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Crime Mapping and Forecasting Using Geospatial Techniques: A Case of Ajmer

Kajal Yadav

Abstract: ***Advances in computer technology, the development of GIS application software, and the ability to access various geographic data through open-source data sources have allowed police and law enforcement agencies to use it effectively. Crime mapping and spatial analysis using GIS tools such as hotspot generation, zoning, crime navigation and profiling, mobile location recognition, and various web applications are clearly recognized and can be scientifically applied to improve citizenship while being effectively used to predict and control crime.***

The present study analyzed the trends and patterns of crime data (murder, rape, robbery, theft, kidnapping, engraving, and gambling) in Ajmer Zone from 2015–2022 (till October) to understand the trends of crime data (IPC crime registered). I also used the demographic data of Ajmer to understand crime trends towards various crime types

The study focused on the most common crimes reported, which were theft and gambling, as opposed to murder, rape, kidnapping, and robbery. All crimes were reported in 1,009 incidents in 2015. In 2016, 1,064 cases were recorded. In 2017, 1081 cases were reported. In 2018, 1034 cases were reported. In 2019, 1415 cases were reported. In 2020, 829 cases were reported. In 2011, 1120 cases were reported. In 2022, 1268 cases were reported. The highest number of cases occurred in 2017, 2019, and 2022, and the lowest number of cases occurred in 2015 and 2016.

According to the crime study for 2015–2022 (till October), I found that many areas where crime is increasing or that are crime hotspots are found every year.

I. INTRODUCTION

Crimes committed or resolved in a given time frame may not be particularly effective. In India the majority of Indian states, crime mapping is done physically to aid in locating Suspects and determining their method of operation. It helps the police identify locations where a specific suspect or suspects are active. A crime is an action carried out by a person or group of people that is immoral, damaging, and unsocial to the community. Illiteracy, poverty, and Vengeance can lead to crime (Ansari & Kale, 2014).

Today, nobody is safe. There are many criminals in the world, and criminal activity is increasing globally nowadays. Due to advances in science and technology, criminals are no adopting scientific methods to carry out their crimes, which have left the police perplexed.

I took into consideration a variety of crimes in this study, including robbery, theft, kidnapping, Rape, murder, and other crimes. The crime incidences are recorded based on coordinates using GPS system and fed using a tool so as to generate maps with color coding for crime analysis.

The basic idea of this is that it does not only curb the crime but can also provide a quick response by the police. Patrolling units that are nearby. The system that is used for capturing, storing, and converting .Data format, exploring and displaying geospatial data is known as Geographic Information.

System (GIS). Crime patterns change over space and time in an area, and hence they are of immense

Help police by using GIS maps and spatial crime patterns to capture and study the patterns.

For better crime control (Pramod Kumar, Ravikumar, & Soma, 2012). The present study focuses

On to identifying crime-prone zones through crime mapping with a probability of occurrence

Based on past incidences of various crimes

II. LIMITATIONS OF THE STUDY

Field survey data has been collected for seven year (2015-2022till October) with respect to certain crimes. Many other aspects like suicide, juvenile delinquency, molestation have not been covered in this study. The socio-economic data was available only for one-year 2011, thus it has been taken as a base year due to paucity of data for the years

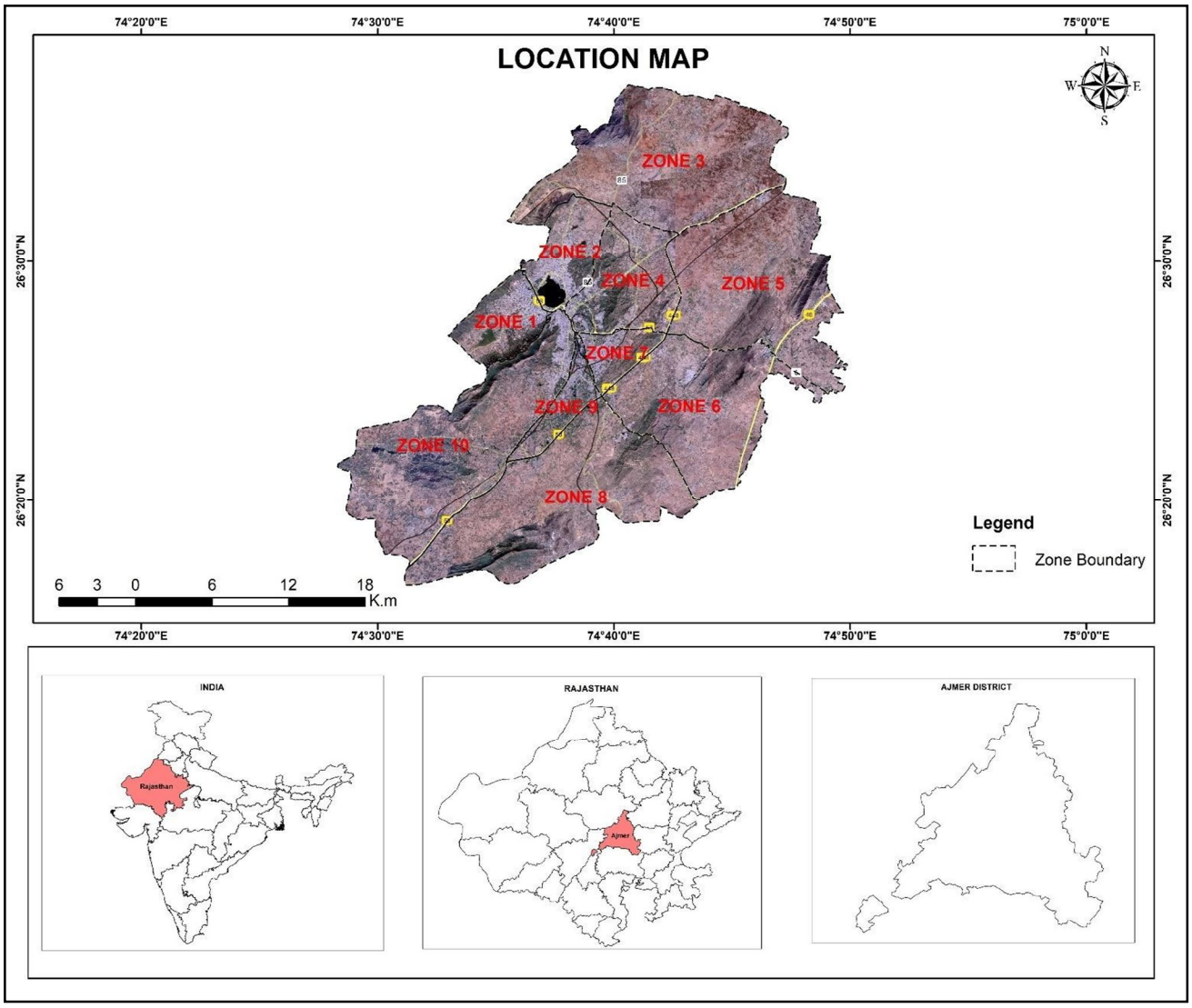
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III. STUDY AREA

Ajmer is one of the oldest cities in the Indian states of Rajasthan. Ajmer is surrounded by Aravalli mountains. Ajmer city is head quarter of Ajmer district and is a popular religious and tourist place. The city was founded by Raja Ajay Pal Chauhan in the 7th century A.D. and continued to be a major center of Chauhan power till 1193A.D. When Prithvi raj Chauhan lost it to Mohmmed Gauri. Since then, Ajmer is a popular pilgrimage center for the Hindus as well as Muslims. Ajmer geographically lies nearly in the center of Rajasthan (India) between 25^0 38' to $26^0$58' North latitudes and $75^0$54' to $75^0$22' East longitudes.

The Ajmer city is divided into 80 wards for which elections are held every 5 years. Ajmer has a population of 542,321 peoples (census2011)



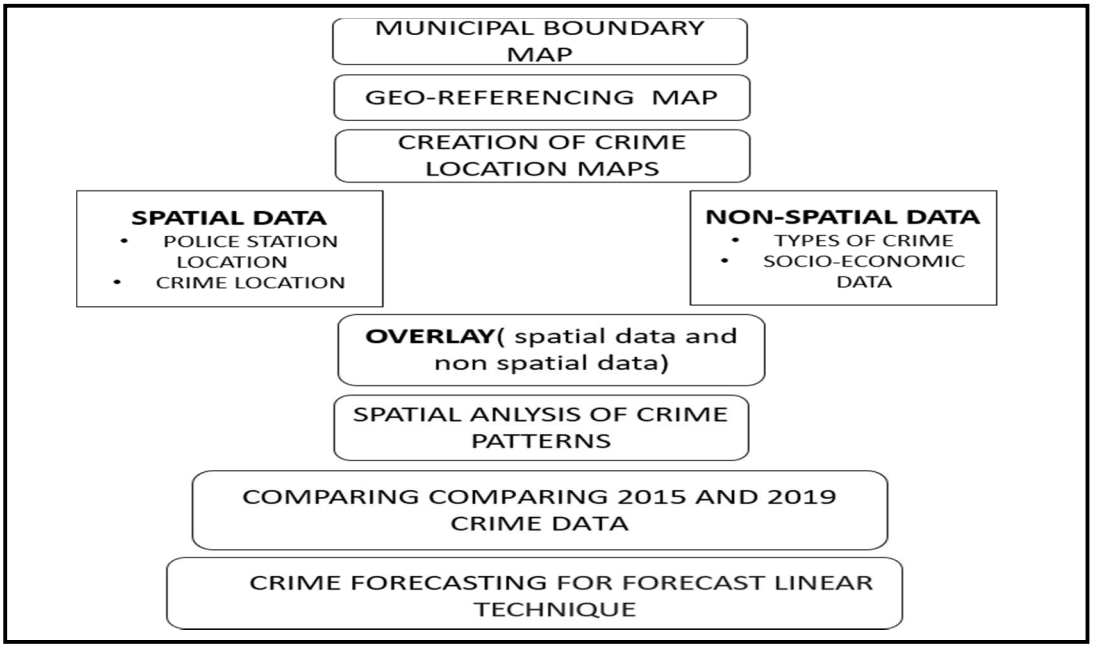
IV. OBJECTIVES

Crime and Geography are interrelated to each other in every possible way, as per Mayhew (2009). The main aim of the present work is to spatial analysis of crime and crime mapping for Ajmer city police force for better management.

1) To understand socio-economic factors behind crime.
2) To analysis crime trends and pattern that occurred in 2015 to 2022(till October)
3) To hotspot analysis and graphs of crime in the study area.
4) To forecast future rate of crime based on time series analysis.

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V. METHDOLOGY

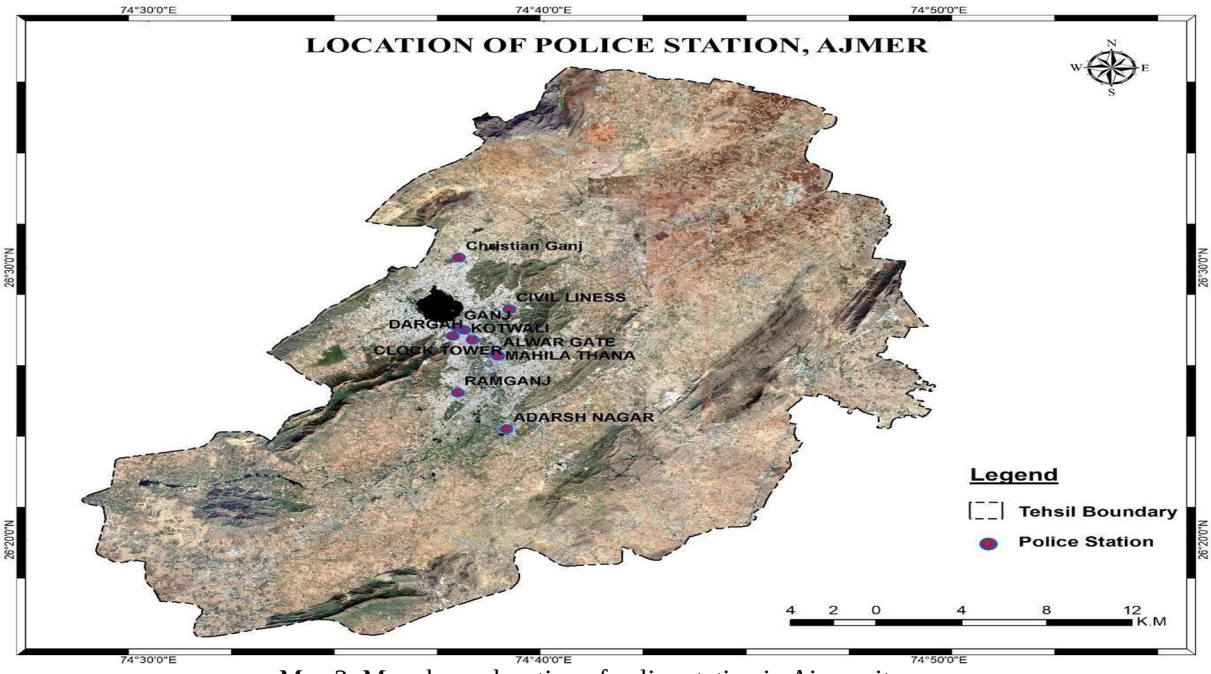


VI. DATA USED

1) The IPC crime incidents data is collected from the SP Office, Crime Branch & each Policestation of Ajmer city from 2015 to 2022 (till October 2022).

2) Crime data About Murder, Rape, Kidnapping, Robbery, Theft, Engraving and Gambling.

3) Census data were collected from Statistical department & Nagar Nigam of Ajmer.



Map 2- Map shown location of police station in Ajmer city

Nine police stations (PS) and one all-female police station are located in the city (Mahila). The city region is traversed by four important national highways: NH-8, NH-58, NH-79, and NH-89.

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VII. RESULTS

A. *Demographic Analysis of Ajmer City*

In 2011, Ajmer had population of 2,583,052 of which male and female were 1,324,085 and 1,258,967 respectively. In 2001 census, Ajmer had a population of 2,181,670 of which males were 1,129,920 and remaining 1,051,750 were females

Population	542321
Male Population	278545 (51.36%)
Female Population	263776 (48.64%)
Children Population	60922
Sex-ratio	947
Literacy	76.8%
Male Literacy	81.41%
Female Literacy	71.94%

Table1 -Demographic details of Ajmer city (2011)

Some of the specific socioeconomic factors that have been found to be associated with crimeinclude:

1) *Poverty:* Individuals and families living in poverty are more likely to be involved in criminal activity than those with higher incomes. This may be due to a lack of economic resources andopportunities, as well as other factors such as poor education, lack of stable housing, and exposure to crime and violence.
2) *Unemployment:* High levels of unemployment can lead to poverty and financial strain, and have been linked to increased rates of criminal activity.
3) *Education:* Individuals with lower levels of education are more likely to be involved in criminalactivity than those with higher levels of education. Poor education can limit job opportunities and economic mobility, which may contribute to criminal behaviour.
4) *Housing:* Poor or overcrowded housing conditions can contribute to increased stress and crime. Communities with higher rates of concentrated poverty, tend to have higher rates of criminal activity. Family Structure: Children from broken homes, or those who grow up in households with a history of criminal behaviour are more likely to engage in criminal activity themselves.

It's important to note that socioeconomic factors do not fully explain criminal behaviour, and there are many other factors that contribute to criminal activity, including individual characteristics such as impulsivity, aggression, and mental health issues. Additionally, the relationship between socioeconomic factors and crime is complex, and further research is needed to fully understand the mechanisms by which these factors contribute to criminal activity.

Social injustice shows itself in crime. It is an unlawful act that violates state law and is stronglycriticized by the general public. Any behaviour that violates the law and is punished by imprisonment or monetary fines is referred to as a crime. Crimes include murder, robbery, burglary, rape, drunk driving, abuse of children, and failing to pay taxes.

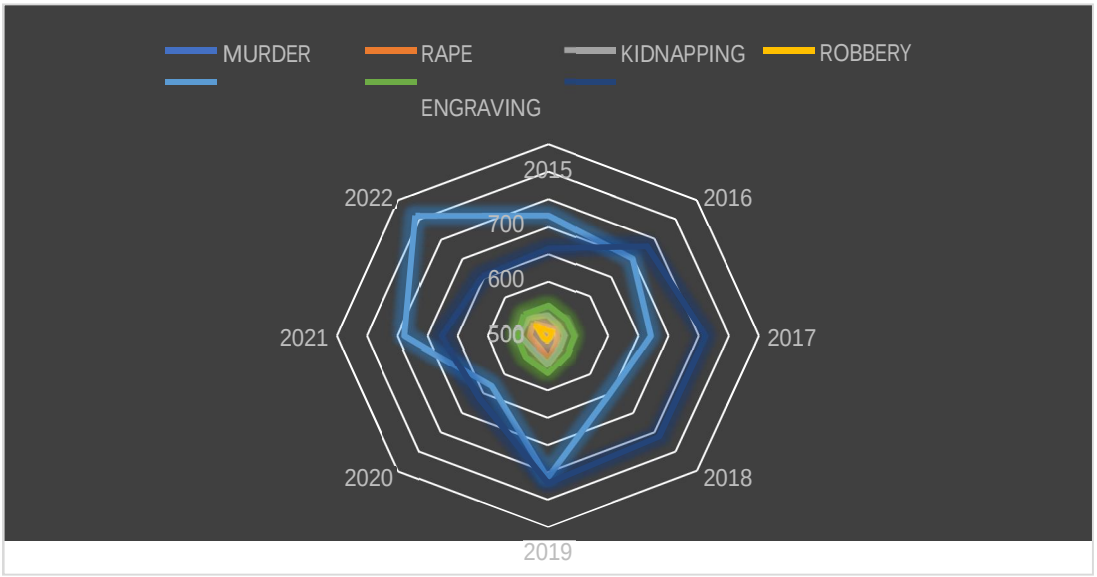
VIII. CRIME ANALYSIS IN AJMER CITY

TYPES OF CRIME	2015	2016	2017	2018	2019	2020	2021	2022
MURDER	11	12	16	10	16	8	16	9
RAPE	33	36	30	41	80	49	61	68
KIDNAPPING	76	52	58	62	105	70	92	93
ROBBERY	17	21	14	12	19	15	17	54
THEFT	439	397	342	297	520	260	477	621
ENGRAVING	113	85	88	91	136	105	104	113
GLAMBLING	320	464	523	522	539	322	353	310
TOTAL	1009	1067	1071	1035	1415	829	1120	1268

Table2- Crime Statistics in Ajmer city during the years2015-2022(till October)

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By looking at and evaluating crime statistics from Ajmer's nine police stations and the crimemap from 2015 to 2022 (till October)



Calculate the crime rate with population and literacy rate of Ajmer city.

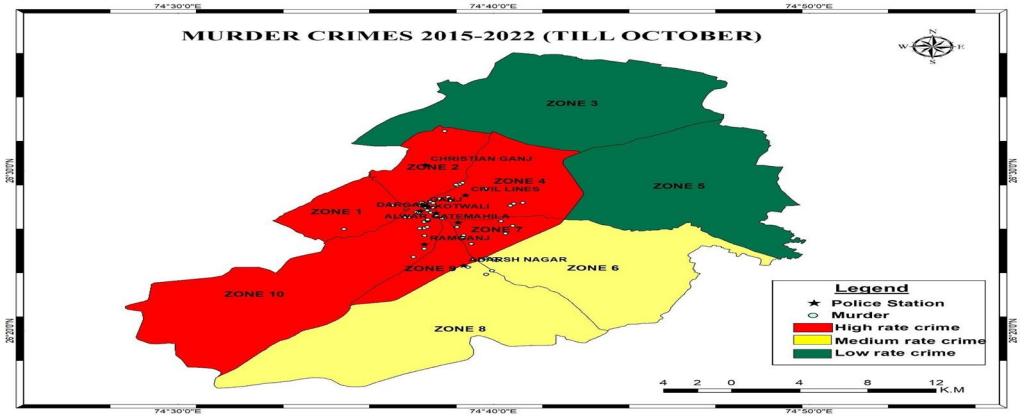
YEARS	NUMBER OF CRIME IN AJMER/ TOTAL POPULATION OF AJMER IN YEAR 2011	CRIME RATE
2015	3190/542321*10000	58.82%
2016	3221/542321*10000	59.39%
2017	3208/542321*10000	59.15%
2018	3241/542321*10000	59.76%
2019	4243/542321*10000	78.23%
2020	3024/542321*10000	55.76%
2021	3617/542321*10000	66.69%

Graph1- Calculate the crime rate with population

According to 2011 population crime rate of 2015 to 2021 increase and decrease manner, mostly decrease crime rate in 2016 and highest crime rate in 2019

A. Murder

Murder is the unlawful killing of another person without a justifiable reason or justifiable reason, especially the premeditated unlawful killing of another person



Crime forecasting refers to the basic process of predicting crimes before they occur. In excel Microsoft office use forecast linear technique.

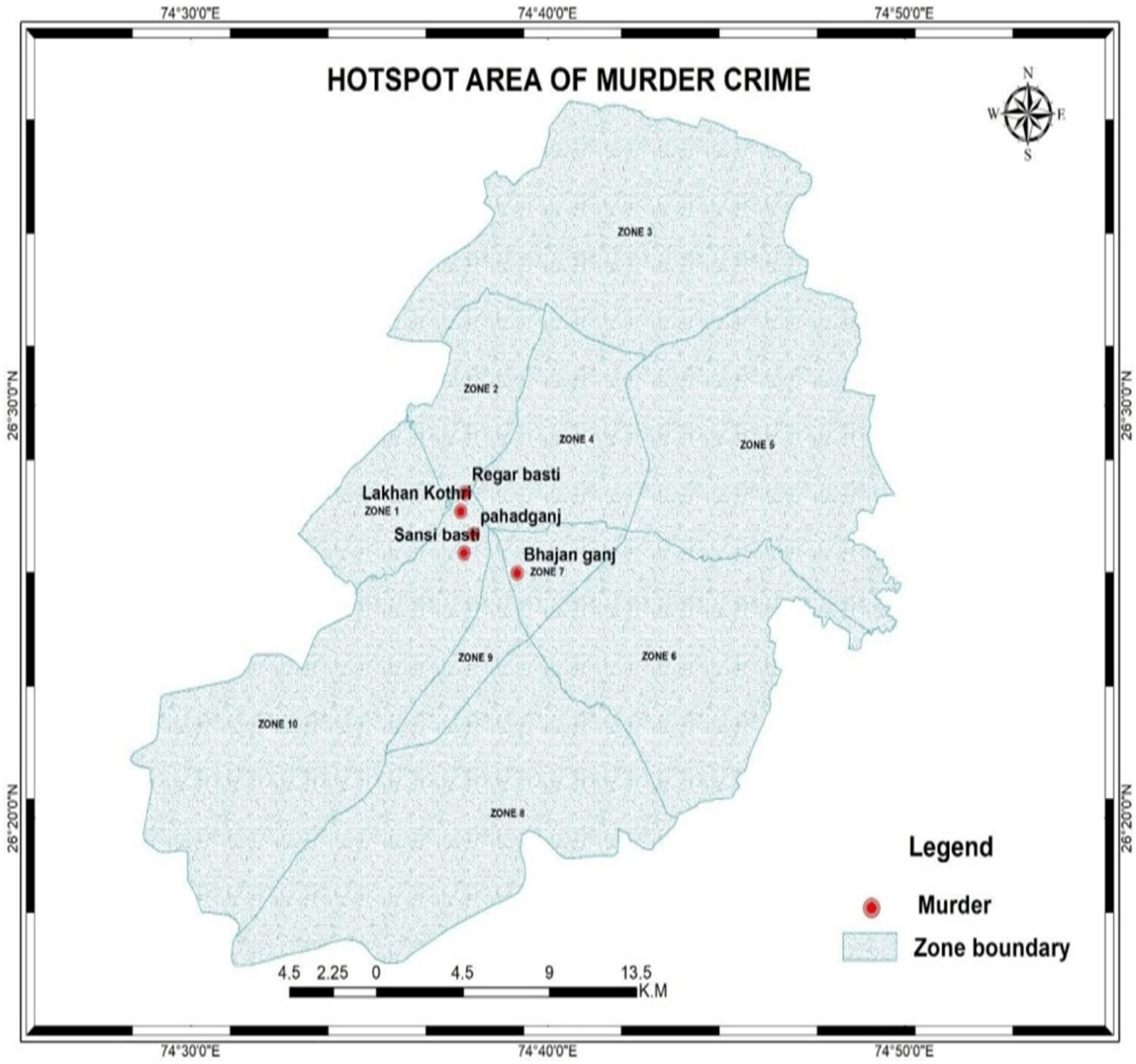
After studying, for 2015 -2022 (till October) crime map of murder, found that murder attemptin the major in three police station area. Hotspot area found near Ganj and Alwar gate zone area.

In Ramganj area- near Shashi basti and pahadganjIn Alwar gate area- bhajanganj

In Ganj area- regar mohalla , Lakhan kothri

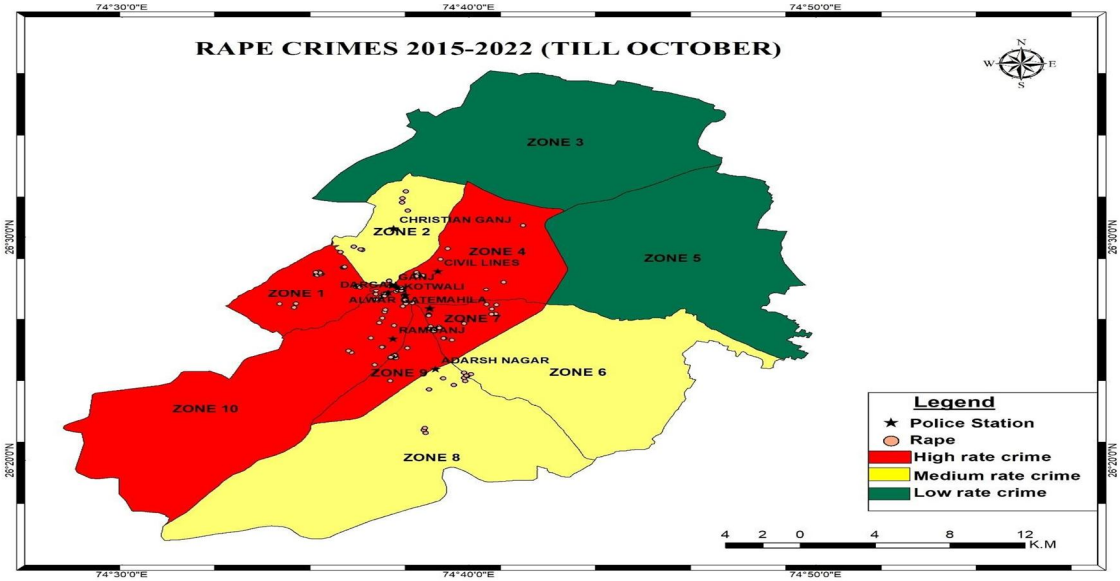
1) Forecast value

2023	11.60714286
2024	11.46428571
2025	11.32142857



B. Rape

Rape is a type of sexual assault that usually involves sexual intercourse or other forms of sexual penetration against a person without their consent. Action that may be taken by force, coercion, abuse of power, or against a person incapable of giving valid consent, such as an unconscious, incompetent, incapacitated person intellectual or not of legal age to consent.



According to this graph more cases were occurred in 2019 and 2022, comparatively other years.

Crime forecasting refers to the basic process of predicting crimes before they occur. In excel Microsoft office use forecast linear technique.

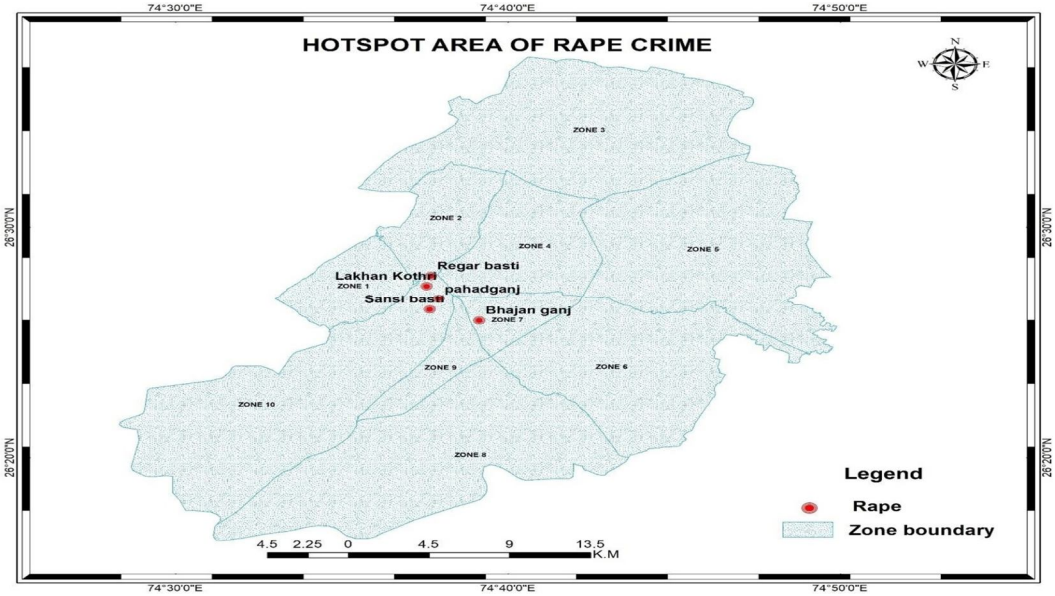
1) Forecast Value

2023	74.71428571
2024	80.26190476
2025	85.80952381

After studying, for 2015 -2022 (till October) crime map of rape, found that rape occurred in the major in two police station area. Hotspot area found near Ramganj and Alwar gate zone area.

In Ramganj area- shashibasti, somalpura

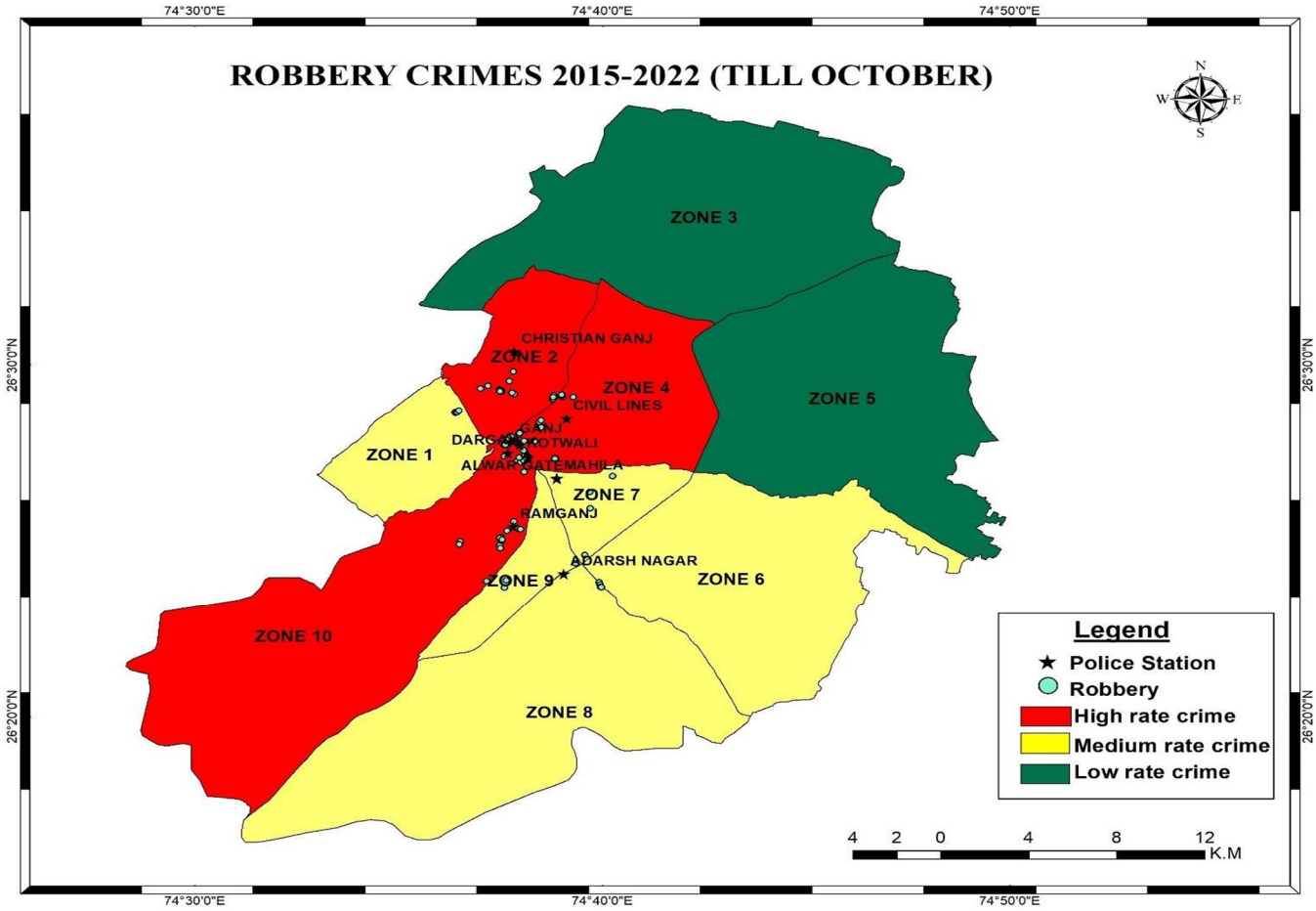
In Alwar gate area- bihariganj , madarpura road, near nagara



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C. Robbery

Robbery is the act of taking anything of worth or attempting to steal it when using force, thethreat of force, or terror. Robbery is crime against person.



According to this graph more cases were occurred in 2016 and 2022, comparatively other years.

Crime forecasting refers to the basic process of predicting crimes before they occur. In excel Microsoft office use forecast linear technique.

1) Forecast Value

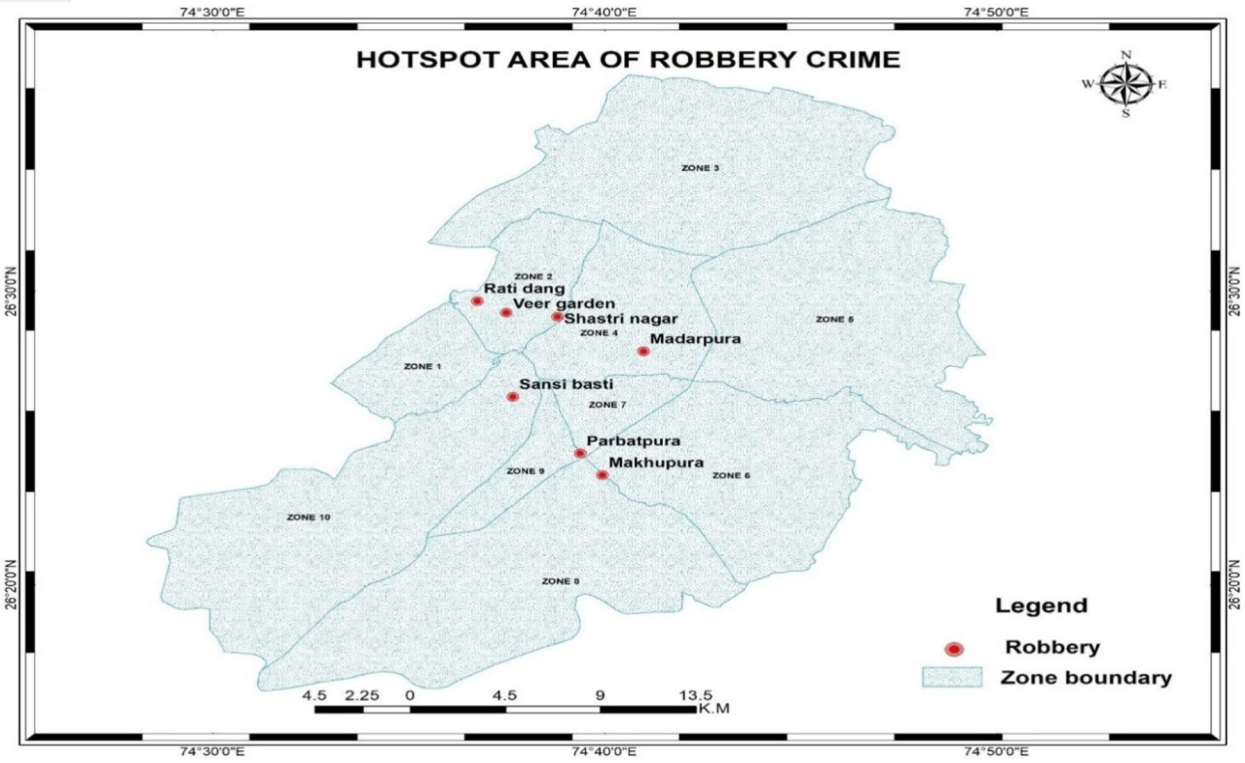
2023	34.46428571
2024	37.42857143
2025	40.39285714

After studying, for 2015 -2022 (till October) crime map of robbery, found that robbery occurred in the major in three police station area. Hotspot area found near Ramganj, AdarshNagar and Christian Ganj zone area.

In Ramganj area- shashibasti

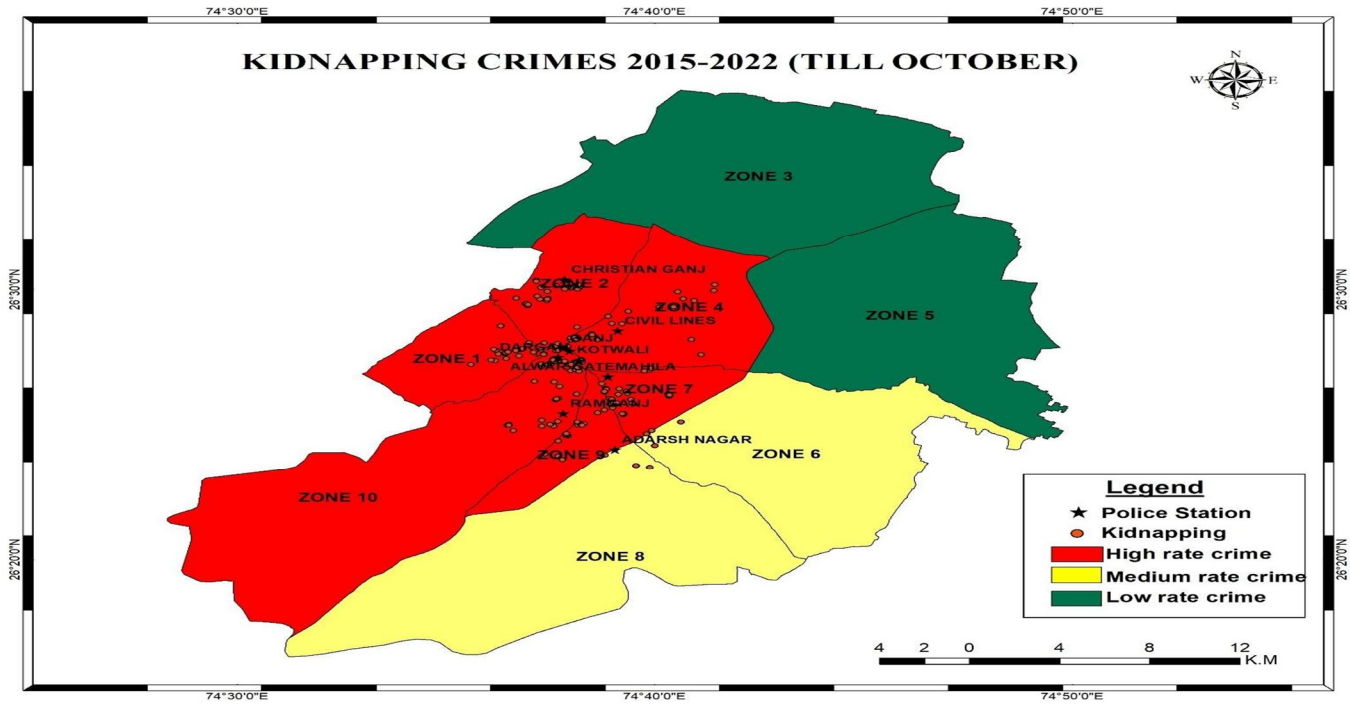
In Adarsh Nagar area- makupura, pravatpura

In Christian Ganj area- shastri nagar, veer garden, rati dang



D. Kidnapping

Kidnapping, also spelled kidnaping, criminal offense consisting of the unlawful taking andcarrying away of a person by force or fraud or the unlawful seizure and detention of a person against his will.



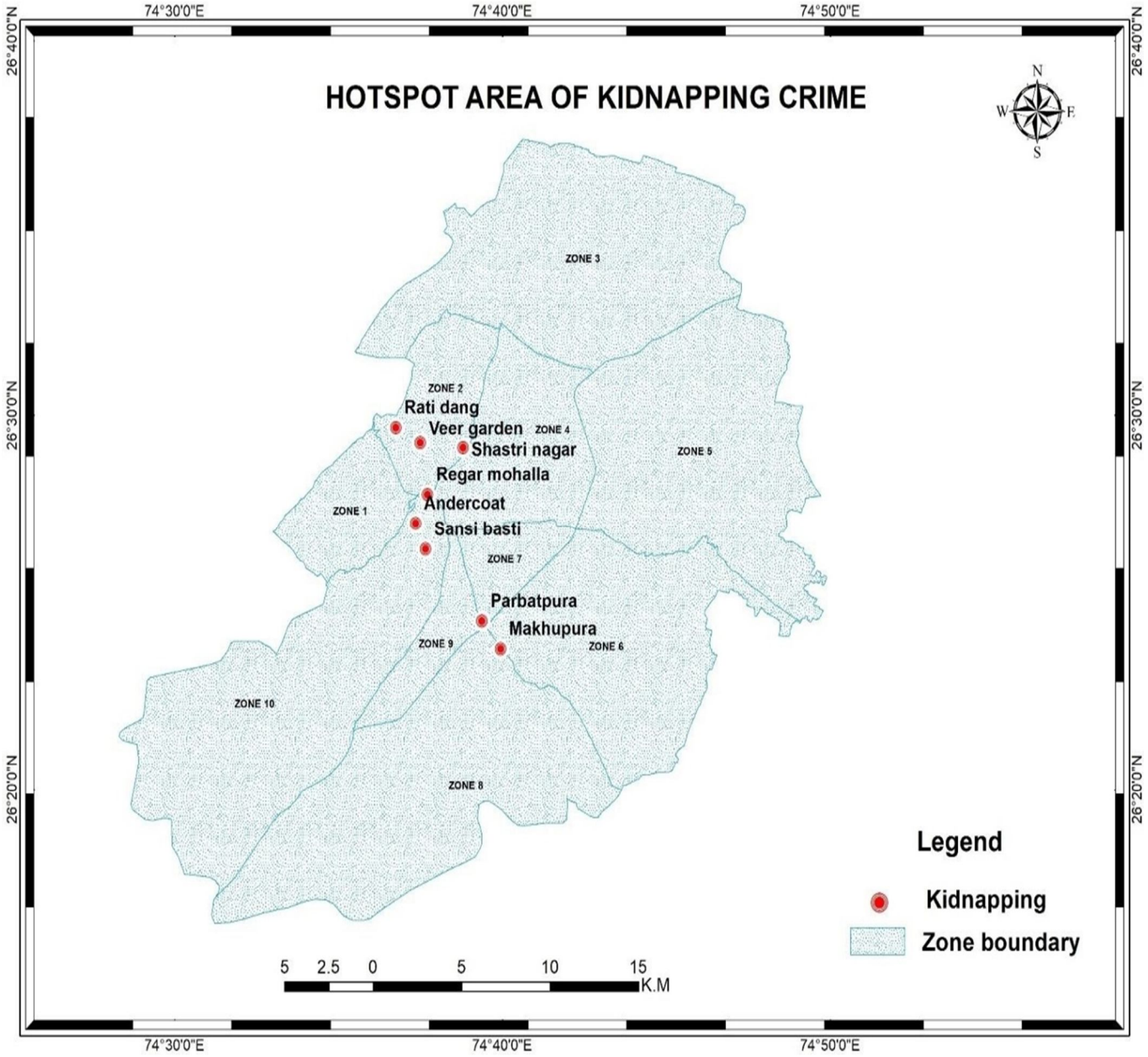
According to this graph more cases were occurred in 2019, 2021 and 2022, comparatively other years.

Crime forecasting refers to the basic process of predicting crimes before they occur. In excel Microsoft office use forecast linear technique.

1) Forecast Value

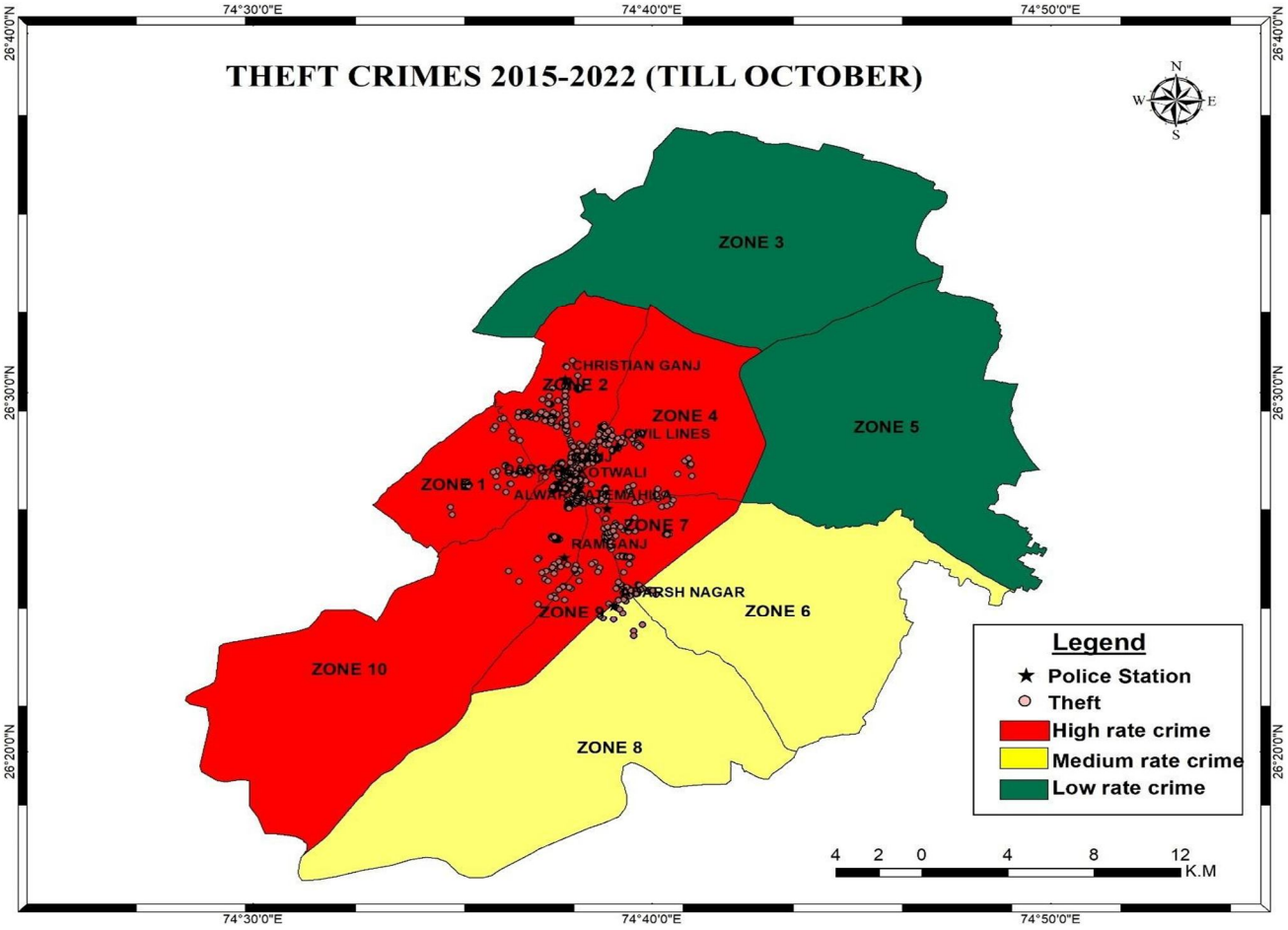
2023	97.32142857
2024	102.0595238
2025	106.797619

After studying, for 2015 -2022 (till October) crime map of kidnapping, found that kidnappingoccurred in the major in four police station area. Hotspot area found near Ramganj, Alwar gate, Ganj and Christian Ganj zone area.
In Ramganj area- shashibasti
In Alwar Gate area- makupura, pravatpura
In Christian Ganj area- shastri nagar, veer garden, rati dang



E. Theft

Theft crimes are crimes that involve the unauthorized taking of the property of another with the intent to deprive them of it permanently.



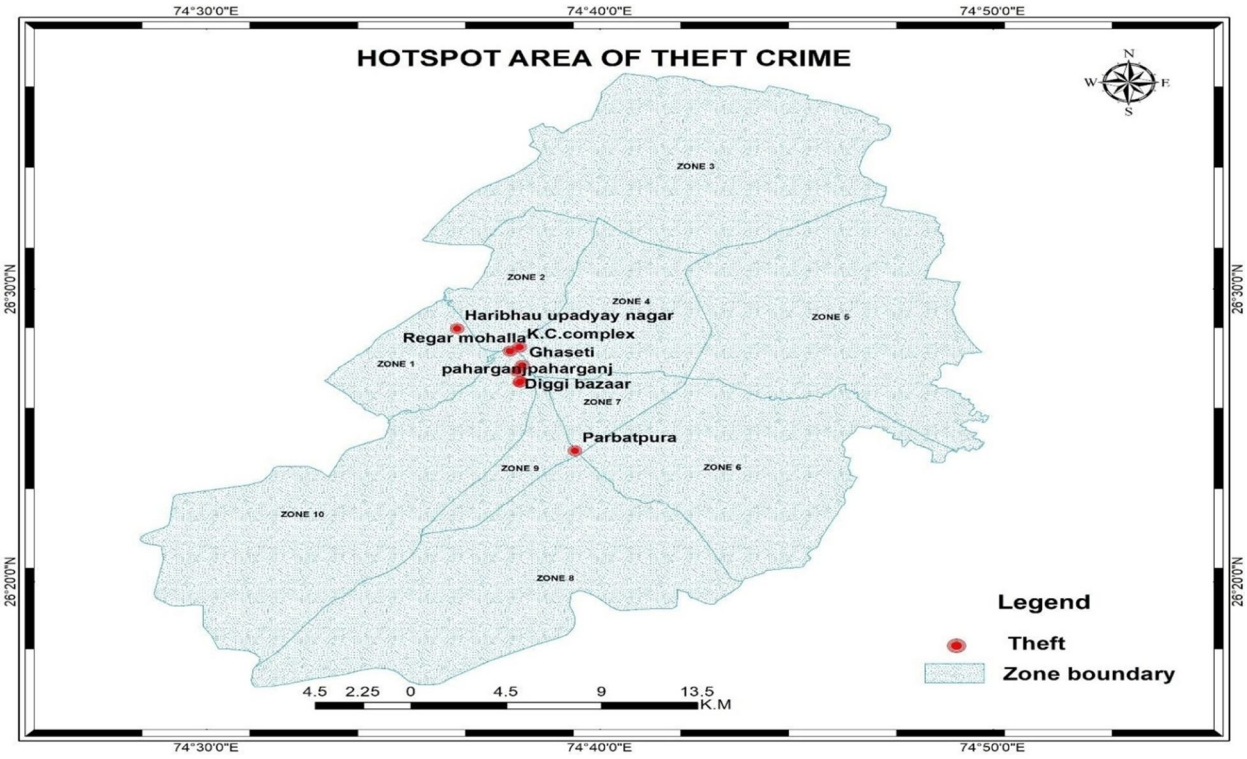
According to this graph more cases were occurred in 2019, 2021 and 2022, comparatively other years.Crime forecasting refers to the basic process of predicting crimes before they occur. In excelMicrosoft office use forecast linear technique.

1) Forecast Value

2023	508.3214286
2024	528.2261905
2025	548.1309524

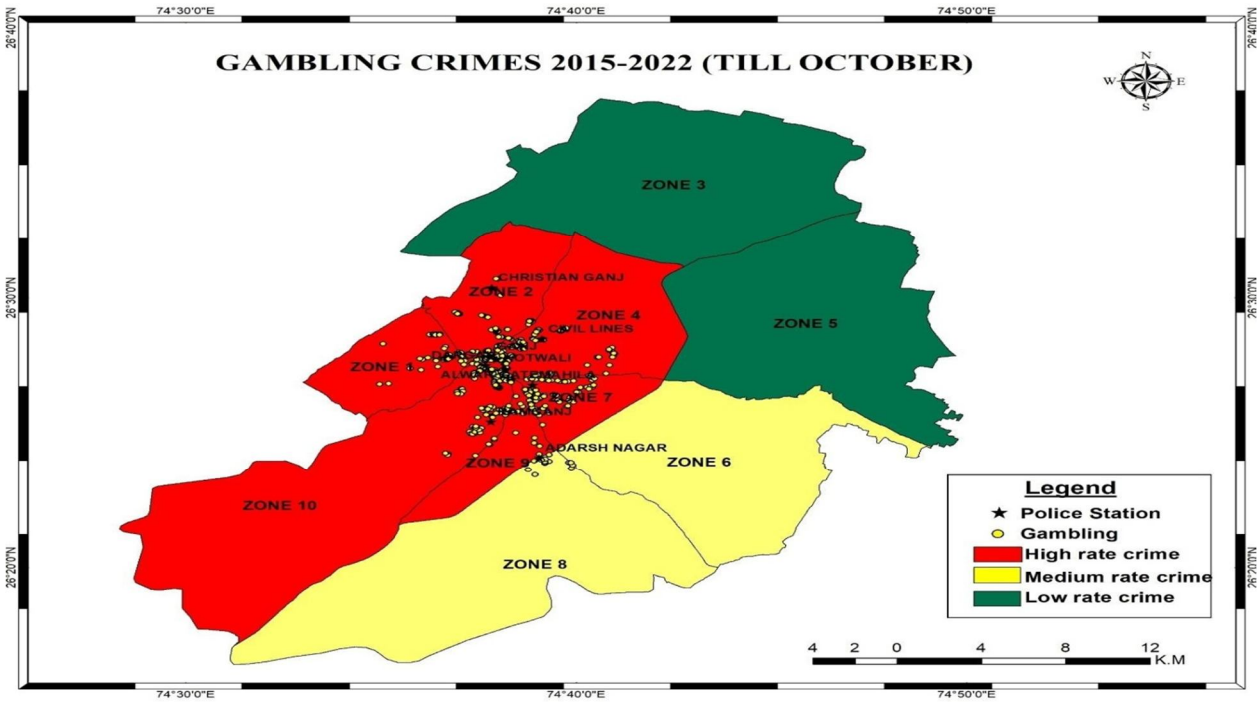
After studying, for 2015 -2022 (till October) crime map of theft, found that theft occurred in the major in four police station area. Hotspot area found near Kotwali, Adarsh Nagar, Ramganjand Christian Ganj zone area.
In Christian Ganj area- chupati, Hari bhau uphaday, Pancheel block2
In Kotwali area- K.C. complex, Swami complex, Amar Plaza, Prabhat cinema, near P.N.B.Kachahri road, near Jag amba bar
In Adarsh Nagar area- Parvatpura circle, khanpura In Ramganj area- Rambag circle, Dorai, Pahad

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F. Gambling

Gambling is the act of placing a bet or gamble on an event with an unknown conclusion with the hope of winning more money or valuables than the original sum. Whenever people gamble, you put something valuable, like money, at risk with the hope of winning more than According to this graph more cases were occurred in 2017, 2018 and 2019 comparatively other years.

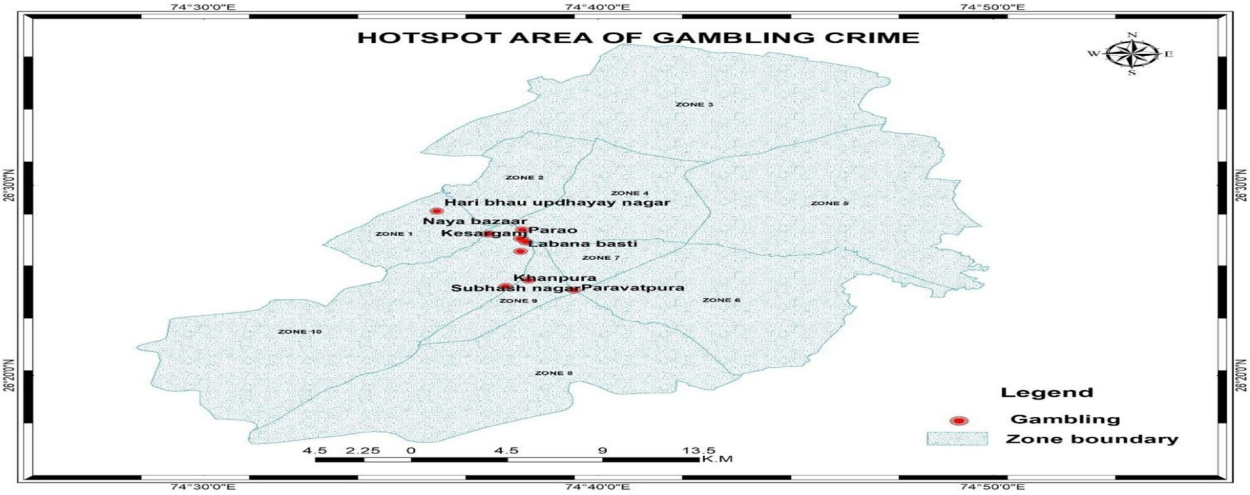


Crime forecasting refers to the basic process of predicting crimes before they occur. In excel Microsoft office use forecast linear technique.

1) Forecast Value

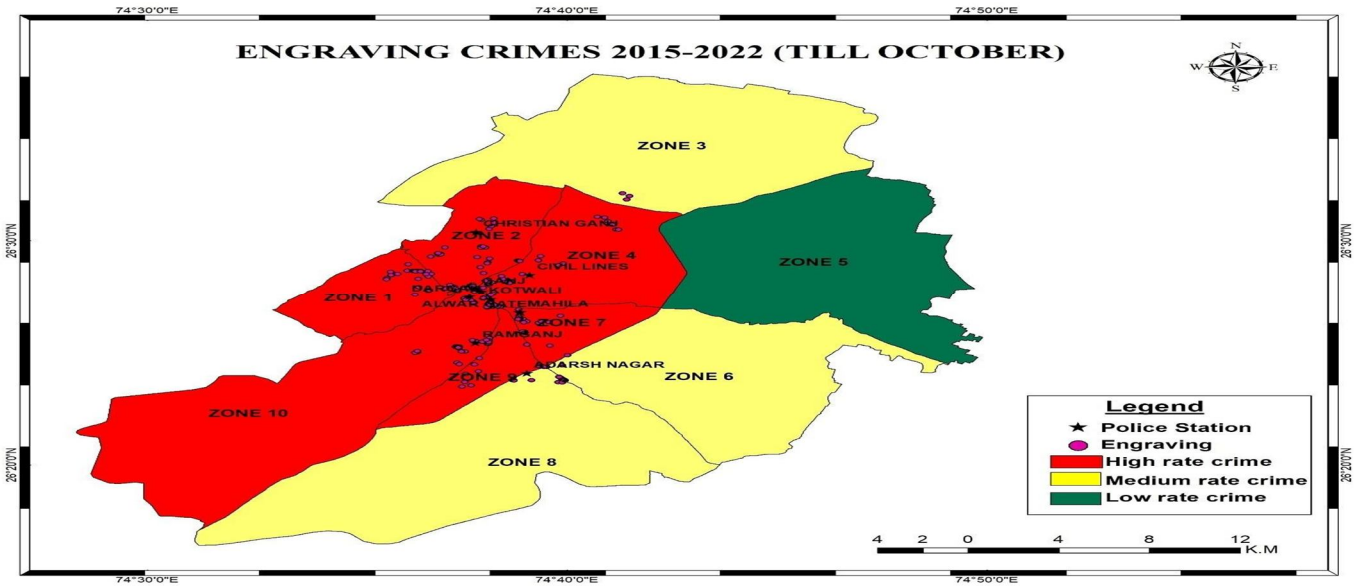
2023	354.25
2024	339.83
2025	325.41

After studying, for 2015 -2022 (till October) crime map of gambling, found that theft occurred inthe major in four policestation area. Hotspot area found near Kotwali, Adarsh Nagar, Ramganjand Christian Ganj zone area.
In Christian Ganj area- near veer garden, Panscheel nagar,gouravpath, haribhau updhaycolony
In Kotwali area- kc complex, naya bazaar, chuddi bazzar, purani mandi In Adarsh Nagar area- subhash nagar, chisti , pahad ganj, paravatpura In Ramganj area- chandravradai, khanpura



G. Engraving

Naqbajni is an Arabic/Persian word. “Naqb” means a hole made in the wall, jani means one who does or does work, burglary or breaking the wall and stealing the goods of the house. Also called Engraving



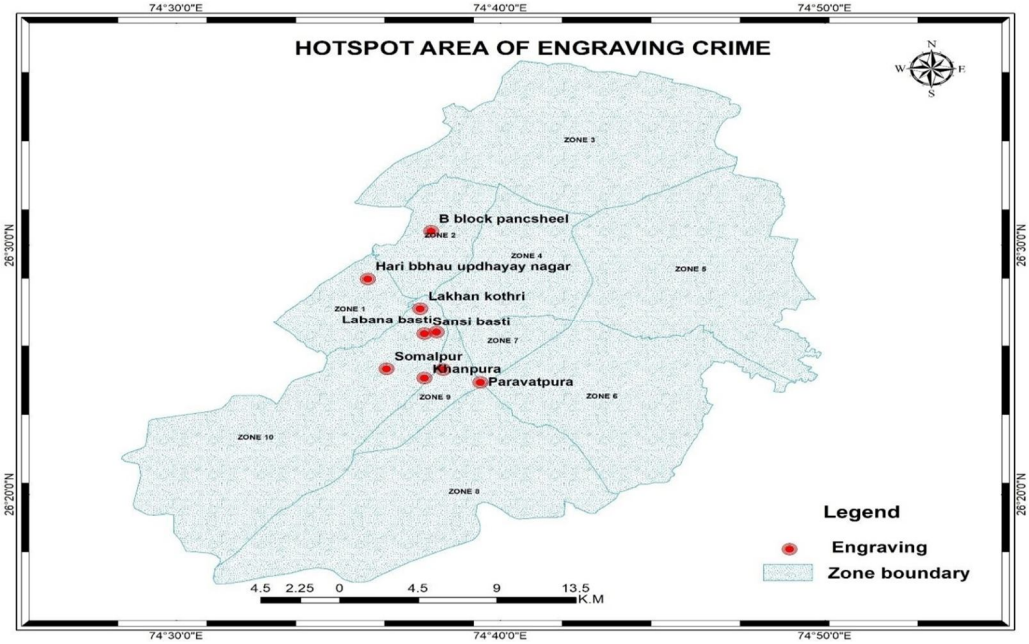
According to this graph more cases were occurred in 2015, 2019 and 2022 comparativelyother years.

Crime forecasting refers to the basic process of predicting crimes before they occur. In excelMicrosoft office use forecast linear technique.

1) Forecast Value

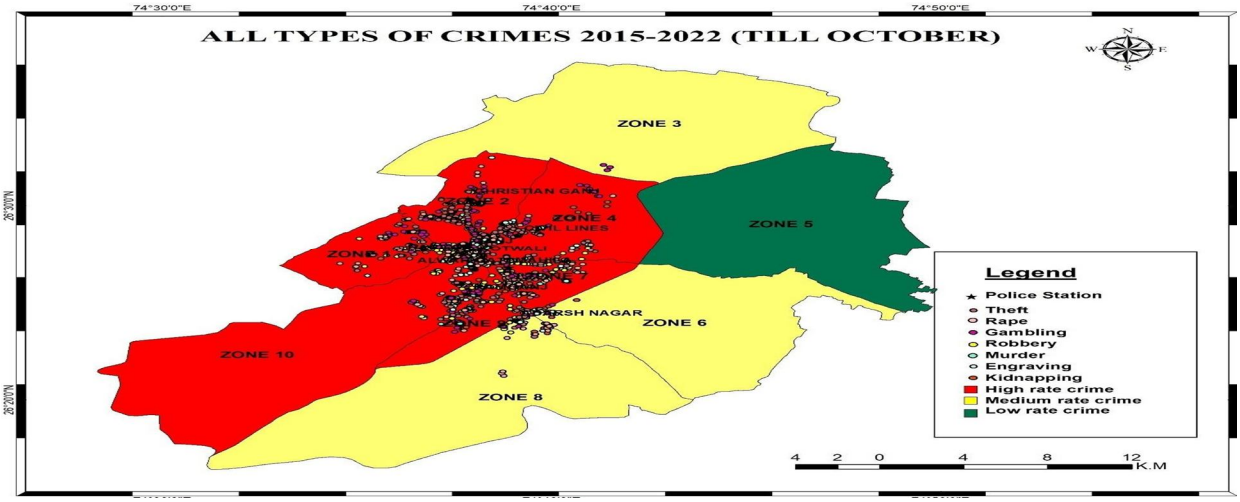
2023	114.60
2024	131.02
2025	134.66

After studying, for 2015 -2022 (till October) crime map of theft, found that theft occurred inthe major in four police station area. Hotspot area found near and Christian Ganj zone area.
In Clock Tower area- Parau, Dayanand chouhrayaIn Kotwali area- Kachari road, Bapunagar
In Adarsh Nagar area- Bhihari ganj,near highway, paravatsarIn Ramganj area-Solampur, sashi basti



H. All types of crimes 2015- 2022 (till October)

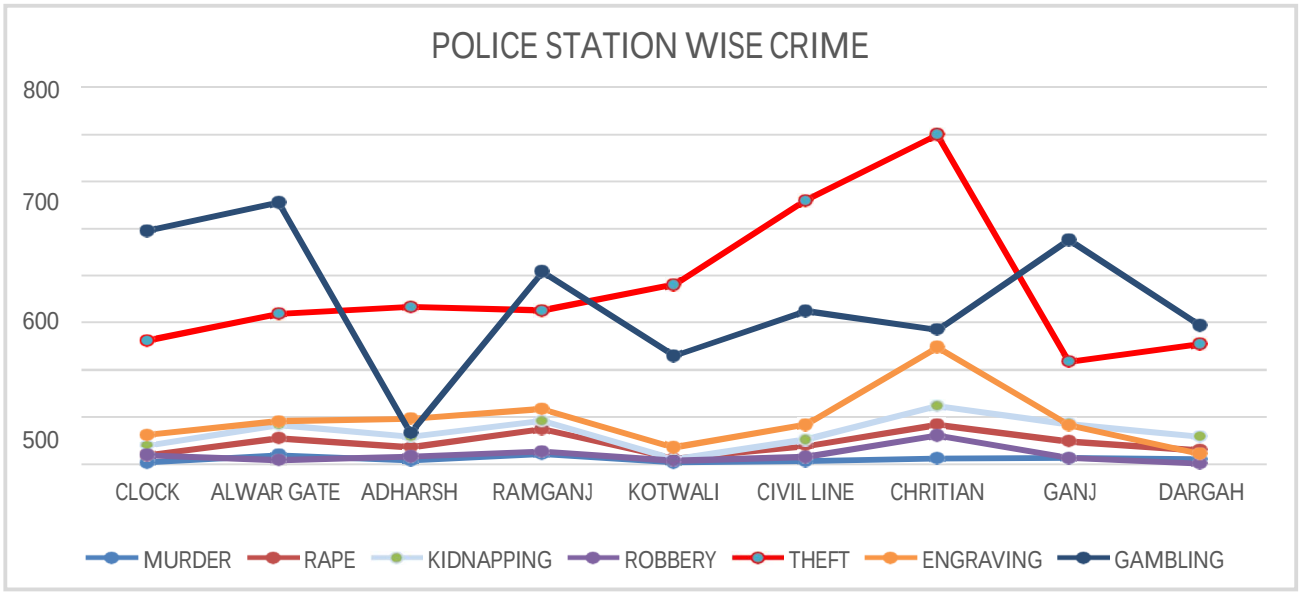
Crime is a human phenomenon, and generating data for it requires the integration of the people and the existing security outfits (police) within the geographical location where the study is carried out. Crime mapping and analysis are recognised as powerful tools for the studyand control of crime, because crime maps help police identify problems in a neighborhood.The most powerful weapon in law enforcement is information technology. In the present study, we have done crime mapping and analysis for Ajmer seven years crimes.



Zone wise all crime cases are registered in seven-year crime

According to crime data from the Ajmer police station, there are seven types of crimes recorded from2015 to 2022 (till October). The central city region is congested, with sections along busy roads, congested alleys, and market complexes said to have higher population densities than the city's periphery.

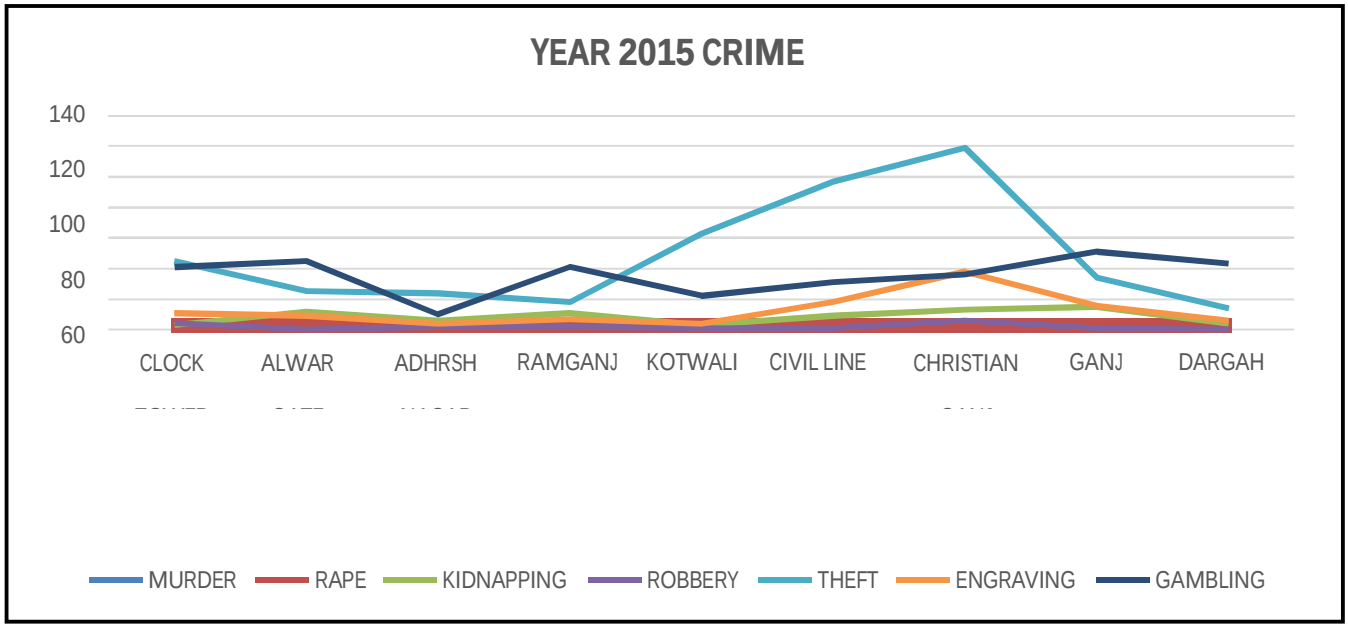
The outcomes of the hot spot analysis were also verified by conducting ground truthing surveys, which indicated the details of the crowded areas of Dargah, Ganj, Kotwali, Christian Ganj, and Purani Mandi. Crime is highly common in the areas near Madar Gate,



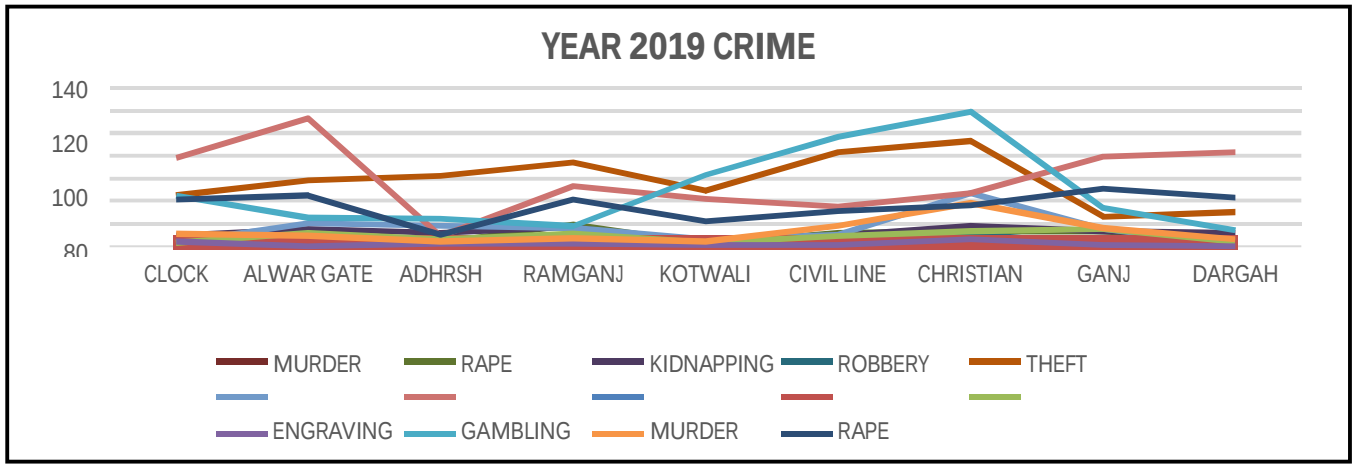
Nala Bazar, Kaiser Ganj, and Kutchery Road. The key causes of these criminal occurrences that were examined included the high percentage of unemployed people, the high rate of ignorance, people who work largely for day pay, and the low per-capita number of street and footpath sellers. Another supporting field observation related to local drug and alcohol consumption Venues, businesses, bars, and low-income housing colonies are crime hotspots that are heavily attracted to crime, while depots, transports, gardens, and grandstands are also strongly attracted to crime.

IX. COMPARING 2015 AND 2019 CRIME DATA

When I compared the crime rates in 2015 at 1009 and in 2019 at 1415, I found that the major crimerate increases were gambling, kidnapping, and theft crimes. Comparatively, the crime rate in 2015 increased in 2019.



In 2015, 1009 crime cases were reported to nine police stations. Major crimes are theft andgambling (439 cases of theft and 320 cases of gambling) In this region, the major hotspots are Ganj, Christian Ganj, and the Clock Tower Area.
In 2019, 1415 crime cases were reported to nine police stations. Major crimes are theft, engravingand gambling (520 cases of theft,



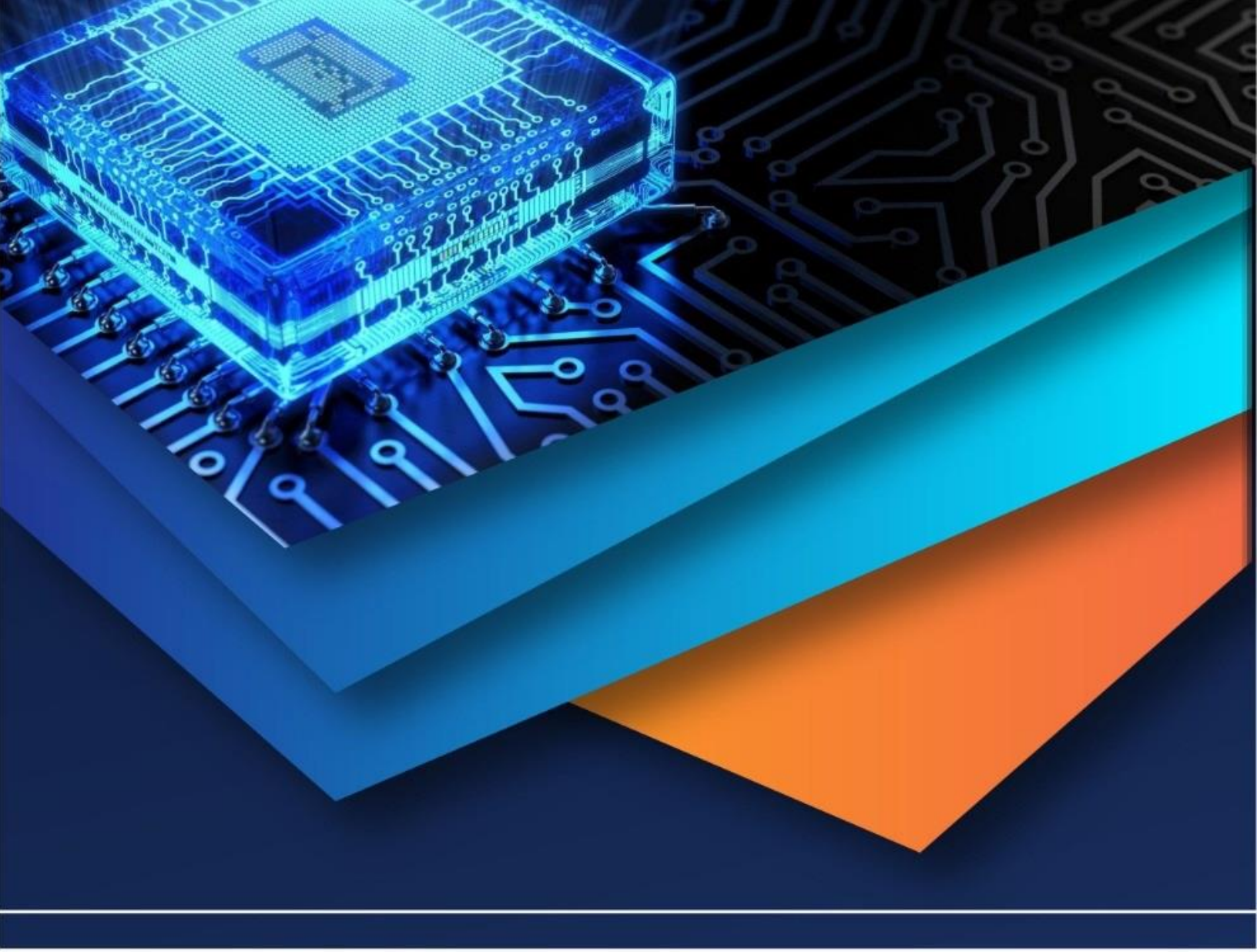
136 cases of engraving and 539 cases of gambling)
In this region, the major hotspots are Ganj, Christian Ganj, and the Clock Tower Area

X. CONCLUSION

As crime is a human phenomenon, gathering data on it requires connecting the local populationwith the police and other security agencies that are already in place. Because crime maps assistpolice in identifying issues at the block level, crime mapping and analysis are considered significant tools for the research and control of crime. The use of informationtechnology is the most effective tool in law enforcement. Based on the availability of the dataon crime in the city,we conducted crime mapping and analysis for the Ajmer Tehsil for sevenyears, from 2015 to 2022(till October), in the current study. After examining the crime case in the study region that has been selected, that is, Ajmer city,theconclusion was made with an in-depth study of the data collected from all police stations,the control room, and the IPC Department. The population is increasing and developing year by year in Ajmer, due to which crimes relatedto crime are also increasing. Criminals are attracted to high density population areaswhere the majority of people live.
The study focused on the most common crimes reported, which were theft and gambling, as opposed to murder, rape, kidnapping, and robbery. All crimes were reported in 1,009 incidentsin 2015. In 2016, 1,064 cases were recorded. In 2017, 1081 cases were reported. In 2018, 1034 cases were reported. In 2019, 1415 cases were reported. In 2020, 829 cases were reported. In 2011, 1120 cases were reported. In 2022, 1268 cases were reported. The highest number of cases occurred in 2017, 2019 and 2022, and the lowest number of cases occurred in 2015 and 2016. Crime forecasting refers to the basic process of predicting crimes before they occur. In excel Microsoft office use forecast linear technique. I estimated the forecasting crime value of 2023to 2025 years.
These four police stations—Alwar Gate, Civil Line, Ramganj, and Christian Ganj—registered moremajor cases than the other police stations. The highest cases are in Christian Ganj, andthe lowestcrime is registered in Adarsh Nagar. Christian Ganj's main hotspots were found atHari Bhau Uppadhay Nagar, Rati Dang, Makarvali, and near Shastri Nagar. Major theft case locations wereregistered in crowded places and on narrow roads.

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