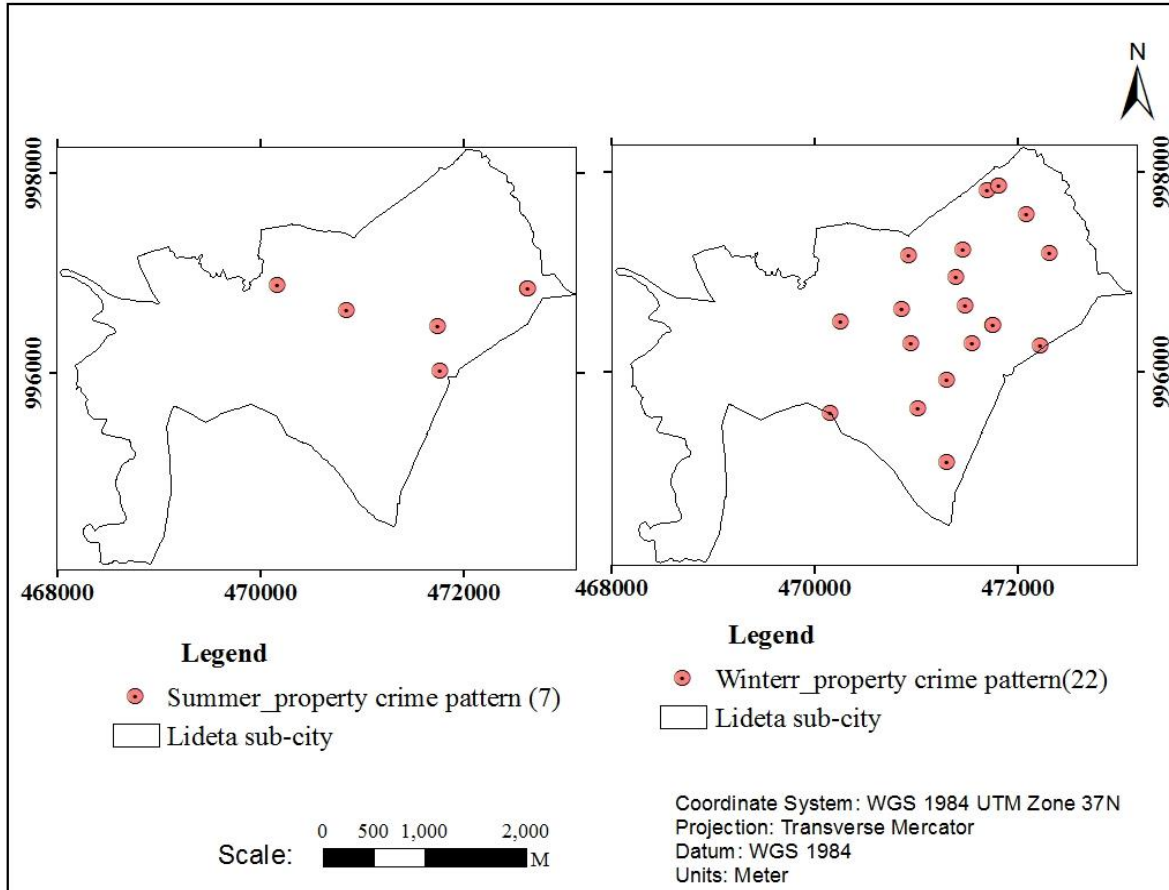


Figure 9(b): Seasonal property crime pattern of 2014 (*Source: Own data survey June, 2019*)

As shown in Figure 9, property crime is high in central and northern part of the area in all seasons. Eastern part of the study has less distribution. Crimes are not evenly or randomly distributed in an urban area, rather crimes are dense in some regions and sparse in others. Similarly, Marzan & Baculo (2017) reported that crime distribution over an area varies in different level of crime rate.

The key informants reported that during summer season crime occurrence rate was increased due to the weather condition, power fluctuation, some street children need to jail and high unemployment rate (freeze of construction and daily work).

## **4.2. Property crime hotspot analysis**

The location where a crime occurs is crucial but much more important is the characteristic of those places and the environment in which the crime takes place. A hotspot is a condition indicating some form of clustering in a spatial distribution (Eck, 2005). There is no universal or national standard numerical threshold that can be used to define the number of crimes that need to have occurred in an area (Sivaranjani,2016). Hotspots are relative to the area under study. Hotspot represents an area of high crime concentration, relative to the distribution of crime across the whole region of interest. For spatial analysis the collected data was plotted with the help of police record of location where the crime take place. The analysis of data reveals a hotspot in Lideta sub-city.

#### 4.2.1. Annual property crime hotspot analysis (2014 to 2018)

Lideta sub-city property crime hotspot area of 2014 is mapped (Figure 10). The map shows that in hotspot and low crime areas the crime occurrence frequency was six and one respectively. The dark red and green indicates the crime sever and safer area respectively.

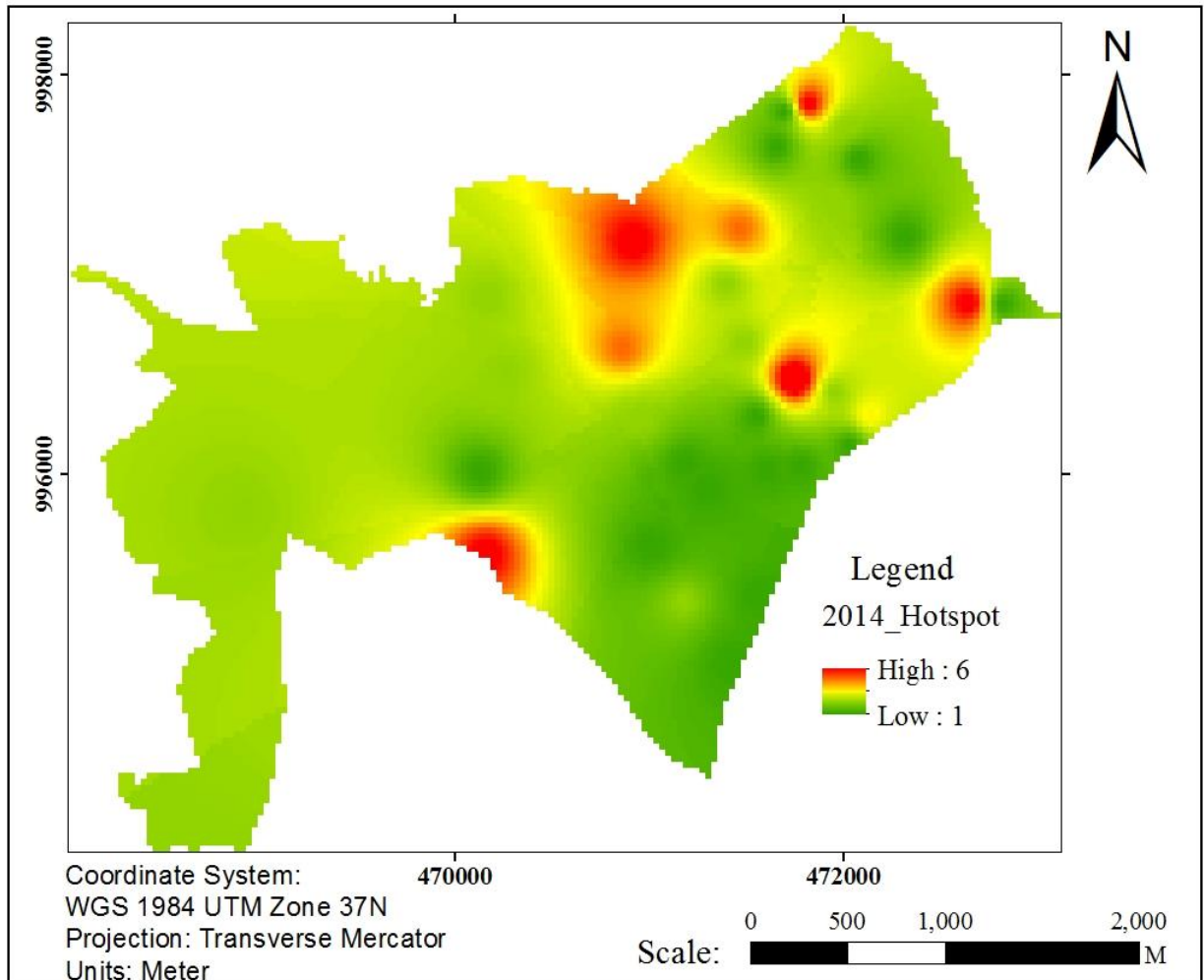


Figure 10: Property crime hotspot map of 2014 (Source: Own data survey June, 2019)

In 2014, property crime was severe in the northern, north-western and central part of the study whereas, the southern and western parts of the study area was relatively safe. However, it does not mean that the area is free from crime. Generally, the hotspot located at the places of commercial centers, some open spaces, and rivers (see Annex 10).

As shown in Figure 11, Lideta sub-city property crime hotspot area of 2015 is mapped. The map shows that in high and low crime hotspot area the crime occurrence frequency was seven to one respectively. Dark red and green indicates sever and safer area respectively.

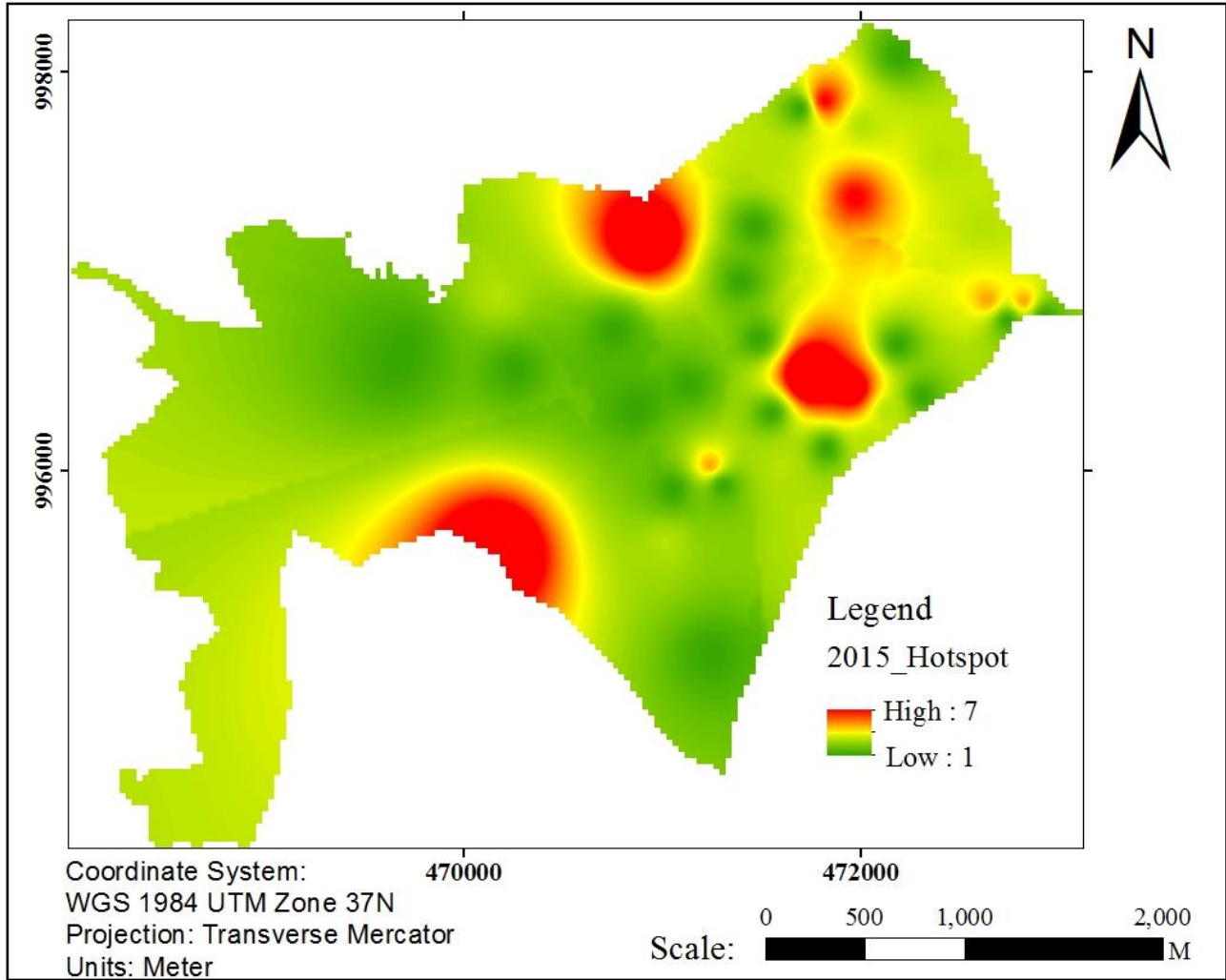


Figure 11: Property crime Hotspot map of 2015 (Source: Own data survey June, 2019)

In 2015, property crime was severe in northern, north-western and southern part of the study whereas, central, north eastern and some part of western areas was relatively safer. That is why crime put their figure print in specific place and used for different analysis.

As shown in Figure 12, Lideta sub-city property crime hotspot area of 2016 is mapped. The map shows that in hotspot and low crime area the crime occurrence frequency was twelve and one respectively. The dark red and green indicate the crime severe and safer area respectively.

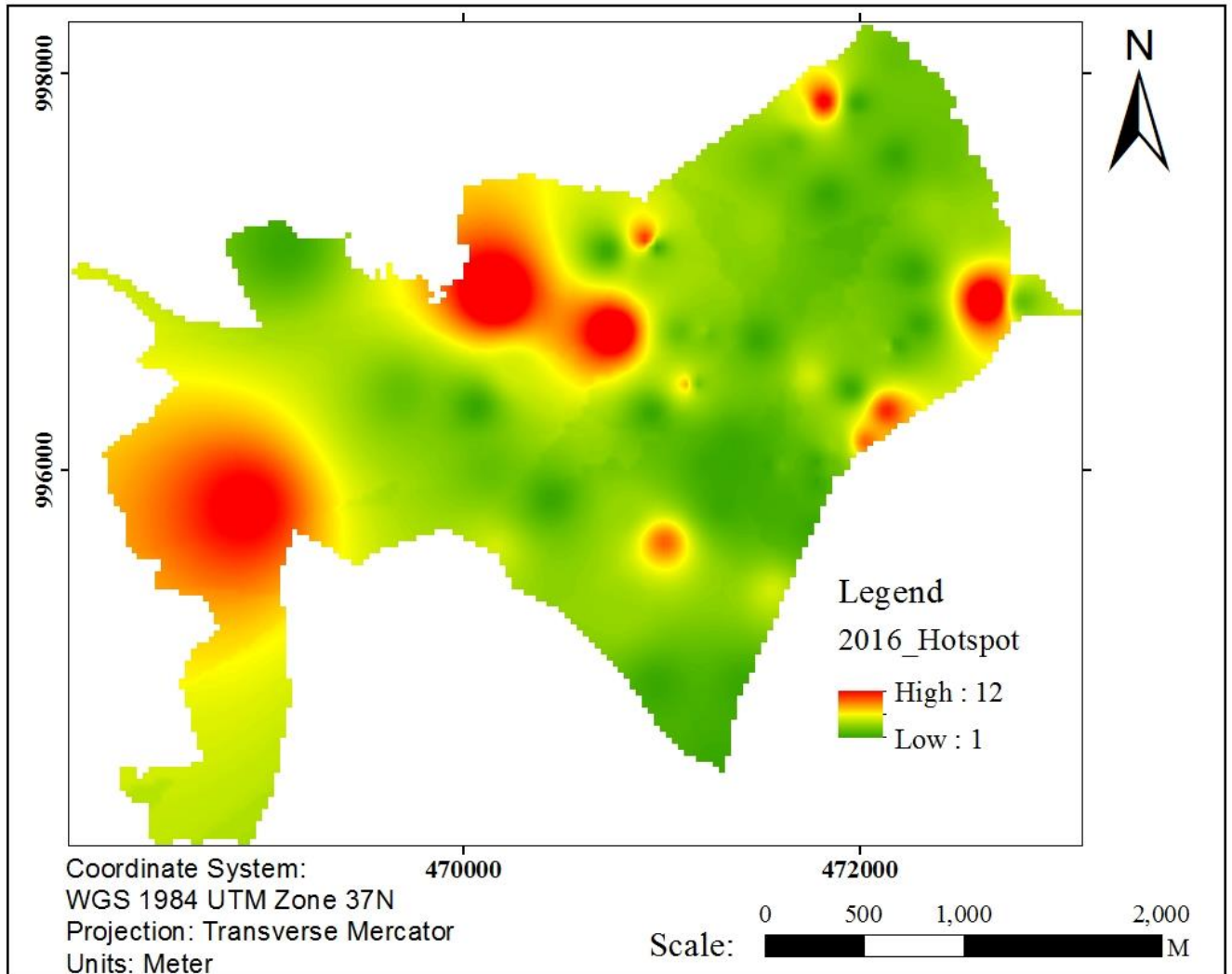


Figure 12: Property crime Hotspot map of 2016 (*Source: Own data survey June, 2019*)

In 2016, property crime was severe in northern and eastern part of the study whereas the central, some southern and western parts of the study area relatively safe. But it doesn't mean that those areas are fully free from crime. From crime safer area one crime record were committed, this indicates there is no crime free area rather the amount of crime committed may varies.

As shown Figure 13, Lideta sub-city property crime hotspot area of 2017 is mapped. The map shows that in hotspot and low crime area the crime occurrence frequency was ten and one respectively. The dark red and green indicates the crime severe and safer area respectively.

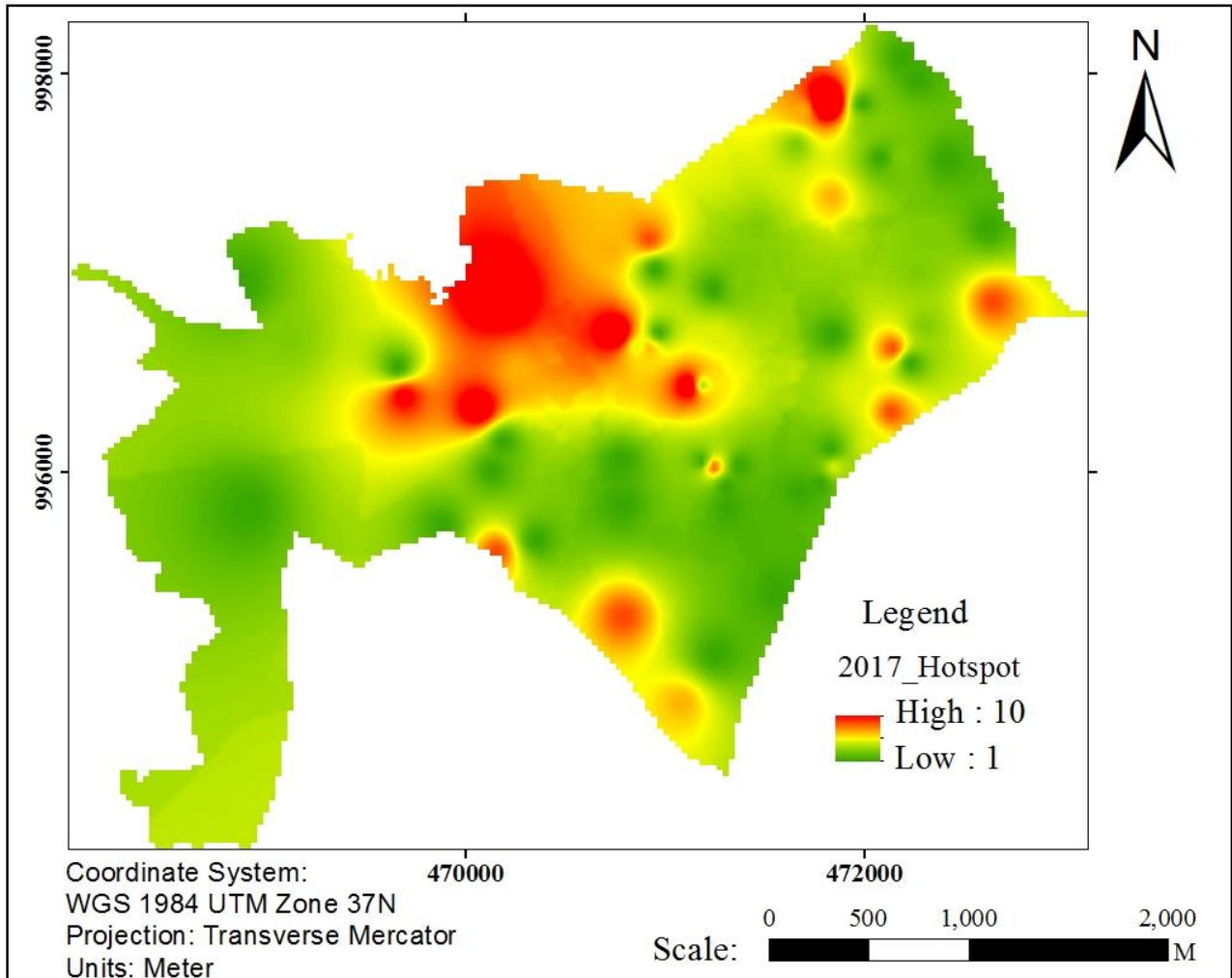


Figure 13: Property crime Hotspot map of 2017 (*Source: Own data survey June, 2019*)

In 2017, property crime was severe in the northern and central part of the study whereas, some northern, eastern and southern part of the study area was relatively safer. Such, hotspot areas are commercial centers. In addition, in my field observation the place has not street light.

As shown Figure 14, property crime hotspot area of 2018 is mapped. The map shows that in hotspot and low crime area the crime occurrence frequency was twelve and one respectively. The dark red and green indicates the crime sever and safer area respectively.

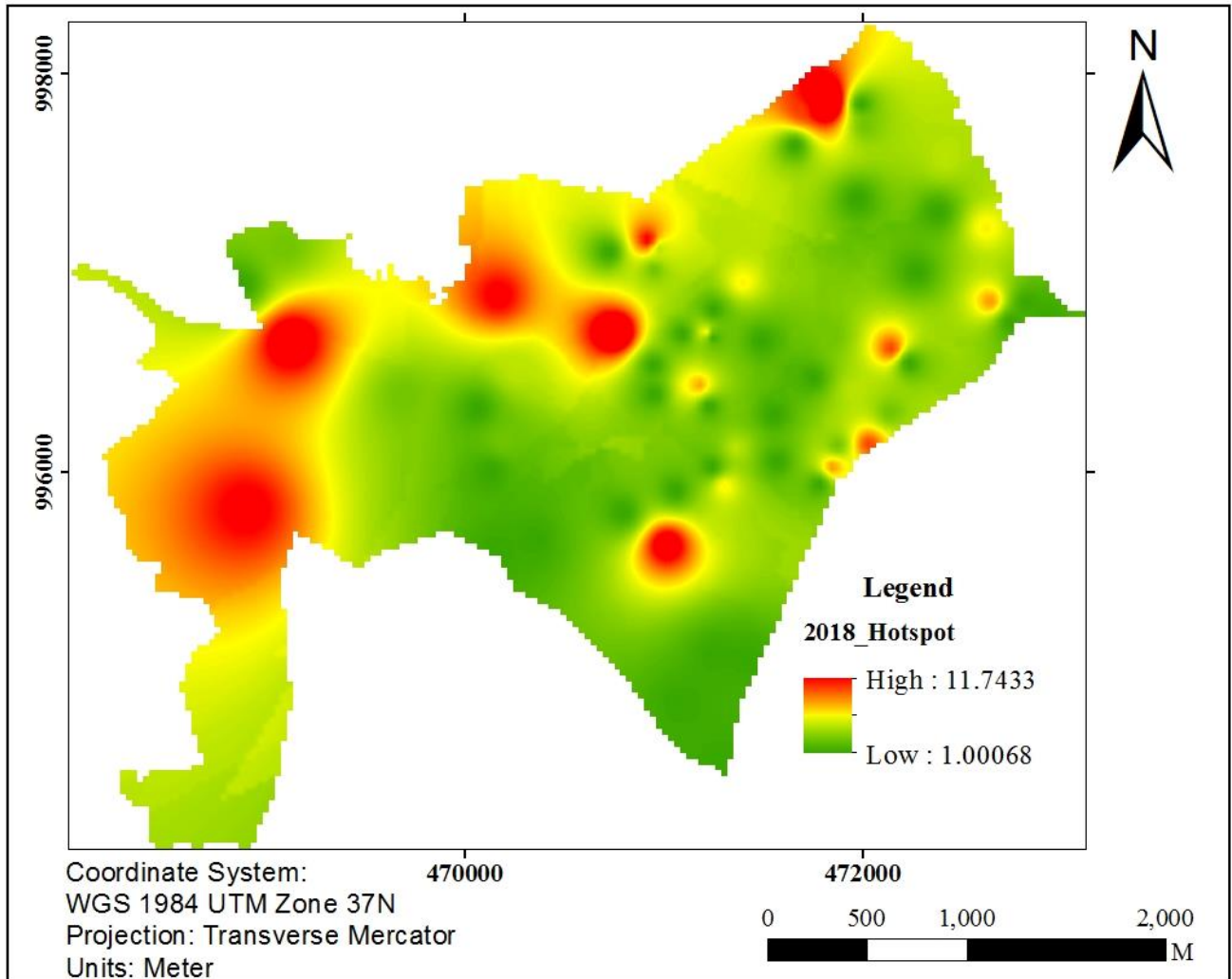


Figure 14: Property crime Hotspot map of 2018 (*Source: Own data survey June, 2019*)

In 2018, property crime was severe in the eastern, northern and north western part of the study whereas the central, some western and southern part of the study area was relatively safe. Similarly, Gonzales.et al, (2018) reported that crime hotspot areas located with different scale.

#### 4.2.2. Property crime type hotspot analysis

##### 4.2.2.1. Looting crime hotspot (2014 to 2018)

The hotspot area of looting is presented in Figure 15(a), (b) and (c) in which dark red and green color indicates high and low crime hotspot area respectively. The highest and lowest values of the hotspot area were 3 to 1 (2014), 2 to 1 (2015), 4 to 1 (2016), 2 to 1 (2017) and 5 to 1 (2018).

In 2015, the north-western parts practice high looting crime, whereas central, eastern, southern and some part of northern have low crime hotspot area. In 2016 and 2018 looting crime was severe in the northern part of the study whereas it was low in central, western, eastern and southern part of the study. In 2017, looting crime was high in eastern and some northern part whereas it was low in the southern, western and central of the study area.

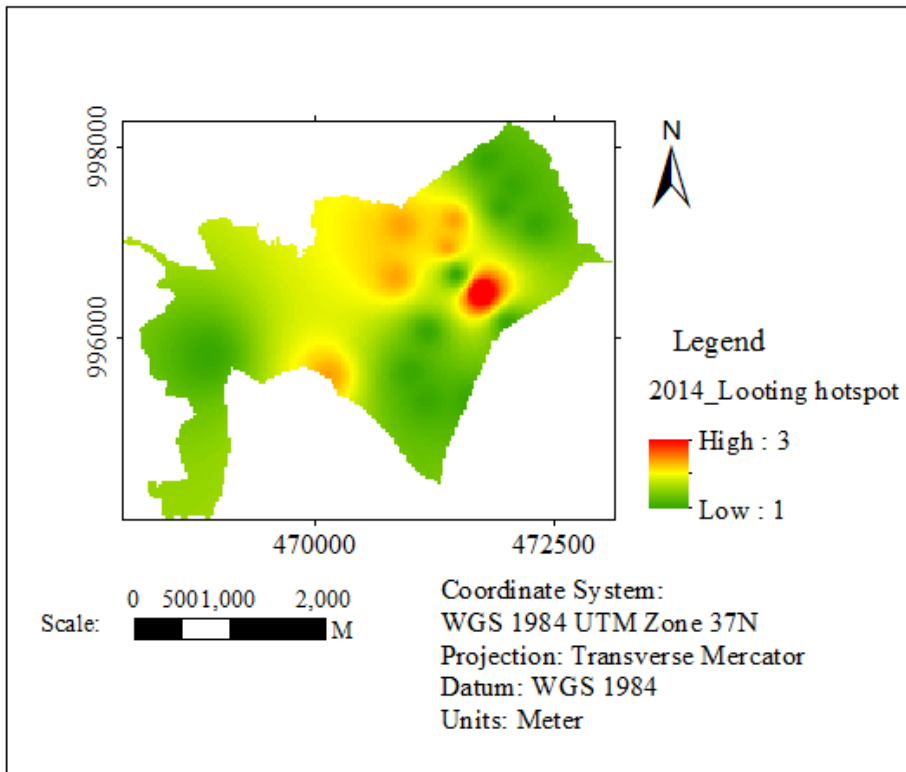


Figure 15(a): Looting hotspot map of 2014 (*Source: Own data survey June, 2019*)

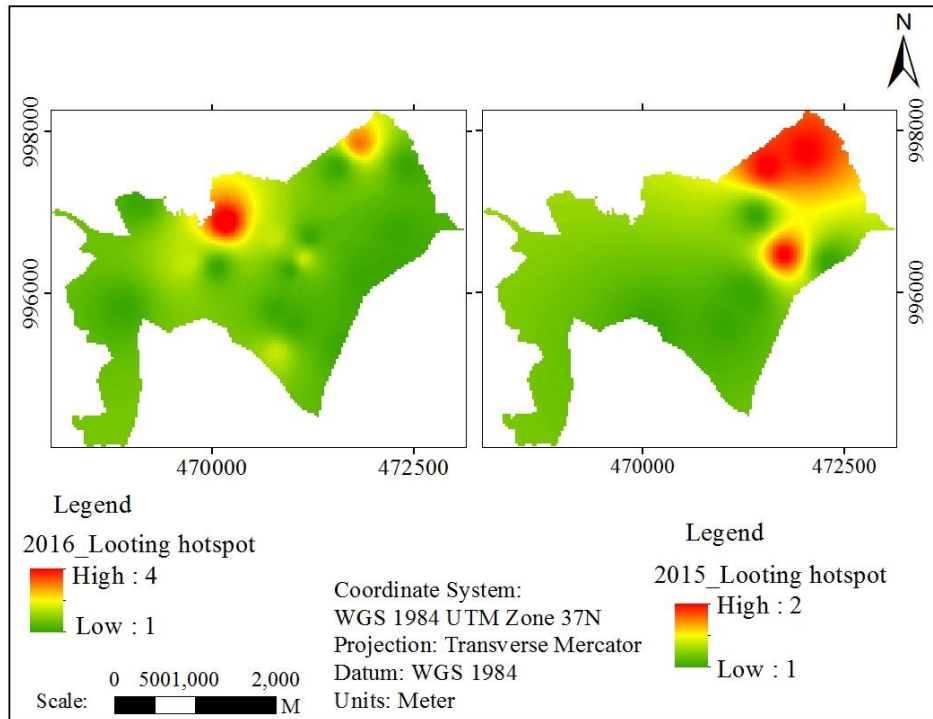


Figure 15(b): Looting hotspot map of 2015 and 2016 (Source: Own data survey June, 2019)

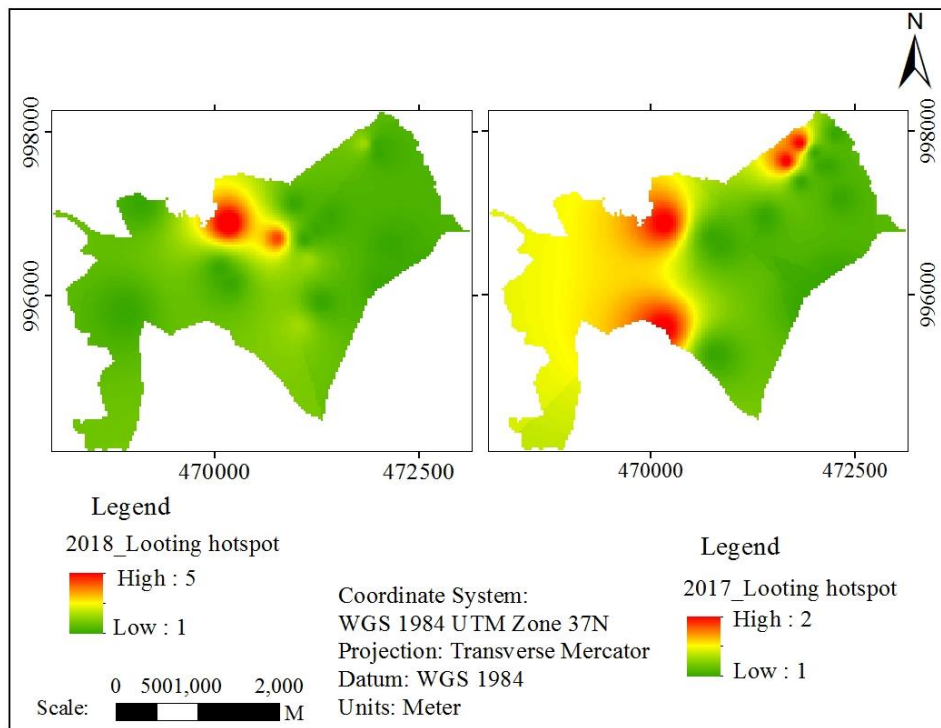


Figure 15(c): Looting hotspot map of 2018 (Source: Own data survey June, 2019)

In 2014 the northern and north western parts of the study have high crime hotspot area. In 2014, looting crime safer areas located in the northern, southern and eastern and western part of the area.

Generally, looting was severe in central, north western, northern, central and north eastern parts of the study area in 2014, 2015, 2016, 2017 and 2018 respectively. The southern part of the study area is safe through the years. The northern part of the study is especially high looting hotspot area. In my observation norther part of the area is downtown of the study area.

#### 4.2.2.2. Misappropriation hotspot (2014 to 2018)

The hotspot area of misappropriation is presented in Figure 16 (a), (b) and (c) dark red and green indicates high and low crime hotspot area respectively. The highest and lowest values of the hotspot area were 4 to 1 (2014), 2 to 1 (2015), 5 to 1 (2016), 4 to 1(2017) and 5 to 1 (2018).

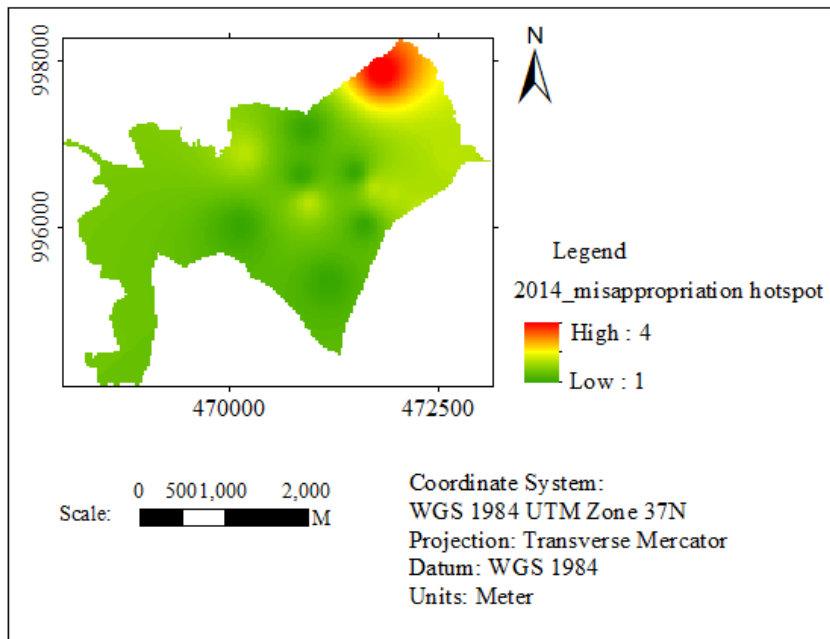


Figure 16(a): Misappropriation hotspot map of 2014 (*Source: Own data survey June, 2019*)

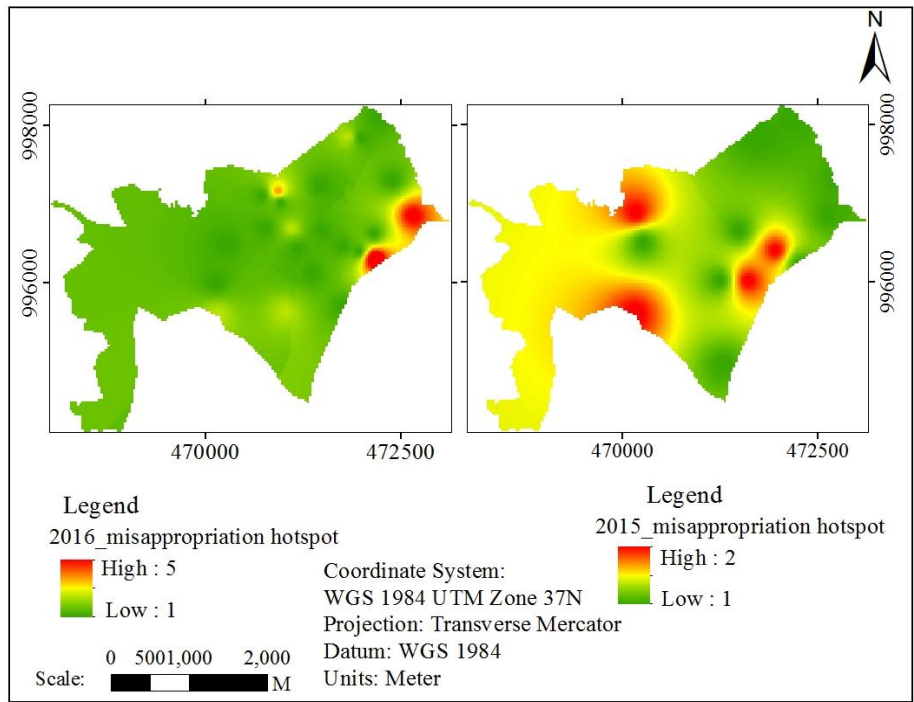


Figure 16(b):2015 and 2016 misappropriation hotspot map (Source: Own data survey June, 2019)

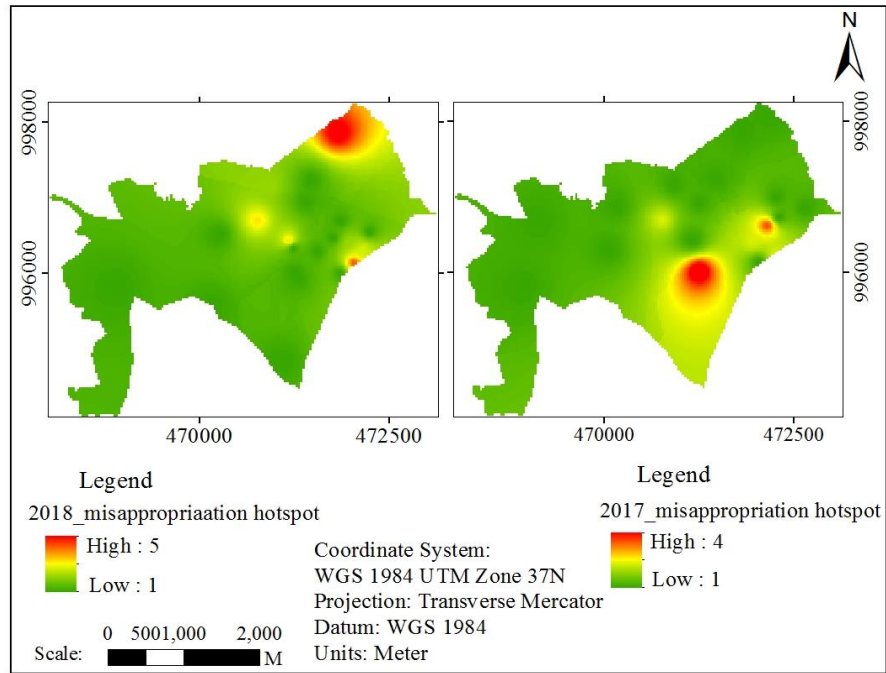


Figure16(c): Misappropriation hotspot map of 2017 and 2018 (Source: Own data survey June, 2019)

In 2014 and 2018 the northern part of the study has high crime hotspot area. In 2014 and 2018, misappropriation crime safer areas located in southern, eastern, western and central part of the study area.

In 2016 and 2017, the south western part of the study practice high misappropriation crime, whereas, northern, some southern, eastern and central part of the study area practice low crime hotspot. In 2015, misappropriation crime was high in the eastern part of the study whereas it was low in northern, central, southern and western part of the study.

Generally, misappropriation was severe in northern, eastern and south western part of the study whereas central, some southern and western part of the study area practice low misappropriation crime practice in this five year (Figure 16 (a), (b) and (c)). The northern part of the study is severe in misappropriation, whereas central, some southern and western part of the study are crime safe area throughout the year.

#### **4.2.2.3. Theft crime hotspot (2014 to 2018)**

The hotspot area of theft is presented in Figure 17 (a), (b) and (c) the highest and lowest value of the hotspot area were 17 to 1 (2014), 13 to 1 (2015), 11 to 1 (2016), 3 to 1(2017) and 2 to 1 (2018). The dark red and green indicates high and low crime hotspot area.

In 2014, 2015 and 2017, the north-western part of the study area practice high theft crime. In 2014, 2015 and 2017, theft crime safer areas located in the south-eastern, central and southern part of the study area. In 2016, some northern and eastern parts practice high theft crime whereas, western and southern parts have low crime hotspot area. In 2018, theft crime was high in western part of the study whereas, eastern, northern, southern and central part of the study have low theft crime practice.

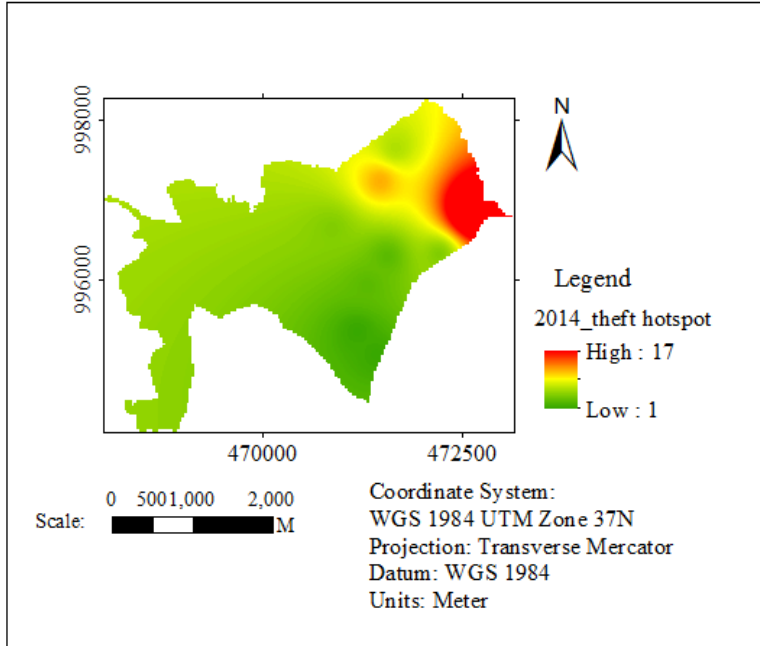


Figure 17(a): Theft hotspot map of 2014 (*Source: Own data survey June, 2019*)

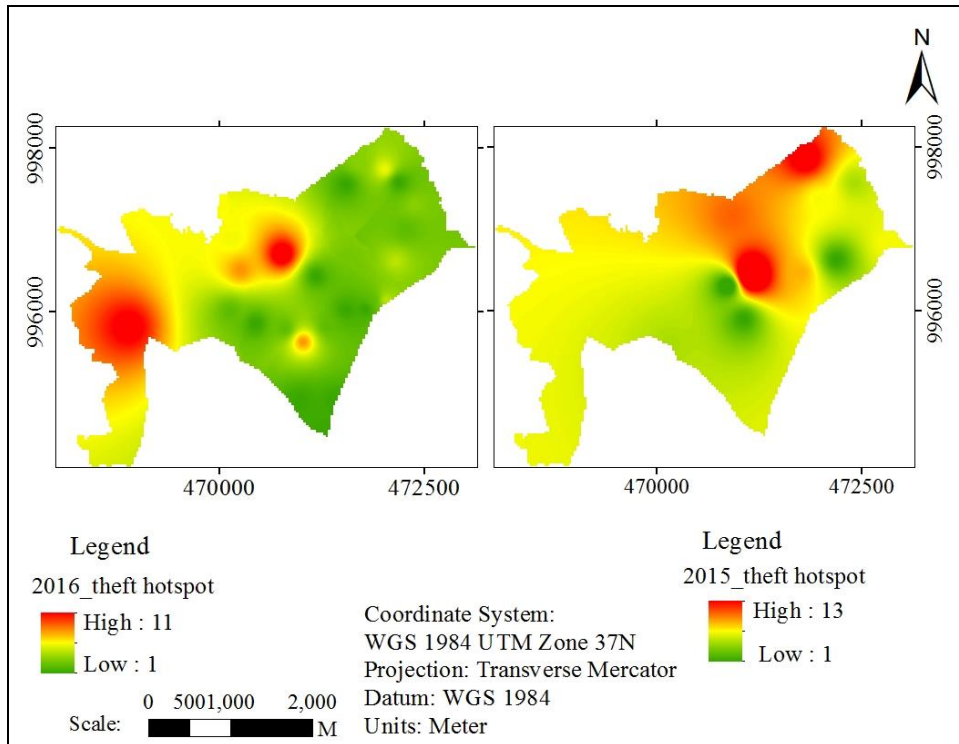


Figure 17(b): Theft hotspot map of 2015 and 2016 (*Source: Own data survey June, 2019*)

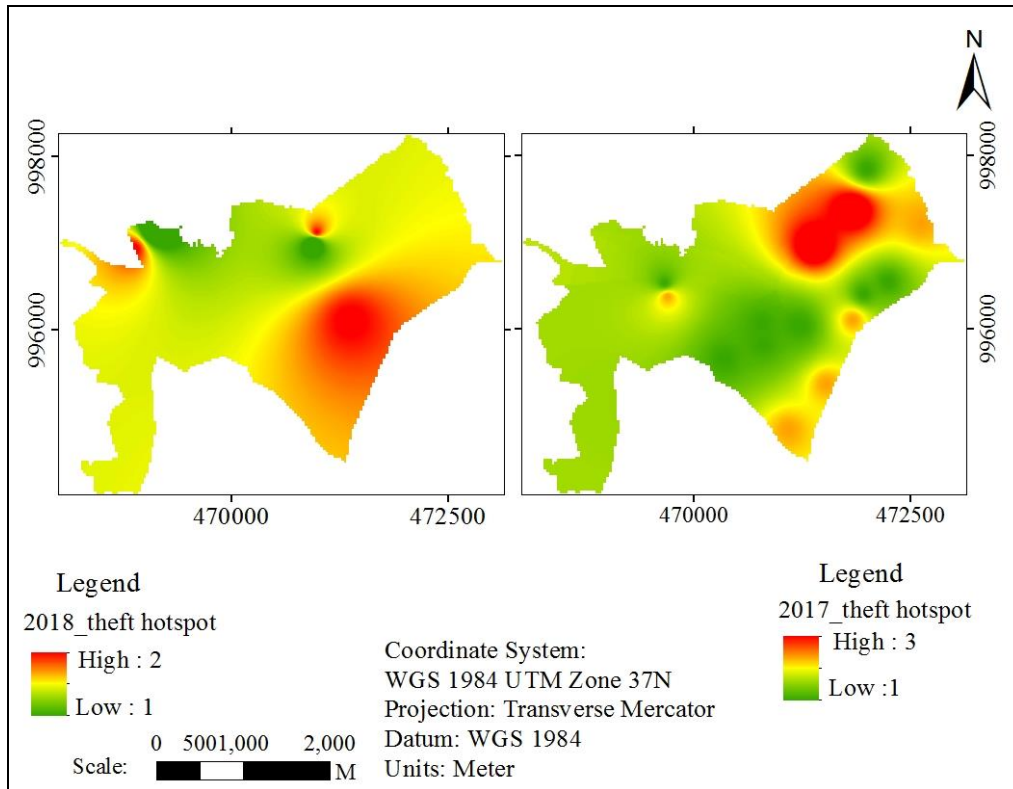


Figure 17(c): Theft hotspot map of 2017 and 2018 (*Source: Own data survey June, 2019*)

Generally, theft was severe in western, northern, eastern, northern and southern parts of the study area in 2014, 2015, 2016, 2017 and 2018 respectively. The central part of the study area is safe from theft crime through the years.

#### 4.2.2.4. Bribery hotspot (2014 to 2018)

The hotspot area of bribery is presented in Figure 18 (a), (b) and (c) the highest and lowest value of hotspot area were 6 to 1 (2016), 6 to 1 (2017) and 7 to 1 (2018). The dark red and green indicates the high and low crime hotspot area.

In 2014 and 2015, there is no bribery crime record. According to the senior police officers of the study area at this time crime is not report to police station. This bribe is commonly related to the traffic police and the drivers. Such crime committed in the street when driver violate the traffic rules then they need to give bribe for traffic police and in addition the interest of some traffic police to take bribe.

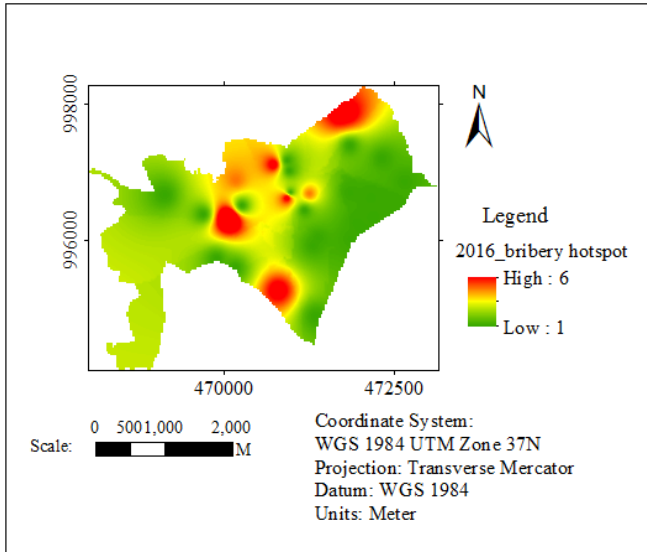


Figure 18(a): Bribery hotspot map of 2014 and 2018 (*Source: Own data survey June, 2019*)

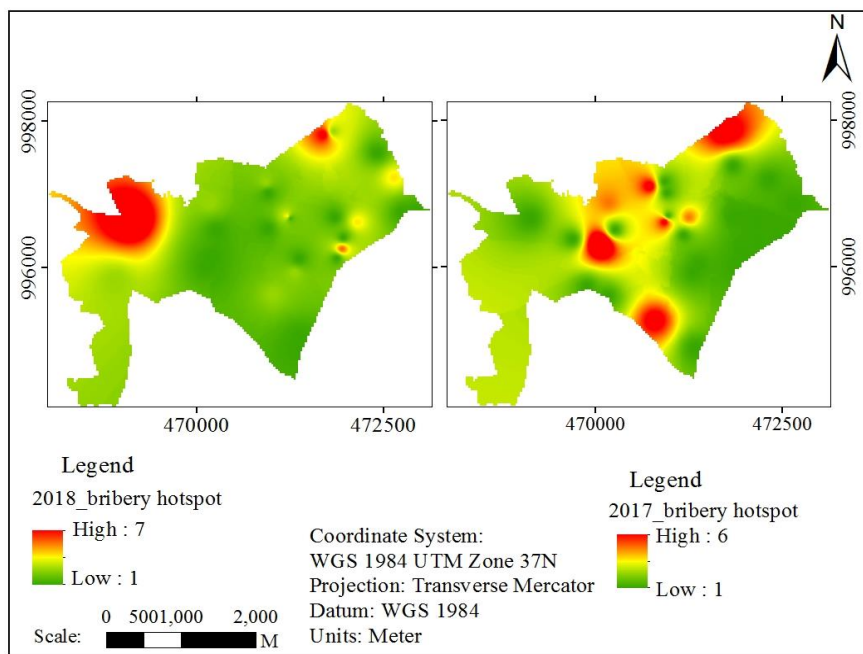


Figure 18(b): Bribery hotspot map of 2014 and 2018 (*Source: Own data survey June, 2019*)

The highest bribery practice was in the northern and central parts, northern parts, and central and north eastern parts in 2016, 2017 and 2018, respectively. In all year western and eastern part of the area has low crime hotspot area. The central part of the study area where roads are densely found is identified as bribery hotspot areas because traffic related bribery practiced in the main street.

#### 4.2.2.5. Pick pocket hotspot (2014 to 2018)

The hotspot area of pick pocket is presented in Figure 19 (a), (b) and (c) dark red and green color indicates high and low pick pocket crime hotspot area respectively. The highest and lowest value of the hotspot area were 1 to 1 (2014), 1 to 1 (2015), 2 to 1 (2016), 3 to 1(2017) and 2 to 1 (2018).

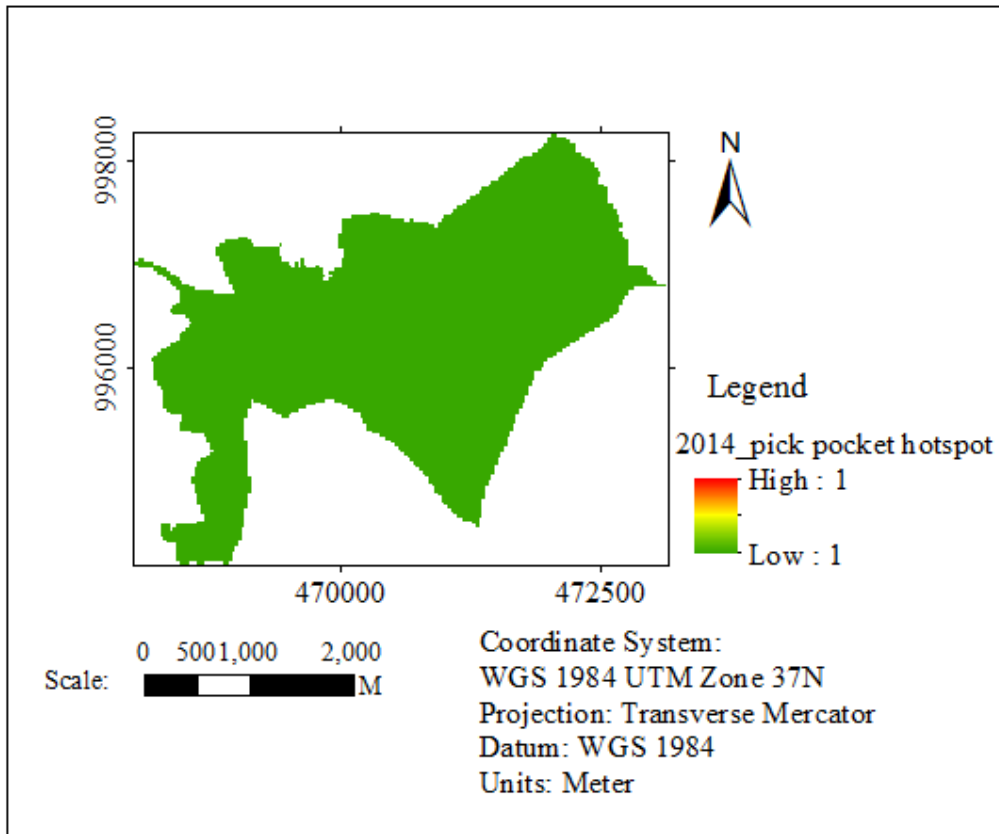


Figure 19(a): Pick-pocket hotspot map of 2014 (Source: Own data survey June, 2019)

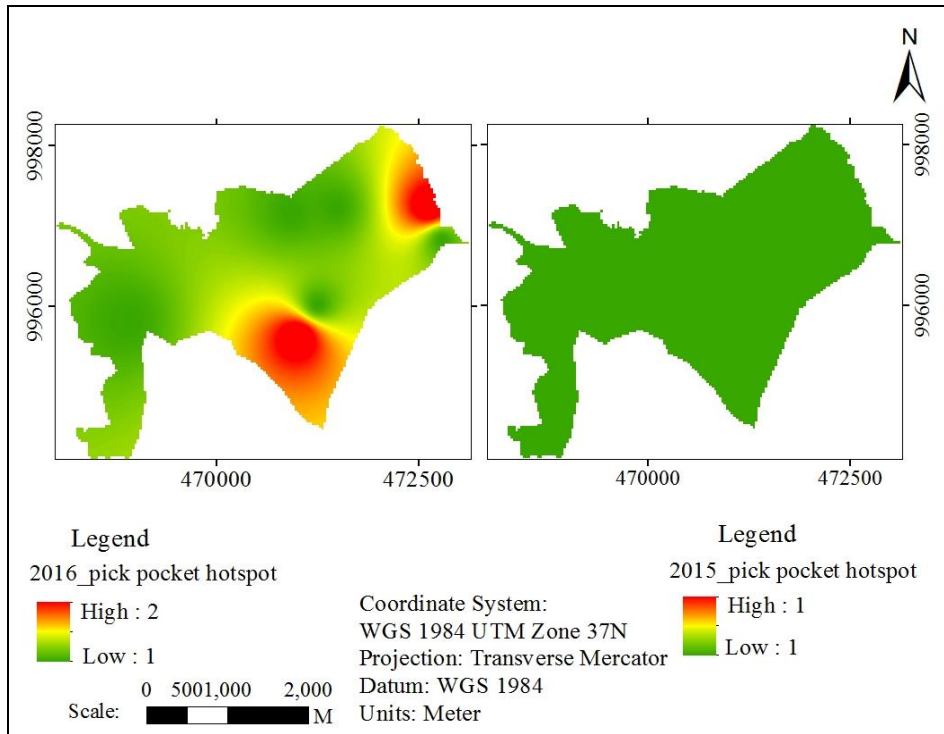


Figure 19 (b): Pick-pocket hotspot map of 2015 and 2016 (*Source: Own data survey June, 2019*)

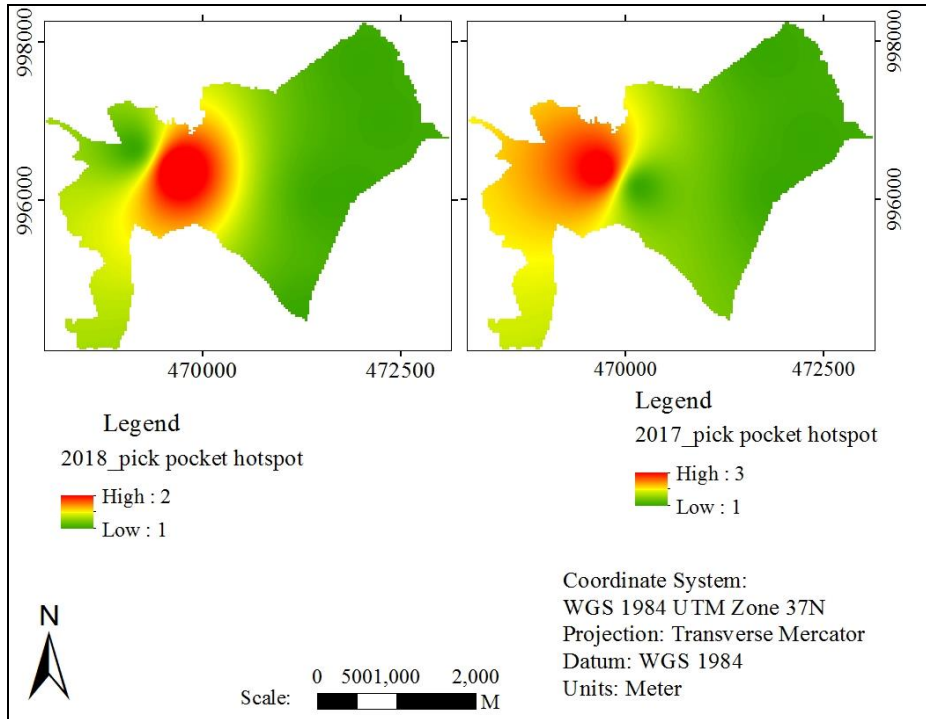


Figure 19(c): Pick-pocket hotspot map of 2017 and 2018 (*Source: Own data survey June, 2019*)

In 2016, 2017 and 2018, western, south-eastern and central parts practice high pick pocket crime respectively. The pick pocket crime safer areas located in eastern and northern (2016), western and southern (2017) and western, some part of northern and southern (2018). In 2014 and 2015, all parts of the study area were safer pick pocket crime. But there is a crime record in all years at all places.

Researcher such as (Brantingham and Brantingham 1982); Henry and Bryan 2000), visualize many of hotspots of theft area. Another study (Clarke and Mayhew 1994), also produce many hotspots of thefts. Therefore, the output of this research is also producing property crime hotspot area visualization, in all selected prioritized property crime, each crime occurrence varies in place and years. The research output visualizes the crime severe and safer place in different crime type and years.

### 4.3. Crime events distributed over place and time

#### 4.3.1. Crime event distribution over time

The crime event distribution of time shows that the lowest crime record registered in night tour and highest crime record registered in day tour hours. The crime committed time record in Lideta sub-city covers 24 hours.

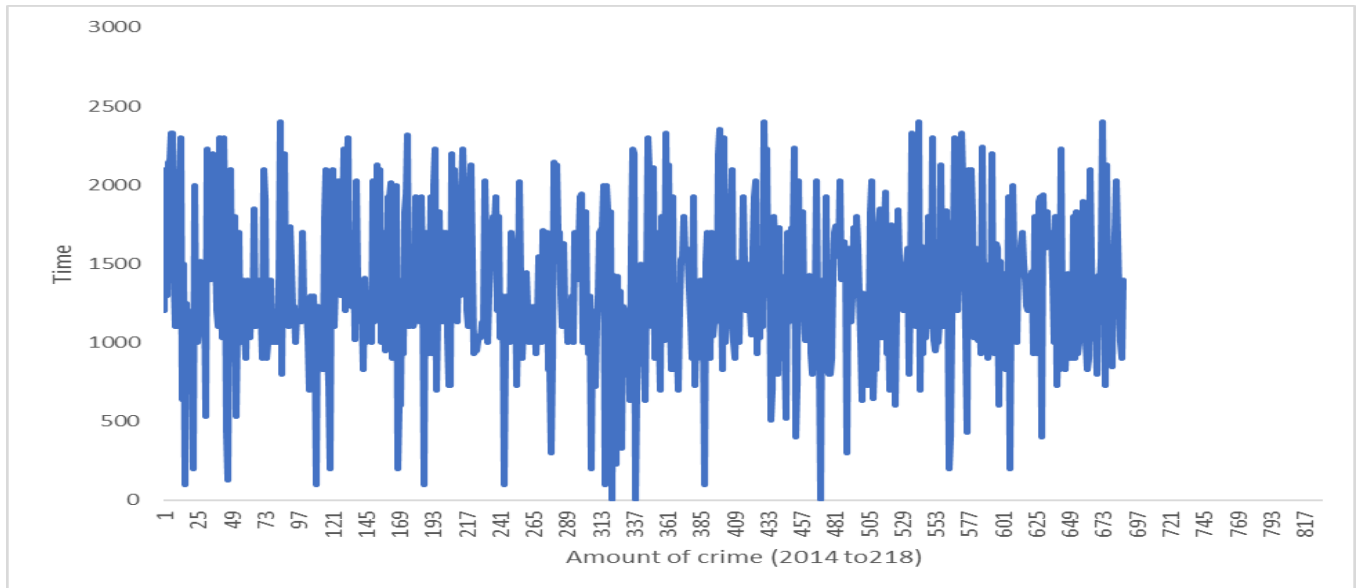


Figure 20: Property crime time series chart (Source: Own data survey June, 2019).

Regarding on crime committed time, in the study area the highest property crime was committed between 0800 to 1600. During this time property crime occurrence rate is very high. According to the key informants the reason for this is that this is the time when there is high movability of person and vehicle, and it is also working and school time. Therefore, the time takes the first in crime commission.

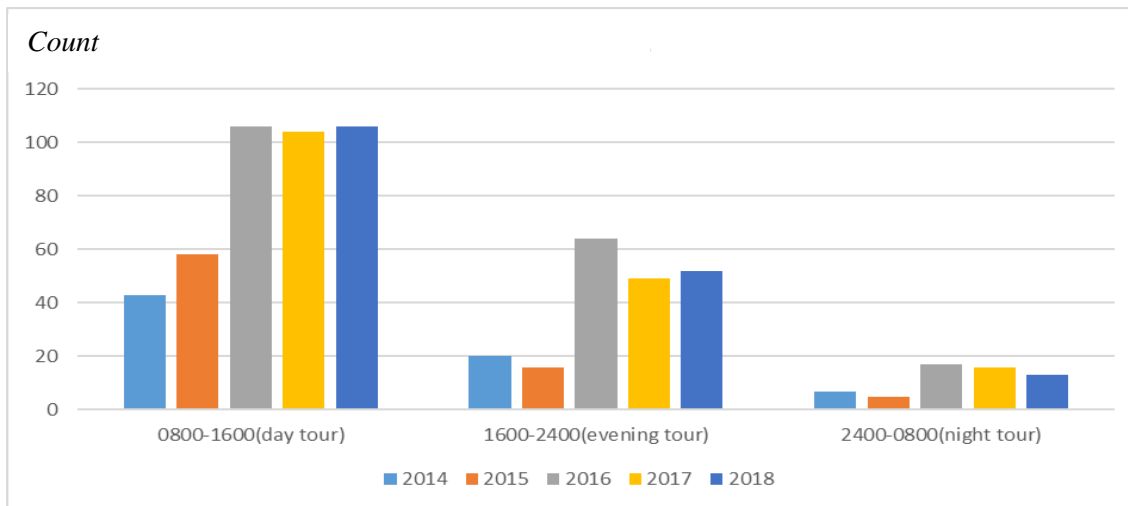


Figure 21: Lideta sub-city property crime time series (*Source: Own data survey June, 2019*).

Figure 21 shows crime committed time between 2014-2018. The highest property crime occurrence police tour conditions were in the day tour followed by evening and night tour. According to the key informants at this time service sectors are functional, workers move to their work, flow of vehicles and persons are high, school time and high economic activities practiced. Whereas, during night tour condition movements are stopped, less vehicle and person flow.

The respondent's crime sensitivity time in high and low crime hotspot area (Table 3) shows 56% and 63% of respondents said property crime hotspot time ranges is from 0800 to 1600. However, 32% and 24% of respondents reported that it ranges between 1600 to 2400 time in high and low crime hotspot area.

Table 2: Respondents response on crime sensitive time

Crime area	Time	Respondents (N=100)	
		Frequency	Percent
Hotspot area	0800-1600	56	56
	1600-2400	32	32
	2400-0800	12	12
	Total	100	100
Low crime area	0800-1600	63	63
	1600-2400	24	24
	2400-0800	13	13
	Total	100	100

(Source: Own data survey June, 2019)

The seasonal, year and time crime event distribution shows that high crime occurred in summer season, 2016 year and between 0800 to 1600 time (Figure 22).

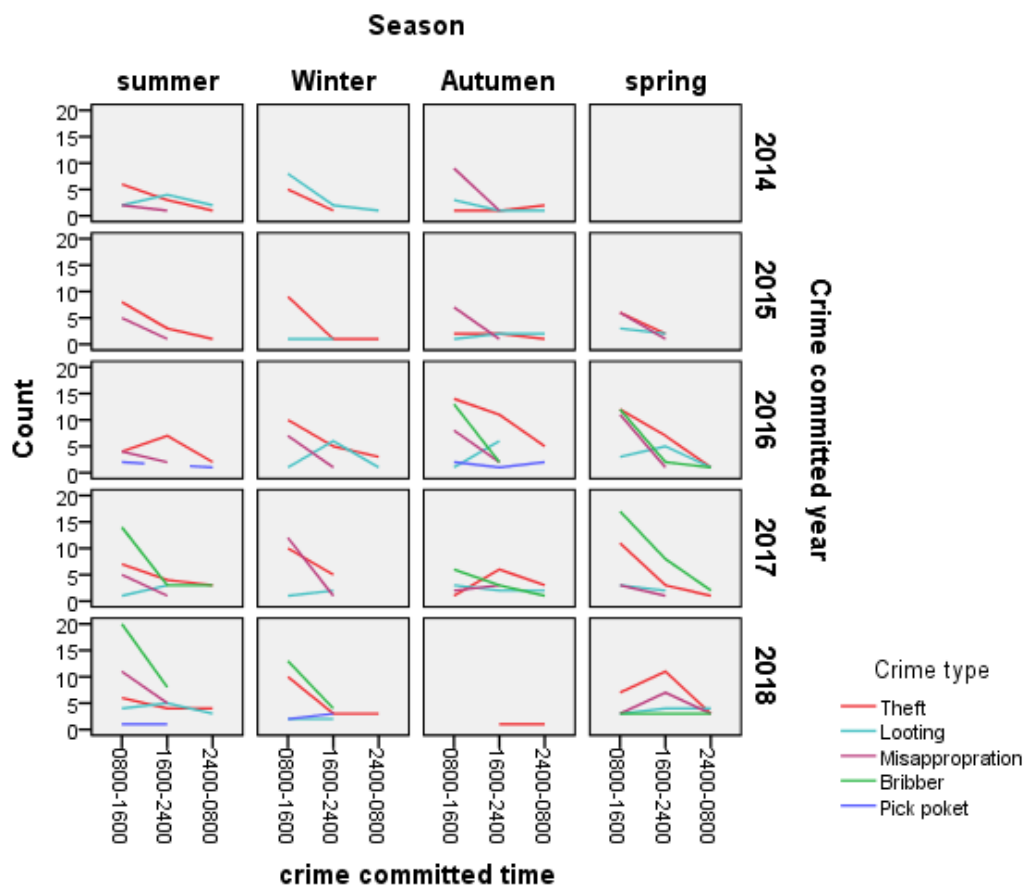


Figure 22: Distribution of crime event overt time (Source: Own data survey June, 2019)

Seasonal variation of crime, in hotspot and low crime area is presented below (Table 3). In the hotspot area, 7%, 25%, 29%,9% and 30% of respondents said crime occurred in autumn, spring, summer, winter and all season respectively. On the other hand, in low crime area 5%, 18%, 30%, 14 and 33% of respondents reported that crime occurred severity was in autumn, spring, summer, winter and all seasons respectively. Similarly, property crime occurred in the same year, season and same time.

Table 3: Seasonal influence on crime respondent response

Crime area	Season	Respondents (N=100)	
		Frequency	Percent
Hotspot area	Autumn	7	7
	Spring	25	25
	Summer	29	29
	Winter	9	9
	All season	30	30
	Total	100	100
Low crime	Autumn	5	5
	Spring	18	18
	Summer	30	30
	winter	14	14
	All season	33	33
	Total	100	100

(Source: Own data survey June, 2019)

Seasonal variation determines the level of crime committed in the area. The seasonal influence on crime statistics shows that in all crime hotspot area high crime occurrence season was summer and low crime occurrence were autumn and winter. According to 30% and 33% of respondents in hotspot and low crime area respectively crime was committed in all season. According to 29% and 30% of respondents from hotspot and low crime area respectively summer is the first season in crime commission. Spring is the second season by crime occurrence rate in Lideta sub-city.

Findings are also consistent with previous research that has found clear seasonal fluctuations in crime rates (see Cohn, 2004, 2006; Téllez et al., 2006; Hird & Ruparel, 2007; Uittenbogaard & Ceccato, 2012).

#### 4.3.2. Distribution of crime event over places

The distribution of crime event in the study area is examined by the respondent's response and the crime data recorded from the Lideta sub-city police office. Based on this data distribution of crime is high in northern, central and north-western.

The distribution of crime event over space is different (Table 4 (a) and (b)). From respondents 60% (in hotspot area) and 55% (low crime area) 60% of respondents confirmed that around school crime is committed rarely. In this area 14% (in hotspot) and 10% (in low crime) reported that crime is committed always.

Table 4 (a): Places sensitive to property crime (N=100)

crime	variables	School available places		Police station		Road have light		Road have not light		Residential		Health center		Commercial center	
		<i>Frequency</i>	<i>percent</i>	<i>Frequency</i>	<i>percent</i>	<i>Frequency</i>	<i>Percent</i>	<i>Frequency</i>	<i>Percent</i>	<i>Frequency</i>	<i>Percent</i>	<i>Frequency</i>	<i>Percent</i>	<i>Frequency</i>	<i>Percent</i>
Hotspot area	Never	22	22	43	43	20	20	12	12	33	33	16	16	8	8
	Rarely	60	60	47	47	48	48	16	16	47	47	51	51	20	20
	Sometimes	4	4	8	8	18	18	45	45	12	12	18	18	33	33
	Always	14	14	2	2	14	14	27	27	8	8	15	15	39	39
	Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Low crime area	Never	19	19	35	35	19	19	10	10	26	26	9	9	10	10
	Rarely	55	55	48	48	45	45	24	24	48	48	56	56	16	16
	Sometimes	16	16	6	6	23	23	38	38	15	15	21	21	41	41
	Always	10	10	11	11	13	13	28	28	11	11	14	14	33	33
	Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100

(Source: Own data survey June, 2019)

In hotspot and low crime areas, 43% (hotspot areas) and 33% (low crime areas) of respondents reported that crime was never committed around police campus. Similarly, around health centers and residential areas crime event is very low mainly due to the availability of law enforcers (Table 4 a and b). The crime rate is high in areas where streetlight is lacking. In commercial center available places crime committed sensitivity level respondents of 39%(hotspot) and 33% (low crime area) reported that crime is committed always and sometimes in low crime and hotspot area respectively. In this area transactions were practiced and routine activities performed. According to the routine activity's theory criminals commit crime at place where daily activities done.

Table 4 (b): Places sensitive to crime (N=100)

Crime area level	Variables	Hotels, pensions and Grocery		Forest		Rivers, Streams and waste disposal		Open space		Others (piracy, corruption)	
		Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
Hotspot area	Never	9	9	1	1	5	5	12	12	14	14
	Rarely	14	14	24	24	21	21	25	25	61	61
	Sometime	33	33	38	38	32	32	20	20	8	8
	Always	44	44	37	37	42	42	43	43	17	17
	Total	100	100	100	100	100	100	100	100	100	100
Low crime	Never	12	12	11	11	9	9	13	13	13	13
	Rarely	18	18	29	29	28	28	26	26	57	57
	Sometime	32	32	32	32	34	34	30	30	16	16
	Always	38	38	28	28	29	29	31	31	14	14
	Total	100	100	100	100	100	100	100	100	100	100

(Source: Own data survey June, 2019)

Table 4(b) indicates the statistics of crime sensitive area, other places crime committed frequency were rarely in all crime hot spot area.

According to respondents report in places such as hotels, pensions, grocery, forested areas rivers, waste disposal tubes and open spaces the crime occurrence frequency is high.

Similarly, Wortley & Mazerolle (2008) indicated that highly crowded places create an opportunity for the rational choice of criminals for committing a crime. Public facilities like shopping malls, high schools, taverns, convenience stores, apartment buildings and public housing are crime attractors (Lama & Rathore, 2017).

#### 4.4. Analysis of the relationship between human landscape and property crime

Social and geographic factors, such as location of schools or neighborhoods with different socio-economic status within an area, can influence the patterns and rate of crime incidents in the area.

##### 4.4.1. Public participation on police activities

As indicated (Table 5) in low crime area, 77% of respondent participate in the police activities, the remaining 23% did not participate. In the high crime area, 59% respondents participate in the police activities and 41% did not participate.

Table 5: Public participation in crime prevention

	Respondents (N=100)			
	<i>Frequency</i>	<i>Percent</i>	<i>Frequency</i>	<i>Percent</i>
Yes	77	77	59	59
No	23	23	41	41
Total	100	100	100	100

(Source: Own data survey June, 2019)

This shows that when public participation is high the rate of crime committed in the area becomes low. Public participation increases the network of the community and the police officer to combat crimes. In low crime area the level of participation is 23%, 8%, 49% and 38% of monthly, weekly, daily and missed respectively (Table 6). Table 6 shows hotspot area respondents' level of participation as 37%, 19%, 6%, 38% are monthly, weekly, daily and others respectively.

Table 6: Level of public participation

Level of participation	Respondents (N=100)			
	Low crime area		Hotspot area	
	<i>Frequency</i>	<i>Percent</i>	<i>Frequency</i>	<i>Percent</i>
Monthly	23	29.9	34	57.6
Weekly	8	10.4	19	32.2
Daily	46	59.7	6	10.2
Total	77	100	59	100

(Source: Own data survey June, 2019)

In low crime area, daily public participation level was high but in hotspot area daily participation level was minimal (Table 6). The level of participation on police activities increases the social interaction and involvement on the crime prevention reactively or proactively. This indicates social disorganization theory concept, when the level of participation increases the social intimacy increase.

The respondent's participation on witness were 68% (low crime area) and 30% (hotspot area) (Table 7). The witness participation of respondents decreases criminal rational choice and opportunity to commit a crime in the study area.

Table 7: Respondents witness participation

Crime area level	Response on witness	Respondents (N=100)	
		<i>Frequency</i>	<i>Percent</i>
Low crime area	Yes	68	68
	No	32	32
	Total	100	100
Hotspot area	Yes	30	30
	No	70	70
	Total	100	100

(Source: Own data survey June, 2019)

In hotspot area, the residential witness participation was less than low crime area. This indicates high witness participation decrease the crime committed rate in the area.

The respondent's crime report participation to the police center was higher in low crime area than in high crime area (Table 8).

Table 8: Respondent crime report statistics

Crime level	Report participation	Respondents (N=100)	
		<i>Frequency</i>	<i>Percent</i>
Low crime area	Yes	82	82
	No	18	18
	Total	100	100
High crime	Yes	56	56
	No	44	44
	Total	100	100

(Source: Own data survey June, 2019)

The crime report participation is high in low crime area than hotspot area. This shows that when residential increase the ability to report crime the crime rate of the area decreases and vis versa. When the participation of reporting crime increased the criminal's opportunity to commit crime becomes less. According to the key informants the reasons that residential dose not report crime to the police include: the fear of being exposed, lack of protection form law enforcement agency, poor social interaction, misunderstanding about time consuming and not need double call from the police if it is appropriate.

As shown on Table 9, 29% of the respondents in low crime area always report crime to the respective office. In hotspot area only 4% of respondents are always report it to the respective office.

Table 9: Respondent crime report level (Source: Own data survey June, 2019)

Report level	Respondents (N=100)			
	Low crime area		High crime area	
	<i>Frequency</i>	<i>Percent</i>	<i>Frequency</i>	<i>Percent</i>
Sometimes	17	20.7	11	19.6
Often	36	43.9	41	73.2
Always	29	35.4	4	7.2
Total	82	100	56	100

(Source: Own data survey June, 2019)

In hotspot area level of crime report is less than low crime area. The result shows high report of crime decrease the rate of crime committed in the area. This indicates that level of crime report determines occurrence of crime in the study area.

Generally, in hotspot area the report level is low whereas, in low crime area crime report level is high. The participation of the residential increase the intimacy of neighbours and interpersonal networks in the area. Such interpersonal connection decrease the social disorganization of the area. Social disorganization creates an opportunity for criminals to commit crime in an area. The crime reporting purposes and public information awareness determine the places crime occurrence frequency. Sureshababu (2014) indicated that when a community is not unified, lack the values and lack the interest in protecting the neighborhood, a criminal considered socially disorganized. Researchers indicated that public participation increase the interpersonal network. The phenomenon in which communities isolate to the institution becomes disadvantageous (Wilson 1982). Public participation is mandatory for the protection and control of crimes. Social ties and local interactions, referring to local interpersonal networks of friends, families and neighborly exchanges; norms and collective efficacy, based on different dimensions of culture, social cohesion, trust, and social control (Sampson et al. 1997)

#### **4.4.2. Level of crime committed in the study area**

In low crime area pick pocket was the first level (46%), theft second level (40%), vehicle part theft third level (37%), misappropriation first level (39%), looting fifth level (23%), bribery sixth level (35) and others seventh level (52%) (Table 10).

As the research of Balogun, Okeke, & Chukwukere (2014) and Lehohla (2014) result the first level order crime committed in Benin was robbery. As a result, based on participants response pick pocket and theft in the sub-city crime record is the first and second crime committed frequently in the study area respectively. The implication of this result was crime is endemic in the study and as such, efforts should be directed at preventing pick pocket. In this study theft crime is the first in secondary data but according to the respondent's response pick pocket is the first level of crime committed in the area. The level of crime committed in the study area is

examined by the respondent's response. Based on the respondent's response the first level of crime by the occurrence rate is pick pocket (see annexes 11).

Table 10: Low crime area respondents on the level of crime committed in the area (N=100)

Variable	Pick pocket		Theft		Vehicle part theft		Misappropriation		Looting		Bribery		Others	
	<i>Frequency</i>	<i>Percentage</i>	<i>Frequency</i>	<i>Percentage</i>	<i>Frequency</i>	<i>Percentage</i>	<i>Frequency</i>	<i>Percentage</i>	<i>Frequency</i>	<i>Percentage</i>	<i>Frequency</i>	<i>Percentage</i>	<i>Frequency</i>	<i>Percentage</i>
1 <sup>st</sup> level	46	46	23	23	12	12	39	39	13	13	11	11	5	5
2 <sup>nd</sup> level	28	28	40	40	19	19	16	16	10	10	8	8	2	2
3 <sup>rd</sup> level	9	9	21	21	37	37	19	19	16	16	12	12	2	2
4 <sup>th</sup> level	10	10	8	8	19	19	15	15	20	20	8	8	6	6
5 <sup>th</sup> level	3	3	4	4	8	8	8	8	23	23	20	20	10	10
6 <sup>th</sup> level	0	0	4	4	3	3	3	3	13	13	35	35	13	13
7 <sup>th</sup> level	4	4	0	0	2	2	0	0	5	5	6	6	62	62
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100

As indicated in Table 11 in hotspot area pick pocket was the first level (43%), theft second level (33%), vehicle part theft third level (30%), misappropriation fourth level (25%), looting fifth level (25%), bribery sixth level (35) and others seventh level (52%).

Table 11: Hotspot area respondents on the level of crime committed in the area (N=100)

Variable	Pick pocket		Theft		Vehicle part theft		Misappropriation		Looting		Bribery		Others	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
1 <sup>st</sup> level	43	43	32	32	23	23	20	20	16	16	6	6	9	9
2 <sup>nd</sup> level	31	31	33	33	14	14	12	12	19	19	10	10	1	1
3 <sup>rd</sup> level	15	15	13	13	30	30	17	17	16	16	6	6	1	1
4 <sup>th</sup> level	3	3	12	12	19	19	25	25	11	11	17	17	3	3
5 <sup>th</sup> level	3	3	7	7	10	10	19	19	25	25	16	16	15	15
6 <sup>th</sup> level	1	1	0	0	2	2	5	5.0	12	12	35	35	19	19
7 <sup>th</sup> level	4	4	3	3	2	2	2	2.0	1	1.0	10	10	52	52
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100

(Source: Own data survey June, 2019)

Generally, both hotspot and low crime area respondents reported that pick pocket is the first severe crime in Lideta sub-city. The second severe crime in both areas is theft crime. Others in the crime type includes, loss of trust, piracy, house and industry intentional burning, corruption and damage government and private property.

According to the residential response pick pocket is the first level by occurrence rate both in high and low crime area (see Table 11(a) and (b)). As the crime record result of Lideta sub-city the pattern and occurrence rate of pick pocket is less than other crime type. Based on the response of the key informants this crime type is not fully report to the police, especially when the property value is less and investigation process.

#### 4.4.3. Concerned bodies of crime prevention and controls

Analysing the concern of crime control and prevention is better to know the effect on crime occurrence rate. Whether crime occurrence increase in community concern, police concern or both community and police concern is the question of every one to make the area safe from crime.

According to the report of respondents 75% (in hotspot area) and 88 % (in low crime area) reported that the concerned body is community and police (Table 12).

Table 12: Respondents response on for whom crime is best concern

Crime concern	Respondents (N=100)			
	High crime area		Low crime area	
	<i>Frequency</i>	<i>Percent</i>	<i>Frequency</i>	<i>Percent</i>
To the police	6	6	5	5
Resident community	10	10	6	6
community and police	75	75	88	88
Depends on the situation or crime	8	8	1	1
I do not know	1	1	0	0
Total	100	100	100	100

(Source: Own data survey June, 2019)

This indicates that when the concern of crime is high for bot community and police the rate of crime committed in the area becomes low. For this reason, in low crime area the concern of crime is high for community and police than hotspot areas.

#### 4.4.4. Crime severity level of the study area

As indicated (Table 13) the place property crime severity is high in hotspot area and low in low crime area of the study area. In hotspot area, the place is not safe to living and communities has in fear of crime. At low crime hotspot area, the place is safe for living compared to high crime hotspot area. This shows that spatial data collected and the GIS application result is the same as the response of the respondents.

Table 13: Respondents response on residential area crime severe level

Crime severe level	Respondents (N=100)			
	Hotspot area		Low crime area	
	<i>Frequency</i>	<i>Percent</i>	<i>Frequency</i>	<i>Percent</i>
High crime	59	59.0	46	46
Low crime	41	41.0	54	54
Total	100	100.0	100	100

(Source: Own data survey June, 2019)

The study area safety based on crime is presented in Table 14. In hotspot area, 21%, 52% and 27% of respondents reported that it was very safe, safe and not safe at all respectively. In low crime area 47% of respondents said that it is safe.

Table 14: Residential area level of safety from crime

Crime level	Safety level	Respondents (N=100)	
		Frequency	Percent
High crime area	Very safe	21	21
	Safe	52	52
	Not safe at all	27	27
	Total	100	100
Low crime area	Very safe	35	35
	Safe	47	47
	Not safe at all	18	18
	Total	100	100

(Source: Own data survey June, 2019)

Based on residential safety from crime, 73% and 82% of the respondents reported that the area was safe for living in hotspot and low crime area respectively. As indicated in Table14, 27% and 18% of respondents reported that the area is not safe at all for living in hotspot and low crime area respectively. In hotspot area level of safety is high than low crime area.

Generally, in hotspot area places are not safe from property crime than low crime area. Kneeshaw-Price et al., (2015) indicated that the perception of crime safety determines by the residential. The crime safety measures in turn may have distinct associations with physical activity. There are multiple dimensions of crime-related safety, and the most important dimensions that determine the safety were public participation, police patrol and crime control functionality, the residential income level and family status. In addition, the place land cover type and economic activities determine to say one area safe from crime or not.

#### 4.4.5. Police performance on crime control and patrol

Police performance on crime control in high and low crime area was illustrated in Table 15. In high crime hotspot area half of the respondent reported 'yes' and the other half said 'no'. From

low crime area 56% and 44% of the respondents reported ‘yes’ and ‘no’ for police activities on their residential area respectively.

Table 15: Police activities on the study area

Crime level	Police availability	Respondents (N=100)	
		<i>Frequency</i>	<i>Percent</i>
Hotspot area	Yes	50	50
	No	50	50
	Total	100	100
Low crime area	Yes	56	56
	No	44	44
	Total	100	100

(Source: Own data survey June, 2019)

The activities of police in law enforcement is the basic thing to decrease crime occurrence rate. When the availability of police becomes low the area crime committed practice increase. In the study area police activity availability is not good both in hotspot and low crime area with response of the half respondents.

As indicated in Table 16, 66% of respondents reported that they see police sometimes in high crime hotspot area. In low crime hotspot area 37% of the respondents always see the police patrol.

Table 16: Respondents perception of police patrol in the study area

Crime level	Level of patrol	Respondents (N=100)	
		<i>Frequency</i>	<i>Percent</i>
Hotspot area	Never	6	6
	Sometimes	66	66
	Always	28	28
	Total	100	100
Low crime area	Never	8	8
	Sometimes	55	55
	Always	37	37
	Total	100	100

(Source: Own data survey June, 2019)

The level of police patrol in respondents see daily police patrol sometimes (66%) in their residential area. Others see always (28%) and never (6%) see the police patrol with in a day. In low crime area, 55% respondents see police patrol sometimes and 37% of respondents see always and 8% of respondents never see. When police patrol and availability is high in an area the criminal's opportunity to commit a crime becomes low. This is due to the deterrence effect of police.

#### 4.4.6. Demographic characteristics of the respondent

In low crime areas, 76% and 24% of the respondents are male headed and female headed respectively (Table 17).

Table 17: Respondent demography characteristics

Type	Demography character	Respondents (N=100)			
		Low crime area		High crime area	
		<i>Frequency</i>	<i>Percent</i>	<i>Frequency</i>	<i>Percent</i>
Gender	Male	76	76	65	65
	Female	24	24	35	35
	Total	100	100	100	100
Age	<18	6	6	6	6
	18-60	87	87	88	88
	>60	7	7	6	6
	Total	100	100	100	100
Education level	Read and write	5	5	4	4
	1-4	1	1	2	2
	5-8	1	1	14	14
	9-12	41	41	30	30
	Diploma	25	25	21	21
	First degree	23	23	25	25
	Above degree	4	4	4	4
	Total	100	100	100	100
Job	Government	55	55	27	27
	Private worker	27	27	44	44
	Self	8	8	17	17
	Unemployed	4	4	8	8
	Other	6	6	4	4
	Total	100	100	100	100

(Source: Own data survey June, 2019)

In low crime area 55% of the respondent's job status is government worker whereas, in hotspot area 47% of respondents job status is government workers. In job categories of the respondent's others specify those respondents include pension, non-governmental organization and student.

In low crime areas, 87% of respondents aged between 18 to 60. Whereas in high crime area 65% of the respondents are male headed and the remaining 35% is female headed.

#### 4.4.7. Family status and crime

As indicated in Table 18, 45% and 51% of respondents said extended homes and unmarried households don't involve in crime, unmarried households involve in crime and unmarried households involve in crime respectively in hotspot area.

In low crime hotspot area (Table 18) 51%, 3%, 16%, 28% and 2% of respondents said extended homes are prone basic needs leading to criminal activities, married households involve in crime, married households do not involve in crime, unmarried households involve in crime and unmarried households do not involve in crime respectively in the Lideta sub-city.

Table 18: Respondents response on family status and crime relation

Variables	Respondents (N=100)			
	Hotspot		Low crime area	
	<i>Frequency</i>	<i>Percent</i>	<i>Frequency</i>	<i>percent</i>
Extended homes are prone basic needs leading to criminal	45	45	51	51
Married households involve in crime	11	11	3	3
Married households do not involve in crime	7	7	16	16
Unmarried households involve in crime	34	34	28	28
Unmarried households do not involve in crime	3	3	2	2
Total	100	100	100	100

(Source: Own data survey June, 2019)

Property crime depends on family status of the criminals. As indicated in Table 18, 45% and 51% of respondents responded that most property crimes are committed by extended homes in order to fulfill their basic needs in hotspot and low crime area respectively. In addition, 34% and 28% respondents confirmed that repeatedly crime is committed by unmarried households involve

in crime on hotspot and low crime area respectively. Family life and marriage are often considered to be an important control for criminal activities. The crime record of the secondary data from Lideta sub-city police office also indicates high crimes committed were by unmarried (see annexes 9).

#### 4.4.8. Age and property crime

Age and property crime relation (Table 19) indicates 11%, 84% and 5% of respondents reported that property crime committed age level in less than 18, 18 to 60 and greater than 60 ages respectively in hotspot areas. In low crime area age groups of crime commission was 7% and 93% of respondents said less than 18 and 18 to 60 age group respectively.

Table 19: Respondents response on crime committed age group with crime

Crime level	Age group	Respondents (N=100)	
	<18	11	11
	18-60	84	84
	>60	5	5
	Total	100	100
	<18	7	7
Low crime area	18-60	93	93
	Total	100	100

(Source: Own data survey June, 2019)

Age determine the commission of crime in an area. When the area is young age and economically not wealth the area becomes high crime place.

The most crime committed age group range from 18 to 60. The respondents of 84% and 93% said that crimes committed repeatedly in the age group of 18-60 on hotspot and low crime area respectively. The Lideta sub-city police office crime record shows high criminals are ages between 18 to 60 (see annexes 8). Property crime committed in Lideta sub-city were highly practiced in the age groups of 18 to 60 followed by those less than 18 age. Property crime by its nature needs a better decision, for this purpose such type of crime is committed by the productive age group residential.

According to Cornelius, Lynch, & Gore, (2015) and (Piquero et al. 2003) the rate of crime committed age is in adolescent age group. It is understood that crime increases throughout

adolescence and then peaks at age 18 (slightly earlier for property crime than for violent crime) and then begins to decrease over the life course moving forward.

#### 4.4.9. Education and income relation on crime

##### 4.4.9.1. Income and property crime

In both crime area (hotspot and low crime) the highest amount of crime was committed by unemployed people (Table 20). As shown in the Table, 73% and 71% of the respondents said property crime committed in the study area is by unemployment in hotspot and low crime area respectively.

Table 20: Employment and crime relation response of the respondent statistics

Variables	Respondents (N=100)			
	<i>Frequency</i>	<i>Percent</i>	<i>Frequency</i>	<i>Percent</i>
Unemployed	73	73	71	71
Government	9	9	12	12
Private worker	6	6	5	5
Self (private)	12	12	12	12
Total	100	100	100	100

(Source: Own data survey June, 2019)

In both crime area, crime was committed in all type's employment status. Income is quite a natural process when the economic situation is deteriorating; unemployment and crime are growing in the country. People are trying to improve their financial situation at the expense of various methods, including criminal ones. People who do not have a permanent source of income, become offenders. Experts believe that growth of crime and unemployment as well are interrelated and have their roots in the economic crisis (Portal, 2016).

A widely shared view in the criminology is that unplanned neighborhoods and cities with their socio-economic manifestations of poverty and deprivation can facilitate crime and the fear of crime (Sampson, 2006; Lersch, 2007; Brunton-Smith and Jackson, 2012; Landman, 2012).

The issue of unemployment is sharply linked to the problem of having families in a socially dangerous situation. In the crime record of the police office high crime was committed by private worker (see annexes 7). The respondents said that high crime committer was unemployed.

According to the key informants the difference of the record and the public perception toward the crime commission are due to the criminal's misperception about their personal profile recording. They assume that when one criminal has not a job the public and police perceive the work of the criminal is committing crime.

As shown below (Table 21) in all crime hotspot area income difference determine the commission of crime, with 40% (hotspot area) and 34% (low crime area). In hotspot area, most respondents reported that strongly disagree (33%), agree (44%), agree (37%) and agree (47%) rich people are not steal another people's property, low income earners engage in criminal offences, poor family headed children commit property crime and middle-income persons involve in crime respectively. At low crime area most respondents reported that disagree (48%), disagree (40%), disagree (42%) and strongly agree (38%) rich people are not steal another people's property, low income earners engage in criminal offences, poor family headed children commit property crime and middle-income persons involve in crime respectively.

In Table 21, income difference determines individuals or communities to engage in criminal offence of property crimes. Both in hotspot and low crime area 75% of the respondents disagree that rich people are not stealing another people's property. On other side, low income earners and poor family headed children engage in property crime to earn income. Middle income earners also involve in property crime both in hotspot and low crime area. According to the result of Table 19 in Lideta sub-city both income earners engage in property crimes. In their crime commit the severity and level of crime engagement may varies based on their income level.

Table 21: Respondents response on the relation of income difference and crime committed perception

Variable	Level	Respondents (N=100)			
		Hotspot area		Low crime area	
		<i>Frequency</i>	<i>Percent</i>	<i>Frequency</i>	<i>Percent</i>
Income difference determine the crime commission	Strongly agree	40	40	34	34
	Agree	28	28	28	28
	Disagree	19	19	30	30
	Strongly disagree	13	13	8	8.0
	Total	100	100	100	100
Rich people are Not stealing another people's property	Strongly agree	12	12	16	16
	Agree	24	24	25	25
	Disagree	31	31	48	48
	Strongly disagree	33	33	11	11
	Total	100	100	100	100
Low income earners engage in criminal offences	Strongly agree	12	12	20	20
	Agree	44	44	32	32
	Disagree	27	27	40	40
	Strongly disagree	17	17	8	8
	Total	100	100	100	100
Poor family headed children commit property crime	Strongly agree	15	15	17	17
	Agree	37	37	31	31
	Disagree	34	34	42	42
	Strongly disagree	14	14	10	10
	Total	100	100	100	100
Middle income persons involve in crime	Strongly agree	32	32	38	38
	Agree	47	47	35	35
	Disagree	20	20	19	19
	Strongly disagree	1	1	8	8
	Total	100	100	100	100

(Source: Own data survey June, 2019)

Niknami( 2013) indicated that the relation of individual income and crime is negative. In this study all income level earners commit crime, so in the study area income difference is not factor for property crime commission. The economic framework only considers financially motivated types of crimes such as property crime. In this framework individuals are assumed to be compare themselves to people that are more advantaged in income and education.

#### 4.4.9.2. Education and property crime

Crime understanding indicates in low crime hotspot area 5%, 90% and 5% of the respondents said crime is normal, harm and nothing respectively (Table 22). In hotspot area 8%, 90% and 2% of the respondents reported crime is normal, harm and nothing respectively.

Table 22: Crime understanding of the respondent

variables	Respondents (N=100)			
	Low crime area		Hotspot area	
	<i>Frequency</i>	<i>Percent</i>	<i>Frequency</i>	<i>Percent</i>
Normal	5	5	8	8
Harm	90	90	90	90
Nothing	5	5	2	2
Total	100	100	100	100

(Source: Own data survey June, 2019)

Crime understanding of both in high and low property crime hotspot area (Table 22) results crime is harm. Therefore, in all crime area harmful of property crime is highly recommended in Lideta sub-city. As a result, crime understanding is high in the study area.

As shown on Table 23, low crime area respondents' knowledge on crime has 92% where as 8% does not have a knowledge of crime. In hotspot area 75% has a knowledge and 25 have not knowledge on crime.

Table 23: Respondents knowledge on crime

Crime area	Crime knowledge	Respondents (N=100)	
		<i>Frequency</i>	<i>Percent</i>
Low crime area	Yes	92	92
	No	8	8
	Total	100	100
Hotspot area	Yes	75	75
	No	25	25
	Total	100	100

(Source: Own data survey June, 2019)

In all crime hotspot area knowledge of property crime is high, but property crime knowledge is high in low crime area than low crime area. This shows knowledge determine rate of crime occur in the place, communities have a knowledge has low crime record and relatively safe from property crime and vis-versa.

Table 24: Relation of education difference and crime committed perception

Variables	Level of agreement	Respondents (N=100)			
		Hotspot area		Low crime hot spot	
		<i>Frequency</i>	<i>Percent</i>	<i>Frequency</i>	<i>Percent</i>
Families headed by educated parents don't engage in criminal offences?	Strongly agree	14	14	16	16
	Agree	46	46	40	40
	Disagree	26	26	34	34
	Strongly disagree	14	14	10	10
	Total	100	100	100	100
Low education level contributes low income and unemployment leading to crime?	Strongly agree	5	5	15	15
	Agree	31	31	26	26
	Disagree	46	46	44	44
	Strongly disagree	18	18	15	15
	Total	100	100	100	100
Good education reduces criminal activities in the community?	Strongly agree	2	2	23	23
	Agree	51	51	39	39
	Disagree	30	30	27	37
	Strongly disagree	17	17	11	11
	Total	100	100	100	100
Education level determine to commit or not to commit crime	Strongly agree	25	25	17	17
	Agree	38	38	43	43
	Disagree	29	29	32	32
	Strongly disagree	8	8	8	8
	Total	100	100	100	100
Educated persons involve in crime	Strongly agree	20	20	22	22
	Agree	55	55	41	41
	Disagree	20	20	31	31
	Strongly disagree	5	5	6	6.0
	Total	100	100	100	100
Educated persons do not involve in crime	Strongly agree	9	9	15	15
	Agree	25	25	19	19
	Disagree	42	42	47	47
	Strongly disagree	24	24	19	19
	Total	100	100	100	100

(Source: Own data survey June, 2019)

Education difference relation on crime (Table 24) shows in high crime hotspot area 60% and 40% of respondents agree and disagree respectively in property crime committed by families headed by educated parents do not engage in criminal offences. In related to low education level 36% and 64% of respondents said agree and disagree to commit crime.

As indicated in the above Table 24, the highest property crime was committed by educated persons. on the other hand, good education reduces the property crime commission. Based on the respondent's response shown in the table education level determine the individual's involvement on crime practice.

Lochner (2004) emphasizes the role of education as a human capital investment that increases future legitimate work opportunities, which discourages participation in crime. It is likely that school quality and the type of school's students attend also affect criminal behavior. Education may actually increase these types of crime if it increases the rewards from crime more than it increases legitimate wages. Lochner (2004) finds some evidence that property crime rates are increasing in average education levels.

Anderson et al, (2009) estimates that increasing the compulsory schooling age from 16 to 17 or 18 years of age reduces arrests at the affected ages by nearly 10 percent, with similar impacts on both violent and property crime. Education may also affect the rewards from crime. This is most likely to be true for white collar crimes like fraud, forgery, and embezzlement.

In contrast to those study, this research output is that educated persons committed property crime than those less educated one. As the key informant's response property crime is almost a white-collar crime committed by educated persons and also by the current governmental official's corruption and bribery practice.

## Chapter Five

### 5. Conclusions and Recommendations

#### 5.1. Conclusions

The trend of property crime was increased from time to time. The pattern of crime was high around north western, central, northern and southern part in five years. Seasonal variation determines the crime commission in in the study area. Property crime was committed in all season of the year however high property crime was practiced during summer season.

Crime event distribution varies among places and times. Based on this day-tour condition (0800 am to 1600 pm) is property crime hotspot time or tour condition. Evening tour (1600pm-2400 am) were the second and night-tour (2400 am-0800 am) in their crime occurrence rate. High crime was committed in places of commercial center, open spaces, places with no street light, places available hotels, pensions and grocery and also places available rivers, streams and waste disposal tubes.

Socio-demographics of the criminal determine crime commission in the area. The participation of the criminal on crime prevention and control have an impact on crime occurrence rate, when there is high participation, the place practice low crime area and vis versa. Crime understanding, knowledge on crime and crime report level of the criminal regulate the crime commission in area. Income difference, family status and education background determine the property crime committed in the study area. A place with high community participation in crime prevention activities and timely available police patrol and reports reduce the occurrence of crime committed and criminal's opportunity to crime commission level.

For crime pattern and hotspot analysis GIS is best spatial technology specially the compatibility of the application to the different data formats and extensions. The result of this technology leads the police officer decision maker for effective and cost-benefit based decision in crime hotspot area. In addition, for the deployment of line officers and resources the importance of GIS for crime analysis was very significant.

Crime mapping and analysis by using GIS application is important for police officers because different types of crime need different strategies in controlling and preventing them. Visualization crime mapping give information for guiding police officers in making decisions on how to allocate specific resources for specific crimes. The police officers and other policy makers can use the output of property crime hotspot and spatial point pattern map of Lideta sub-city.

Generally, crime mapping analysis is important for the police institution, residential and other stakeholders to know the severity and safer area. The police institution also used crime map for deploying resources and formulate future crime prevention and investigation mechanism. In addition, the police institute use this spatial technology out put for proactive policing implementation. Therefore, the police institution start to record spatial data at the time of crime record and introduce and implement GIS application across the country.

## **5.2. Recommendations**

The following recommendations are synthesized from the research work in Lideta sub-city:

### **Policy implications**

- The police institution should develop the process of implementing crime mapping and other spatial technology as a policy to work across nations.

### **Research implications**

- Further research should be conducted on crime mapping analysis and the police institution should be supported by the gaps identified with empirical evidences.

### **Practical implication**

- GIS is an important software for crime mapping and analysis for the best decision-making process and deployment of the resources. Therefore, the institution should train and employee experts in the institution that have knowledge of such spatial technology application and software.
- The police institution should start to introducing the crime spatial analysis and crime record taken in the field should be include the spatial location of an area in addition to take the place and institution names.

- The police institution should introduce and spread out the concept of crime mapping among police officers.
- Police patrol is one deterrence effect of crime. When police patrol is available the criminal's opportunity to commit a crime becomes low. Therefore, police officers should deploy sufficient police patrol around the selected hotspot area such as north western, central and south eastern part of the study.
- Police officer should create awareness about participation, crime knowledge, witness and crime report for the residential.
- The Lideta sub-city police office should give high emphasis for places that experience high in crime.
- To make visible and minimize the criminal's opportunity to commit crime the police officer should check the availability of line police officers in their jurisdiction.
- The higher education sector should give GIS for law enforcement sectors.
- The Lideta sub-city should fix street light around roads that experience high crime.

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## Annexes

*Annex 1:* English language questionnaires

**Addis Ababa University**

**Collage of Social Science**

**Geography and Environmental Studies Department**

**Questionnaire to be filled by the respondents**

**Dear respondents I am postgraduate student in Addis Ababa University, collage of Social Science Department of Geography and Environmental studies. I am doing master thesis on the title entitled: “Crime Mapping Analysis using GIS techniques.” This research is being done for the fulfillment of Master of Arts Degree in GIS, Remote Sensing and Digital Photogrammetry in Addis Ababa University. Therefore, you are kindly requested to give genuine responses for the questionnaire. Your responses have pivotal role for the success of this research. The researcher will keep the confidentiality of the responses of the participants.**

Thank you in advance for your cooperation!!!!

### **PART 1. Background information**

**DIRECTION:** The following items require you to provide information about you. Please provide the information requested by writing on the space provided for the open-ended items and by putting a mark for those items, which are followed by list of options.

1. Sex      Male                            Female
2. Age
3. Education level
4. Job level

**Part 2: Questions that measure crime and human built-up environment relationship.**

5. Do you participate in police work activities?

Yes

No

6. If your answer is “yes” how often do you participate?

Monthly

Weekly

Daily

7. What is crime for you?

Normal

Harm

Easy

8. Do you have a knowledge of crime prevention?

Yes

No

9. Did you report the crime committed in around to the police?

Yes

No

10. If your answer is “yes” how often do you report to the police?

Sometimes

Often

Always

11. The crime types are listed in the next table, please select based on their doing level in your area.

No	Type of crime	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>
1.	Pick Pocket					
2.	Theft					
3.	vehicle part theft					
4.	Looting					
5.	Misappropriation					
6.	Bribery					
7.	Others					

12. Have you ever witnessed a crime in your area?

Yes

No

13. For whom crime prevention is the best concern in your perception?

To the police

Community residents

community residents and police working together

Depends on the situation or crime

I do not know

14. Do you consider your area a high, medium or low crime area?

High crime

Low crime

15. Do you think that the police do very well with controlling crimes in your area?

Yes

No

16. How frequently do you see police patrols in your area within a day?

- Never
- Sometimes
- Always

17. Individuals from which family status tend to commit property crime repeatedly in your area?

- Extended homes are prone basic needs leading to criminal activities
- Married households involve in crime
- Married households don't involve in crime
- Unmarried households involve in crime
- Unmarried households don't involve in crime

18. Individual from which employee tend to commit property crime repeatedly in your area?

- Unemployed
- Government employee
- Private employee
- self

19. In your area which age group commit property crime repeatedly?

- Age less than 18 engage in criminal activities
- 
- Age between 18 to 60 engage in criminal activities
- 
- Age greater than 60 engage in criminal activities

20. How safe do you feel in your area based on crime situation?

- Very Safe
- Safe
- Not safe at all

21. In the table there is financial and education related questions. So, please answer the question based on your perception by selecting the choice and put tick mark.

No	Concerned Questions	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I.	Finance					
1	When people with low financial standing steal other people's					
2	Rich people are Not likely to steal another people's property					
3	Low income earners engage in criminal offences in the community					
4	Investments owned by the rich, in the community are illegally acquired					
5	Youths from poor families result to crime is to earn their daily bread					
6	Poor people commit criminal activities by engaging in property crime in your community					
II.	Level of Education					
1	Families headed by educated parents don't engage in criminal offences?					
2	Low education contributes low income and unemployment leading to crime?					
3	Good education reduces criminal activities in the community?					
4	The level of education has no impact on development and crime among the households?					
5	Highly educated, skilled community members hardly engage in criminal activities?					

**Part 3: Questions Related with crime and place**

22. In the table there is listed service sectors and places. In which service sector area and place crime committed in your area? Please answer by tick mark.

1: Never 2: Rarely 3: Sometimes 4: Always

No	Service sectors and places	1	2	3	4
1.	Places available school				
2.	A place which have a police station				
3.	Roads that have a street light				
4.	Roads that don't have street light				
5.	Residential area				
6.	Availability of health Center				
7.	Commercial center				
8.	Hotels, pensions and Grocery				
9.	Forest				
10.	Rivers, Streams and waste disposal tubes				
11.	Open spaces				
12.	Other				

23. In your area at what time you observe property crime repeatedly?

0800 to 1600

1600 to 2400

2400 to 0800

24. In which month property crime committed repeatedly in your residential area?



**ክፍል ሁለት፡ ወንጀል እና የሰዎች አጠቃላይ ሁኔታን የሚመለከቱ ጥያቄዎች**

5. በፖሊስ ስራ ተሳትፈው ያውቃሉ?

አዎ

አላውቅም

6. በተራ ቁጥር 5 መልስዎ አዎ ከሆነ በምን ያህል መጠን ይሳተፋሉ?

በወራት

በቀናት

በሳምንታት

7. ወንጀል ለአንተ/ቺ ምንድን ነው?

የተለመደ ነው

ጉዳት የሚያደርስ

ምንምአ ይደለም

8. ስለ ወንጀል መከላከል እውቀት አለዎት?

አዎ

የለኝም

9. በአካባቢዎ የተፈጸመን ወንጀል ሪፖርት አድርገው ያውቃሉ?

አዎ

አላውቅም

10. በተራ ቁጥር 9 መልስዎ አዎ ከሆነ በምን ያክል መጠን ሪፖርት አድርገው ያውቃሉ?

አንዳንድ ጊዜ

ሁልጊዜ

አልፎ አልፎ

11. በሚቀጥለው ሰንጠረዥ የተለያዩ ገንዘብ ነክ ወንጀሎች ተዘርዝረው ይገኛሉ። ከእነዚህ ወንጀሎች በአካባቢዎ በሚፈፀሙበት ድግግሞሽ በቅደም ተከተል ያስቀምጡ።

ተ.ቁ	የወንጀል አይነት	1ኛ	2ኛ	3ኛ	4ኛ	5ኛ	6ኛ	7ኛ
1.	ኪስ ማውለቅ							
2.	ስርቆት							
3.	የመኪና ዕቃ ስርቆት							
4.	ቅሚያ							
5.	ማታለል(ማጭበርበር)							
6.	ጉቦ							
7.	ሌሎች							

12. በተፈፀመ ወንጀል ምስክር ሁኔታ ያውቃሉ?

አዎ

አላውቅም

13. ወንጀልን መከላከል የማን ስራ አድርገው ያስባሉ?

የፖሊስ

የአካባቢው ማህበረሰብ

የፖሊሱ እና የአካባቢው ማህበረሰብ

እንደ ወንጀሉ አይነት ይወሰናል

አላውቅም

14. በወንጀል የመፈፀም ብዛት እና ድግግሞሽ የሚኖሩበትን አካባቢ በምን መጠን ይገልፁታል?

ከፍተኛ የወንጀል ቦታ

ዝቅተኛ የወንጀል ቦታ

15. ወንጀልን በመቆጣጠር እና በመከላከል ረገድ ፖሊስ ተገቢ ስራ እየሰራ ነው ብለው ያምናሉ?

አዎ

አይደለም

16. በአካባቢዎ የፖሊስን ቅኝት በምን ያክል ጊዜ ያያሉ?

በጭራሽ

ብዙ ጊዜ

አልፎአልፎ

17. በሚኖሩበት አካባቢ በየትኛው የቤተሰብ ሁኔታ ገንዘብ ነክ ወንጀሎች በተደጋጋሚ ይፈጸማሉ

- የተበተነ ቤተሰብ ያላቸው በወንጀል ስራ ይገባሉ
- ያገቡ በወንጀል ይሳተፋሉ
- ያገቡ በወንጀል አይሳተፉም
- ያላገቡ በወንጀል ይሳተፋሉ
- ያላገቡ በወንጀል አይሳተፉም

18. በሚኖሩበት አካባቢ ገንዘብ ነክ ወንጀሎች በአብዛኛው በምን የስራ ሁኔታ በተሰማሩ ወይም በሚተዳደሩ ሰዎች ይፈጸማል?

- በሥራ-አጥ
- በመንግስት ሰራተኛ
- በግል ተቀጣሪ
- በግል ስራ በሚተዳደሩ

19. በሚኖሩበት አካባቢ በየትኛው የዕድሜ ክልል ውስጥ ያሉ ሰዎች በተደጋጋሚ በገንዘብ ነክ ወንጀሎች ይሳተፋሉ ብለው ያስባሉ

- ዕድሜአቸው ከ 18 ዓመት በታች የሆኑ በወንጀል ይሳተፋሉ
- ዕድሜአቸው ከ 18 እስከ 60 ዓመት የሆኑ በወንጀል ይሳተፋሉ
- ዕድሜአቸው ከ 60 ዓመት በላይ የሆኑ በወንጀል ይሳተፋሉ

20. ወንጀልን መሰረት አድርገው ከምቻት አንፃር የሚኖሩበትን አካባቢ እንዴት ይገልጹታል?

- በጣም ምቹ
- ምቹ
- ምቹ አይደለም

21. በሚቀጥለው ሰንጠረዥ ኢኮኖሚ እና ትምህርትን መሰረት ያደረጉ ጥያቄዎች ይገኛሉ። በዚህም መሰረት በተሰጡት አማራጮች ስር የጭረት ምልክት በማድረግ መልስ/ሽ።

ተ.ቁ	ዝርዝር ጥያቄዎች	በጣም እስማማለሁ	አስማማለሁ	አልስማማም	በጣም አልስማማም
	ገቢን መሰረት ያደረጉ				
1	ትንሽ የገንዘብ መጠን ያላቸው ሰዎች የሌላን ሰው ንብረት ይሰርቃሉ				
2	ሀብታሞች የሌላ ሰውን ገንዘብ አይሰርቅም				
3	ዝቅተኛ የገንዘብ መጠን ያላቸው በወንጀል ይሳተፋሉ				
5	የድሀ ቤተሰብ ወጣቶች በወንጀል ይሳተፋሉ				
6	በካክለኛ ገቢ ያላቸው ሰዎች በወንጀል ይሳተፋሉ				
	ትምህርት መሰረት ያደረጉ				
1	የተማሪ ቤተሰብ ያላቸው በወንጀል አይሳተፉም				
2	ዝቅተኛ ትምህርት ያላቸው ሰዎች በወንጀል ይሳተፋሉ				
3	ጥሩ ትምህርት ወንጀልን ይቀንሳል				
4	የትምህርት ደረጃ ለወንጀል መስራት እና አለመስራት ተፅዕኖ አለው				
5	የተማሩ ሰዎች በወንጀል ይሳተፋሉ				
6	የተማሩ ሰዎች በወንጀል አይሳተፉም				

**ክፍል ሶስት፡ ወንጀል እና ቦታን የሚመለከቱ ጥያቄዎች**

22. በሚኖሩበት አካባቢ በየትኛው ተቋማት እና ቦታዎች ምን ያካል የወንጀል ድርጊት እንደሚፈጸም ከታች ከተዘረዘሩት አማራጮች በመምረጥ መልስ/ሽ፡፡

1፡ በጭራሽ 2፡አልፎ አልፎ 3፡ ብዙ ጊዜ 4፡ ሁልጊዜ

ተ.ቁ	ተቋማት እና ቦታዎች	1	2	3	4
13.	ትምህርት ቤቶች ባሉበት አካባቢ				
14.	የፖሊስ ተቋማት ባሉበት አካባቢ				
15.	የመንገድ መብራት ባለው መንገድ				
16.	የመንገድ መብራት በሌለው መንገድ				
17.	የህግ ማስከበሪያ ተቋማት ባሉበት ቦታ				
18.	የጤና ተቋማት ባሉበት አካባቢ				
19.	የንግድ ተቋማት ባሉበት አካባቢ				
20.	በሆቴሎች፣ በግሮሰሪዎች እና ፔንሲዎኖች				
21.	ዛፎች በሚበዙበት አካባቢ				
22.	ወንዞች ፤ የቆሻሻ ቱቦ መስመሮች				
23.	ባዶ ቦታዎች (ኳስ ሜዳ፣ ወደ ግንባታ ያልገቡ ቦታዎች.....)				
24.	ሌሎች				

23. በአብዛኛው ገንዘብ ነክ ወንጀሎች በየትኛው የስዓት ክልል ውስጥ ይፈፀማሉ?

ከጥዋቱ 2:00 እስከ ቀኑ 10:00

ከቀኑ 10:00 እስከ ሌሊቱ 6:00

ከሌሊቱ 6:00 እስከ ጥዋቱ 2:00

24. በሚኖሩበት አካባቢ በአብዛኛው በየትኛው ወር ገንዘብ ነክ ወንጀሎች ይፈፀማሉ ብለው ያስባሉ?

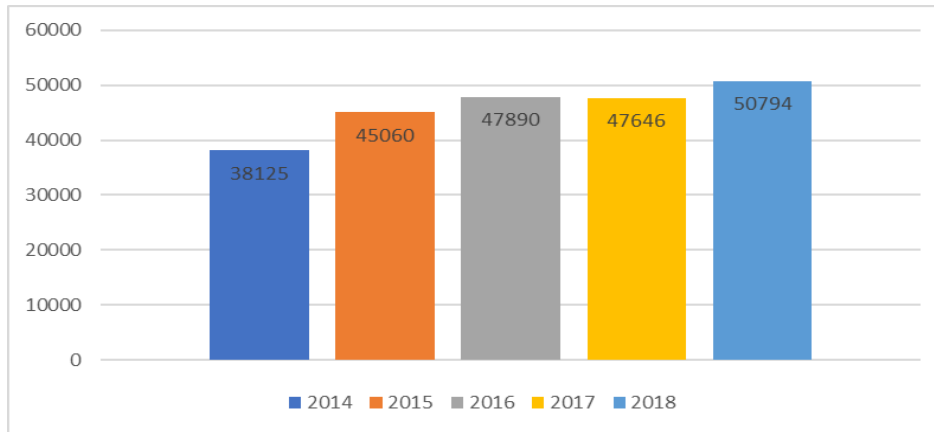
### Annex 3: Interview guide

1. In the sub-city crime is highly committed in day tour condition. What do you think about the reason of this issues?
2. In Lideta sub-city property is committed frequently by unmarried and extended families. Why such families frequently commit a crime?
3. What do you think about the participation of the community for the reduction property crime?
4. Based on your crime record data and respondent's response high property crime commission were by 18 to 60 age range and unemployed. What is the reason for this?

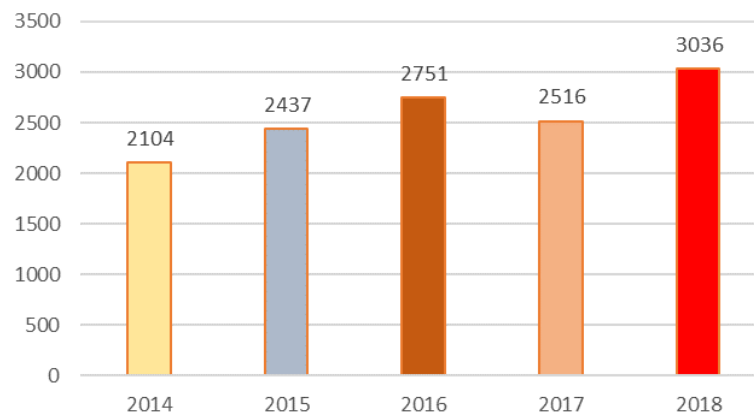
### Annex 4: Attribute data used

FID	Shape *	longitude	latitude	Season	Date	Crime_type	Sex	Time	Age	Education	Job	Family_sta	Residentia
0	Point	38.752057	9.022026	Autumn	2010	Theft	Male	930	31	Junior	Private	Unmarried	Lideta
1	Point	38.74248	9.026712	Autumn	2010	Bribery	Male	830	35	Junior	Private	Unmarried	Lideta
2	Point	38.7357	9.015109	Autumn	2010	Bribery	Female	1210	55	Diploma	Private	Married	Bole
3	Point	38.74248	9.026712	Autumn	2010	Bribery	Male	1745	22	Junior	Private	Unmarried	Kolfe keranio
4	Point	38.743852	9.016496	Autumn	2010	Bribery	Male	1850	21	Junior	Unemployed	Unmarried	Nifas silk lafto
5	Point	38.745209	9.010857	Autumn	2010	Bribery	Missed	1030	Missed	Missed	Missed	Missed	Missed
6	Point	38.745209	9.010857	Autumn	2010	Bribery	Male	1030	24	Diploma	Private	Married	Gulelle
7	Point	38.728772	9.011656	Autumn	2010	Bribery	Male	1700	34	2nd level	Private	Married	Kirkos
8	Point	38.744861	9.013962	Autumn	2010	Bribery	Male	1955	25	2nd level	Private worker	Unmarried	South
9	Point	38.746571	9.015877	Autumn	2010	Bribery	Male	930	21	Junior	Private worker	Unmarried	Nifas silk lafto
10	Point	38.736319	9.00697	Autumn	2010	Theft	Missed	1200	Missed	Missed	Missed	Missed	Missed
11	Point	38.7404	9.02137	Autumn	2010	Theft	Missed	700	Missed	Missed	Missed	Missed	Missed
12	Point	38.74446	8.998871	Autumn	2010	Bribery	Male	1750	22	2nd level	Private worker	Unmarried	Nifas silk lafto
13	Point	38.719094	9.016254	Autumn	2010	Bribery	Male	1520	22	Junior	Private	Unmarried	South
14	Point	38.719094	9.016254	Autumn	2010	Bribery	Male	1515	23	2nd level	Private worker	Married	Oromia
15	Point	38.735948	9.020422	Autumn	2010	Looting	Male	600	17	2nd level	Unemployed	Unmarried	Lideta
16	Point	38.752057	9.022026	Autumn	2010	Bribery	Male	1200	20	Degree	Private	Unmarried	Bole
17	Point	38.739461	9.011345	Autumn	2010	Theft	Male	1845	16	2nd level	Private	Unmarried	Lideta
18	Point	38.73808	9.016605	Autumn	2010	Bribery	Male	1515	36	Junior	Private worker	Married	Oromia
19	Point	38.747383	9.015222	Autumn	2010	Misappropriation	Missed	1400	Missed	Missed	Missed	Missed	Missed
20	Point	38.741175	9.012864	Autumn	2010	Misappropriation	Missed	1400	Missed	Missed	Missed	Missed	Missed
21	Point	38.743608	9.027077	Autumn	2010	Misappropriation	Missed	1200	Missed	Missed	Missed	Missed	Missed
22	Point	38.743608	9.027077	Autumn	2010	Theft	Male	1200	37	2nd level	Private	Married	Bole
23	Point	38.74555	9.011532	Autumn	2010	Misappropriation	Missed	1500	Missed	Missed	Missed	Missed	Missed
24	Point	38.728261	9.010315	Autumn	2010	Bribery	Male	1600	34	2nd level	Private worker	Married	Nifas silk lafto
25	Point	38.734	9.0166	Autumn	2010	Looting	Missed	800	Missed	Missed	Missed	Missed	Missed
26	Point	38.744105	9.011459	Autumn	2010	Bribery	Male	1330	31	Diploma	Private	Married	Nifas silk lafto
27	Point	38.738425	9.017607	Autumn	2010	Looting	Male	2330	18	Junior	Unemployed	Unmarried	Lideta
28	Point	38.74555	9.011532	Autumn	2010	Looting	Male	1130	20	2nd level	Private	Unmarried	Lideta
29	Point	38.716836	9.018753	Autumn	2010	Theft	Male	1310	21	Junior	Private	Unmarried	South
30	Point	38.736701	9.009426	Autumn	2010	Theft	Male	1100	25	Junior	Private	Unmarried	Lideta
31	Point	38.73808	9.016605	Autumn	2010	Bribery	Male	1120	25	Junior	Private	Unmarried	Oromia
32	Point	38.751133	9.018011	Autumn	2010	Theft	Male	2400	23	2nd level	Private worker	Unmarried	Nifas silk lafto
33	Point	38.7286	9.01824	Autumn	2010	Looting	Male	700	25	Diploma	Private	Unmarried	Lideta
34	Point	38.73808	9.016605	Autumn	2010	Bribery	Male	1615	38	2nd level	Private	Unmarried	Lideta
35	Point	38.746571	9.015877	Autumn	2010	Bribery	Male	930	16	Diploma	Private	Unmarried	Oromia
36	Point	38.747607	9.012419	Autumn	2010	Misappropriation	Male	1600	32	Diploma	Private	Married	Oromia
37	Point	38.738943	9.009611	Autumn	2010	Misappropriation	Missed	1030	Missed	Missed	Missed	Missed	Missed
38	Point	38.741344	9.010749	Autumn	2010	Pick pocket	Male	1145	21	2nd level	Private	Unmarried	Arada

**Annex 5: Addis Ababa crime trend of five years**



**Annex 6: Lideta sub-city property crime trend (2014 to 2018)**



**Annex 7: Criminal job categories**

	Frequency	Percent	Valid Percent	Cumulative Percent
Private(self)	250	30	30	30
Government	12	1.4	1.4	31.5
Private worker	67	8	8.0	39.5
Farmer	1	0	0.1	39.6
Unemployed	71	8	8.5	48.1
Missed	432	51.9	51.9	100
Total	833	100	100.0	

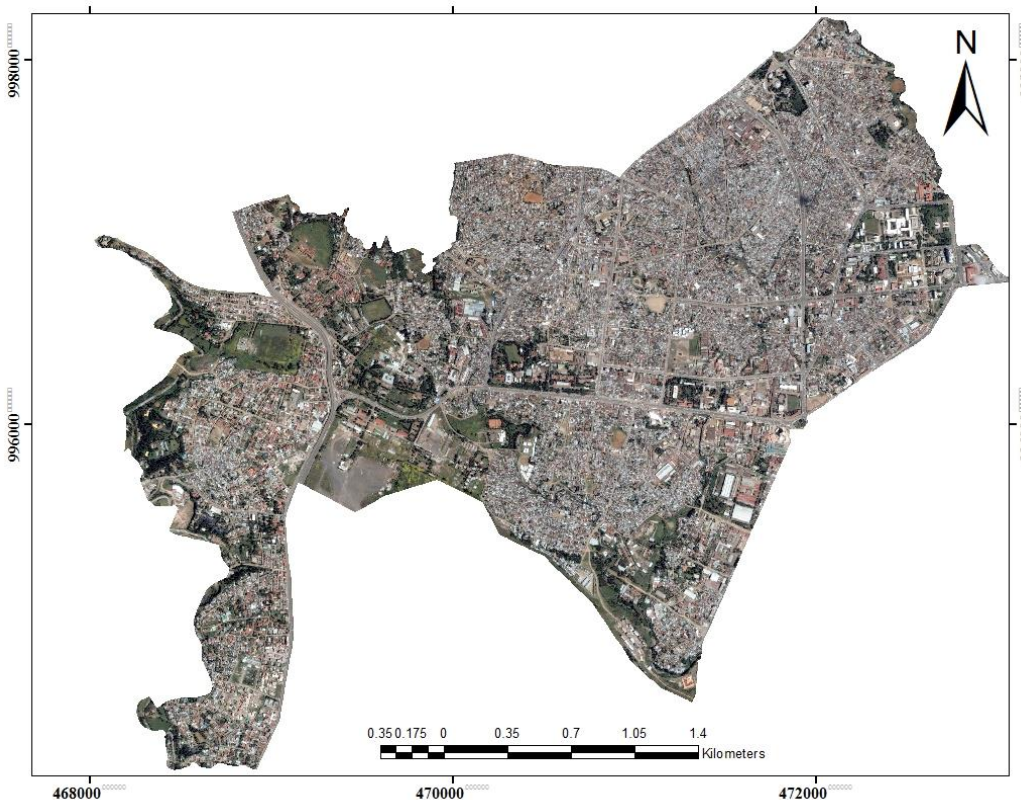
**Annex 8:** Criminal age record from Lideta sub-city police office

	Frequency	Percent	Valid Percent	Cumulative Percent
<18	66	7.9	7.9	7.9
18-60	357	42.9	42.9	50.8
>60	1	0.1	0.1	50.9
Missed	409	49.1	49.1	100
Total	833	100.0	100	

**Annex 9:** Family status of the criminal from Lideta police office crime record

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Married	114	13.7	13.7	13.7
Valid Unmarried	301	36.1	36.1	49.8
Valid Missed	418	50.2	50.2	100.0
Total	833	100	100	

**Annex 10:** Lideta Sub-city orthophoto



Annex 11: Crime type level of Lideta police office crime data

	Frequency	Percent	Valid Percent	Cumulative Percent
Theft	248	29.8	29.8	29.8
Looting	113	13.6	13.6	43.3
Misappropriation	149	17.9	17.9	61.2
Briber	145	17.4	17.4	78.6
Pick-pocket	29	3.5	3.5	82.1
No crime record	149	17.9	17.9	100.0
Total	833	100.0	100.0	

Annex 12: Crime type and committed severe time

	crime committed time			Total	
	0800-1600	1600-2400	2400-0800		
Crime type					
	Theft	131	80	35	246
	Looting	40	55	17	112
	Misappropriation	116	29	3	148
	Briber	101	34	10	145
	Pick pocket	19	6	4	29
Total		407	204	69	680

