SPATIAL ANALYSIS OF ROAD ACCIDENTS ON NATIONAL HIGHWAYS-44, FROM KUNDLI TO PANIPAT: A STUDY IN TRANSPORT GEOGRAPHY

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GEOGRAPHY

By

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DECLARATION

I Parveen Kumar hereby declare that the work present in the thesis entitled "***Spatial analysis of road accidents on national highway-44, from Kundli to Panipat: a study in transport geography***" in the fulfilment of the requirements for the award of Ph.D. degree, submitted in the Department of Geography, Lovely Professional University, Punjab, India is an authentic record of my own work done under the supervision of **Dr. Anand Kumar**, Assistant Professor and is plagiarism free as per rules and regulations of Lovely Professional University. This work done in the thesis has not been submitted for the award of any other degree to the best of my knowledge and belief.

Praveen Kumar

CERTIFICATE

This is to certify that the thesis entitled "***Spatial analysis of road accidents on national highways-44, from Kundli to Panipat: a study in transport geography***" submitted in partial fulfilment of the requirement for the reward of the degree of**Doctor of Philosophy (Ph.D)** in the Geography, Social Science and languages is a research work carried out by**Praveen Kumar**(**Registration No. 41800253**) under my supervision. Certified further, that to the best of my knowledge the work reported herein does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other scholar.

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ABSTRACT

In India, citizens frequently do not admire road signals, rules, regulations, and laws. The thought of people that it is their right to use roads for each person's suitability. Due to violations of rules and regulations, they create a hazard for themselves and other road users. An estimated of 743 deaths in 2018 on NH-44 which makes it is the most accident-prone highway in India

The number of fatalities from these traffic incidents in a single year exceeded the annual death toll from all of the Netherlands and even the United Arab Emirates. Cyclists, two-wheeler drivers, and pedestrians account for the bulk of fatalities. The busiest location in Sonipat and Panipat, where a lot of people have to cross the National Highway 44 on foot. There has been an increase in traffic fatalities. to elevate NH-44 to the top of the nation in terms of safety so that it may serve as an example for the whole nation. Road Safety Engineers of Faridabad (IRTE), the Police Department, PWD (B & R) Haryana, the National Highway Authority of India (NHAI), and the Transport Department, Haryana, Road Safety Engineers of Faridabad (IRTE) and the Police department serves to save lives of people who are dying in road accidents In the light of above preamble area based on secondary and primary data sets aims to achieve the following objectives given below: -

- To identify the black spots on NH-44 between the Kundli to Panipat.
- To evaluate the social and economic costs due to road accidents.
- To purpose a planning model for the minimizing the road accidents.
- To determine the major causes and factors of road accidents.

The study area is situated along National Highway 44 (NH-44), India's longest roadway, stretching from Srinagar in the north to Kanyakumari in the south. The study area is situated along National Highway 44 (NH-44), This national route holds immense significance as a pivotal transportation link connecting diverse regions and cultures across the country. However, our research narrows its focus to a specific segment of NH-44 located in the northern state of Haryana, spanning approximately 184 kilometres. The total length of the study stretch is 65 kilometres between the Kundli border and Panipat. The study area lies between 29° 24' 06"N to76°58' 35"N latitudes and 28° 52' 03"E to 77° 07' 22"E longitudes. This stretch is crucial in linking

Haryana with the national capital, Delhi. Of historical importance, this Haryana section of NH-44 is a part of the illustrious Grand Trunk Road, renowned for connecting Attari in Punjab, near the India-Pakistan border, to Delhi. The historical relevance of this road network extends into the contemporary era, retaining its strategic importance. These endeavours aim to mitigate congestion, enhance road conditions, and facilitate smoother traffic flow along this vital corridor. Panipat City presents distinctive challenges to travellers on NH-44. Encroachments on both sides of the highway have contributed to traffic congestion and driver frustration.

This action was taken in order to meet the section's criteria. "A statistical study of the incidents that occurred along the chosen section road" (Khurshid and Hussain, no date of publication) Road professionals and the general public alike are becoming more conscious of the significance of safety because vehicle accidents remain one of the greatest causes of mortality. Furthermore, billions of rupees are thought to be lost annually in economic damages as a result of injuries and fatalities. These losses might manifest as a reduction in the number of working days or as property damage. The ideas of sustainable safety and quality management have been more popular during the past 20 years.

It might have been one of the factors that made project managers and legislators realize that, in order to reduce the accident rate, they need instruments that are entirely focused on safety. Research has demonstrated that driving is one of the main factors contributing to accidents, injuries, and fatalities. Furthermore, because to unique features of the high terrain, severe traffic accidents have occurred in the mountainous portions of the state of Jammu and Kashmir, which make up the bulk of the state's geographical area. The state government's records show that up until November 2018, there were 5,529 car accidents in the state that left people dead were hurt in the attack. Based on information gathered over the past eight years, there are, on average, fifteen accidents recorded daily. Furthermore, the project aims to develop a simplified method for identifying critical accident-causing factors on US four-lane national highways. Multiple linear regression analysis allowed us to identify the critical accident causation elements. Consequently, the characteristics that most influence the likelihood of an accident happening on a roadway have also been found to be the ones that are most accountable for causing these kinds of events. A multiple linear regression exercise was conducted for modeling purposes and to identify the elements

influencing safety. The leftover data from the calibration process was utilized to validate the developed model. The model's value is 0.695 throughout the calibration process; however, following the validation phase, it rises to 0.70. The aforementioned research indicates that road markings, shoulder conditions, traffic volume, cross drainage, and spot speed are the variables that most affect driver safety. If the relevant parameters that were identified are taken into consideration. It might be feasible to improve the National Highway System's overall safety. (Idaho n.d.) Capacity increases are necessary to meet the projected expansion as well as the current demand. A highway's capacity to handle vehicle traffic may be increased in two ways: by widening the route and by strengthening access control. Installing Intelligent transit System (ITS) infrastructure, upgrading crossings, or enhancing public transit are more ways to increase capacity. Large-scale improvements to the highways or transit system are not now possible due to a lack of funding. On the other hand, creating an access control plan is a tactic that can be used immediately to improve operations, capacity, and safety in both current and future scenarios.

The single most important design factor that will affect the standard of transportation service along the highway is the management of access to US 20/26, which includes the placement and layout of private driveways, grade separations, and crossings. The quantity of grade separations and lanes in each direction are other variables that will be taken into account while making this decision. Numerous studies show that access management solutions may reduce total collisions by sixty percent, boost capacity by twenty to forty percent, and reduce travel times by around forty percent in terms of delay reduction. In the event that access control and transportation planning are not properly execute,the capacity to provide sufficient long-term capacity, travel times, and safety levels will be diminished. Furthermore, there would be a detrimental effect on the effectiveness of future highway expansion attempts. (Burke and others, 1992) Transportation-related aspects of the maquiladora business in the Texas–Mexico border region the volume of commerce between the United States and Mexico has increased significantly, particularly in the maquiladora industry and other industries. The rise in truck traffic along the US-Mexico border, which has been growing quickly over the last five years, is mostly due to this boom in trade.

On the basis of on the study, it has been found that the graph and table above, which show the sample data made up of 350 respondents, are accurate. There was talk about

occupation. 40 respondents (11.4%) said they were employed, 95 respondents (27.1%) said they had their own business, 50 respondents (14.3%) said they were retired, 60 respondents (17.1%) said they were students, and 60 respondents (17.1%) said they were unemployed. It was determined on the research conducted, it became apparent with the use of the above table and graph, which show the sample data consisting of 350 respondents. When the topic of vehicles was brought up, 120 respondents (or 34.3%) said they drove two-wheelers, 60 respondents (17.1%) said they drove three-wheelers, 100 respondents (or 28.6%) said they drove four-wheelers, and 70 respondents (20%) said they drove heavy vehicles.

Depending on the examination, we have discovered the information shown in the table and graph above, which indicates that the sample data includes around 100 respondents. Factors Contributing to Accidents: Road Conditions Eight(8%) respondents said they strongly agreed, nine(9%) said they agreed, sixty-three(63%) said they had no idea, thirteen(13%) said they disagreed, and seven(7%) said they strongly disagreed. Based on our research, we have discovered the information shown in the table and graph above, which indicates that the sample data includes around 100 respondents.Factors Contributing to Accidents: Car Seven percent of respondents said they strongly agreed, twenty percent said they agreed, forty-seven percent said they had no idea, nineteen percent said they disagreed, and seven percent said they strongly disagreed. Throughout the investigation, we have discovered the information shown in the table and graph above, which indicates that the sample data includes around 100 respondents. Factors Contributing to Accidents: Weather Situations Seven percent (7%) of the respondents gave a response. firmly Indeed, 29 (29%) of the respondents said Yes, 48 (48%) of the respondents said Ten (10%) respondents said they had no idea, while six (6%), said they disagreed. vehemently disagree Based on the search, we have found the information shown in the table and graph above, which indicates that the sample data includes around 100 respondents.vFactors Contributing to Accidents: People on foot 52 respondents said they had no idea, 2 respondents said they strongly agreed, 28 respondents said they agreed, 11 respondents said they disagreed, and 7 respondents said they strongly disagreed. Based on our research, we found the information shown in the table and graph above, which indicates that the sample data includes around 100 respondents. How can the government minimize accidents? Strongly Agree was the response from 9 (9% of respondents), and 14 (14% of respondents) Agree was the response from 60 (60%) respondents, followed by No Idea, disagree (16%), and Strongly Disagree (1%).

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TABLE OF CONTENTS

S. No.	Particulars	Page No.
	Declaration	*i*
	Certificate	*ii*
	Abstract	*iii*
	Acknowledgement	*vii*
CHAPTER-1	**INTRODUCTION**	**1-37**
1.1	General	1
1.2	The Problem Statement	3
1.3	Traffic Accidents in India	4
1.4	Need For Access Management	5
1.5	Problems with Heterogeneous Traffic	5
1.6	The specific objectives of this India Road Safety Report are to	8
1.7	Traffic Calming and Intelligent Transportation Systems	13
1.8	Effects of Speed Limit Increase	14
1.9	Network Screening	16
1.10	Road Design	19
1.11	Traffic Operations	20
1.12	Accident Analysis	21
1.13	Recording of Crashes	22
1.14	Reporting of RTI Crash Data	23
1.15	RFID Placement in Road Surfaces	25
1.16	Stakeholder Needs in the Region	26
1.17	Landslide Zones along Highway	29
1.18	The importance of spatial analysis	31
1.19	Road Traffic Policing	32
CHAPTER-2 METHODLOGY	**REVIEW OF LITERATURE AND RESEARCH**	**38-92**
2.1	Growth of vehicles and road accidents	38
2.2	Black spots or Hot spot in different studies	46
2.3	Social and Economic costs due to road accidents	56
2.4	Planning models for the minimizing the road accidents	62
2.5	Major causes and factors of road accidents	69
2.6	Others studies related to accidents	76
2.7	Research Methodology	83
2.8	Primary Ecological Effects of NH-44	85

2.9	Objective of the study	86
2.10	Study area	86
2.11	Database and Methodology	87
2.12	Significance of the study	88
2.13	Justification of selecting study area and theme	88
2.14	Limitations of the research	89
2.15	Statistical Technique used	89
2.16	Data Collection	89
2.17	Data collection methods:	90
2.18	Importance of data collection	90
2.19	Data Analysis:	91
2.20	Data requirements:	91
2.21	Data collection:	91
2.22	Data processing:	
2.23	Confusing fact & opinion:	92

CHAPTER-3 TREND IN THE GROWTH OF VEHICLES AND ROAD ACCIDENTS **93-98**

CHAPTER-4 IDENTIFICATION OF BLACK SPOTS **99-123**

4.1	Identification of black spots	99
4.2	Definition of black spot according to (MoRTH)	99
4.3	Methodlogy	99
4.4	Result and discussion	101

CHAPTER-5 SOCIAL AND ECONOMIC COSTS DUE TO ROAD ACCIDENTS **124-132**

5.1	Introduction	124
5.2	Social and Economic Costs Due to Road Accidents	125
5.3	Extended Impact of Road Accidents on Society and Economy	129
5.4	Methodlogy	131
5.5	Limitation of study	131

CHAPTER - 6 PLANNING MODEL FOR THE MINIMIZING THE ROAD ACCIDENTS **133-143**

6.1	Introduction	133
6.2	Methodlogy	133
6.3	Planning Model for Minimizing Road Accidents	137
6.4	Comprehensive Strategies in Road Safety Planning	139
6.5	Conclusion	142

CHAPTER - 7 MAJOR CAUSES AND FACTORS OF ROAD ACCIDENTS **144-173**

7.1 Introduction 144

7.2 Result and discussion 145

7.3 Conclussion 173

CHAPTER - 8 DISCUSSSION, CONCLUSION AND SUGGESTIONS **174-209**

8.1 Introduction 174

8.2 Result and discussion 175

8.3 Key finding and conclusions 206

REFERENCE **210-225**

LIST OF APPENDICES **226-253**

a Appendix I – Interview Schedule

b Appendix II – Analysis the Causes of Road Accidents on National Highway-44, Panipat to Kunldy

c List of publication

d List of conferences/Presentation

LIST OF TABLES

Table.no.	Title	Page no.
3.1	Growth of registered vehicles in India	95
3.2	Road accidents and fatalities in India	96
3.3	Monthly wise of road accidents on NH-44, Kundly to Panipat	98
4.1	Accidents classification on the basis of type of vehicles	110
4.2	Do you follow road sign and signals	113
4.3	Have you meet road accidents while driving	114
4.4	Age wise accidents frequency and percentage	115
4.5	Frequencies and percentage of position duties	116
4.6	Frequencies and percentage of location of accidents	117
4.7	Types of accidents observed	118
4.8	Number of accidents occurred daily	119
4.9	What type of vehicles usually involve accidents in duty location	120
4.10	Classification of accidents on the basis type other vehicles/ objects	121
4.11	Classification of accidents on the basis of type of vehicles	122
5.1	year wise estimated economic loss due to accidents on NH-44 from Kundli to Panipat (Crores)	126
7.1	Monthly wise distribution of accidents on N.H-44 Kundly-Panipat	145
7.2	Road accidents by type of traffic rule violation	147
7.3	Show age wise driver percentage and frequency	149
7.4	Educational level of accidental people	150
7.5	Type of vehicles on the basis of number of wheels driven by people	151
7.6	Have you gone under gone driver training	152
7.7	Which time you observed maximum traffic congestion at this road ?	153
7.8	Factors involves in accidents : Drivers	154
7.9	Factors involves in accidents : Road conditions	155
7.10	Factors involves in accidents : Vehicles	156

7.11	Factors involves in accidents : Weather conditions	157
7.12	Factors involves in accidents : Pedestrian	158
7.13	Sectors involving road accidents-Government action	159
7.14	Specify reason according to you traffic accidents in your location	160
7.15	Do you observed traffic congestion in your location	161
7.16	Specific timing traffic high traffic congestion	162
7.17	How many traffic signal working in your location	163
7.18	Are all traffic signal working in your locations	164
7.19	Factors Involving Accidents: Road Conditions	165
7.20	Factors Involving Accidents: Vehicle	166
7.21	Factors Involving Accidents: Weather Conditions	167
7.22	Factors Involving Accidents: Pedestrians	168
7.23	Do you follow the road signs and signal?	169

LIST OF FIGURES

Figures no.	Title	Page no.
2.1	The spatial analysis model for road accidents on National Highway-44.	84
2.2	Showing accidents situation on GT road national highway-44	85
2.3	Study Area Map of National Highway-44 from Kundli (Sonipat) and Gharaunda (Panipat)	87
3.1	Schematic diagramof themethodologyfor thestudy.	94
3.2	Growth of registered Vehicles in India (2011-19) Fig 3.2 Road Accidents and Fatalities (2011-19)	96
3.3	show month wise accidents in different years from 2010 to 2020.	98
4.1	Different police stations picture which are situated on GT Road from Kundli to Panipat.	100
4.2	All black spots showing in map on the National highway are Accidents Points.	101
4.3	Different types of injuries show in the year wise graph base	102
4.4	Different types of injuries show in the year wise graph base	103
4.5	Different types of injuries show in the year wise graph base	104
4.6	Different types of injuries show in the year wise graph base	105
4.7	Different types of injuries show in the year wise graph base	106
4.8	Different types of injuries show in the year wise graph base	107
4.9	Spatial presentation of Injury on all Accidents Black spots**.**	108
4.10	Accident Classification on the basis of types of vehicle.	111
4.11	Classification of Vehicles in Road Accidents on NH-44.	112
4.12	Shows follow the roads signs and signal.	113
4.13	Show meet accidents while driving	114
4.14	Show age wise frequency of road accidents	115
4.15	Show position frequency	116
4.16	Show location and frequency	117

4.17	Show types of accidents observed frequency	118
4.18	Show number of accidents occurred daily frequency	119
4.19	Show vehicles usually involve in accidents duty location	120
4.20	Show the classification of accidents on the basis of type of object	121
4.21	Show the classification of accidents on the basis of type of vehicles	122
5.1	Show estimated cost (Economic lose) in crores clam of accidents	126
5.2	Estimated cost claim due to road accidents on different accident - 44	127
5.3	Total number of male female lost life due to road accidents on N.H	128
5.4	Number of accidents on N.H-44 at black spot	126
6.1	Show model of data assessment in regarding accidents	140
7.1	Month wise accident in different year show in graph	146
7.2	Reasons behind the road accident on N.H-44 at different black spot	148
7.3	shows age and frequncy of accidents	150
7.4	shows education and accident frequecy.	151
7.5	shows vehicle driven and frequency.	152
7.6	show driving training and frequency.	153
7.7	shows maximumtraffic congestion at the road.	154
7.8	shows factors involving accident: Driver	155
7.9	show factor involving accident: Road conditions.	156
7.10	Shows Factor involving accident:Vehicles.	157
7.11	Shows factors involving accident:weather conditions.	158
7.12	shows factors involving accident:Pedestrian	159
7.13	shows factors involving accident:Government actions.	160
7.14	Shows traffic accidents in specific location.	161
7.15	shows traffic congestion in duty location.	162
7.16	shows specify the timing you observed high traffic congestion.	163
7.17	show how many traffic signals in duty location.	164

7.18	shows traffic signals in duty locations working.	165
7.19	shows factors involving accidents:Road conditions.	166
7.20	shows factors involving accidents: vehicle.	167
7.21	shows factors involving accidents: weather conditions.	168
7.22	shows factors involving accidents:pedestrians.	169
7.23	shows follow the road signs and signal.	170
7.24	show location of study area in India**.**	171

CHAPTER - I

INTRODUCTION

1.1 General

The roads are the most economical way to travel in India, they are also very vulnerable to traffic accidents, which put users' lives in jeopardy and seriously damage their cars and other possessions (P. Kumar and A. Kumar, 2023). Victims, their families, and society at large have suffered significant financial damages as a result of road accidents (S. R. Shariff, HA Maad, N. A. Halim, Z Derasit, 2018). Reducing the detrimental impacts of accidents and traffic congestion on society is essential. Ideally, both would be decreased simultaneously, but given the likely inverse relationship between traffic congestion and road safety, this may not be possible. In a less crowded road system, Shefer and Rietveld argue, regular traffic speeds would be higher, increasing the likelihood of major injuries or deaths. Conversely, a slower moving traffic flow on a crowded road system may reduce the number of major injuries and deaths. More accidents could occur as a result of the rise in traffic volume, but they might not be as serious if the roads are less crowded (M. A. Sial and others, 2024). This indicates that congestion may reduce the overall external cost of accidents. Congestion may seem to increase road safety, but it also diminishes mobility, which in turn lowers economic output, creating a possible conundrum for transportation policymakers (D. Mahataa, P. K. Narzaryb and D. Govil, 2019) . In order to develop successful strategies to address both traffic congestion and road safety, it is crucial to comprehend the relationship between the two. Few studies have been conducted in this area, and those that have are often analytical in nature and rely on a poor surrogate for traffic congestion. Therefore, it is important to collect more rigorous scientific data and quantify congestion accurately. In this study, we use a spatial analytic method to examine how traffic congestion affects road safety, taking other variables into account as much as possible. As an example, we broke down the M25 London circular freeway into 70 individual sections. The STATS19 national road accident database was mined for accident data, and a system was devised to properly allocate M25 collisions to each of the 70 individual stretches of highway (Sachita Shahi and others, 2023). The UK Highways Agency was consulted for information on traffic characteristics including delay, “flow, and average speed for

each route stretch (UKHA1). A congestion index created by was used to precisely assess the amount of congestion on each route section. Congestion index, traffic flow, traffic speed, road geometry (e.g., radius of curve and gradient), and the length of the road segment are all taken into account when calculating the accident rate for each section of road. Multiple statistical models, including the Poisson-lognormal model, the poisson-gamma model and the Poisson-lognormal model" with conditional autoregressive (CAR) priors, are used. Here is how the remainder of the paper is organized: To begin, we provide a brief overview of the existing research on how traffic congestion affects road safety and statistical models (F. Haghighi, E. Karimi, 2018). The data utilized in this research, including the technique used to correctly attribute M25 incidents to specific stretches of the highway, are then described. First, the statistical methods used in this research are outlined, then the findings themselves are presented and analyzed (B.R. Sharma, 2011). In the last section, we draw some final findings and provide some suggestions for further study.

As the middle class expands, there has been a dramatic shift toward individual mobility, with practically everyone now owning a car and opting to drive themselves everywhere they go, even though just a little distance may separate them. Maybe it's a sign of development, and maybe people just don't have time to wait for public mass-transportation, but either way, it's inconvenient. Rather of utilizing school buses or shared automobiles, most parents drive their children to and from school. Congestion is exacerbated by inadequate roads and the inappropriate placement of numerous organizations.

When the number of cars on the road exceeds the available road space, we get traffic congestion. Increases in travel time and gas prices as well as delays in certain activities, missed chances, fewer company operations, worry, and so on are all consequences of traffic congestion (J.A. Hansen, 2019). Congestion on the roads in Shillong has grown into a major issue for everyone there. Spending hours stuck in traffic has a negative impact on employees' productivity, businesses, and commuters' general well-being (WHO, 2022). All-importanth crossroads have congestion throughout the day. Economic and other activity determine the rush hours in different cities. Now that classes have resumed at universities and colleges, traffic has reached all-time highs, making it challenging for commuters to get where they need to be on time. Though gridlock is a citywide problem, it is most severe around universities,

corporations, and government buildings (J. Hussian, 2020). Because of this, it is crucial that we analyze the root causes of traffic congestion and their effects on the community.

Congestion in urban areas is a worldwide issue that has a significant economic and social impact on cities. As its population, socioeconomic activity, and vehicle traffic have all increased rapidly, Shillong, the Meghalayan capital, has also been experiencing growing congestion. Congestion has been growing at an exponential rate, and its negative consequences are beginning to outweigh those of transportation in certain situations (T. Vambere and others, 2021). That is to say, as the number of cars on the road grows, the negative externalities it causes, in the form of gridlock, grow at an alarming rate.

1.2 The Problem Statement

In India, "citizens frequently do not admire road signals, rules, regulations, and laws. The thought of people that it is their right to use roads for each person's suitability. Due to violations of rules and regulations, they create a hazard for themselves and other road users. An estimated of 743 deaths in 2018 on NH-44 which makes it is the most accident-prone highway in India. As study area is situated between Metropolitan city Delhi to Chandigarh, both are highly crowded India and have a very high density of population. Effect of both city showing on traffic which lead to hactic and accidental situation mainly in study area. It is an important hub of Dabas (Murthal), manufacturing industries (Kundli and Panipat) and transportation. During the recent years, reported huge number of accident is taking place rapidly in these area. In this background this study is focused to find out answers to the following questions:

- What is the level of awareness of road users regarding safety rules and what are the factors contributing to awareness level?
- What are the reasons for road accidents?
- What are the measures to avoid road accidents?
- What are the problems faced by road users?

The scope

The study shows that this investigation is confined to certain areas inside Ahmadabad. It leads the causes of traffic collisions and the general lack of awareness about road

safety using a range of statistical techniques. For drivers of all kinds of vehicles as well as officials in the government, police department, and regional transport office, the present research will provide fresh insight into the problem of traffic safety. In addition to the outcomes of this study, the measured volume count, spot speed study analysis, and density may be used as a reference for comparable future research. This newly discovered connection may be valuable for facilitating the traffic allocation process on analogous lines. Additionally, this research is helpful for contrasting the state of the chosen segments before and after the implementation of traffic calming measures.

The studies monitoring the use of private vehicles and motorbikes might become a significant input for urban transportation policy. In many developing nations, automobiles and motorbikes play equally significant roles in the motorization process. This is why many major Asian cities like Bangkok, Jakarta, and Hanoi have become motorbike cities and are often referred to as traffic catastrophe cities by transportation experts. According to Kenworthy's research, the average amount of road space per person in underdeveloped countries is just 1 meter, but in wealthy countries that number rises to between 5 and 8 meters.

1.3 Traffic Accidents in India

In India, there are annually about 85,000 homicides and 300,000 traffic-related injuries. On Indian roads, a death happens every ten minutes, and an accident happens every three minutes (Z. K. Thoker and others (2018). There is a direct correlation between the increase in cars on the road and the rise in collisions. Over 10 million accidents have happened in India since motor vehicles became widely used, with over 1.5 million people dying and numerous others being injured. India is responsible for 6% of all road fatalities even though it has the second-lowest motorization rate globally (Pasricha, 1997).

Although the government is acting appropriately, no benefits have yet been seen. Every year, a lot of lectures about road safety are given. Even if the country observes Road Safety Week, the underlying problem endures and gets worse. Any country's ability to expand economically depends on its ability to connect via air, train, and road. The decision of which road to take is the most crucial. It is essential to have a dependable road network that links rural and urban areas. But just as important as this

is, is being considerate of other drivers. It's a crucial component of a long-term strategy to enhance public transportation. Car crashes that result in injury or death are a sad byproduct of the transportation system we have today. Despite the fact that there are fewer traffic accidents in

The growing middle class and other advantages of consistent economic growth have led to an increase in the demand for transportation services in general and road transport in particular. Accidents are more likely to occur when there are a lot more cars on the road. Many events are seen to be the result of human error and negligence on the part of drivers and pedestrians. However, both the incidence and the impact may be reduced with the deployment of the appropriate traffic control systems and safe road design. To determine the "success or failure of such control systems and design requirements," however, a detailed analysis of traffic accident records in specific areas is essential.

A methodical and scientific strategy based on the utilization of precise and trustworthy traffic accident data is widely acknowledged as an efficient technique towards accident reduction. This kind of study, however, requires data that is not always readily accessible. Most of the information on accidents that can be found in police records is sketchy at best. Facts gathered from records are used to inform policy and practice in areas such as law enforcement, education, maintenance, vehicle inspection, emergency medical services, and highway engineering".

1.4 Definition of Transportation Corridor and related reweid area

A transportation corridor is a strip of land that includes many modes of transportation, such as a roadway, train, or canal. To reduce environmental impact, new transportation corridors are often constructed next to old ones.

- **National Highway (INDIA)**

The "National Highways Network" is a network of roads that is managed and maintained by the Indian government. The entire length of these roads as of 2014 was over 79,243 km (49,239 mi), of which over 1,000 km (620 km) were expressways. Only about 15,000 of the 71,000 kilometers of national highways have four or six lanes (A. Das, 2008). The National Highways Authority of India (NHAI) constructs, upgrades, and maintains the majority of the country's roads. Its operations are supervised by the Ministry of Highways and Transportation. The vast National

Highways Development Project (NHDP) aims to enhance and expand the nation's road network. When it comes to building, maintaining, and collecting tolls on highways, NHAI frequently uses a public-private partnership framework. In 2010, national highways were responsible for

Existing national highways are mostly two-lane roads (one lane in each direction), however many of them are being widened to accommodate four lanes, and even six or eight lanes, in the near future. There are paid-access routes inside the system (C. Bothers, 2017). More than 30,000 kilometers (19,000 miles) of new roadways are either planned or under construction as part of the NHDP as of 2011. More than 1,600 miles of Expressways, or over 2,600 kilometers, are now in the planning and design stages".

- **Primary Ecological effects of Nh-44**

There are direct and indirect effects of "infrastructure on the natural world: New habitat margins are created, hydrological dynamics are altered, and natural processes and habitats are disturbed when highways are present in the landscape. Just two instances of the harm that traffic and road maintenance inflict to the environment are chemical pollution and noise pollution. In addition, infrastructure and traffic present dispersal obstacles for the majority of terrestrial non-avian species, and car crashes claim millions of lives annually. Animal habitat is lost and fragmented due to the interaction of biotic and abiotic processes at various geographical scales.

The principal impacts of infrastructure on the environment and wildlife are the subject of this examination since they are often the responsibility of the transportation sector. Construction of new roads or railways may have unintended consequences, such as altered land use, increased human settlement, increased industrial growth, or increased resource exploitation, however these impacts will not be considered here. Primarily, most empirical research on the impacts of infrastructure on wildlife focuses on the immediate, local, and observable consequences that result from a single road. Primary ecological consequences may be broken down into five broad categories:

1. Habitat loss

2. Disturbance

3. Corridor

4. Mortality

5. Barrier”

- Edge Effects and Pollution

The Road building affects the surrounding ecology because it necessitates clearing, leveling, filling, and cutting. This is due to the fact that building activity modifies surface and ground water flows, soil density, and landscape relief. This might have an influence on nearby ecosystems, plants, and animals. Wetland and riparian habitats are frequently disregarded in the construction of roadways due to their susceptibility to the hydrological changes caused by road embankments.

• Aquifers may be depleted, the likelihood of soil erosion increased, andimprove riparian networks by shifting disturbance regimes.

Where highways slash through forests, local climates are drastically changed. Interior forest species, such as lichens and mosses, are less likely to thrive under conditions of higher wind and light intensity, lower air humidity, and lower temperatures. Distractions from outside sources, especially traffic noiseTraffic noise are another source of environmental disruption. Although the disruptive effects noise is harder to quantify and less well known than those of pollution with chemicals or dust, it is nonetheless one of the principal contributors damaging natural ecosystems.

It's debatable whether or not noise has the same effect on animals as it does on people. Nonetheless, certain more reticent species may

In other words, take the sound of cars passing by as evidence of people around and steer clear of busy streets. Numerous species respond differently to the disturbance and modification of their natural habitats brought about by roadways. It is imperative to investigate dose-effect thresholds in wildlife in order to comprehend the pattern and develop techniques for measuring and analyzing disturbance affects.

- **The Injury and The Mortality**

The NH-44 is congested from May to December, when the majority of pilgrims visit the area. Every year, traffic causes a great deal of harm or death to animals. The building and extension of NH-44 has increased average speed (60–70 km/h), which has been associated with a rise in fatal wildlife-vehicle crashes. Due of the sun's warmth and the abundance of food, both the hanuman langur and the rhesus monkey

are lured to the road. Young langurs and monkeys frequently use highways as places to run, play, and seek for food in the plants that grow alongside the roads. Due to their nocturnal lifestyle, langurs and monkeys are more likely to perish in auto accidents.

Every year, countless numbers of pilgrims journey along NH-44 to see the sacred sanctuary of Vaishno Devi, located in Katra. Many tourists along NH-44 feed the monkeys and langurs they see because of their religious beliefs. Because of this, langurs and monkeys have developed the habit of hanging out by the road in the hopes of getting food from passing cars. These vehicles frequently kill or injure langurs and monkeys. The terrain and habitat composition, traffic and road features, species biology, and other factors all influence the spatiotemporal pattern of road deaths. To determine the extent of the local need for mitigation and to design and implement suitable solutions, a thorough understanding of these various factors is required.

Using geographic information system (GIS) analysis, researchers may gain the understanding they need to create predictive models for impact assessment and the localization of mitigation measures by tracing the locations of traffic fatalities and the routes taken by animals as they traverse the landscape.

1.5 Problems with Heterogeneous Traffic

There are both "fast-moving and slow-moving vehicles, as well as motorized and non-motorized ones" in a setting with heterogeneous traffic flow. The vehicles differ in terms of size, operational complexity, and static versus dynamic properties. Since there isn't a specific mechanism in place to guide various vehicle classes, all cars have to share the road.

In order to squeeze through the gaps between the larger cars, the smaller ones just drive wherever. These issues arise in situations with heterogeneous flow:

Every activity involves the passenger and the vehicle wasting time.

- Delays, which may cause the start of a variety of events, including meetings, office work, education, business, emergency services, and so on, to be delayed.
- An inability to provide reliable estimates of trip times.

Because of fuel waste, levels of pollutants and carbon dioxide in the atmosphere have risen.

The health of drivers is negatively impacted due to an increase in stress and dissatisfaction.

- In the event of an emergency, blocking traffic might make it difficult for emergency vehicles to get through.

Traffic and Road Conditions in Indonesian Cities The database of the Indonesian Road Management System provided the data for this study (IRMS). For national road planning, programming, and budgeting, the IRMS system is used in all Indonesian provinces and is managed by the Ministry of Public Works' Directorate General of Highways. "National road capacity and the number of lanes in this study are determined by inventory data, which is input into the IRMS and used in this investigation. Roughness data is used to compute the International Roughness Index (IRI) variables, and traffic survey data is used to measure VKT values for cars and motorcycles."

Before the model and regression findings are reviewed, a disaggregated examination of the model's variables—especially those derived from road data—may provide significant insight into the situation of urban road transportation in Indonesia. It is customary to discuss and assess Indonesia "in terms of Java and outer Java," a reference to the country's neighboring islands. This is a result of Java being the center of more than half of Indonesia's population and economic activity. Another widely used expression is "big cities,"

which refers to urban areas with populations of at least 500,000. The population threshold between what are considered medium and small cities is often about 500,000. The average Though statistically not significant, the average VKT for motorcycles in Java is almost three times higher than that of motorcycles outside of Java. In major cities, motorcycles have an average VKT value five times greater than in small and medium-sized cities; nonetheless, this difference is not statistically significant. For cars, the opposite is true; however, the mean VKT values for motorbikes and other vehicles in Java and outside of Java do not differ statistically significantly. The country's transportation infrastructure is given a lot of attention. Though it comprises only 2.3% of the whole road system, About 40% of all vehicle

traffic is accounted for by it. The "Ministry of Road Transport and Highways" is the main organization in charge of the National Highway System's expansion. Work on National Highways is approved after taking into account the impact on trade, tourism, strategic, tribal, remote, and border areas. Examples of these schemes are the Bharatmala Pariyojana (Phase-I), Development of Road in Left Wing Extremism Affected Areas, Special Accelerated Road Development for North Eastern Region, Inter-Connectivity Improvement Programme, etc. The Department of Transportation's main Bharatmala Pariyojana project includes building coastal highways, connecting non-major ports, developing economic corridors, feeder routes, and inter-corridors, as well as integrating with Sagarmala.

The following are MoRTH Associated Offices: The National Highways Authority of India Act, 1988, a law passed by the Indian parliament, created the NHAI, or National Highways Authority of India. The National Highways Administration, Inc. (NHAI) is responsible for the establishment, upkeep, and management of National Highways under its purview, along with any related matters. In February of 1995, the National Highway Traffic Safety Administration began taking passengers. The Indian Academy of Highway Engineers (IAHE) is the third item on the list.

The Institution of Engineers (IAHE) is a government-sanctioned organization. It was established in 1983 as a joint effort between the federal government and state governments to address a pressing need: the lack of initial and ongoing education and preparation for the nation's highway engineers. As part of its outreach programs, MEA also provides training for engineers from other nations.

In 2009, the Ministry of Shipping, Road Transport, and Highways was split into two separate Ministries, creating the “Ministry of Road Transport and Highways (MoRTH). Construction and maintenance of National Highways (NHs), administration of the National Highways Act, 1956, the National Highways Authority of India Act, 1988, the National Highways Fee Rules, 2008, the Motor Vehicles Act, 1988, and the Central Motor Vehicles Rules, 1989, as well as the formulation of broad policies relating to road transport, environmental issues, automotive norms, etc., fall under the purview of India's Ministry of Road Transport and Highways. Traffic-handling capacity on the nation's highways must increase to match the expansion of the manufacturing sector. India's road system is the second biggest in the world, with

over 58.99 million kilometers. Included are U.S. Routes, State Routes, Major District Roads, Other District Roads, and Village" Streets.

Enhancing road safety involves a wide range of industries and factors to take into account. It covers topics including planning urban land use, ensuring the safety of children and the elderly, developing and managing transportation infrastructure, and providing car safety features. Put another way, it includes both the design of highways and vehicles and the treatment of injured parties in medical facilities (in the event of an accident). To increase road safety, a wide range of governmental entities and organizations as well as the general people have a part to play. India's rate of fatal traffic accidents is increasing as the country's multilane highway network and automobile population grow.

While fatalities and injuries caused by traffic accidents are a worldwide problem, they are most severe in congested areas, such as those seen on India's multilane roads. Since automobile accidents account for a sizable percentage of all fatalities, ensuring the public's and highway workers' safety on the roads has become an increasingly pressing issue. Furthermore, it has been projected that billions of rupees are lost every year due to economic losses caused by property damage or loss of working days due to injuries. It is widely accepted that India has the highest rate of traffic-related deaths in the world. In emerging countries like India, concerns about the future of road safety are surging to the forefront of public discourse. Numerous lives lost, as well as damage to health, property, social stability, and the environment, are the inevitable results of a crash's cumulative effect on a nation's economy and its growth. There are a number of elements, including but not limited to those listed above, that have an impact on motorists' actions and the security of four- and six-lane roadways.

One major contributor to traffic accidents is the presence of human error. To name a few examples, this includesDriving under the influence of alcohol or drugs, failing to properly assess upcoming hazards, or failing to maintain a sufficient focus on the road all contribute to an unsafe driving environment.

1) The education and experience of the driver, the presence or absence of mental illness, the age, gender, and physical condition of the driver, etc.
2) Elements of traffic, such as velocity, density, capacity, traffic mix, and vehicle variety.

3) Thirdly, the brakes, lights, tires, and steering of the vehicle might all be in disrepair.
4) Hazards presented by the roadway, such as slick or skittish surfaces, potholes, ruts, and the intersection and separation of lanestraffic.
5) The elements, such as rain, snow, dust, and fog.

Additional factors include lack of enforcement, improper signage and signaling, an inconveniently positioned service station, and an inadequately situated service station.

To promote or publicize in any way.

To determine how the road itself affects safety, the first step is to choose those aspects that may properly characterize the road. The aforementioned causes of road accidents are the primary reasons. The amount of traffic for any given cross section, for instance, may be simply calculated from known design specifications. While accidents are the consequence of a combination of several circumstances, analyzing the connections between these elements might provide useful information. In the same way that road conditions are crucial, so too are human behavior, vehicle condition, and environmental factors.

In summary, the circumstances surrounding the road collision. It is a widely known fact that accidents occur on a daily basis in every nation. Although they can't be totally eliminated, road accidents can be decreased. A thorough analysis of the road safety infrastructure is necessary to assess the situation and pinpoint the underlying causes of accidents. New highway building projects are frequently identified as the most dangerous. as soon as it was finished, following many years of construction. Road safety research can be used to identify the reasons behind traffic accidents as well as offer suggestions for solutions.

The purpose of the paper is to present a comprehensive review of the current situation regarding road safety and road traffic injuries (RTIs) with a focus on public health. In order to guarantee the implementation of suitable corrective measures by policy makers, specialists, and political leaders in the upcoming years with the aim of saving lives, the study gathers and examines all available data from India, including unpublished and public data. From a public health perspective, it is imperative to gather all available Indian data on traffic crashes, notwithstanding their modest quantity, to identify information gaps regarding the incidence, causes, and

consequences of these incidents. This will open the door for more research, modifications to policies, and advancements. In addition to producing a nationwide profile and trends of traffic accidents,

but also examines traffic safety in each of the 29 Indian states and provides vital details on important topics such as state fact sheets (which are part of the study). Execution is crucial when it comes to raising road safety in India. Indeed, and. For reported national data, there isn't a single, unified source. Over the course of the following few days, additional thorough state reports will be added to the initial basic data on a few important parameters. Since preserving traffic safety is primarily the responsibility of each state, this information is essential for developing state-specific policies, initiatives, and interventions.

Notably, the Indian government has proposed revisions to the India Motor Vehicles Act that, if passed by the Rajya Sabha, will significantly strengthen road safety regulations in a number of regions. The amendments have been approved by the Lok Sabha. In March 2017, the updated format for accident reports and documentation was put into effect. Concurrently, numerous other enhancements ordered by the courts have also been put into place. Numerous changes have been put into place by the Ministry of Health to enhance the care given to trauma patients. In the near future, it will be critical to evaluate the outcomes of the bill's approval and the implementation of these initiatives throughout the states.

Therefore, it was decided that a baseline report was necessary at this time. Furthermore, since its inception, road safety has garnered the attention of several organizations, experts, and academics.decade dedicated to improving vehicular safety. The lack of a nationally unified report on road safety has led many of these organizations to turn to the WHO CC for both broad and detailed information.

1.6 The specific objectives of this India Road Safety Report are to

- "Assess the current burden of RTIs in terms of mortality, morbidity and disability(ies)
- Delineate the characteristics and distribution of RTIs
- Understand the various risk factors for road crashes
- Examine the outcomes and impact of RTIs
- Identify the burden and pattern in all Indian states

- Review intervention strategies and approaches
- Understand ongoing mechanisms and polices for RTI prevention
- Trace the major global developments and lessons learnt
- Provide a framework for implementing road safety policies, programmes and interventions”

1.7 Traffic Calming and Intelligent Transportation Systems

To find out how Canadian drivers feel about speeding and how they can manage their speed while driving, Transport Canada commissioned a study. In-car warning systems should be used to alert drivers when they exceed a speed limit, according to 75% of respondents, and speed-activated signs should be used to alert drivers when they do so (72% of respondents agreed or strongly agreed). However, rather than serving as a deterrent, the majority of Americans (63%) would prefer to use "black boxes" in cars for accident investigations. The wording used in the survey question, "Use of speed bumps/roundabouts to slow down traffic," may have played a role in the Canadian public's lackluster support for these approaches to traffic calming.

Despite the fact that speed control measures are meant to increase road safety, people may see them unfavorably because they think they would prolong their daily commute. This is due of the stigma associated with the phrase "to slow down traffic." Rather than having more inconsistent vehicle speeds, roundabouts can assist reduce the amount of possible places for confrontation at a junction.

Certain speed control techniques lower speeds by utilizing both technology and law enforcement tools. Numerous studies have been conducted on the use of ITS for automated speed enforcement in order to control speed. Researchers examined the efficacy of automated speed enforcement devices installed on Italian roads using a before and after design. The technique being investigated computes an average speed over a significant distance instead of gathering vehicle speeds in a single image. Following the implementation of the automated enforcement method, the number of major and horizontally-curving collisions dropped. Over time, Montella et al. discovered that the system's effectiveness decreased, which they attributed to users altering their driving habits.

The considerable drop in accident frequency persuaded Montella et al. to support the system's wider implementation despite its waning usefulness. To maintain the

system's effectiveness over time, they suggested stepping up enforcement. If the recommended method requires a lot of additional enforcement to remain effective over the long term, it might not be able to be implemented, even if the automated system operated effectively throughout the inquiry period.

Speed-activated signs are used to alert drivers who are going faster than the posted speed limit. After these signs were installed, researchers in the Netherlands observed a substantial decrease in mean speeds. The posting of these signs was accompanied by increased enforcement and public education campaigns. According to the author, automated enforcement technology ought to replace police officers. The number of crashes has decreased, which the author acknowledged to be a significant safety gain; but, the analytic techniques she employed to get that data were oversimplified and did not take into consideration confounding variables such as exposure to traffic volumes or regression to the mean.

The distance over which these signals affected drivers' speeds, as well as the variations in speeds as cars approached and passed the signs, were not discussed. examined the effectiveness of speed-activated signage at various places on rural American two-lane roadways. The speed-actuated signs were positioned 1200–1400 feet upstream, where the most effect on speed was observed. After passing the sign, the pace increased dramatically to within 300–500 feet. According to Santiago-Chaparro et al., speed-actuated signs work best when they are placed in strategic locations where a slowdown in speed is needed.

researchers analyzed how the presence of speed cameras affected the number of traffic accidents in a city. There was a considerable difference between the effective downstream distance of speed triggered signs and the effective downstream distance of speed cameras, with the latter being much shorter than the former.

Variable speed limits (VSL) have been the subject of much recent research as a means of controlling highway speeds in response to shifting traffic loads and environmental factors. Weikl et al. assessed the use of VSL on the German Autobahn. Weikl et al. believe that around one-third of the Autobahn has a permanent speed limit and another third has a temporary or variable speed limit, despite the highway's well-known lack of speed restrictions. When the VSL system was in operation, traffic was more likely to encounter periods of stop-and-go movement, and shock velocities were

much lower, according to research that contrasted data obtained with and without the system. While there is a slight decrease in traffic flow and capacity, safety and speed uniformity are improved.

Even while the highway's annual efficiency may go up due to fewer accidents and shorter wait times, Weikl et al. say it's still not worth the trade-off in flow and capacity.

1.8 Effects of Speed Limit Increase

What happens when reasonable speed restrictions are put in place on existing roadways. Average speeds were observed to rise when the speed limit was raised from 55 to 65 miles per hour on several routes in Virginia. They also discovered that drivers were more satisfied overall. Variation in speed within a given range did not alter much between the before and after time periods. To begin with, the new speed restriction was enforced more strictly by the police. After the time of stricter enforcement ended, there was no discernible uptick in either speeding or noncompliance. There was no decrease in the overall collision rate that could be considered statistically significant.

The impacts of raising the speed limit on some California freeways in terms of collisions were studied using various statistical methodologies. The effects of speed restrictions from 55 to 65 and 65 to 70 miles per hour were analyzed. Simple regression, ANOVA, and a before-and-after observational study were used for statistical analysis. Nighttime accidents were found to be much higher on roads where the speed limit was raised from 55 to 65 miles per hour, according to the report. After increasing the speed limit from 65 to 70 miles per hour, it was discovered that the fatal accident rate for such roads rose significantly. Possible spillover effects from higher speed to lower speed routes were not investigated in this research since only roads with an increase in listed speed limit were analyzed.

1.9 Network Screening

Network screening may be used to detect stretches of roadway that might benefit from speed regulation. According to the Highway Safety Manual, network screening is the process by which road sections with PSI potential are located. After a network is screened a list of locations with PSI is generated, and those sites are then prioritized for further engineering analysis to decide what, if any, safety countermeasures need to

be implemented. There are a number of approaches to network screening, with some of the current research analyzing the HSM-recommended approaches and detailing how to get the best accurate screening findings possible using those strategies. It was discovered that DOTs in the US employed a wide variety of network screening techniques to choose potential locations and/or road segments for safety enhancement. In this research, we used three distinct approaches to network screening: basic ranking, potential for safety enhancement, and sliding window. While many DOTs use a basic ranking system for network screening, Azam et al. discovered that the measurements of effectiveness varied considerably throughout the agencies. The lack of data and knowledge to calibrate the Safety Performance Functions (SPF) and the absence of necessary training and abilities in statistical analysis for the application of Empirical Bayes (EB) techniques have both been mentioned as explanations for the prevalence of the simpler ranking approach among state DOTs. Researchers then compared several network screening techniques. The aforementioned three network screening approaches were used to perform facility-specific screening as well as segment-based screening. This led to the testing of six different situations along Indiana's State Road 144. Sites were chosen from the six test scenarios based on three performance measures: target crash numbers, coefficient of variance, and comparable property damage alone (EPDO). Sliding window network screening combined with a coefficient of variation (CV) performance metric was discovered to be an accurate tool for vetting potential facilities. The combination of the sliding window technique with the CV performance measure allows for pinpoint accuracy in identifying the location and duration of problematic road portions.

This research proposes a statistical model for predicting accidents on individual stretches of road. Using a directed road network topology that takes traffic flow into consideration, we are able to accurately depict the neighbouring connections between individual road segments. In conclusion, we set out to accomplish three methodological goals:

1) present and discuss some issues that arise when conducting a spatial analysis of traffic accidents located on a road network;
2) analyse traffic accidents at road intersections, including a specific strategy that draws together both road intersection and non-intersection zones along the network; and

3) combine the results produced by the two statistical approaches finally chosen, spatial count models and cold spot/hodgepodge analysis.

Here is how the remainder of the paper is organized: Following this, a detailed explanation of the data used in the analysis is provided, including the traffic accident dataset collected during the time period under consideration as well as the network structure used to describe the underlying space in which these incidents took place. Next, we define one class of network-constrained kernel density estimation and describe the steps we used to get z, which included taking into account intersection zones and defining spatial neighborhoods between road segments in the network. Finally, the results and consequences of the approaches used are discussed.

Managing the public's and emergency responders' expectations during traffic situations including secondary accidents may be difficult. This research investigates the connections between geographic features, such as geometry and land use, and event outcomes. This research makes use of incident records from Hampton Roads, Virginia, from 2006, as well as data on route inventories that have been improved with the use of geographic information systems in order to provide precise geographical information. Using a queue-based technique, we were able to determine which occurrences occurred in the same direction as the primary incident and which occurred in the opposite way. These accounted for less than 2% of all occurrences observed, although they tended to last much longer than average. Higher risks of secondary events in some highway segments were not always connected with comparatively high risk of non-secondary incidents, as shown by the study's finding of statistically significant differences between the distributions of secondary and non-secondary incidents. Combining traffic exposure, road segment characteristics, and spatial–land use information, Poisson, zero-inflated Poisson, and negative binomial regression models were calculated to investigate causes of secondary occurrences. The models assisted in the proper allocation of incident management resources and provided backing for regionally based strategy planning. Accidents, road debris, broken down cars, and abandoned cars are all examples of traffic mishaps". Unexpected incidents on the road that need help and disrupt traffic flow by lowering highway capacity are what we call them. The issue of secondary incidents, which typically occur in close spatial and temporal proximity to primary incidents, further complicates matters and necessitates extensive incident management resources. The

population of the greater Hampton Roads area in Virginia is close to 1.7 million, and this research analyses both secondary and non-secondary events in this region. In 2006, there were an average of 105 road-assist occurrences each day on highways, with an additional 2-3 cases each day requiring secondary assistance. By building and running a traffic operations centre equipped with video traffic surveillance, reaction teams, and specialized resources to deal with complicated event scenarios, the Hampton Roads area has established operational tactics to cope with such congestion. Even if the region has a coordinated program to react to problems, there are still a lot of them, which causes a lot of backups.

1.10 Road Design

Planning professionals have always taken a broad view of road safety, as seen by the widespread adoption of 19th-century urban grid networks. Community road design in the first half of the 20th century was built on enhanced utility and purpose, thanks to the advent of the vehicle and its spectacular development and progress. Wide, straight roads, for instance, allow drivers to go faster without sacrificing safety because they give drivers more time to see and respond to any dangers. Economic and social development-oriented transportation plans depend critically on a system of road classifications. Through describing the ability to convey traffic and the patterns of adjacent land use development, this functional categorization method gives a measure of road layout. Local roads, collector roads, arterial roads, and highways are the typical subdivisions of urban road networks.

Access to residential areas is provided via local roads, which often have low speed restrictions and see little traffic volumes. High connectivity between neighbouring communities is made possible via collector highways. A collector road's purpose is to carry traffic over small distances and direct it to major thoroughfares. Urban collector roads rely heavily on signalized junctions, however they slow down traffic and add to congestion. Since collector roads serve multiple purposes, they can't accommodate very heavy traffic loads and force many vehicles to travel at lower speeds. Arterial thoroughfares are predominantly high-speed, high-volume road networks that run through a town, and they were built with drivers' safety in mind. The arterial's primary function as a fast transportation route means that it blocks access to private homes and businesses in the area. While frequent interchanges and junctions are a must on arterials, doing so might strain the capacity of individual traffic lights. Limited-access

highways, often with multiple lanes or an interstate-style layout, are used to move large volumes of traffic quickly and efficiently between cities and regions. Since they have few places of junction and interchange, more land is likely to be developed there. Significant to any and all transportation systems is the intersection, or the region where two or more routes meet and cross. The efficiency and efficacy of traffic movement, as well as the safety and cost of road networks, rely on the layout of their junctions. Vehicles, bicycles, and pedestrians are all likely to collide at intersections, thus these areas are planned to minimize the impact of collisions. Drivers approaching a junction may get helpful information on where to go and how to get there from equipment like pedestrian crossing timers and traffic lights. Devices like this are used to draw attention to hazards on the road and in the surrounding environment, as well as to offer directions to drivers. Yet, studies have shown that most car accidents happen at or near busy city junctions. Additionally, just over 20% of all traffic deaths in the US occur at junctions.

1.11 Traffic Operations

To aid the Federal Highway Administration's (FHWA) Highway Performance Monitoring System, the state of Tennessee follows the advice of the Project Planning Division and routinely collects data on highway conditions and performance (HPMS) Better choices may be made during the design, planning, and operation of transportation networks by following the examples provided by published guidelines on traffic monitoring and forecasting. Road condition data, congestion data, and traffic data are collected, processed, and summarized by the Short-Range Planning and Data Office of TDOT's Planning Division. Traffic data analysis is crucial to meeting transportation goals and is included in every decision made. Highway and traffic control system placement, funding, and design are all highly impacted by traffic statistics (TDOT, 2006). Analysis of traffic data is crucial for gauging the effectiveness of safety programs and maintaining their users' compliance as they anticipate and respond to changes in traffic levels (TDOT, 2006). Local and state governments often concentrate on traffic safety, congestion research, road condition assessments, and capacity measurements. High injury and fatality accident hotspots are identified by traffic safety professionals based on factors like traffic volume, accident frequency, road classification, collision type, and proximity to traffic control equipment.

1.12 Accident Analysis

Information from an official accident report is the primary source of information for conventional engineering methodologies and processes for analysing car crashes. Vehicle travel direction, collision damage, crash type and severity, route parameters, driver demographics, and proximity to traffic control devices are often examined in statistical reviews. One of the most telling characteristics of an area plagued by vehicular mishaps is the frequency of accidents, as documented in detail in the reports the police investigate. Each year, the National Highway Traffic Safety Administration (NHTSA) releases a number of reports detailing accident statistics on a national and state level. These reports primarily concentrate on aggregated data from statistically significant samples of traffic collisions. Since data aggregation may mask or even invert trends, we estimate traffic conditions and motor vehicle accident frequencies based on a quantitative census of reports from 60 different sites. Tennessee and the Federal Highway Administration collaborate to reduce dangerous spots along highways (TDOT, 2006). The U.S. Department of Transportation, the Federal Highway Administration, and the National Highway Traffic Safety Administration gather annual data on car accidents for most states to make public as part of a nationwide effort to improve road safety. By analyzing traffic data that records the kind, intensity, and precise location of each incident involving motor vehicles, dangerous or potentially dangerous accident hotspots may be identified and mitigated (TDOT, 2006). Decisions affecting the national and local transportation networks are often informed by this data utilized by government and transportation authorities (TDOT, 2006). The United States of America. Using this estimate to gain a detailed comprehension of the If a traffic collision in Tennessee results in death, injury, or property damage of more than $400, the investigating officer must file a written report with the Tennessee Department of Safety. The severity of an accident, the number of vehicles involved, and the climate are all factors that may be used to pinpoint potentially risky areas. There are often more than a hundred separate fields in a standard Tennessee accident report. Property damage must surpass $1000 in several jurisdictions in order for a report of a car crash to be filed. Because of this limitation, it may be difficult to get a true picture of the frequency with which car accidents occur. Moreover, the investigating law enforcement officer's observations are crucial to the veracity and correctness of accident reports. However, not all law enforcement

officials have the education or experience to properly assess a driver's mental or physical health.

Road Safety Audit refers to an organized, methodical, and complete assessment of a road project conducted by a certified and trained team of auditors in order to identify and summarize any potential safety hazards with the project (RSA). Since the audit is conducted according to a predetermined protocol and results in a formal report that is archived with the project, we can safely say that this is a well-organized investigation. It is a lengthy investigation that necessitates knowledge, skill, insight, depth, and attention to detail. The purpose of any road safety audit is to identify potential hazards on the road and provide solutions for addressing them.Pedestrians, cyclists, motorcyclists, truck drivers, bus passengers, drivers of three-wheeled vehicles, and drivers of animal-drawn vehicles are all considered in a road safety audit. "Evaluation of road safety issues in a road design, a Traffic Management Plan for road works, a newly completed road scheme, or the identification of safety concerns on any existing road is accomplished through a systematic procedure (not just an informal check) carried out by individuals who are independent of the design and conducted by persons with sufficient qualification, training, and experience. It is possible to conduct a Road Safety Audit before, during, and after a construction project is built.

1.13 Recording of Crashes

Official government statistics on road traffic injuries in India are compiled by the traffic police, as is the case in most countries. The Ministry of Home Affairs' annual reports and the Ministry of Road Transport & Highways' annual publication titled Road Accidents in India are the primary resources for national-level data on traffic collisions. Both of these reports rely on data submitted by local police departments across the country. Following is a short synopsis of how national statistics are compiled. First Information Reports are created whenever a traffic collision is reported to a police station (by anyone involved in the collision, anyone with knowledge of the collision, or a police officer who becomes aware of the collision) (FIR). The FIR contains information about the crash as seen by the person filing the report. This initiates the criminal justice system, and the police begin their investigation. Once a First Information Report (FIR) has been filed, the information contained therein cannot be altered without a new ruling from either the High Court or the Supreme Court of India. After the investigation is complete, a case file is created,

in which the details of the crash are recorded as determined by the police department (which need not necessarily tally with those in the FIR), and the 'offending party' (as determined by the investigation) is charged with offenses under provisions of the Indian Penal Code and the Motor Vehicles Act of India, 1988. (Ministry of Road Transport and Highways 1988 MoRTH). These are some of the applicable clauses":

- **Indian Penal Code**

• Section 279. Rash driving or riding on a public way

• Section 304A. Causing death by negligence

• Section 336. Act endangering life or personal safety of others.

• Section 337. Causing hurt by act endangering life or personal safety of others.

• Section 338. Causing grievous hurt by act endangering life or personal safety of Others.

- **Motor Vehicles Act**

• Section 185. Driving by a drunken person or by a person under the influence of drugs

• Section 184. Driving dangerously

The above provisions determine how a police officer investigates the crash to assign blame to one of the participants in a crash (usually one of the drivers). This is an important issue, as the 'cause' of the crash has to be recorded as a 'fault' of a road user under one or more of the above provisions in most cases. This procedure ensures that 80% or more of the cases get attributed to 'human error' and there is no place for understanding crashes as a result of a host of factors including vehicle, road and infrastructure design".

1.14 Reporting of RTI Crash Data

Police stations provide crucial information concerning road traffic injuries to their district's Crime Records Bureau, which then sends the data upstream "to the state's Crime Records Bureau and the National Crime Records Bureau (NCRB), which publishes the official statistics for the nation. In many nations, the number of people killed and injured in car accidents is underreported by the police. At India, it is often believed that although many injury cases may be treated in private hospitals and not

be documented by the police, the majority of fatal RTI cases do get reported for the following reasons:

The filing of a First Information Report (FIR) with the police is mandatory in the event of a significant injury or death that occurred on the scene or before medical attention could be obtained. All State Governments have been given the authority to establish Motor Accident Claims Tribunals under Section 165 of The Motor Vehicles Act 1988 to decide compensation claims arising from road traffic accidents that result in death, personal injury", or property damage. Injured parties, property owners, or the estates of the dead may file a claim. In the event of a hit-and-run, victims or their legal representatives may file claims as well. It is for this reason that attorneys monitor hospital and police waiting areas, offering free legal representation to those who need it most in order to file a claim.

When a patient who is the subject of an RTI complaint is admitted to a public hospital, the on-duty police officer will document the incident as a "Medico Legal Case." If the victim dies in the hospital, an autopsy is required and the details must be sent to a police officer seconded by the local police station before the corpse is discharged.All automobiles on public roads in India must have third-party liability insurance, under Section 146 of the Indian Motor Vehicles Act of 1988 (excluding those owned by the Central or State Governments).

What is the Internet of Things? (IoT) The Internet of Things (IoT) is the foundational idea that makes smart trac systems possible. To put it simply, the Internet of Things is the concept of improving gadgets by letting them communicate wirelessly with one another and with the wider world. This enables for remote decision-making based on data acquired by the improved devices or for the enhanced devices to gain capabilities that were not previously available. Real-time interaction is made possible with networked gadgets. With the use of IoT, the sensors used in Sections 4 and 5 of this study may exchange data with one another, and the trac lights used in Sections 3, 4, and 5 can adapt to traffic conditions in real time. Pi Raspberry In Section 3, Raspberry Pi is employed to enable authorities to transmit signals to trac lights, so enabling dynamic adjustments to the time of light cycles. Each trac light has its own Raspberry Pi, which enables authorities to control the light from afar. Raspberry Pis are Linux-based single-board computers. Popularity of the Raspberry Pi may be attributed, in part, to its lower price tag compared to competing single board computers. Raspberry

Pisare often used as smart trac systems because to their versatility as web servers and the ease with which their software can be installed and updated. Input/Output for General Purposes (GPIO) The Raspberry Pi's GPIO (General Purpose Input/Output) pins are a great extra. On every Raspberry Pi, you'll find the pins at the board's upper border. Since GPIO pins don't have a predetermined function, they may be altered to suit the requirements of any individual user. All GPIO pins function as switches. When a pin's status is "high," 3.3 volts are distributed from that terminal. On the other hand, when the pin is in the low position, no voltage is generated. Using numerous GPIO pins, users may code responses depending on the total number of active pins. In order to alter the colour of an LED, for instance, we would only need to utilize two GPIO pins. They could set the system such that the LED glows green when both pins are delivering a voltage, red when just one is, and yellow when neither is. In this work, Section 3 makes use of GPIO pins to modify the duration of a given green LED.

Real-World System Implementation Using a Raspberry Pi, GPIO pins, and a camera on each traffic light at a junction, authorities may adjust the amount of time that green lights are on in the direction of traffic congestion. Images captured by a camera mounted on the northbound trac light at a standard four-way junction, for instance, would show police officers that there is an unusually high volume of traffic heading north. Using a signal sent by the authorities, the northbound trac light's green light time would be changed to one pre-set in the Raspberry Pi. The signal would be received by a Raspberry Pi, which would then transform it into a voltage for use with its GPIO pins. Once the trac light picks up the sent voltage, the amount of time that the green light is on will correspond to the amount of time that the voltage represents. From that point on, the northbound trac light would observe the green light period set by the authorities until it received another signal from the authorities instructing it to change.

1.15 RFID Placement in Road Surfaces

The use of RFID to track and record flow is key to this system. Every lane that trac travels on will have a scanning antenna, transceiver, and transponder embedded into the road surface. RFID tags would be installed in every car, allowing for the collection of data on the relative speeds and proximity of moving vehicles. The method recommends installing sensors at intervals of 500 meters to 1000 meters

(3280.84 feet) to ensure precise data collection. Figure 2 is a simplified schematic depicting the operation of the system at a single junction. Each lane of trac in the figure has an RFID transmitter and antenna installed at its centre, broadcasting a signal. Whenever a vehicle with an RFID tag travels over the RFID transmuter and antenna, the tag will exchange data with the system.

Ditch locations were prioritized for this research based on whether or not they were surrounded by a permanently wetland that would cause flooding. The other requirement was that each lawn had to have been cut in 2003. Our goal was to choose segments of ditches that were cut "early" in 2003 and were next to segments cut in accordance with the most recent state requirements in eastern South Dakota. To maintain a uniform research design, the same selection methodology was used even though this mowing date restriction does not apply to the Winner study region. Several days before the nest search team arrived, the study roads were inspected to obtain an adequate sample of road ditches that were mowed after 9 July near to early-mowed ditches.

1.16 Stakeholder Needs in the Region

There are a variety of groups in the area that have an interest in meeting the region's mobility demands, from those who plan and establish policies to those that offer day-to-day transportation services. These parties will gain directly from the PDNRMIS's provision of historical transportation data. Users of the advanced travel information also include the general public, everyday commuters, local media, and international border crossers. Local and state transportation authorities in El Paso, Ciudad Juarez, and New Mexico are the region's key players. These include the Texas Department of Transportation, Sun Metro, and the New Mexico Department of Transportation.

A Metropolitan Planning Organization for the El Paso Area;For the City of El Paso;

In this case, El Paso CountyCBP stands for Customs and Border Patrol.

As a paraphrase, Ciudad Juarez;New Mexico Department of Transportation; Organization: EPA Region 6Institution for Municipal Research and Planning; andPeople from all walks of life include the general public, regional journalists, regular citizens, and foreign travellers called a series of meetings with key regional players to determine what kinds of mobility data were needed. Stakeholders

highlighted the following requirements for archivedInformation about travel and transportation systems:

- Make a regional data warehouse where information from many sources may be stored and handled;
- Keep track of transportation data in real time for use in future planning, design, operation, management, and research.
- Encourage the use of historical transportation records;
- Reduce data acquisition expenses as much as possible for optimal cost-effectiveness in data collecting;Giving drivers and others in charge of large vehicles access to trip-planning tools in advance;
- Make available a setting in which cutting-edge methods of collecting and disseminating traveller information may be studied.

The state of Jammu and Kashmir (J&K) is located in India's far north, and its entire territory, or 90%, is encased by the Himalayas. Politically, militarily, touristically, and spiritually, the state of J&K is vital. The sole route that leads to both the Kashmir valley and the Ladakh area is National Highway-44 (NH-44; formerly NH-1A), which runs from Jammu to Srinagar. Everyone relies on the Jammu-Srinagar section of NH-44. From the outer Himalayas to the higher ranges, this route travels through a region that is both difficult and prone to landslides. During the wet season, NH-44 regularly closes, isolating the Kashmir valley from the rest of India. Widening the roads is a priority to improve traffic flow.

Udhampur road segment (road chainage from KM 67+000 to KM 89+000 and KM 130+000 to KM 1+000) studied for major geological concerns owing to hill slope collapse. The address for the construction site is shown below. Road elevations range from 327 to 2400 meters above sea level, demonstrating the wide range of terrain in the region. When it rains, the road from Udhampur to has a high risk of collapsing since the ground is so unstable. These slips not only impede operations, but also exacerbate traffic management issues. Over the and sub-“Himalayas, the route winds over rocky hill layers. This route has an elevation range of around 500 meters to 600 meters. Hill slopes deteriorate mostly due to the effects of climate change. When summer arrives, expect temperatures ranging from 10° to 42°. Temperatures drop to -10 degrees Celsius at night and 15–20 degrees Celsius during the day during the

winter. This is a region prone to intense downpours accompanied by sudden cloud bursts. It has rained as much as 200 millimetres in a single day on occasion. Devastating cloud bursts occur often. There are also somewhat steep dips along this stretch of road's geomorphology. The principal geomorphologic characteristics of the project area include the presence of a narrow river valley and many minor perpendicular tributaries, moderate to severe hill slopes, and colluvium deposits at the toe of the slopes. Slopes on each side of the river valley range from around 30 degrees to about 70 degrees. Weathered rock mass on the slopes, loose rock blocks, ancient landslide debris, and rock slide debris deposits all over the slopes give the impression that the geomorphology of the region is particularly prone to erosion. Most of the valleys go in a westerly to eastern orientation.

These sediments include semi-consolidated to cemented sandstones, siltstone, mudstone, shales, conglomerates, and clay layers, and they are all part of the Murree formation, which is part of the Outer Himalayan range. Large anticlines and synclines characterize the underlying structure of these rocks. The local geology has a sequence of thrusts. The Main Boundary Fault (MBF) in the outer Himalayas is the most well-known of these faults.

From the MBF/ Murree fault northward, the prevailing rock formations are composed of alternating layers of quartzite and phyllites, with occasional thin bands of slate and phyllites. Quartzite bands range in colour from a pale grey to white and may be up to a meter thick. Different geological discontinuities, including shear zones, slip planes, joints, and foliation shear zones, have been found to have experienced shearing motions during the survey of the site. Small (10-20 cm) as the sequence of movement may be, it has generated fractured character in the rocks, established continuity, and linked geological phenomena. The former describes changes in the foundation rocks' load bearing qualities, while the latter describes seepage in the foundations' media. Considering the area's seismic past, the magnitude of recent earthquakes, and the existence of both longitudinal and transverse thrust faults, it is clear that the research area is in a high-risk earthquake zone. Jammu and Kashmir is located in both Seismic Zone IV and Zone V. The hill excavation had begun in accordance with the approved design and with the granted ROW (Right to Work), but the poor geology encountered by the civil team had caused a number of unexpected problems, including the collapse and cracking of residential buildings, agricultural land, a high tension electricity

tower, and the more common landslide. The Civil Team had lost time, money, and resources in the form of manpower and machinery. To save time and money, government agencies should be cautious in future construction projects and implement the preventative measures and possible reasons of landslide/ground collapse addressed in this article.

1.17 Landslide Zones along Highway

Landslides near NH-44 are a common occurrence. Several formerly active landslide areas have been seen beside the current road. One or more of many processes, including geological, geomorphological, geotechnical, hydro meteorological, precipitation (rain or snow), pore water pressure (increased during periods of intense precipitation), and shear parameter (decreased during periods of intense precipitation) combine to cause a landslide. Planar and wedge failures result from the meeting of negatively angled joint planes, whereas rock falls occur along closely spaced, steeply descending joints. Collapses in the heavy colluvium layers have also been detected. The increased likelihood of liquefaction in the presence of water is a result of the colluvium deposit's composition of pebbles, boulders, silty sand, and clay sand soil. A number of scholars have noticed major landslide regions in Bali, Sam roli, and Nar so.

- **Major Landslides along The Highway Alignment**

Road breakdown is more likely during the rainy and snowy seasons since the section of road between Udhampur and Ramban is in a tectonically unstable area. Udhampur is a district in the Himalayas, namely the Shivalik range, and the topography there is gently sloping mountains. When winter comes around, the higher elevations of the area get dumped on with snow. There are numerous tiny water bodies, Nallas and Major River is Ta wi, and the rock is mostly soft, consisting of “mud stone, clay stone, and siltstone with alternating bands of sandstone. Vegetation on the hills increases the risk of landslides, ground shrinkage, and mud/debris flow down the slopes owing to water penetration along joints and reactivity with soft rocks. The elements that lead to landslides in the region under study are as follows: Natural features such as topography and geology: Overlying boulders and dirt hide the area's geological weakness: rocks with four to six pairs of joints. The frequency of landslides has been shown to rise with factors such as slope angle (45° to 70°), alternating bands of unstable rocks, and the natural slope of valley sides. As nominal

rainfall promotes the erosion/sludge flow and as rainfall fluctuates 600-900 mm yearly with twice in a year; water percolated in between the joints and creates liquefaction, one of the reasons of landslides in this region is the hydrological elements. There has been an uptick in the frequency of cloud burst events", which generate flash floods, transport stones and muck, and ultimately obstruct roads. Aspects of human and building behaviour: Cutting down natural vegetation and redirecting water for irrigation and drinking purposes via tiny drains, the local populace had created agricultural land to meet their daily requirements. Water percolated through the soil during the diversion process, leading to slope collapse in certain areas. The natural slope was ruined by excavation work beside the road or in shaky layers. Along both the current and planned replacement path, many large landslides can be seen. These landslides are primarily caused by the geological and geomorphic environment's fragility, weather conditions like rain and snow, and the decrease in shear characteristics caused by the saturation of pore water during periods of intense precipitation. Planar and wedge failures result from the meeting of negatively angled joint planes, whereas rock falls occur along closely spaced, steeply descending joints. Sliding has been seen on the heavy colluvium deposits, mainly in the portion before Km 145. The composition and size of slides might change depending on the composition of the mother rock. The slides in the Murree series are often controlled by the comparably weak Mudstone/Siltstone/Shale layers that are sandwiched between the Sandstone layers. Joint plane bedding, or plane characteristics, influence slides in other forms. This section has substantial slides such.

Research along the roadway has analyzed kinematic stability and qualitatively estimated rock mass condition using rock mass classifications as a contribution to the mitigation procedure. Kinematic research reveals that rock slopes are vulnerable to several failure modes, including debris flow, rock fall, rotational, circular, wedge, and planar failure. Planar and wedge failures result from the meeting of negatively angled joint planes, whereas rock falls occur along closely spaced, steeply descending joints. Collapses in the heavy colluvium layers have also been detected. The increased likelihood of liquefaction in the presence of water is a result of the colluvium deposit's composition of pebbles, boulders, silty sand, and clay sand soil.

1.18 The importance of spatial analysis

When information has a physical location, it requires a method known as spatial data analysis. There is a potential for using point pattern analysis, which involves looking at the locations of specific occurrences to see whether there is a pattern, to investigate the occurrence of road traffic incidents. All of the incident locations are on or near roads, making the lines the fundamental building blocks for further study. Because data is segmented first into police authority regions, and then into force areas like the heart of Birmingham or Oxford, the predominant method of analyzing traffic accidents is area analysis. This will be determined by the authority's structure, with some having traffic departments that are centralized and others having traffic departments that are delegated to other departments. Because, unlike crime mapping, road traffic events always happen on roads, the resulting patterns always have the same structure, that of being along a road; nonetheless, the road itself must be split down into pieces for analysis. In her study,, the author addresses this issue, focusing on the need of spatial data aggregation and the appropriate level of event analysis before pinpointing problem areas along roads. In order to analyze traffic accidents, Bailey and Gatrell provide three distinct approaches to spatial data analysis.

1. “Visualising – this is the practical mapping and cartography. Linking the dataset to a GIS and plotting the accidents on a map, where clusters can be seen and filtering can enable to identify for example clusters of accidents that were fatal and occurred on B roads.
2. Exploratory – There is a significant blurring between this and visualising but implies descriptions ofthe patterns identified.
3. Modelling – In terms of statistical models concerned with the fact that road accidents and their data aresubject to uncertainty. In the road traffic incident and road policing environment spatial analysis has three main aims based on those identified by Haining (1994):

- A careful and accurate descriptions of road accidents in geographic space
- Systematic exploration of patterns of accidents and association between the accidents in space and time Improving the ability to predict and control accidents occurring in geographical spaceGeographers have been slow to integrate both a spatial and temporal dimension with regard to road trafficincidents which has meant that the understanding of the location of road

traffic incidents has barely gone past a purely locational and statistical evaluation of patterns. However little attention has been paid to systematically understanding the patterns of causes accidents and identifying how to tackle the locational causes through engineering, policing and improving driver behaviour".

1.19 Road Traffic Policing

This section deals with the current policing practices and the extent to which they embrace the issues of spatial analysis, GIS and data accuracy. It will focus on how the policies surrounding today's traffic policing need to be enhanced to embrace a more spatial and locational based focus. The section will be based on findings and policies outlined in the two reports:

- Road policing and traffic – HMIC Thematic Inspection Report 1998
- Tomorrow's roads: safer for everyone – Department for Environment, Transport and the Regions 2000

There has been little attempt to merge road traffic incident reduction and road traffic policing within a spatial context. Both themes have received separate attention in the past. This has partly been because of the different organisational structure of the police authorities and because some authorities do not even employ analysts for the data because the emphasis of the force and its goals do not concern road traffic policing. The next section broadly outlines the main policy initiatives of the government concerning road accidents and road policing".

- **Current government policy**

There is a wide range of options for organizing law enforcement on the road, from a centralized command to a decentralized network, with no one model emerging as clearly superior. Training police to interpret and comprehend the data in order to apply it to day-to-day policing has been cited as a key problem in both government publications and at the "ground policing" level. The value of the investment will decrease significantly if the acquired expertise is not put to frequent use. Proving the value of data gathering and analysis to police officers on the beat has been a challenge. How to evaluate police effectiveness on the road is another topic covered by the HMIC's study. It is necessary to establish some kind of universally applicable measurement or standard against which police departments may be compared. This is

a crucial consideration for analyzing road accident data and for policing roadways, but it is omitted from the graphic below. In this regard, it has been crucial in recent years to recognize road policing as an integral part of police work and to include it into overall policing goals and strategies rather of seeing it as a distinct entity (see diagram below). This intelligence model illustrates the requirements for traffic enforcement, highlights the need of intelligence-led police, and acknowledges the usefulness of multitasking. Officers saw themselves as police officers first and traffic cops second; combining their two sets of abilities would greatly benefit the department. Analysts and scholars agree that there is a growing need for proactive and problem-oriented policing, a view echoed in a recent government study on road policing. This must be done to improve police finances and boost public confidence in their ability to reduce crime and traffic accidents. The police's image is on display while they are out on the roads, therefore it's crucial that they seem to be proactive and able to handle many tasks at once. However, the two government papers' biggest problem is that they don't include efficient spatial referencing at all. It is important to handle road policing as a spatial job within the police and to do so with an eye toward theory and efficient resource management. It's obvious that the proliferation of speed cameras has required a new spatial element, but this principle has to be extended more broadly to the character of road policing as a whole. Better data collecting methods and increased attention in police forces on road policing are essential first steps in addressing the issue, which may be easily identified after a review of the systemic failures within road policing divisions. It's important to remember that the job entails more than just pulling over speeders and dealing with occasional major accidents. According to the intelligence model we discussed before, the following are the four most important things to do:

1. “Hot spot management (proactive policing)

2. Targeting identified offenders (e.g. disqualified offenders)

3. Behaviour management

4. Preventative measures (e.g. speed cameras and traffic management systems)

The common thread connecting these four considerations is the importance of information to their successful implementation”; hence, there is increased demand on law enforcement to improve data collection and analysis. The HMIC research notes

that many police departments handle road-policing intelligence on a "piecemeal, ad hoc manner which is frequently personality driven." The paper also emphasizes the need to differentiate between a collaboration and a connection with other authorities. In a partnership, two or more organizations work together to develop a shared plan, which is then either overseen jointly or independently by each partner. Conversely, multi-agency liaison entails different organizations with different missions and approaches working together because they complement one another. It is challenging to identify "under-achieving" police departments in the field of road policing, since one department may be effective in decreasing fatal accidents while another department may have similar success in lowering speed-related accidents. While the study accepted numerous suggestions, their effectiveness is contingent on execution at a local force broad level and on how each force confronts its own difficulties, which are unique to its own region. Over a decade has passed since the publication of "Traffic Policing in Changing Times," yet little research has been done on the topic, suggesting that the function of police and, more especially, the spatial component, has been neglected. To begin with, it is important to recognize that the police cannot prevent or decrease every single accident on the road. This is because the majority of accidents will have causes that are outside the control of the police. This is a reference to the increased risk of collisions in densely populated areas owing to factors including road design, weather, and volume of traffic. Despite the potential for this area to be an issue, law enforcement has no real options other than to forge a productive cooperation with city planners and/or highway engineers to address it.

Injuries sustained on the country's roads pose a threat to public health. Many people have been killed, and many more have been severely hurt or made permanently crippled as a result of them. As shown by the data, over 70% are of working age (defined as being between the ages of 15 and 45). More than 60% of them are impoverished because they have incomes of less than $1 per day and spend an average of US$17 per day on healthcare costs. This has heavy repercussions for the victims and their loved ones. Many of them are of working age but had to stop working or going to school to focus on their recovery or care for a loved one during the time they were hospitalized. In a similar vein, the amount spent daily on medical bills is capable of further deepening the current degree of poverty of victims and who experienced lifelong handicap are now beggars, often located at intersections,

marketplaces, and main streets in almost all cities in the southwest. Therefore, it is crucial to integrate pre- and post-crash efforts in southwest-specific traffic victim care. This should lessen the trauma and extent of injuries sustained by those who are hurt in traffic accidents. The typical definition of peak hours for passenger travel on weekdays is 7:00 to 9:30 in the morning and 16:30 to 19:00 in the evening. In contrast to the theoretical peak hours of 7:30-19:00 or 9:30-17:00 that are derived from calculations based on traffic wave theory, the actual peak period is found to be 7:30-20:00, as determined through mathematical and statistical analysis. In this study, we analyze data from GPS devices used to track freight movement in Shenzhen and find many causes for this phenomenon. The peak hours for transit and international traffic on Shenzhen's western traffic channels are unusually lengthy, running from 9:30 am to 17:00 pm. There is a lesson to be had in the fact that the ever-present traffic on the Freeways cannot be met with the current infrastructure. Other conferences have shown that if freight vehicles made up more than half of all traffic, security would be compromised, passenger safety would be compromised, and traffic capacity would decrease overall due to the size discrepancy between the two models. Inadequate throughput at the crossroads is a direct consequence of the interchange's influence on the horn traffic congestion on Binhai Avenue. "Regulation to postpone the peak hour time of freight traffic in order to increase passenger traffic at the peak period, then decrease freight traffic during the overlapped peak period between passenger and freight traffic, and finally bring the overlaid flow into a state of equilibrium. Naturally, in line with the preexisting network design in Shenzhen, shifting freight traffic or boosting freight channel development may become the enhancement methods. Decision-makers in the field of mixed freight passenger road traffic control may benefit from the research of temporal distribution of urban freight corridors, and it may give useful supplementary viewpoints on policies relating to management. Based on the findings of the Road Safety Audit performed on the project" roadway, the following conclusions were reached.

For example:

• The planned roadway did not have any kind of traffic separation in place.

Inadequate provision was made for pedestrians and other vulnerable road users.

Possibility of injury due to

- Trees;
- Portable concrete crash barriers;
- Missing or damaged kerbs and footpaths; etc.Disrepair of road signs and line painting.

Limitations on the ability to see different gantry and shoulder-mounted traffic signageSeveral places had traffic signs that didn't conform to the standardsIntersections, steep horizontal bends, service road entrance and exit ramps, median openings, and other critical sites lack necessary road signs and markings. Many places lack road markers.

Lack of retroreflective raised pavement markings and traffic impact attenuators along the route; Poor condition of metal beam crash barriersNumerous damaged or missing pedestrian guard railingsProblems with Visibility at IntersectionsInadequate pruning and care for overgrown shrubs and treesFor a long time, researchers have been interested in traffic safety evaluations performed across areal spatial units, but with the advent of new statistical approaches for linear networks, this field is now facing exciting new opportunities and problems. In this research, we employ a linear network to examine a geocoded dataset of incidents that occurred in Valencia (Spain) between 2005 and 2017. In this light, we have stressed the importance of taking into account road junctions and combining various statistical methods. Given the concentration of traffic collisions at junctions and other points of interaction, studying these collisions is of particular importance. These kinds of studies are usually conducted separately from the values seen along individual stretches of road away from junctions. This approach runs the risk of obscuring significant linkages (often of a spatial nature) between nodes and the segments connecting them.

With the introduction of "IAZs and MAZs along the available directed linear network, a unified solution (including spatial connections and the defining of covariates) to this problem has been made possible, one that does not exclude any kind of road entity (A, Azimian, 2020). From a modelling standpoint, however, the existence of multiple methodologies to treat accidents datasets provides a flexible framework for analyzing many different types of specific questions of interest, but this fact also leads to great difficulties when attempting to decide on a particular approach (A. Fan and others 2015). This research used a zero-inflated negative binomial distribution to deal with the problem of overdispersion of accident counts and the divergent impacts that

develop at road segments at crossings, where there is both a large concentration of traffic accidents and a high presence of zeros. Further, a CAR distribution based on a neighborhood matrix that included traffic flow was incorporated. Later, the validity of the models was evaluated using a battery of validation tools, such as tests on simulated data that led to outlier discovery and more traditional methods like correlation coefficients and Moran's I. In addition, spatial count models and hotspot and coldspot detection were used in tandem in this investigation (J. Gabry, 2018). The findings from each method have been compared and analyzed, and although there were minor variances, the overall picture was consistent. In order to make the final findings more robust, this kind of local study might be extremely helpful in evaluating the results from the statistical models and disputing some of the conclusions generated by the former. When doing a geographical analysis of this sort, particularly at the road segment level, the geocoding mistakes that may result are significantly reduced because to the nature of KDE. As a matter of fact, the generation of the response variable indicating accident numbers at the road segment level is more susceptible to error as a result of poor geocoding. Here, even a little error might change the totals over two sections of road since an accident was recorded in the incorrect section **(**Gattis, J and others, 1998**).** However, as stated, kernel density estimation yields a smooth representation of the severity of traffic accidents over the network, which may even account for some of the common geocoding" mistakes.

CHAPTER- II

REVIEW OF LITERATURE & METHODLOGY

It is essential to incorporated a theoretical basis into every study. Therfore, numerous academics and writers have occasionally examined the spatial analysis of traffic accidents from various angles. One crucial step in the research process is the review of the literature. Although the literature review that follows may not directly address the research challenge, it does provide the foundation for further investigation. in order to prevent research from becoming aimless. Sincere attempts were made to gather and examine the body of knowledge pertaining to the subject study. Many trips were made to the library, books, M.Sc. dissertations, Ph.D. theses, research journals, etc. in order to obtain pertinent material.

were reviewed. Other sources were various government publications; newspapers, magazines, personal collection etc. were referred. Theoretical as well as Research Reviews were arranged and the literature has been divided in the following themes.

2.1 Growth of vehicles and road accidents

Greene (2020) studied "Deadly designs: the impact of road design on road crash patterns along," between 2010 and 2014, there were 25 average monthly road deaths in Mexico, along with numerous injuries. The connection between weather and accidents must be established, even if there are many other elements that contribute to auto accidents. It focused on safe road design as a single strategy to reduce their frequency. The purpose of the study was to determine the relationship between road design specifications and traffic collision distribution along Jamaica's North Coast Highway (NCH). The Getis-Ord Gi* and Anselin Local Moran's I models were used to analyze crash sites.

Additionally, this article developed a scoring system for determining how safe or hazardous road segments were based on the kind, quantity, and presence of road design attributes using Esri's Weighted Sum Analysis tool. The research design criteria included bus stops, pedestrian crossings, traffic lights, junctions, points of interest, walkways, speed limits, soft shoulders, medians, lanes, and roadside barriers. Using the zero-inflated negative binomial (ZINB)" regression model, more empirical

relationships were discovered between crash counts, crash types, road design features, and safety ratings. The model classified large concentrations of point-of-interest (POIs), single lanes, medians, and many junctions as characteristics of crash-prone road segments, regardless of the kind of crash.

Using geographical analysis of road design elements and collision distribution, this research reveals how road safety may be improved and where road safety policies can be implemented.

Azimian and Pyrialakou (2020) according to the study "Researchers may easily alter geographical data into new forms and extract more meaning as a result of spatial data analysis, which is rapidly increasing in the transportation business, as demonstrated by the findings of "Exploratory Spatial Data Analysis in Traffic Safety." The two main categories of spatial analysis methods are exploratory data analysis (ESDA) and confirmation data analysis (CSDA). In addition to the objectives of the exploratory data analysis (EDA), the ESDA has numerous other objectives that are all derived from Turkey's research. Finding instances or collections of cases that are unusual based on where they are located on a map is the main objective of the ESDA. Additionally, it is utilized for the estimation and validation necessary for the analysis of spatial components.CSDA The CSDA uses a range of techniques, such as geographic regression, spatial econometrics, and hypothesis testing. A study titled "Two Hundred Twenty Second Report the Management of Worsening Traffic Situation In" found that cities' capacity to move people around is a major factor in their ability to thrive and continue growing. Megacities and metropolitan areas depend heavily on the efficient movement of people and products, as well as on the flow of traffic and transportation. Megacities experience an increase in both public and private transportation due to the influx of new residents. When compared to public transportation, private transportation typically provides more flexible, enjoyable, and all-encompassing mobility in all major cities worldwide. In the long run, however, this growth is not sustainable.

Technica (2016) it is submitted that "Effects of traffic volumes on accidents: The case of romania's national road discovered and Every traffic accident is critical. The most important thing to do in the phases of preventive and prediction is to conduct investigations on traffic accidents and their causes. For this article, the primary objective is an investigation of road accidents in Romania, one of the most dangerous

countries in the European Union (EU). Research in the nation was found to be inconsistent, with just a few studies completed in various sectors and a lack of accident prediction methodologies. The research validates a worldwide model that might be used in Romania for accident prediction. The purpose of this research is to examine how traffic volume affects the number of accidents that occur. The National Road Infrastructure Management Company supplied the traffic statistics used in this report (CNAIR). According to GIRPTD, data on traffic accidents gathered in 2015 on Romania's major highways was supplied by the Traffic Department of the General Inspection of Romanian Police (GIRPTD). For the purposes of this research, it was necessary to keep the database as simple as possible by only storing information that was directly related to the accident, the cars involved, and the people that were inside. Geographic Information System (GIS)" software was used to conduct the early assessments. Using power regression, researchers were able to show the association between accidents and traffic volume. Congestion has a significant influence on accident incidence, according to the study findings, up to a certain point. An investigation into road safety is more important than the stated objectives, and this underlines the need for a nationwide research approach. Data must be improved, techniques and expertise must be adopted, and local situations must be taken into account in order to ensure a better future for Romanian roads.

Zin and A (2016) study has been concluded that "Traffic Accidents/Geographic Information System (Gis)/ Accident Analysis" discovered and in both rich and developing nations, traffic accidents are widely acknowledged as a significant source of fatalities and economic losses. In 2030, auto accidents are expected to rank seventh in terms of causes of mortality, according to the World Health Organization's 2015 Global Status Report on Road Safety. In traffic accidents, 20 to 50 million people are injured and 1.25 million people die annually. Ninety percent of traffic deaths happen in countries with a low to medium economic development. In Myanmar, the number of fatal traffic accidents has increased since 2013. The World Health Organization estimates that in 2015, there were over 10,000 road deaths in Myanmar, or 20.3 fatalities per 100,000 inhabitants. Implementing accident reduction strategies requires a thorough analysis of high-risk road regions.

The smooth operation of the road networks is ensured by the combination of this management. In order to have a better knowledge of the causes of traffic-related incidents, road accident analysis is performed.

Morelle, Lehaire, and Lejeune (2013) studied evident that "Wildlife-vehicle collision patterns in a region with a high-density road network were found to have spatiotemporal patterns, and In Wallonia, southern Belgium, a vast road network has led to a high rate of wildlife-vehicle collisions (WVC). We found 3965 occurrences of "free roaming animals" that were reported to the police between 2003 and 2011. We discovered that the animals were killed (death) in less than 1 percent of these cases, whereas the drivers or passengers sustained injuries in 13 percent of them. The majority of these fatalities are caused by wild boar, who account for 78% of the total (39%). WVC increased by 21% annually over the course of the study. Hunting statistics, which are used to gauge population density for wild boar and red deer, were shown to be highly connected with this rise. According to the results of the temporal study, there was an increase in WVC at night and a peak in accidents between dark and morning. Breeding, dispersion, and hunting all had a part in determining the temporal patterns of accidents, as seen by the monthly distribution. Spatial investigation focused on wild boar, roe deer, red deer, and red fox showed clustering of accidents for all of these species till scale between 20 and 70 kilometers for all of these species.. We were able to identify high-risk WVC locations via the use of accident mapping based on Kernel density analysis. In our research, we found that the issue of wildlife-related traffic accidents in Wallonia is becoming more prevalent, however the findings of regional and temporal patterns may aid in determining the most appropriate mitigation methods. Furthermore, we recommend that police data be utilized for national and international comparisons. Kevin Morelle et al. All rights reserved

Bennett (2010) it is revealed that "Spatial Analysis of Motor Vehicle Accidents in Johnson City, Tennessee, as Reported to Washington County Emergency" discovered and Motor vehicle accidents that occurred inside the city boundaries of Johnson City, Tennessee, between January 1, 2000 and December 31, 2009, were analyzed in this research using 911 call-for-service data. For nearby houses, the kind of road, and the distance from a traffic light to check records were all taken into consideration. Nearby analysis, point pattern analysis and hotspot analysis were used to analyze the data.

The Washington County Emergency Communications District is the primary source of information for this study's evaluation of motor vehicle accidents. According to the findings, the majority of traffic-related injuries occur in densely populated regions with a high volume of collisions. Near commercial premises, there are two times as many car accidents as there are near residential ones. Accidents involving motor vehicles are more common on major thoroughfares. Roadway junctions account for 40 percent of injury accidents, with signalized intersections accounting for 22 percent.

Erdogan (2009) it is found that "Explorative spatial analysis of traffic accident statistics and road mortality among the provinces of discovered and For this research, we are attempting to understand the disparities in traffic accidents and deaths that occur across provinces in Turkey. The performance of Turkey's provinces in terms of road safety was assessed using two separate risk indicators. As a measure of exposure to traffic risk, these ratios are the number of people died in a road traffic accident (1) divided by the number of accidents (2) (nominals) (denominator). The number of people and automobiles registered in each province was utilized as a denominator separately. The mean annual rate of mortality and the number of fatal accidents obtained between 2001 and 2006 were analyzed in a spatial context. Since there are so few people in each province and so few accidents and deaths, empirical Bayes smoothing was employed to eliminate any unwanted noise from the raw mortality and accident rates. The results of global and local spatial autocorrelation studies were used to determine whether the provinces with high rates of deaths–accidents clustered together or if this was a random coincidence. Clustering of provinces with high mortality and accident rates was discovered using spatial autocorrelation analysis with a significance level of P 0.05. As a result, the provinces that include the roadways linking Istanbul, Ankara, and Antalyaprovinces have large concentrations of deadly accident and death zones. We also used regionally weighted regression analysis with forward step-wise elimination to predict accident and fatality rates using certain independent variables, such as the number of motor vehicles and road length. P 0.05 was used as the threshold for statistical significance". According to denominators in the provinces, there were significant disparities in the rates of fatalities and accidents. The modified R2 values show that the regionally weighted regression analysis predicted both accident and mortality rates more accurately than standard least regressions. Ordinary least squares regressions produced mortality and accident rate

adjusted R2 values of 0.88–0.95, while geographically weighted regressions generated values of 0.89–0.99. An industry's impact: Geographically weighted regression may uncover local trends in the geographical distribution of rates that would otherwise go unnoticed by the conventional least-squares technique. Accident data and mortality rates at the provincial level in Turkey may be used for spatial analysis and modeling to identify regions with particularly high accident and death rates. This might contribute to more effective administration of Turkey's road safety.

Anon N.D it is concluded that "Current Recording Road Practices In Reference To Spatial Data: With Specific Traffic Incident Analysis And Road Policing Policy" discovered and The road infrastructure, human factors, and vehicles all have a role in road safety. Geo-referenced traffic occurrences connect these three components, which serve as the foundation for road safety evaluations and efforts to cut down on crashes and enhance traffic safety. More than 100 people are killed or injured every day, even though the number of automobiles on the road has decreased significantly since the 1950s. This is a significant waste of human capital. This study will focus on the link between traffic incidents and traffic enforcement from a location viewpoint, which is generally considered as the best approach for analyzing various traffic occurrences. Road and vehicle engineering will be covered in more detail later. A point to be made here is that the meanings of the terms "accident" and "incident" have been the subject of significant debate in the literature. Because the great majority of so-called "road accidents" are really criminal acts, I'll refer to them as "incidents" in this study. Accidents are often alluded to in academic literature and reports;therefore, I'll use the word "accident" in these cases. An undesired encounter between two or more moving items, or between a stationary object and a moving object, is what causes a traffic accident (Whitelegg 1986). Road safety and incident reduction affects a wide range of activities, including education, driving training, media campaigns, police enforcement, road traffic policing, the justice system, and the National Health.

Cottage and Road n.d (2004) concluded that the Land Acquisition for Construction of Two Liningwith Paved Shoulder of Nh-44" discovered and The transportation of people, products, raw materials, and other services in the nation relies heavily on road connection. When it comes to hilly places, such as the Himalayas or the Karakoram ranges, high-altitude communication is essential. As a result, the federal and state governments have both implemented policies aimed at promoting the construction of

new roads around the nation. The current overall "length of Indian highways, expressways, and other rural and district roads is roughly 33 million kilometres. The total length of all of the National Highways is 92.851.07 Km. State Highways in India cover a total distance of 1,31,899 kilometres. More than 22,900 kilometres of the National Highway are 4 to 6 Lanes apiece, despite the fact that the majority of the highways are Double Lane. Roads and roads are the responsibility of the National Highway Authority, which works under the Ministry of Road Transportation and Highways". Our aim is to ensure that the nation's highway needs are met in accordance with worldwide standards in order to improve economic and social well-being and quality of life for all citizens.

Ghosh, Parida, and Uraon (2004) studied "Traffic Accident Analysis For" concluded that & India's percentage of the world's road accidents is an issue of great concern. New and more advanced automobile models are becoming accessible as technology advances, and their numbers are expanding every day. An collision on the road has a variety of features. GIS technology has become an essential part of a thorough investigation of traffic accidents. The northern Indian city of Dehradun, capital of Uttaranchal, has been chosen as the site of the investigation. Nearly two-thirds of all incidents in the last five years have resulted in death or serious injury. A majority of collisions occur between the hours of 2:00 pm and 10:00 pm, with the majority involving cars, trucks, or vans. A good traffic management system is needed in order for the city to reduce the number of traffic accidents, according to the report.

The, Powered (2016) studied "Report of The High-Powered Committee on Decongesting Traffic" discovered and As outlined in the MoUD's National Urban Transportation Policy (NUTP), mobility in cities should be on moving more people rather than more automobiles. In Delhi, traffic jams caused by automobiles are a big issue. Congestion and pollution in Delhi were emphasized in many media, with the support of specialists, to bring the problem to the forefront. High-Powered Committee was formed by the Minister of Urban Development to develop a detailed action plan for "How to Decongest Delhi."' Important stakeholders came together to discuss and formulate recommendations for decongestion measures in Delhi. Delhi's car and traffic populations have grown at a spectacular rate since 1981, according to the city's Master Plan of Delhi (MPD) 2021. Travel rates per person increased from 0.72 in 1981 to 0.87 in 2001 and by a factor of around ten or more in 2011 (excluding trips

made on foot). From 45 million trips in 1995 to 118 million trips in 2001, and 144 million trips by 2008, this represents an increase in population. “Between 2001 and 2008, private motor vehicle trips increased from 28% to 35%, while non-motorized vehicle trips increased from 9% to 15%, according to the Transport Demand Forecast Study (TDFS) carried out by GNCTD and approved by UTTIPEC in 2011, but bus trips decreased from 60% to 42% of total trips. TDFS 2007 is the data source”.)

Khan, Singla, and Ahmad (2019)studied “Accident mitigation and management measures for NH-44(India)” discovered that and Accidents are not natural, but they are caused is a familiar cliché in the realm of road safety. In this way, if accidents occur, they may be traced back to the root causes and corrective actions can be devised and executed as far as possible. National Highway-1A (NH-44) from Khanabal to Qazigund, which is the primary route between Kashmir Valley and Jammu and the rest of the nation, is the focus of this investigation. As a result of its tremendous traffic and strategic importance to the state of Jammu and Kashmir, this route is one of the most congested and hazardous in the nation. The presence of mixed traffic, including cars, trucks, and pedestrians, makes it difficult to maintain a steady flow of traffic. There is a direct correlation between traffic accidents and the loss of lives and the destruction of property. During the winter, the length being studied is especially exposed to harsh weather. For this project, the 24 km section of National Highway-1A(NH-44) between Khanabal and Qazigund will be thoroughly analyzed for traffic safety, with the ultimate goal of finding a solution to the many accidents that occur along this route. The National Highway-44, which connects Kashmir Valley with the rest of the nation through what was originally known as NH 1A, has always been prone to accidents.

Mahata, Narzary, and Govil (2019) studied “Spatio-temporal analysis of road traffic accidents in Indian large cities” discovered and In India, there are an average of 1374 RTAs and 400 fatalities every day. In 2030, the daily death toll from RTAs would rise to 662 and wouldn't start declining until 2042, which is a severe issue for public health. Objectives: The current article aims to examine the trends and patterns of RTAs in India between 2000 and 2015, and the patterns in 2015 in cities with a population of at least 2 million. Methods: The data is smoothed out using a three-year moving average, and an exponential curve is constructed to examine the trend. To compare the years 2000 to 2015, a simple growth rate is computed and the absolute

change is discovered. The number of RTAs in India grew at an exponential pace between 2000 and 2015. Based on our geographical study, we may conclude that there is no correlation between accident frequency and accident severity. Analysis of RTAs by vehicle, age, location, and time of accident demonstrates a wide range of patterns in the cities studied. Cities should take action to decrease RTAs, injuries and fatalities under national policy by implementing city-based measures.

Transport Research Wing (2020) studied "Road Accidents in India 2019" discovered and almost half of the 1.27 million persons who die each year in road traffic accidents are walkers, motorcyclists, and cyclists, according to the World Health Organization (WHO). About 61% of the victims died in Indonesian traffic accidents were riding in two- or three-wheel vehicles, according to recent research. According to National Police in 2008, in three provinces, pedestrians (15 percent), bicycles (13) and 4-wheel-vehicle passengers (4 percent) were the next most common modes of transportation. Data and information collecting in Indonesia, despite the country's high incidence of road accidents, remains challenging. Many various sources, such as the police, hospitals, and insurance organizations, may provide data or information. It's possible that various numbers may be tallied depending on how an accident victim is defined, for example, the police department may define death/casualty as a person who dies immediately after an accident. This death/casualty does not have to be one that occurs on the spot and as a result of an accident, but a hospital may define it differently. Such a person may die in the hospital after a period of time, while insurance company may use this term. Because of the underlying structural difficulties of an imbalance between the supply and demand of transportation infrastructure, the accident statistics in many Indonesian cities, particularly large ones like Jakarta, may follow a similar pattern. In addition, the statistics and information offered regarding accidents is based on reports from three sample provinces, namely Jakarta, Jambi and West Java.

2.2 Black spots or Hot spot in different studies

Afolayan et al. (2022) studied "GIS-Based Spatial Analysis of Accident Hotspots: A Nigerian Case Study" discovered and This research used geographic information systems (GIS) and spatial analysis to identify high-risk regions (hotspots). The Lokoja-Abuja-Kaduna motorway in Nigeria provided five years of accident statistics (2013-2017). Mean center analysis and Kernel density estimate were used in the

accident concentration study. Moran's I Statistics (Spatial Autocorrelation) was used to verify the grouping of these places with statistical significance. The Getis-Ord Gi* statistic was utilized to find hotspots using the Fishnet polygon and Network spatial weight matrix techniques. With a relevance level of 95 percent to 99 percent, three hotspots have been identified for 2013. As a result of this, there are no hotspots for 2014 and 2015. The total accident sites were found to have a z-score of 0.0575, a p-value of 0.9542, and a Moran's I statistic of -0.0089 from the spatial autocorrelation analysis. In order to take preventative steps against hotspots, an annual hotspot analysis should be used. The Abaji-Abuja stretch has daily average traffic of 31,270 for northbound traffic and 16,303 for southbound traffic. Geometric factors seem to have a role in determining hotspot sites with high confidence levels.

Manap et al. (2021) studied "Identification of hotspot segments with a risk of heavy-vehicle accidents based on spatial analysis at controlled-access highway" discovered and To reduce the severity of traffic accidents, various research have looked at the significant risk variables that impact heavy-vehicle collisions. Despite the low volume of big vehicles on the road, it is critical to investigate areas with a high risk of collisions with large trucks because of the serious repercussions for other road users. An approach that takes into account the severity of the collision, "the number of heavy trucks involved and the location of clustering hotspots is proposed in this paper as a means of resolving this issue. The Moran's I spatial autocorrelation and the Getis–Ord Gi* statistics were used to find the clustering of each criterion; the network's risk probability was estimated using the Getis–Ord Gi* statistic. Each criterion is evaluated at significance levels of 0.10 to 0.01 with a buffer radius of 1355 m in order to produce segments for each one. Three criteria for hotspots were examined inside the overlapping buffer zone. Crash rates for 22 heavy vehicle risk segments (HVRSs) were rated, and the most dangerous segments were discovered and scored highest. There are various criteria that can be used to identify accident hotspots involving a specific vehicle type, and this study demonstrates how these criteria can be used to help prioritize segments with a high risk of heavy vehicle accidents, as well as provide HVRSs with information for the purpose of developing appropriate countermeasures".

Bassani, Rossetti, and Catani (2020) studied "Spatial analysis of road crashes involving vulnerable road users in" identified that and to be "vulnerable road users"

(VRU) in the case of a collision because of their lack of physical protection. In order to provide a more secure and Pedestrians, cyclists, and motorcyclists, commonly referred to as vulnerable road users (VRU), account for nearly two-thirds of all deaths on urban roadways. There must be suitable safety countermeasures for this user group in order to make the road transportation system more sustainable and safer. In order to ensure a long-term viability of the road transportation system, it is necessary to implement steps to safeguard this particular group of passengers. There are, however, limits on the amount of money and resources that may be used to enhance safety in high-risk locations. For the years 2006-2016, this research looked at the geographical distribution of traffic collisions involving VRU in Turin. Italian National Institute of Statistics (ISTAT) traffic-related crashes database was utilized. Using Geographic Information System (GIS) tools, the investigators were able to first pinpoint the exact location of the collisions. VRU crashes were studied using a cluster analysis and a Kernel Density estimate to construct spatial patterns. On a regional basis, hazardous areas were discovered. By focusing on just those locations where accident rates were consistently high throughout the course of the study, researchers were able to avoid the common errors that arise from short-term studies (eleven years). Many of the crossings where clusters appear are situated along corridors with significant traffic volumes and extensive cross-sections, as shown by the findings. The layout of the most dangerous parts and junctions was examined in further detail to determine the degree to which the geometric configuration (layout) contributed to the severity.

Le, Liu, and Lin (2020) studied "Determining the road traffic accident hotspots using GIS-based temporal-spatial statistical analytic techniques discovered and Analysis of accident severity indexes on the patterns of accident hotspots in relation to time of day and season was carried out using GIS-based statistical analytic approaches. This technique was tested using RTA data from Hanoi, Vietnam, during a three-year period (2015 to 2017). Hanoi's weather conditions and time intervals, such as daytime, nighttime, or peak hours were taken into consideration while dividing up the RTA data into four seasons and time periods. Once the time intervals and seasons were taken into consideration, the Kernel Density Estimation (KDE) approach was performed. Finally, the comap method was used to display the findings. Both SI and SI-free analyses were included in this research. The severity of an accident is measured by the accident SI. Rather of using the excessively high values computed on

a direct rate to accident" expenses, the approach technique is to provide bigger weights to the more severe accidents that have occurred. Although the hotspots identified by both methods were quite comparable, the order in which they appeared in the rankings differed significantly owing to the inclusion of SI. Because the findings obtained and the rankings of hotspots are more exact when using SI, it is advisable to utilize SI for identifying RTA hotspots. The authorities in charge of traffic safety may thus more readily determine the root causes of each accident and devise workable remedies to the most hazardous problem areas when funds and resources are few. Additionally, this is the first research of its kind in Vietnam, thus the findings of the paper will enable traffic authorities quickly and efficiently deal with this issue in other cities.

Pleerux (2020) studied "Geographic information system-based analysis to identify the spatiotemporal patterns of road accidents" discovered and To minimize the frequency of accidents in high-accident-density locations, an examination of the road accident hotspots is necessary. This study was conducted in the Sri Racha district of Chon Buri province. The Road Accident Statistics Center gathered the 2012-2017 accident data (ThaiRSC). Accidents that occurred during the week, weekends, during the day, or at night, as well as those that resulted in death or injury, all had a role in the spatiotemporal pattern of these collisions. A geographic information system (GIS) was used to determine trends and distribution of traffic accidents using spatial statistical techniques, kernel density estimation (KDE), and Ripley's K-function (K-function). Road accidents were found to be particularly common in three localities: Sri Racha, Laem Chabang City, and the Bowin subdistrict. All sorts of traffic accidents were grouped at varying distances from one other. The findings may be used by a number of organizations in the development and implementation of programs aimed at reducing traffic accidents. Accident analysis may also benefit from the use of GIS and spatial statistical approaches like as regression analysis.

Briz-Redón, Martínez-Ruiz, and Montes (2019) studied "Spatial analysis of traffic accidents near and between road intersections in a directed linear network" discovered and Many studies on traffic safety have been conducted across general geographic areas, but there has been an increase in the use of specialized road structures known as linear networks in spatial statistics. It is difficult to accurately locate traffic accidents using linear networks, and it is much more difficult to define variables at a micro

spatial level when using linear networks. Consequently, this study's major objective was to give a thorough analysis of a dataset of traffic accidents reported in Valencia (Spain), which were placed into a linear network covering more than 30 kilometres of urban road structure belonging to one region of the city. Covariates relating to traffic were created at the road segment level for the purpose of this study. Linear networks include a number of intrinsic difficulties and methodological methods, which have been shown and debated. The network was designed in such a manner that incidents at road crossings could be investigated explicitly, as well as the directionality of traffic flow. A zero-inflated negative binomial count model was utilized to account for geographical variability. With the higher variability and greater number of zeros that can be observed at these road entities and the differential contribution of covariates depending on the proximity of a road intersection, the study specifically took traffic safety at road intersections into account when conducting the study. Cold spots and hotspots around the network were also discovered as an explanation for the findings of the count models used. The accident numbers recorded in the investigated road network were explained by geographical heterogeneity, over dispersion, and the near proximity of road crossings. There are various factors that may be influencing accident numbers at the road segment level that were not included in the models, according to hotspot detection.

Samantha and Almalik 2019studied "Spatial Analysis Of The Road Traffic Accident statistics'in "discovered and The study's goal is to characterize and predict the geographical distribution of the rate of road traffic accidents (RTAs) across Turkey's provinces between 2013 and 2018, taking into account aspects such as space–time relationships. RTA rates are based on population, vehicle types registered and road lengths in each province, as well as similar parameters assessed in neighbouring provinces. A first step is to show how RTAs in Turkey vary greatly in terms of their distribution over space. The RTA in provinces with high rates of accidents is examined using both global and local spatial autocorrelation studies to see whether there are clusters. To investigate the time–space link between the RTA and its surrounding neighbourhood features, spatial regression and panel models are deemed viable options. The RTA rate is not evenly spread throughout Turkey, according to our findings. Non-random distribution of provinces with high accident rates (Moran's I shifts between 0.52-2.59 with p =0.001) is seen in the spatial distribution of

provinces. There is a positive correlation between the RTA rate and number of automobiles, vans, private vehicles and asphalt road length in the LISA analysis, however a negative correlation exists with other variables and non-asphalt road is not significant in explaining the RTA rate. Instead of affecting the explanation, nearby area features as explanatory variables are not significant in any models (p 0.1) while spatial parameters are significant in all models.

Shariff et al. (2018)studied "Determining Hotspots of Road Accidents using Spatial Analysis discovered and Malaysia is plagued by road accidents, which often result in the death or destruction of people or property. Consequently, highway concessionaries or build-operate-transfer operating businesses in the nation have gathered extensive data on road accidents in order to develop appropriate countermeasures. The collected data may be analysed in a variety of ways to enhance road safety. During the 2011 to 2014 timeframe, the NSE from Sungai Petani to Bukit Lanjan was studied for reported road incidents. One of the main goals is to see if there is any clustering of the pattern and to identify the spatial pattern of high-risk hot spots along Malaysia's longest controlled-access expressway. A high-risk hot spot denotes a section of road where traffic accidents are more likely than on other parts of the expressway. No worldwide consensus has been reached on how to identify hotspots, hence the results of this research were used to determine the best principles and methodologies for doing so on Malaysian roadways. In order to compute the concentration of occurrences, two geographical analytic approaches were used: Nearest Neighbourhood Hierarchical (NNH) Clustering and Spatial Temporal Clustering, which were visualized in ArcGISTM software and evaluated on the basis of their accuracy. Results indicated that the number and position of hotspots varied based on the parameter settings. Spatial Temporal Clustering (STAC) has a better accuracy index than Nearest Neighbour Hierarchical Clustering (NNHC) after further study of a specified hot spot location (NNH)". On the basis of the specific findings, some proposals for countermeasures have also been made.

Virginia (2018)studied "Bayesian Spatio-Temporal Analysis of Road Traffic Crash" discovered and Death and severe injury caused by road traffic accidents in the United States is a substantial source of economic losses as well as human misery. There have been a number of studies in recent years aimed at determining the locations of hotspots and identifying the elements that contribute to traffic accidents of various

severities. It is common for this kind of study to combine crash sites into geographical units at the macro- or micro-levels, such as counties. Numerous approaches to crash estimate have been put out in the scientific literature. Linear, Poisson and negative binomial regression methods are among the most often used techniques. Other methods include empirical Bayesian (EB), spatial autoregressive and complete Bayesian methods. The regression-to-the-mean bias and possible unobserved heterogeneity may lead to unstable and skewed parameter estimations when classical techniques are used. Multilevel data and random effects at the group level cannot be addressed by EB or spatial autoregressive approaches. It is more versatile and may be readily modified to incorporate random effect terms that can serve as proxies for unobserved or missing variables with spatial or temporal structure in the Bayesian framework.

Seo et al. (2015)studied "23 Disentangling roadkill: the influence of landscape and season on cumulative vertebrate mortality" discovered and On 107 kilometers of rural roads in rural South Korea, researchers documented and evaluated cumulative data on vertebrate roadkill. Over the course of 30 months, every day or every other day, on three kinds of roads: highway, local, and riverbank, roadkill hits and associated landscape elements were documented. The Getis–Ord Gi* statistic was used to compute roadkill hotspot portions for 250-meter-long sections of road. Multiple logistic regression analysis was used to determine the relationship between roadkill hotspots and 18 different parameters of the roads and surrounding terrain. Spring through autumn saw a rise in mammal deaths, whereas summer was the greatest season for bird deaths During the autumn, the mortality of reptiles and amphibians was at its highest. Only the eastern scops owl (Otus scops) had annual mortality that peaked 2 months sooner than the rest of the taxonomic groupings it represented. Roadkill hotspots for mammals and birds were concentrated along the mountain roadway, whereas amphibians and reptiles were concentrated along the riverfront road due to movements associated with nesting, juvenile dispersion, and hibernation. In particular during harvest season, various species made advantage of the spatially complicated agricultural fields along the nearby road. In terms of overall roadkill hotspots, water and rice fields made up a large fraction of the terrain, as did low traffic volumes, a large proportion of natural vegetation, the absence of road banking,

a large proportion of roadside grass, and a lack of drainage. The results of South Korea's wildlife-crossing management program may be used to help develop.

Matos, Sillero, and Argana (2012)studied "Spatial analysis of Amphibian road mortality levels in northern Portugal" discovered and One of the biggest ecological repercussions of roads is the death of animals due to car accidents. Road deaths have a substantial influence on the population dynamics and survival of amphibians, which are the most vulnerable. Amphibian road mortality has been found to be a major problem for Iberian frogs, although little is known about the situation in northern Portugal. Country roads are a more significant cause of amphibian death than highways because they operate as barriers. Due to the large road network, specific locations (hotspots) and characteristics connected to animal-vehicle accident must be identified in order to properly develop mitigation measures. It was the goal of the research to examine the geographical distribution of frog mortality on a variety of rural roads in northern Portugal, utilizing spatial statistics implemented in GIS and a binary logistical regression. Amphibians were found on 631 kilometers of road in seven transects, and we found 74 of them living and 330 of them dead. More than 80% of the deaths were caused by Bufo bufo. This study found a clustered distribution of road-kills along three transects, with broadleaved woods and road ditches being the most critical determinants. Based on the results of logistic regression models, it was shown that Bufo bufo habitat preferences, road ditches, and average height and wall length were all positively linked with amphibian road mortality in northern Portugal. This research is a valuable tool for determining the geographical distribution of amphibian road-kills in northern Portugal, where mitigating measures have been implemented. Amphibian local populations must be assessed to understand their road-kills spatial patterns and mitigation actions on rural roads must be applied urgently. This research also takes that into consideration strategies and practices for avoiding, minimizing, and mitigating harm.

Carrick and Author (2009) studied "A Case Study in Spatial Misclassification of Work Zone Crashes Grady" discovered and Law enforcement traffic collision data are often used in studies of work zone accidents. When an accident occurs in or near a road construction zone, it is possible to separate it from the overall crash statistics using specific coding on the accident report. Crash reports and work zone borders may be seen in a GIS context by providing a geographical representation of a street

and the closest crossing highway fields. A validation of the location information is feasible when the street location of the crash report is compared to the coded work zone field. The misclassification of more than one-third of the work zone accidents in this case study may be attributed to a mismatch between the geographical location and the location of the coded report.

Erdogan et al. (2008) studied "Geographical information systems aided traffic accident analysis system case study: city of Afyonkarahisar" revealed that that GIS technology has been a popular tool for visualizing accident data and analyzing hot areas on roadways. Accident investigations have long relied on geographic information systems (GIS). An accident analysis study aims to locate roadways with high rates of accidents and unsafe zones. As a result, traffic cops may put in place safeguards and procedures to ensure public safety on the road. This scenario makes it harder to examine accident findings in Turkey since accident reports are generated in textual format. To geo reference this tabular data onto the roadways, we devised a technique for converting the textual data in our research. Afyonkarahisar administrative border hotspots were then investigated and found using two separate approaches of KDA and repeatability analysis. Afterwards, the accident circumstances in these hot locations were studied. It became clear to us that the hotspots defined by two different methodologies indicate areas that are particularly dangerous, such as cross roads or junctions. Numerous earlier research merely used GIS to show where accidents occurred. With statistical methodologies, the hotspots in Turkey were identified using GIS as a management system for accident analysis. All rights reserved. 2007 Elsevier Ltd.

dentify the most unsafe road lengths inside each hotspot

Choudhary, Ohri, and Kumar (2015) studied "Spatial and statistical analysis of road accidents hot spots using GIS discovered and Traffic accidents may be reduced in both the number and severity by introducing, analyzing, and then revising safety measures that are part of highway engineering. The identification of hot spots is critical to safety management since highway improvements are meant to be applied to the most dangerous regions or accident hot spots. Road safety professionals and academics alike are always looking for the best ways to identify hotspots for accidents on the road. To define a hot spot, there's no one-size-fits-all answer. GIS and spatial analysis will be used in this study to visually and quantitatively identify high-risk

areas for car accidents. Moran's I technique of incremental spatial autocorrelation, Getis-Ord Gi* statistics, and Kernel Density Estimation were used to examine the geographical clustering of accidents and the density of hot spots (K). For the comparison of the statistical methods, Varanasi city accident data from 2009-2013 was used. In addition to accident numbers and severity indices, both methodologies were used to analyze and rank hot zones. Minor and Property Damage Only (PDO) type accidents were evaluated using a variety of severity weighting techniques. With the use of the Z value associated with statistical significance, Gi* was ranked in order of hotspots. K was used to rank hotspots based on the pixel values of different places detected".

Hari and Jalegar (2017) studied "Black Spot Analysis and Accident Investigations on National Highway – 44" developed nation with road safety in 2030 proven to be true. Deaths on the roadways are continuing rising at an alarming rate, which has pushed up the death toll significantly. In low- and middle-income nations, the severity of accidents is on the rise because of an increase in the number of vehicles on the road. Accidents are a leading cause of disability, death, and damage to health and property in developing countries. Fast-growing economies are accompanied with these. Road accidents in India are becoming more and more common. Records demonstrate that nations have not kept pace with accidents despite the fact that road modifications and enforcement levels result in one fatality every 2.75 minutes. To a significant extent, the high accident rate may be attributable to people driving. Many high-income countries, on the other hand, have inadequate highways and other major roads to meet increasing traffic demands, road user behavior, vehicle defects, and poor road traffic deaths. Some of these countries have even managed to dramatically improve road geometrics and visibility to combat this problem. Traffic fatalities may be reduced by improving road safety. As a consequence of improved vehicle safety, infrastructure safety, and road user friendliness, these accomplishments result in fewer accidents involving both people and automobiles. In addition to NH-44, a number of additional measures have been shown to be beneficial in lowering road traffic injuries in Srinagar.

Srikanth, Srikanth, and Arockiasamy (2019) studied "Identification of Traffic Accident Hotspots using Geographical Information System (GIS)" discovered and One of the primary objectives of traffic safety management is to reduce the frequency

and severity of traffic accidents. The alarmingly high number of traffic accidents throughout the world highlights the need of a well-managed traffic safety system. The first step in implementing effective traffic safety management is identifying accident hotspots. Traditional statistical approaches were used to analyze traffic accidents prior to the emergence of Geographical Information Systems (GIS). With the development of GIS-based approaches, engineers and researchers can now account for change in the geographical properties of hotspot sites in the study, leading to enhanced traffic accident analysis using spatial statistics. Different statistical and geographical techniques are discussed in this research in order to identify traffic accident hotspots. Des Moines, Iowa, is used as a case study to demonstrate how Planar Kernel Density Estimation (PKDE) may be used to identify hotspots. Variations in bandwidth have been studied in the creation of density maps, with 500 meters being the ideal bandwidth for obtaining discrete hotspots in the intended research region. Aspects of future study in traffic accident hotspot analysis are also addressed in the report.

2.3 Social and Economic costs due to road accidents

Newaz, Hasanat-E-Rabbi, and Miaji (2017) studied "Spatio-temporal study of road traffic crash on a national highway" discovered and RTCs have grown to be a major societal issue in Bangladesh, and the problem only becomes worse from day to day. Despite the country's growing urbanization and motorization, the country's road infrastructure is not up to international standards. As a result, the scope of the issue makes it intractable. Crash data does not follow a predictable pattern, although scientific investigation may reveal certain commonalities, such as the timing and kind of collision involved. It is the greatest way for a nation to deal with the problem of road accidents by ensuring that the whole route is safe. But for a nation like Bangladesh, where investment is prioritized, these norms are impossible to meet. Driving safety would be jeopardized if characteristic analysis and black spot recognition were used in these circumstances. This study's approach makes use of Arc GIS' kernel density (KDE) tool to locate the majority of RTC occurrences and potentially dangerous road areas. The Dhaka to "Sylhet national highway has been linked to the methodology in this research. KDE's method for determining evidence of hazardous road location (HRL) might be used on all other national roads in Bangladesh and also in developing countries. In order to reduce RTC in Dhaka-

Sylhet, especially in problem areas", policymakers have been advised to consider many options.

Epni and Arslan (2017) conducted research titled A GIS Approach to Evaluate Infrastructure Variables Influencing the Occurrence of Traffic Accidents on Urban Road and found and discussed the factors that contribute to the occurrence of traffic accidents. Numerous studies have been carried out in various parts of the world to investigate the factors that lead to traffic collisions from a range of perspectives. The study looked at the users of the road system from a variety of perspectives, including legal and technological considerations, as well as psychological, behavioural, and socioeconomic factors. Geographic information systems (GIS) have lately been employed in a number of analytical procedures, which has made it possible to build spatial distribution maps, models, and risk assessments via the use of these approaches. Quantitative statistical methods, which place an emphasis on the course of occurrences, are often used in the analysis of vehicular collisions. There have been researches that have shown that traditional statistical models are not always adequate for estimating the frequency of traffic accidents because they could provide inaccurate conclusions. This is one of the reasons why this is the case. The use of a Geographic Information System (GIS) as a management system for accident analysis and the identification of hot spots, or spatial and temporal visualisation technologies, has led to the discovery of patterns of vehicle accidents and significant contributing factors. This research of urban traffic accidents takes into account a variety of factors, including the amount of traffic, the infrastructure of the roads, and the surrounding environment. Kocaeli's GIS technologies have the capacity to zero in on certain locations that have a higher risk of being involved in a car crash. It is a big cause for worry that accidents happen on urban roadways in Kocaeli, and many people believe that infrastructure issues are to blame for this problem. An investigation was carried out in an effort to establish a connection between the occurrence of traffic accidents in metropolitan areas and the condition of different elements of the road network in the city. The findings of the study pointed to some locations as being potentially more hazardous in the event of an accident.

Vivek Chatto; Usman Nasim (2016) studied "TRUCKS Heavy-duty Pollution and Action" discovered and the heavy-duty vehicle market isn't a simple one to navigate. It has been shown that the sector is the primary source of air pollution and fossil fuel

use in India's major cities. On a national scale, it accounts for 66% of the on-road transport sector's particulate matter burden. As a result, there are major repercussions in the immediate area. Local pollution management is rendered ineffective in cities like Delhi because of the daily 30 percent1 contribution of trucks to particle load from transportation. Lung cancer, heart disease, and a variety of other metabolic and respiratory disorders are all linked to diesel pollution exposure. In addition to trapping 16 times more heat than carbon dioxide, black carbon from diesel automobiles is also a more dangerous warming agent.

Yalcin and Duzgun (2015) studied "Spatial analysis of two-wheeled vehicles traffic crashes" discovered and the number of traffic-related fatalities and injuries is on the rise all around the globe. Economic, social, physical, psychological and public health is only some of the ways in which road traffic accidents affect people. Rapid and unplanned urbanization has exacerbated the problem of traffic accidents in emerging nations and cities. Road accidents are on the increase because of inadequate city infrastructure and a lack of regulatory consistency. Turkey is in the same boat, with the number of accidents on the rise each year. More than only how many accidents take place, the severity of the road accidents depends on their form. Pedestrians, bikers, and riders of motorized two-wheelers make up a significant percentage of the road accident fatalities in low- and middle-income nations. Two-wheeled vehicle riders are more likely to be killed or injured in a road accident because they share the road with four-wheeled vehicles like automobiles and buses. The study's objective is to examine and gauge urban two-wheeled vehicle collisions. "According to the Turkish Statistical Institute (TURKSTAT) Road Motor Vehicle Statistics, Osmaniye city center has a higher percentage of two-wheeled vehicles than the national average because of its climatic availability to use two-wheeled vehicles. GIS-based spatial statistical approaches are used in the accident analysis to examine the geographical pattern of the accidents and their relationship to different land use features of the urban environment."

Thurfjell et al. (2015) studied "Avoidance of high traffic levels results in lower risk of wild boar-vehicle accidents" discovered and automobile collisions with animals result in human deaths, physical pain and financial damage. Animal behaviour near roads and traffic has received little attention in studies that have focused on accident sites. There is a lack of understanding of the factors that influence animal movement

and collision risk. Many animals' daily activities, migratory patterns, and land cover choices may be affected by roads and vehicles, according to previous research. We used GPS collar data from a female wild boar (Sus scrofa) in Sweden to examine how road crossings and incidents involving wild pigs are affected by several circumstances. According to our findings, wild pigs often cross highways in areas where they forage. Most accidents occur at middle traffic levels due to a lack of incidents at high traffic levels. According to the findings of this research, wild boars seem to be able to alter their behaviour in order to avoid near encounters with vehicles. When it comes to reducing the number of wild boar-vehicle collisions, these findings may be put to use by altering driving habits and agricultural methods along high-risk roadways.

Ipingbemi (2008) studied "Spatial analysis and socio-economic burden of road crashes" road traffic accidents are a significant cause of death and injury in the United States, according to studies like these. The number of people killed or injured in car accidents has risen steadily throughout the years. When comparing 1970 to 2005, the overall mortality rate increased from 5.3 percent. Road accident victims' patterns and socioeconomic burdens will be examined in this article. To conduct the study, researchers administered 438 questionnaires in both public and private hospitals to road-accident victims. Descriptive statistics were used to display the data. Findings showed more than 70% of the accident victims were between the ages of 15 to 45, with more than 60% of those people living below the poverty level. Motorcycles and buses made up 70% of the vehicles, while pedestrians accounted for 40% of the casualties. Each victim, on average, spent US$17 per day on medical bills and was accompanied by at least one companion throughout their stay in the hospital. This has serious consequences for the well-being of families and the country's economic growth. Using preventative measures and post-crash management strategies may help lessen the impact of traffic accidents on society, according to the report.

Authority n.d. studied "Rating & Ranking of National Highway Stretches" discovered and It was after the Second World War that the Government of India moved its attention to road building, which had lagged behind in comparison to British rule's railroads. Road sector planning began to take place at a much greater scale when several Indian Road Development Committees made suggestions. In 1998, the National Roadways Development Project (NHDP) was launched to improve,

repair, and expand India's key highways to a higher level. Road sector development accelerated further in 2015 when the Bharatmala Pariyojana was launched. In exchange for paying a Toll Fee, highway users in India demand rapid, efficient, and safe movement on roads, which the government has mandated. Highway users expect the Highway Sector to answer for the use of their tax dollars in highway construction. By providing Road users with world-class services, accountability may be assured. Road users will benefit from the increased quality of highways as a result of this 'Benchmarking and Rating of Corridors' program. Additionally, better-quality Indian highways will lead to a more enjoyable driving experience and a reduction in the number of traffic-related fatalities and injuries.

Deloitte (2019) studied "LEADS 2019 - Logistics Ease Across Different States" By nominal GDP, India is the fifth-largest economy in the world and one of the world's fastest-growing. The foundation of a thriving economy like India's is efficient logistics. Reduced logistics costs might have a significant impact on all economic sectors, allowing them to compete better. It is critical that India capitalize on this strategic change and accomplish the Hon'ble Prime Minister's well-defined aim to become a USD 5 trillion economy7 by improving supply chain efficiency and decreasing logistics costs. India's logistics costs are estimated to account for around 14 percent of its gross domestic product. The cost is almost the same in most underdeveloped nations. Even still, logistical expenses are very modest in wealthy nations, at about 8-10 percent8. Suboptimal mode mix, fragmented regulatory/Institutional framework, storage and packing losses, dearth of competent labor and inadequate fleet size are just some of the difficulties that need to be addressed as India continues on its economic growth path.

Scholar and Instutution (2019)studied "Research paper on Accident Analysis of Jalandhar To Phagwara Road Stretch (NH44)" discovered and Car ownership in India is increasing at a far quicker pace than the country's overall economic and demographic growth. As the number of cars on the road has grown so too have the number of accidents. By the World Health Organization (WHO), road traffic injuries are the sixth largest cause of mortality in India. Table 1.1 lists the number of vehicles registered in the country. There were 73 million vehicles on the road in 2004, up from 37 million in 1997, a jump of 11% for motorized two-wheelers and automobiles and a 7% rise for trucks and buses. However, only 60 to 70 percent of these vehicles are

actually used on the roads. A yearly rise of 10-12 percent is seen in Table 2, which compares sales figures from 2007 and 2017. Table 1.2 displays India's population and road traffic deaths from 1997 to 2007. From 1997 to 2003, the number of deaths rose by an average of 5% each year; since then, it has risen by an average of 8% per year. From 1997 through 2003, the annual death toll was between 79 and 83, but it now stands at 101.

Anon (2020) studied "Traffic Accidents" India's well-coordinated transportation infrastructure plays a significant part in the growth of economic activities by facilitating equitable distribution of generated commodities and services and mobility of people. As a percentage of India's total GDP, the transportation industry is continuously increasing its contribution. It is a critical metric for gauging a country's socioeconomic progress. NCRB gathers data on traffic accidents, including road accidents, in order to infer trends and patterns of traffic accidents so that planners may develop suitable preventative policies for easing traffic congestion.

De and Rajbongshi (2020)studied "Statistical Application for the Analysis of Traffic Congestion and Its Impact in a Hill City" discovered and Traffic congestion is a major issue in every rapidly expanding metropolitan region, and it has a significant economic and social impact. Traffic patterns in the city have a significant impact on the city's economic activity and social well-being. Increasing wealth has led to a rise in the number of automobiles on the roads, which has outpaced the expansion in road length and space. From 2001 to 2015, Meghalaya's East Khasi Hills district had a 20.87 percent rise in the length of its roads. Since that time, the number of automobiles has grown by 293.63% from 34996 to 137753. As a result of a lack of land space to widen roads, hilltop terrain, and curvy roads, the issue is much more serious in mountainous locations like Shillong. Rush hour traffic may be slowed by steep slopes and limited spaces, making it difficult for people to get where they need to go quickly. As a result, congestion fluctuates from location to location and time to time. There are several factors to consider, including the road's terrain, the activity and schedule of vehicle usage, and the locational layout of institutions across the city. Congestion on the national highway that runs through Shillong City was examined in this study to see how it affects commuters, which resulted in the findings shown below. Congestion index and other indications reveal that Shillong city traffic is congested virtually the whole day except on Sunday, when it is free of congestion.

Around government and educational institutions, traffic is particularly bad at intersections when the establishments' opening and closing times coincide. It has a significant influence on the commuters' work schedules, productivity, and income, as well as social and psychological effects.

Santhosh et al. (2021) studied "Spatial distribution of nickel and chromium concentrations in roadside agricultural soils effected by different traffic densities with moisture and various incubation periods in Haryana state, India" discovered and Haryana's three major highways (the NCR, the NH1, and a local route through Hisar district) had their heavy metal levels and distribution studied in this research. The Global Positioning System (GPS) was used to collect soil samples from six points along each "traffic route at four distinct distances (10m, 50m, 100m, and 500m) (GPS). In order to determine the chromium and nickel content, 200 g of soil was placed in a 500 ml plastic container without the inclusion of any heavy metals for testing purposes. Soil moisture was maintained at a level appropriate for the conditions. For the measurement of DTPA-extractable Cr and Ni, samples were taken at regular intervals (0, 20, 30, 40, 50, and 60 days after incubation). DTPA-extractable heavy metal levels were greater in National Highway soils than in State Highway and local route soils at each stage of incubation. The DTPA-extractable Ni decreased gradually up to 60 DAI, but the DTPA-extractable Cr was not detected at 20 to 60 DAI. According to WHO, FAO", and Indian

standards, all heavy metal concentration in roadside soils was determined to be below the acceptable levels.

2.4. Planning models for the minimizing the road accidents

Thodi et al. (2021) studied "Learning Traffic Speed Dynamics from Visualizations discovered and In order to better comprehend and evaluate road traffic dynamics, traffic engineers utilize space-time representations of macroscopic or microscopic traffic variables. We illustrate the implementation of a deep learning algorithm to understand the macroscopic traffic speed dynamics from these space-time images. Instead of being reliant on the beginning circumstances, as is the case with other estimating methodologies, our methodology is independent of variables such as traffic demand, road inhomogeneities, and driver behavior. The robustness of our estimate is enhanced since our model takes causation in traffic dynamics into account. The Next

Generation Simulation Program (NGSIM) and German Highway (HighD)" datasets were used to predict high-resolution traffic speed fields for multiple motorway sections. As an example, we show how to infer vehicle trajectories from an estimated speed field, and we describe how deep neural network models may be used to represent traffic dynamics more accurately.

Al-hasani (2021)studied "Spatio-Temporal Modelling, Analysis and Forecasting of Road Traffic Accidents" It was discovered that RTAs are one of the leading causes of mortality and disability in the world. Road traffic accidents (RTAs) in nations with a high number of accidents have been studied extensively over the years, yet there are still many unanswered questions. To better understand a broad range of RTA concerns, including accident frequencies, observable and unobserved variables, unobserved heterogeneity, and endogeneity, several sophisticated mathematical models have been constructed. There are a lot of RTAs in Oman since it is one of the richest nations in the Middle East. Road traffic accidents in the Sultanate of Oman are unknown in terms of their type, variety, and causes. Thus, this work uses mathematical modelling tools to characterize the temporal, spatial, and combined spatial-time patterns of RTAs in Oman. The Sultanate of Oman has been included in this study's RTA data collection. The first step was to use a variety of temporal models in order to determine the overall trend, other time components, and a prediction of RTI in Oman. The SARIMA model was shown to be the optimum temporal model for RTA and RTI, according to the research.

(Mal n.d.) Plan Operational de Transporte para la Región de la Capitale Nacional para 2032 The Regional Plan 2021. Proposed the development of a road and rail network in the region in order to provide efficient and economically viable rail/road based transportation networks (including mass transport systems). These networks would be well integrated with the land-use patterns in order to support balanced regional development in the Region for the purpose of sustainable development, along with the development of intra-city urban transportation. It suggested developing and upgrading a primary road network, which would include expressways, national highways, and some important state highways; a secondary road network, which would include major district roads; and a tertiary road network, which would provide access to all villages, work places, employment centres, residential areas, and so on. This proposed system of road networks would be organised in a hierarchical structure.

In addition, it suggested the creation of a Regional Rapid Transit System (RRTS) to link regional towns with Delhi and with Sub-regional Centres, in addition to orbital rail and a Mass Rapid Transit System (MRTS) for towns in the CNCR and in Delhi. The numerous ways in which transportation operates have an impact on our day-to-day lives. It has an effect on the growth of the economy, the distribution of the people, the form that cities take, the use of energy, the availability of markets, and the quality of life. It takes in significant investments, employs millions of people, and makes a sizeable contribution to the country's overall gross GDP. The NCR is a high-intensity travel zone that has several levels and modes of transportation". Within the National Capital Region (NCR), there is a significant amount of travel between Delhi and the many regional and sub-regional centres, as well as between these centres themselves. Accordingly, the provisions of section 16 of the NCR Planning Board Act, 1985 require that an integrated transportation plan or a functional plan of transport for the NCR be prepared, and it was required that the recommendations of the Regional Plan-2021 be elaborated on the basis of research studies on the movement of traffic after conducting appropriate surveys. This was done in order to comply with the requirements of the section.

Bhattacharya (2016) studied "Greening the roadway: An assimilated planning approach and techniques based on spatiality"discovered and with no geographical or temporal boundaries, environmental characteristics allow for the interrelationship between different types and patterns of contiguous land uses. In order to prepare for a greener path from an Indian viewpoint, we need to have a firm grasp of the scale and direction of the effect. Road runoff and nearby settlement liquid waste are interconnected in this study, as are emissions of greenhouse gases, air pollutants and noise from moving vehicles and the exposure of roadside residents to these, all because of the lack of adequate sinks or abatement measures; the massive extraction of groundwater for road construction at a time and the resulting conflicts with nearby users are also explored. SMA Solution, a simultaneous multi-approach strategy, has been used to overcome these concurrent movement difficulties. Road runoff is captured and used to create an emission sink; special material combinations are used to reduce air pollutants; innovative techniques and simultaneous approaches are used to manage liquid and solid waste generated in the immediate area; and reparation activities are devised in order to offset the use of natural resources.

Guo, Shi, and Li (2013) studied "International Conference of Transportation Professionals (CICTP" discovered and According to the research presented in this article, freight transportation exhibits several interesting temporal distribution features. Programming languages like SQL were used to simplify and filter GPS data in this study. Mathematica was used for data validation and smoothness checks, while Excel was used for analysis of temporal features of freight traffic in Shenzhen City. Then, the traffic wave theory model was used to generate a quantitative estimate of its influence. It depicted the snarl of traffic that occurs during peak commuting hours when passenger and freight traffic are mixed together. When looking at freight traffic in Shenzhen City from a macro-level perspective, researchers were able to derive running features from the phenomena by analyzing the temporal and geographical dynamics of freight transit. As a consequence of the proper allocation of resources, the research findings play a positive and vital role in the development of social goods and traffic conditions. It might help the modernization of the city, as well as improve the overall efficiency of transportation. The study's findings aim to have a positive and significant influence on Shenzhen City's core competitiveness in the globalization setting.

Khattak, Wang, and Zhang (2010) studied "Spatial analysis and modelling of traffic incidents for proactive incident management and strategic planning" discovered and Secondary incidents in traffic may be extremely difficult for both the public and the incident management to deal with. Geometric and land use elements, as well as secondary and non-secondary occurrences, are examined in this research. The data utilized in this research includes 2006 incident reports from Hampton Roads, Virginia, as well as highway inventory data augmented by geographic information systems (GIS). A queue-based technique was used to identify secondary occurrences in both directions. Nearly 2% of all occurrences were of this kind, but they lasted far longer than the rest. An investigation of secondary and no secondary incident data showed statistically significant variations, suggesting that the probability of secondary events in specific highway segments is not always connected with the risk of non-secondary incidents in the same area. Regression models were used to investigate the relationship between traffic exposure, road segment characteristics and spatial-land use information to identify parameters that may be linked with secondary occurrences.

For incident management resources to be allocated effectively and regional strategic planning to be supported, the models offered useful information.

Transport, Package, and Nn (2012) it is concluded "National Highways Authority of India Government of India Intercontinental Consultants and" In light of projected traffic increase over the next few decades, the National Highway Authority of India (NHAI) has been charged with implementing an ambitious development plan for a number of national highway routes in India. Providing a fair playing field for producers and manufacturers throughout the country is expected to need a network of high-quality national roads. The National Highways Development Phase III Program includes the construction of a two-lane highway from Jowai, Meghalaya, to Assam/Meghalaya segment of NH-44 (km 69.2 to km173.200). This highway, NH-44, which begins in Shillong and ends in Agartala, is part of the NH-40 corridor. Because it crosses the international border, this National Highway serves as a vital lifeline for the state of Tripura.

Indian Road Congress (2013) studied "Ministry of Road Transport & Highways" road infrastructure is essential to a country's economic and social growth, according to research. Because of this, the country's growth would be affected greatly. India's transportation industry is dominated by road transportation. The country's road network is greatly enhanced by the presence of National Highways. A variety of programs that consider the impact on tourism and trade potential, strategic and tribal areas as well as remote or frontier locations are used to determine which National Highways projects can be funded, including the Bharatmala Pariyojana (Phase-I), Development of Road in Left Wing Extremism Affected Areas, Special Accelerated Road Development for North Eastern Region, Inter-Connectivity Improvement Programme and others. National Highway projects, on the other hand, suffer from a variety of problems, including long delays, cost escalation and environmental issues. Land acquisition and compensation issues are also common. There are disputes and litigations, alignment issues, bad quality and bad design; lack of maintenance and repair; toll issues; safety and security issues; accidents, etc. In light of these concerns, the Committee has decided to conduct a thorough investigation of the matter.

Indian Road Congress (2013) it is revealed that "Ministry of Road Transport & Highway the country's road network would be incomplete without Interstates and National Highways, which were discovered to be crucial components. Despite making

up just 2.3% of the overall road network, it is responsible for carrying 40% of all traffic. This ministry is in charge of developing National Highways. A variety of programs, including the BharatmalaPariyojana (Phase-I), Development of Road in Left-Wing Extremism Affected Areas, Special Accelerated Road Development for the North Eastern Region, and Inter-Connectivity Improvement Program, sanction work on National Highways in consideration of its impact on tourism and trade potential areas, strategic, tribal, remote areas, and border areas. It is the Ministry's flagship program, which intends to improve border connections, coastal highways, non-major ports, inter-corridors, and feeder routes along with the integration of Sagarmala into the Bharatmala Pariyojana".

Feroz Ahmed Khan, Iqbal Faheem, and Minhajuddin Aquil (2018) studied "Assessment of Roadway Capacity For A Four-Lane Divided Road Under" discovered and Transportation is essential to every country's overall economic progress. Highways in India are characterized by a wide range of traffic patterns, compared to those in other nations. As a result, the models used in other nations to estimate the capacity of roadways cannot be used in India. There are two 60-meter portions of National Highway 44 that will be examined in this research to determine the capacity of the route. Variations in road geometry and pavement surface characteristics as well as probable traffic situations on average weekdays were considered while selecting the portions. In order to capture the impacts of peak morning and evening traffic as well as heavy nighttime traffic, videography was used to collect traffic data consisting of categorized traffic volumes, space mean speeds, and free vehicle speeds in blocks of four hours each for 10 to 12 hours in a day. 1) free flow speed is the methodology used in this research. Vehicle dynamics unit and flow studies are the next two steps in this process. Study sections were used to construct speed-flow relationships, and capacity flow was defined as traffic flowing at a section's half-way free flow speed. VISSIM 7.0 was used to simulate traffic on the study sections in microscopic detail. According to measured volumes and spatial mean speeds, the model was calibrated and confirmed by the simulation. Following this, the capacity was determined based on the simulation model's speed and flow data. There is an estimate of 4100 PCU/hr/lane/direction for a four-lane divided

national highway's maximum capacity. Field data and model refinement may be used to assess four-lane lane change behaviour

Damani and Lakkad (2018) it is evident that "Road Location for Road User Using discovered that that India's percentage of the world's road accidents is a major worry. Due to their high costs, road traffic accidents have been identified as one of those negative components that contribute to suffocating economic progress in developing nations, creating social and economic worry. The importance of traffic safety cannot be overstated when it comes to the advancement of environmentally friendly modes of transportation. It is no longer uncommon for contemporary road transportation systems to have a significant negative effect on people's lives and property due to accidents". The accuracy and reliability of traffic accident data is critical to the success of traffic safety and highway development projects. Use of spatial statistics and geo-information technologies helped to reveal how geographical elements influenced their creation. With each passing day, more and more advanced car models come to market, and their numbers continue to rise. It is possible to identify unsafe regions objectively and simply by developing a model for traffic accident density estimate explained by GIS data, suggesting where area-wide traffic calming may be applied most effectively. Multiple factors contribute to a traffic accident's complexity. Use of GIS techniques in traffic accident analysis has become an essential tool. This research looked at the relationships between traffic accidents and several city features, such as the population, road conditions, and geographic location. A traffic accident density model has been created to estimate the number of accidents. Effectively assessing the relationships was done using kernel density estimation (KDE) approaches. Traffic accidents might be difficult to locate on a map since the location is often represented as an address with text. The thesis focuses on how to use GIS to record traffic incidents in Spatial Analyst. As an index for extracting trouble locations, your thesis should demonstrate an approach that relies on decreasing accidents.

Associates and Asia (2018) studied "Detailed Project Report for City Bus Services" For the city of Faridabad, a Gross Cost Model (basic) has been suggested. As a private operator (PO), you'll pay a flat fee based on how many miles you serve each day, rather than a percentage of how much money you make. On the basis of the amount of kilometers driven (subject to a maximum number of guaranteed kilometers

by the Authority during a certain term), PO is paid in a different type of GCC. Later payments would be scaled to compensate PO at increasing rates for reaching higher levels of load factors. However, in the first stages of a new PT system, a simple GCC model is recommended for operational convenience. Bus queue Shelters (BQS) and control rooms are provided free of charge by the authority. It also puts forth operating routes and timetables, as well as standards and specifications, monitors and oversees performance, and arranges for revenue collection. PPP revenue collection is used in this scheme. Alternatively, revenue collection can be arranged by the authority through a contracted manpower supply agency, which would supply customer service providers (conductors) and supervisors to manage them, their attendance as per the service roster, service matters, and other related records for the agency. The vendors of Electronic Ticket Vending Machines (ETVMs) will be recruited separately to provide their repair and maintenance services.

Yadav et al. (2020) its found that "The Changing Nature and Pattern of Industrial Complexes discovered that that the National Capital Zone (NCR) is an economic development-based region created to absorb the large influx into Delhi and fulfill job needs and municipal demands. One fourth of India's total foreign direct investment flows through this planning area, which has a combined GDP of US$370 billion. As an economic center, this area relies heavily on agglomeration effects and economies of scale. While service sector-related activities account for 66% of the NCR's GDP, just 26% comes from the secondary sector. As one of the region's largest employers, the secondary industry has enormous growth potential. There has been a lot of interest in the changing character and patterns of the industrial sector" in the NCR and Delhi, which accounts for around 17 percent and 6 percent of the entire GDP, respectively. Other factors to be taken into consideration include infrastructure, migration patterns and income categories as well as industry's standing as well as its role in creating jobs in the area. Traditional polluting businesses must be replaced by ones that rely more on technical know-how. The industrial sector's potential expansion in this planning zone is hampered by policy gaps that are examined in this research.

2.5. Major causes and factors of road accidents

Satria (2020) studied "Spatial Analysis of Traffic Accidents using GIS. The Case of Banda Aceh, Indonesia" the AADT (Annual average daily traffic) coefficient produced positive significant values in all scenarios (total collisions, fatal crashes,

major injury crashes, minor injury crashes, and PDO (property damage only) crashes) and was determined to be statistically significant In the total crashes scenario, the coefficients for land use and horizontal alignment were adversely significant, but favourably significant in the fatal crashes scenario. On winding and meandering rural and urban-rural routes, the overall number of crashes was lower, but the fatality rate was greater, according to this study. As a consequence of the analysis, a number of countermeasures have been proposed. Localized countermeasures are designed to take into account the hazard and peculiarities of hot zones. Urban regions, for example, have a high risk of car accidents. As a countermeasure, increasing the frequency of speed restrictions and patrols is recommended, as are other methods of making sure that drivers adhere to the law. It is recommended that road safety measures in rural regions concentrate on trouble spots with a high collision rate. Medical care is also harder to get by in rural locations, even if traffic on rural routes is lower on a regular basis. Authorities may utilize the outcomes of the suggested two-step process to begin adopting suitable countermeasures based on limited high-quality data and information. Methodology is especially crucial in Indonesia and the wider South-East Asian area, where data availability and data access are still a major problem with this information in hand; transportation organizations in the province can better plan and execute road safety Improvements.

Mellton (2019) Studied "Road Accidents in India discovered and Almost half of the 1.27 million persons who die each year in road traffic accidents are walkers, motorcyclists, and cyclists, according to the World Health Organization (WHO). About 61% of the victims died in Indonesian traffic accidents were riding in two- or three-wheel vehicles, according to a recent research. According to National Police in 2008, in three provinces, pedestrians (15 percent), bicycles (13) and 4-wheel-vehicle passengers (4 percent) were the next most common modes of transportation. Data and information collecting in Indonesia, despite the country's high incidence of road accidents, remains challenging. Many various sources, such as the police, hospitals, and insurance organizations, may provide data or information. It's possible that various numbers may be tallied depending on how an accident victim is defined, for example, the police department may define death/casualty as a person who dies immediately after an accident. This death/casualty does not have to be one that occurs on the spot and as a result of an accident, but a hospital may define it differently. Such

a person may die in the hospital after a period of time, while anûinsurance company may use this term. Because of the underlying structural difficulties of an imbalance between the supply and demand of transportation infrastructure, the accident statistics in many Indonesian cities, particularly large ones like Jakarta, may follow a similar pattern. In addition, the statistics and information offered regarding accidents is based on reports from three sample provinces, namely Jakarta, Jambi and West Java.

Çepni and Arslan (2017)studied "A GIS Approach to Evaluate Infrastructure Variables Influencing the Occurrence of Traffic Accidents in Urban Road discovered and numerous studies have been conducted across the globe to examine the causes of road accidents from a variety of angles. Legal, technical, and psychological, behavioural, and socioeconomic aspects of the road system users have all been examined in the research. Geographic information systems (GIS) have recently been applied in several analytical methodologies that allow for the development of spatial distribution maps, models, and risk estimations. Quantitative statistical approaches are often used to analyse road accidents, which emphasize the progression of incidents. There have been studies that suggest that typical statistical models are sometimes insufficient to estimate the frequency of traffic accidents because they might offer incorrect judgments. Vehicle accident patterns and major causes have been revealed using a GIS method as a management system for accident analysis and the detection of "hot spots," or spatial and temporal visualization technologies. Traffic volume, road infrastructure, and the environment are all included in this study of urban traffic accidents. GIS technologies in Kocaeli have the ability to pinpoint areas that are more prone to traffic accidents. Accidents on urban roads in Kocaeli are a major concern, and it is considered that infrastructural aspects are to blame. An attempt was made to determine the link between urban traffic accidents and various aspects of the city's road infrastructure". The results of the research indicated specific areas that may be more vulnerable to accidents.

Newaz et al. (2017) it is found that "Spatio-temporal study of road traffic crash on a national highway" In Bangladesh, road traffic accidents have become a major societal concern, and the situation is developing rapidly...and This country's road system does not meet international standards and is not designed to keep pace with the fast increase of urbanization and automobile use. As a result, the scope of the issue makes it intractable. Crash data does not follow a predictable pattern, but scientific

investigation may reveal certain commonalities, such as the time and place where a collision occurred as well as the sort of collision. Making the whole route safe by providing all necessary safeguards is the greatest choice for a nation looking to reduce the number of traffic accidents. But for a nation like Bangladesh, where investment is prioritized, these standards are impossible to meet. Driving safety would be jeopardized if characteristic analysis and black spot recognition were used in these circumstances. Using the kernel density (KDE) tool of Arc GIS, the technique of this research is to find the most RTC incidence areas or dangerous road places. The approach was used to a highly vital and economically significant route, like as the Dhaka to Sylhet national highway. An investigation conducted here suggests that the KDE approach for identifying hazardous road locations might be used to all other Bangladeshi national roads as well as those in other developing nations. In order to help policymakers minimize RTC in Dhaka-Sylhet, certain suggestions have been made.

Zahran et al. (2017) studied "A Novel Approach for Identification and Ranking of Road Traffic Accident Hotspots" discovered that and RTAs are well-known for being a major cause of death all around the globe. The identification of RT A hotspots along a road, so that they may be prioritized and addressed, is one useful technique to improving road safety. This research offers a method for identifying and prioritizing RTA hotspots throughout a road network utilizing historical RTA data from a Geographical Information System (GI S). The route Jalan Gadong in Brunei was chosen as a case study because of its historically high prevalence of RT As. A GIS database was created to store five years of RTA data from the appropriate agencies. The geographical extent of the RT A hotspots was subsequently determined using GI S analysis. The RT A hotspots was rated based on the frequency, severity, and socioeconomic effect of RTAs. In addition, a composite ranking system was devised to integrate these methods; this allowed the prioritization and formulation of intervention and maintenance programs for the identified RTA hotspots. For treatment prioritization when resources are limited, a visualisation approach of RTA spatial distribution was also created to it.

Mohan, Thomas, and Thomas (2016) studied "Study on the Road Intersection at 26th Mile" discovered and Parking, accidents, delays, congestion, etc. have all been exacerbated by the rapid rise of the vehicle as a handy form of transportation. Rather

than only constructing roads with sufficient structural strength to accommodate cars, it is now necessary to assure the safe, efficient, and pleasant passage of all types of traffic and other road users. Intersections on major highways are high-crash zones because of their central placement. They are the spots when cars from diverse routes and approaches come together and compete with one another. Compared to highway segments, unsignalized intersections are more likely to be the scene of a traffic accident. This research is based entirely on the already existing circumstances of unsignalized intersections, including geometric design, visibility distance, traffic control devices, etc. of the crossing. The crossroads at 26th mile, where we're doing our research, has parking, accident, and delay issues as well. Because there are no traffic signals at this crossing, there is a considerable risk of an accident during rush hour. The traffic flow is disrupted since it is a junction of a national highway and a state highway, both of which have different design speeds. Improvements in geometric and safety aspects, such as signal placement, adequate sight distances, continuous traffic flow, etc., are the primary goals of our investigation of 26th mile junction.

Tse, Hassan, and Patterson (2015) it is revealed that "Utilization of methods of spatial analysis in road safety evaluation" discovered that and Network screening is a crucial part of road safety analysis. The Highway Safety Manual and the 4 Safety Analyst software use statistical approaches that are 3 now accessible. However, the process of doing such analysis might still be difficult. Data from Ontario's provincial highway network is analyzed in a variety of ways, including using spatial analytic tools. A comparison is made between the findings and those of Safety Analyst In road network screening, the Local Moran I index 8 approach and its seven outcomes show great promise. Using spatial analytic tools to 9 identify clusters of a certain collision type, they may readily be utilized to detect clusters of speed-related crashes in speed control initiatives.

Khan, Qin, and Noyce (2008) studied "Spatial analysis of weather crash patterns discovered and Analyzing trends and autocorrelation in accident data, particularly those caused by weather, may be aided by spatial statistical approaches. Because weather is a spatial phenomenon, it tends to display different geographic patterns that influence certain regions more than others.. Similar trends or clusters may also be seen in weather-related accidents. Use spatial statistical approaches to discover

weather related -crash trends was the goal of this study. Using the Getis-Ord Gi*(d) statistic, we looked at crashes that may have been caused by weather-related factors. Weather-related crashes are grouped in various places depending on the weather, according to this data (snow, rain, and fog). As a consequence of these findings, statistically significant high and low relative accident rates for each meteorological condition may be identified across counties throughout the country. By comparing counties with high and low accident rates to places with a wide range in meteorological data, the results of the study were confirmed".

Munehiro et al. (2007) studied **"**Effect of Retro-Reflecting Performance for Traffic Signs by Driving Visibility Evaluation under Foggy Conditions" discovered and Drivers must be aware of warning signs in foggy conditions to ensure their safety. Driving in foggy conditions was used to examine the impacts of retro-reflective performance on signs. Four visibility situations were tested: daylight clear, evening clear, overnight thick fog on a route in service. We employ wide-angle prism and enclosed lens retro-reflective materials, respectively, to test for visibility targets in these two different configurations. Drivers drove a test automobile in a free-flowing environment and signaled an experimenter in the rear seat whenever they saw a warning sign and again when they understood its significance. When it comes to visibility and readability in thick fog, wide-angle prism retro-reflective material outperformed encapsulated-lens retro-reflective material in both daylight and nighttime conditions. Installing high-reflectivity traffic signs may improve visibility and readability in fog, according to the study's results.

Munehiro et al. (2007) it is concluded that "Effect of Retro-Reflecting Performance For Traffic Signs By Driving Visibility Evaluation" discovered and It is critical for drivers to be aware of warning signals while driving in a foggy environment. Driving in foggy conditions was used to examine the impacts of retro-reflective performance on signs. Four visibility situations were tested: daylight clear, evening clear, overnight thick fog on a route in service. Retro-reflective prisms and encapsulated lenses are used to assess visibility targets in two different ways. Experimenters in the backseat of a free-flowing test automobile were notified by drivers when they saw the warning sign and again when they understood what it meant. When it comes to visibility and readability in thick fog, wide-angle prism retro-reflective material outperformed

encapsulated-lens retro-reflective material in both daylight and nighttime conditions. Installing high-reflectivity traffic signs may improve visibility and readability.

Mistry (2021) studied "Road Safety Audit of Existing National Highway-44 discovered and Road Safety Audit is an organized, methodical, and complete assessment of a road project by certified and trained auditors that results in a summary of the project's prospective safety concerns (RSA). Due to the fact that audits are carried out in accordance with a predetermined process, they are considered to be structured investigations. Time, experience, knowledge, judgment, depth and attention to detail are all required for in-depth research. In the end, a road safety audit produces a road safety audit report that identifies and recommends solutions to road safety issues. Pedestrians, bicyclists, motorcyclists, truck drivers, passengers on public transportation, three-wheelers, and animals pulling carts are among the many road users whose safety is examined during a safety audit. An evaluation of road safety problems in a road design, a Traffic Management Plan for road works, a newly completed road scheme, or the identification of safety concerns on any existing road is a systematic procedure (not just an informal check) carried out by individuals who are independent of the design and conducted by individuals with sufficient qualification, training and experience.

Khurshid and Hussain N.D studied "Statistical Analysis Of Accidents For The Selected Stretch Of Nh-44" road accidents are a significant cause of death, and road safety has been an increasing concern for the general public and highway professionals in particular. In addition, billions of rupees in yearly economic losses are attributed to property damage or lost working days as a consequence of injuries and deaths. After gaining traction in recent decades, the notions of quality management and long-term safety may have helped policymakers and project managers see the need for safety-focused instruments to lower the accident rate. The use of motor vehicles for transportation has been linked to an alarming number of collisions, deaths, and injuries. There have been a number of significant traffic accidents in the mountainous parts of the state of Jammu & Kashmir, which makes up most of the state of J&K. A total of 908 individuals were killed in 5,529 traffic accidents throughout the state in 2018 alone, according to the state's official figures. Another 7,250 people were hurt as a result of the incident. On average, 15 accidents occur each day, according to data from the last eight years. To that end, researchers

are working on a more straightforward strategy for identifying the factors responsible for deadly crashes on four-lane National Highways. Multiple linear regression were used to identify the crucial accident causing characteristics. As a result, the most important factors that contribute to highway accidents have been identified. Using multiple linear regression, we were able to identify the factors that have an impact on safety. After calibration, the remaining data were utilized to verify the generated model. After calibration, the model's R2 value is 0.695; this increases to 0.70 throughout the validation procedure. Safety is influenced by a number of factors including Road Markings and Shoulder Conditions, Traffic Volume, Cross Drainage, and Spot Speed. The overall safety of the National Highways might be enhanced if the key factors are addressed.

2.6 Others studies related to accidents

Parliamentary Panel (2020) studied "Two Hundred Twenty Second Report The Management Of Worsening Traffic Situation In" discovered and The ability of cities to flourish and maintain growth is largely dependent on their ability to move people around. The smooth flow of traffic and transportation, as well as the mobility of people and goods, are critical to the efficiency of megacities and metropolitan centers. The rise of both private and public transportation in megacities goes hand in hand with the influx of people moving there. It is generally private transportation that offers more comprehensive, pleasant, and flexible mobility in all metropolitan locations across the globe when compared to public transit. In the long run, however, this growth is not sustainable.

Samantha and Almalik (2019) studied "Spatial Analysis of the Road Traffic Accident Statistics discovered and the 2019 new coronavirus was responsible for a recent outbreak of pneumonia in Wuhan, China (2019-nCoV). There is a lot of information about these individuals' medical histories and treatment results that we're going to share with you here. All patients suspected of having the 2019-nCoV virus were sent to a designated Wuhan hospital. We gathered and analysed data on 2019-nCoV-infected individuals using real-time RT-PCR and next-generation sequencing on a prospective basis. The WHO and the International Severe Acute Respiratory and Emerging Infection Consortium used standardised data collection forms to gather data from electronic medical records. In addition, researchers contacted patients or their families to gather epidemiological and symptom data directly from the source.

Between individuals hospitalized to the intensive care unit (ICU) and those who weren't, outcomes were also compared. Results: A total of 41 hospitalized hospital patients has been found to be infected with 2019-nCoV as of January 2, 2020. Over three-quarters of the infected individuals (30 [73 percent] of 41] were males; fewer than a third (13 [32 percent]) had underlying conditions such diabetes (eight [20 percent]), hypertension (six [15 percent]), or cardiovascular disease (six [15 percent]). 490 years old was the median age (IQR 410–580). The Huanan seafood market had been visited by 27 (66%) of the 41 patients. There was just one identifiable family in the study area. Fever, cough, and myalgia or weariness were the most common first symptoms in 40 of 41 patients (98 percent); Sputum production (11 [28 percent] of 39 cases), headache (three [8 percent] of 38 cases), haemoptysis (two [5 percent] of 39 cases), and diarrhoea (two [5 percent] of 39 cases) were less prevalent symptoms (one [3 percent] of 38). It took 80 days for 22 of the 40 individuals studied to develop dyspnoea (median time from the beginning of illness to dyspnoea). There was lymphopenia in 26 of 41 individuals (63 percent). In all, 41 of the patients developed pneumonia, and a chest CT scan revealed aberrant abnormalities. There were 12 cases of respiratory distress syndrome, six cases of Anaemia, five cases of acute cardiac damage, and four cases of secondary infection (four [10 percent]). Patients were admitted to the ICU at a rate of 32 percent, and six (15 percent) died. There were greater levels of IL2, IL7, and IL10 in ICU patients' blood than in non-ICU patients', as well as GSCF, IP10, MCP1, MIP1A, and TNF. 2019-nCoV infection resulted in clusters of severe respiratory disease akin to severe acute respiratory syndrome coronavirus and was related with ICU hospitalization and significant mortality. Research is needed to fill up the gaps in our understanding of illness aetiology, epidemiology, duration of human transmission and clinical spectrum. Government, Chinese Academy of Medical Sciences; National Natural Science Foundation of China; Chinese Science and Technology" Commission

Roh and Sharma (2019) studied "Truck Traffic Volume Changes in Canadian Provincial Highway Network" discovered and Nonparametric chi-squared and binomial probability statistical "tests are used to assess the influence of weather conditions on the distribution of vehicle types. Researchers in this research look at how different truck types, such as single-trailer and multi-trailer units, are affected by winter weather conditions. Weigh-In-Motion (WIM) traffic data from the Alberta provincial highway network in Canada was used to conduct this analysis, which spanned five years. There are six WIM locations along the 2, 2A, 3, and 16 and 44 highways where the data is gathered. The purpose of this research is to use a

nonparametric statistical test to evaluate the relationship between the distribution of three truck types by month and season depending on weather conditions. Regional commuter routes and long-distance country roads have an effect on the distribution of truck types, according to the statistical findings. On certain kinds of highways, the distribution of truck types may also be affected by the time of year (winter vs. non-winter)". Using the findings of this research, transportation authorities may establish programs and regulations that help maintain a safe and efficient truck traffic monitoring system and roadway network year-round.

Wandani et al. (2018) studied "Automobile and Motorcycle Traffic on Indonesian National Roads" discovered and This study uses the spatial lag model and the spatial error model to examine the geographical correlations across Indonesian cities when it comes to the dimensions of private car trips on national highways. Vehicle kilometres travelled (VKT) are used to measure the number of journeys or use levels for both private cars and private motorcyclists. There is no evidence of a geographical association between motorcycle travels and surrounding cities, but vehicle trips often cross city borders, yet the models created in this research show very modest spatial correlations among neighbouring cities. Vehicle Kilometres Travelled (VKT) for both automobiles and motorbikes may be influenced by factors such as road capacity and fuel costs; population density; city size; the number of public buses; and worker density. Due to the fact that local solutions may be beneficial in alleviating traffic issues in particular cities, these results imply that the design of urban transportation regulations on national routes in Indonesian cities should be simplified.

Evaluation, State, and Emphasis (2015) studied "An Evaluation of the Idaho State Police Emphasis Patrols in Construction Zones "discovered and GARVEE bonds have allowed the Idaho State Police to pay Idaho State Troopers for time worked when they were assigned to construction sites along Idaho's highways. Extra patrols are subsequently conducted in certain locations to ensure that traffic laws are observed. Overtime money for Idaho's State Troopers was intended to reduce collisions, DUI's, narcotics on the road, and aggressive driving, among other things. The idea was that by making Troopers more visible, the rest of the world would follow suit.

(IRC: 53-2012 2012) studied "Road Accident Recording Forms A-1 And A-4 determined that the Road Accident data is the foundation measure of safety and without it the magnitude and form of road safety concerns cannot be substantiated

with certainty. The presence of an accurate accident database is therefore a critical aspect in the administration of road safety. Considering this, Transport Planning, Traffic. The sub-group employed the existing theory and research for carrying out the assigned job. The Transport Research Wing of Ministry of Road Transport and Highways was also contacted with regard to present practice, methodology followed by them in gathering and compilation of accident data, mandatory data collection forms etc. The draft document was considered at a number of sessions of Transport Planning, Traffic Engineering and Road Safety Committee (H-1) of Indian Roads Congress (people mentioned below) and eventually adopted during its".

Ekram (2009) studied "Reduced visibility related crashes in Florida: crash characteristics, spatial analysis and injury severity" revealed that and fog/smoke (FS) conditions provide a significant challenge to traffic engineers in terms of preventing collisions on the road. Snow and rain-related collisions were the primary focus of previous study efforts. The state of Florida is in the top three in terms of FS-related accidents, according to data. A detailed analysis of fog and smoke-related accidents in Florida was the result of this investigation. The study accounted for accidents that happened on state roadways in Florida between 2003 and 2007. There have been notable findings from spatial analysis and injury severity analysis. Geographic information systems (GIS) are used to evaluate the areas of high FS-related accident rates on state roadways in Florida. Crash clusters for certain kinds of collisions caused by FS have been discovered using the statistical characteristics of the GIS tool, which is widely utilized in traffic safety studies. The optimum segmentation method for this research was to divide the state highways into one-mile pieces, keeping the route attributes consistent. There were 10 unique clusters detected throughout the whole state road network that may be directly linked to these kinds of accidents. However, there was no evident trend in terms of location, since the ratio of FS-related accidents in rural and urban regions was close.

Robert and Mohammed (2003) studied "Congestion and Safety" discovered and Using London enumeration district data, a disaggregated geographical analysis was undertaken to examine how congestion affects traffic safety. While it's possible that clogged roads increase the amount of collisions and interactions between vehicles, the severity of those collisions is thought to be lower in crowded areas. Vehicles go at slower speeds when there is congestion on the road. During times of high traffic, we

looked at whether variables impacting the number of casualties (deaths, severe injuries, and minor injuries) varied from those that did not. Because pedestrians account for a significant share of the city's fatalities, we included a variety of proxy variables to account for congestion in the study's geographical analysis. The results are inconclusive for the time being, though. As a consequence of our findings, we hypothesize that the impacts of road infrastructure on congestion in London are significantly minimized. Models with and without congestion show some minor variations, but no discernible patterns can be discovered. Congestion may be less of a mitigator of collision severity on city streets than on highways and high-speed routes, according to our findings.

Souleyrette and Strauss (1998) studied "Accident Location And Analysis System" discovered and The GIS-ALAS project's first phase report details the project's achievements to date. Iowa State University, the Iowa Department of Transportation, law enforcement agencies, and others have been working for years to construct a database of highway accidents in Iowa that is georeferenced. The Iowa DOT's creation of a PC-based accident location and analysis system (PC-ALAS), which has been highly welcomed by users since its introduction in 1989, is the most prominent of these initiatives. Portable and user-friendly, PC-ALAS is an improvement over its mainframe counterpart. Accident data may be retrieved for certain locations and time periods by logging on to the site. It is possible to target certain sorts of accidents or drivers with specified features in a search. You may view, save, or print your output in a variety of ways depending on your preferences. In spite of the numerous advantages of PC-ALAS, it might be challenging to utilize. In order to identify "node numbers" (intersections, bridges, highway/rail crossings, etc.), laborious node tables or paper maps must be used. Because of the lack of current advances in computer graphics and spatial analytic methodologies such as geographic information systems, PC-ALAS is unable to leverage these new technologies (GIS).

Navin Gupta (2014) studied "Ecological Impacts from Transportation Corridor Nh-44 And"roads are the most common human infrastructure, and their connection with the natural environment of wild animals is all pervasive. Wild animal populations are directly impacted by roads because their home ranges are divided and individuals are killed or injured when they come into contact with automobiles. Wild animal crashes are a severe concern that requires the widespread use of mitigating measures. Vaishno

Devi, a world-famous Indian temple situated in Trikuta Hills, is accessible by the National Highway-44 between Jammu and Katra (50 kilometers). The research area spans 30 kilometers of NH-44 between the Nagrota and Domel interchanges. NHAI and Border Roads Organization are responsible for building and maintaining the roadway. NH-44 in Jammu and Kashmir has undergone extensive road expansion during the last two years. As a vital link between Srinagar, Kargil, Leh, and Ladakh, this road is also of strategic significance. We conducted a detailed survey of the whole research site. It was determined that monkeys died in car accidents because of specific feeding grounds, crossing zones, conflicts, and the locations where monkeys died when they were hit by vehicles. When NH-44 was built, it resulted in habitat fragmentation, mobility limitation, injury and death, soil erosion and hydrological changes and pollution of the environment, all of which had a negative impact on primate populations. Small portions of natural habitat have been displaced by the construction of NH-44. In order to meet the growing public demand for environmental effect reduction and prevention, civil engineers and ecologists must create assessment techniques that they may use in transportation infrastructure design and construction.

Bedi (2014) studied "Background Paper on Issues related to Land Economics" discovered and The public sector's active engagement in maintaining supply ahead of demand was the technique used to keep the growth in housing prices under control until 2000. NCT Delhi's middle- and high-income residents can now afford to buy a home because of this policy, which has helped keep property values stable. However, there was a dearth of EWS and lower-income housing. Unauthorized construction's explosive expansion may be attributed to a variety of factors, including the ability to build on a variety of different-sized plots. Builders took full advantage of the DDA's absence from significant land development after 2000, turning single-story homes into multi-story structures. NCT Delhi's population growth was lower than it was in 1991-01, but the supply of dwellings expanded at a far higher rate between 2001 and 2011 than it did between 1991 and 2001 since other NCR areas were also developing at a much quicker pace in the later decade. It was a boon for entrenched interest groups that cooperated on price hikes because of easy and concessional access to loans for housing, tax advantages for purchasers, and aggressive public sector programs to enhance infrastructure like as the metro and road transportation. Because land,

transportation, and other resources were made available to developers (and thus allowed to be acquired) at prices far below market value, the public sector should not have withheld from ensuring that the rules of a free and fair market mechanism were not violated. This is especially true in light of the importance of making affordable housing available to the general "public in order to improve social well-being. That the supply control for future development was turned over to builders under the land pooling policy plan comes as a surprise following such an experience. There will be a significant reduction in property prices as a result of the big 2011-21 growth plans, but only after the builders have collected the majority of the agreed-upon sum for their large housing and commercial projects presently under construction. Certain markets", on the other hand, would constantly be short on supplies.

G Gururaj and Gautham (2017) studied "Advancing Road Safety in India-Implementation is the Key" discovered and From a public health viewpoint, this paper examines the current state of Road Traffic Injuries (RTIs) and road safety in the United States. As a result, the study examines the progress that has been accomplished or is expected in the next several years so that appropriate corrective steps may be implemented by policymakers, experts, and political leaders. For public health reasons, it is imperative that all available Indian data be brought together to identify gaps in our knowledge of road collisions, including their burden, causes, and effect. This will set the platform for additional study, policy efforts, and future advances. Additionally, the research investigates the 29 Indian states and gives critical information on vital topics such as state fact sheets (which are supplied in the report) in order to construct a national profile and patterns of road accidents. How to Improve India's Road Safety: Focus on Customization. In reports, national data is dispersed and unified information is missing. An initial focus will be on a few critical issues, and more extensive state reports will be developed in the following days. State-specific policies, initiatives, and interventions can only be developed with the help of this data.

Verma, Vajjarapu, and Thuluthiyil Manoj (2020) studied "Recent Advances in Traffic Engineering discovered and Copyright protection applies to this document. The publisher reserves all rights, including the right to translate, reprint, reuse illustrations, recite, broadcast, reproduce on microfilms or in any other physical way, and transmit or store and retrieve information electronically, computer software or by

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Anon n.d. studied "Government of Haryana Building & Roads Department" I out that and technical proposal may be submitted online and in paper form as well. Except for the RFP document cost and the Bid Security, all financial proposals must be provided electronically. The RFP document fee and Bid Security must also be sent in hard copy (original) by 1500 hours on 8 April 2016 at the address below. Unless otherwise noted, all RFP document fees and bid security must be submitted in hard copy by the stipulated deadline and will be accepted at the following office the next business day if the above office is closed. RFP document fee and Bid security must be sent within a stated time frame for a bid to have a chance of being downloaded or analyzed. If a bid is not supported by an approved bid security (valid for a duration of not less than 90 days), it will be considered non-responsiv

2.7 Research Methodology

Transportation is essential to the development of society as a whole. Meeting this fundamental human need is the focus of daily life. One's ability to move from one location to another is determined by the availability of transportation services. Motorcycles, trains, buses, cars, boats, and airplanes are just a few of the many different forms of transportation that people have invented. Cars, buses, and motorcycles are common modes of transportation. Because of this, the road transportation sector is vital to any nation's economic growth. The movement of people and products depends on the surface transport network. Because they are so crucial for starting and accelerating growth, roads are usually regarded as one of the fundamental components of infrastructure. Road travel is vital to India's economy,

and connectivity is regarded as a barometer of development. Due to traffic congestion and auto accidents, people on the road considerably increase society costs. Those who utilize the roads bear the societal costs of traffic congestion, which include lost time and money, less mobility, and a lower standard of living. Road traffic accidents have resulted in huge financial damages for victims, their families, and the community at large. Accidents and traffic congestion are major issues that need to be addressed. Road fatalities and congestion may be inversely correlated, making it unlikely that both objectives would be met at the same time.

According to Shefer and Rietveld, less traffic would increase the chance of grave injury or death. Conversely, fewer serious accidents might occur on congested roads if traffic is moving more slowly. Accidents may occur more frequently when there is more traffic on the roads, but the severity of those accidents may also decline. This is suggested that the financial cost of accidents worldwide may be mitigated by traffic congestion. Finally,

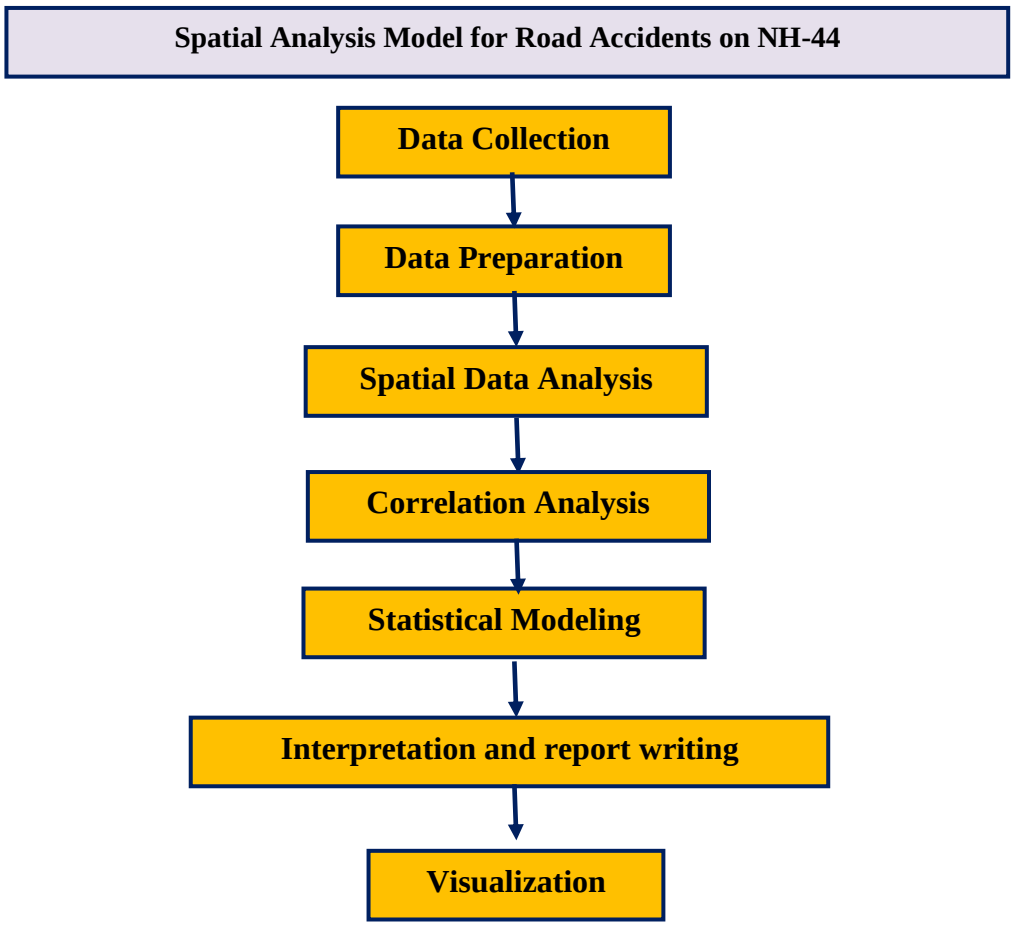


Fig. 2.1. The spatial analysis model for road accidents on National Highway-44.

2.8. Primary Ecological Effects of NH-44

The presence of highways in the environment affects natural processes and habitats, creates new habitat limits, and influences hydrological dynamics. The natural environment is directly impacted by "infrastructure" in all of these ways. Chemical contamination and noise pollution are two of the environmental harms brought on by traffic and road maintenance. Millions of animals are killed in auto accidents every year, and the majority of terrestrial species that are not birds have difficulty spreading because of infrastructure and traffic. Animal habitat is lost and fragmented as a result of biotic and abiotic processes interacting at various geographic scales. In general, it is the duty of transportation companies to lessen the adverse effects that infrastructure projects have on the environment and wildlife.

Building more roads or railroads may have unanticipated consequences that are not considered in this research, such as altered land use, more human settlement, increased industrial expansion, or increased resource exploitation. The majority of empirical research on how roads and other infrastructure affect animals has concentrated on the obvious, immediate, short-term effects.

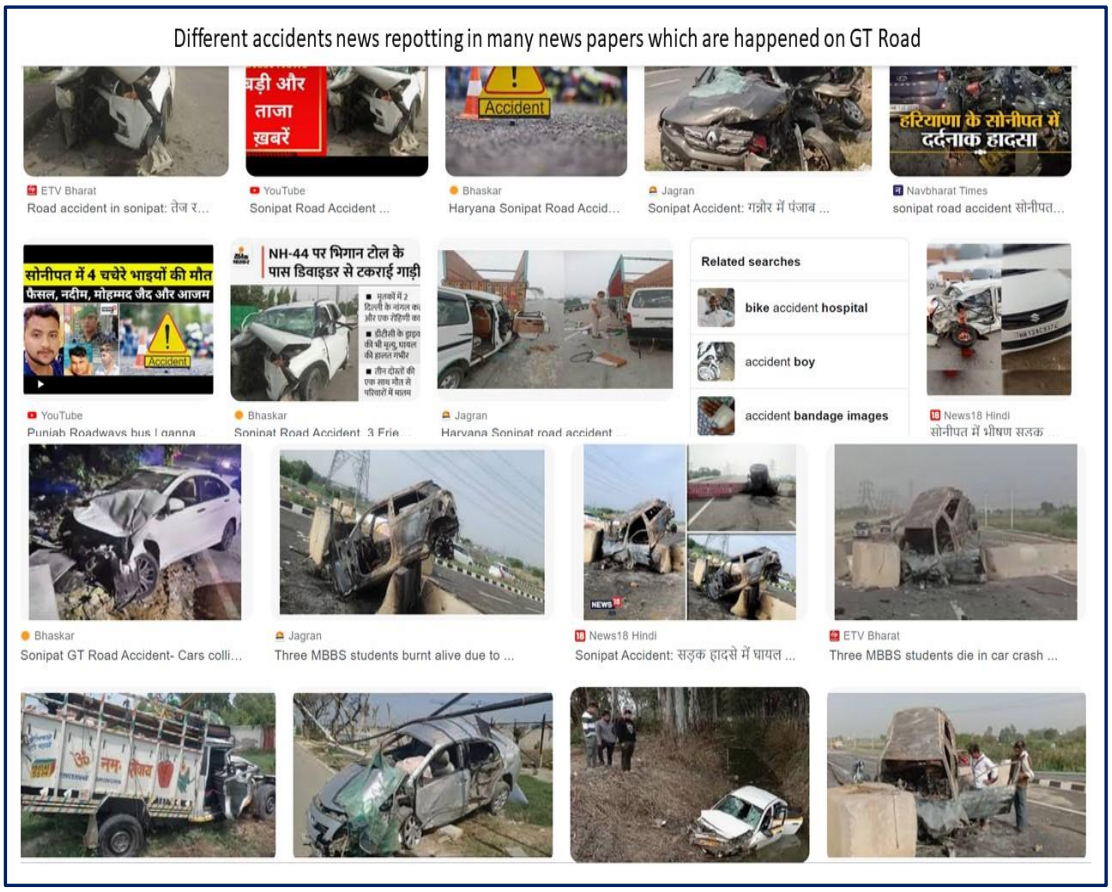


Fig. 2.2. Showing accidental situation on GT road (National Highway -44).

2.9 Objective of the study

The present study aims to achieve the following objectives given below: -

- To observe the trend in the growth of vehicles and road accidents from the last ten years, 2010to 2020.
- To identify the black spots on NH-44 between the Kundli to Panipat.
- To evaluate the social and economic costs due to road accidents.
- To purpose a planning model for the minimizing the road accidents.
- To determine the major causes and factors of road accidents.

2.10 Study area

The study area is situated along National Highway 44 (NH-44), India's longest roadway, stretching from Srinagar in the north to Kanyakumari in the south. The study area is situated along National Highway 44 (NH-44), This national route holds immense significance as a pivotal transportation link connecting diverse regions and cultures across the country. However, our research narrows its focus to a specific segment of NH-44 located in the northern state of Haryana, spanning approximately 184 kilometres. The total length of the study stretch is 65 kilometres between the Kundli border and Panipat. The study area lies between 29° 24' 06"N to76°58' 35"N latitudes and 28° 52' 03"E to 77° 07' 22"E longitudes. This stretch is crucial in linking Haryana with the national capital, Delhi. Of historical importance, this Haryana section of NH-44 is a part of the illustrious Grand Trunk Road, renowned for connecting Attari in Punjab, near the India-Pakistan border, to Delhi. The historical relevance of this road network extends into the contemporary era, retaining its strategic importance. These endeavours aim to mitigate congestion, enhance road conditions, and facilitate smoother traffic flow along this vital corridor. Panipat City presents distinctive challenges to travellers on NH-44. Encroachments on both sides of the highway have contributed to traffic congestion and driver frustration.

Consequently, there's a pressing need to address these encroachments and implement effective traffic management strategies within the city, a significant concern within our study area. A central focus of this study revolves around the identification and analysis of accident blackspots—specific areas along the road where accidents occur at a significantly higher rate compared to other sections. While highway engineers and traffic police may have some knowledge of these locations, a more

comprehensive analysis is imperative to understand the multifaceted factors contributing to accidents in these areas. NH-44 in this region has gained notoriety for its safety challenges, with an alarming estimated 743 fatalities reported in a single year. This alarming statistic underscores the immediate need for comprehensive investigations and interventions to rectify safety issues within the study area.

Map of Study Area

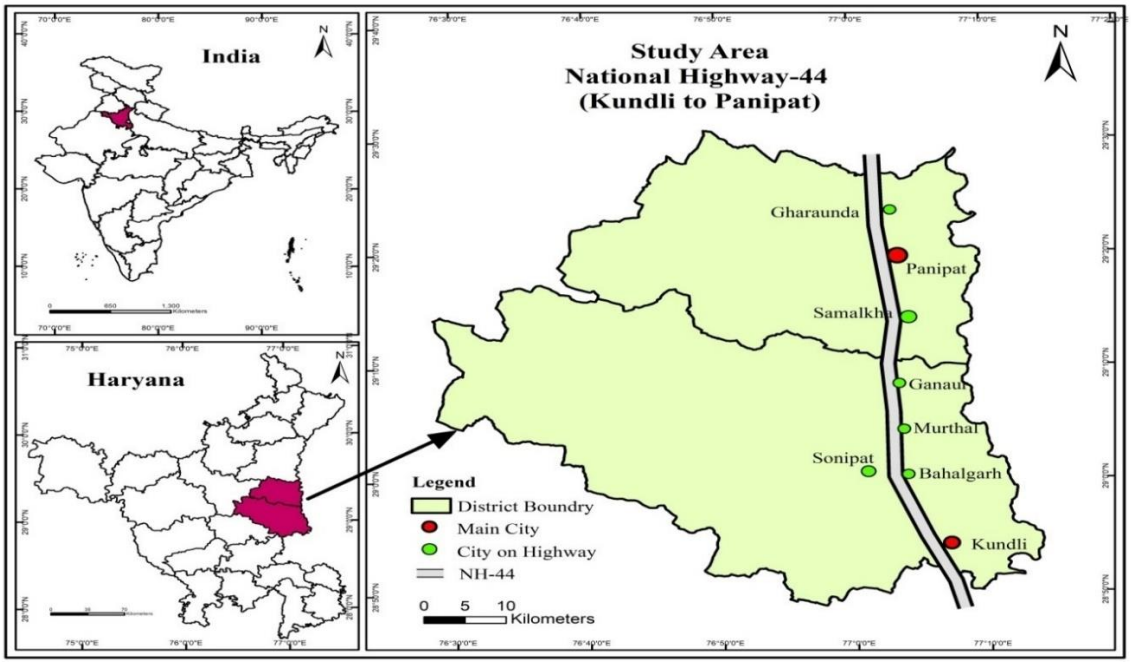


Fig.2.3. Study Area Map of National Highway-44 from Kundli (Sonipat) and Gharaunda (Panipat)

2.11 Database and Methodology

The study is empirical research based on the survey method. This research is based on both types of data such as primary and secondary data which were collected for different sources.The entire procedure used in the study to achieve all of its goals is quite straightforward and narrative, as it is presented here. The secondary data will be collected from the National Highway Authority of India (NHAI), PWD (B & R) Haryana, Office of the Superintendent of Police and other area Police stations on highways. Moreover, the Secondary data will also be collected from various journals related to road accidents. Numerous standard textbooks and published articles will be studied to attain relevant literature on road accidents. While the primary data which are very necessary for the study is collected threw a well-structured questionnaire will be prepared using closed and open-ended questions.

For more accuracy and validation of the studythe sample size of 350 respondents will be collected through a convenient sampling method. For the same, a well-structured questionnaire will be prepared using closed and open-ended questions.

After collection of primary and secondary data related to the requirement of my research an annual growth rate (AGR) will be calculated to observe the percent change in accidents of each year and the compound annual growth rate (CAGR)" will also be analysed. To make all result very impressive and presentative different modeling and statistical methods are applied in this study.

2.12 Significance of the study

Present study will provide insight into vehicle-related deaths and collisions. We will look into the underlying causes of traffic collisions and the general lack of awareness about road safety using a range of statistical techniques. For drivers of all kinds of vehicles as well as officials in the government, police department, and regional transport office, the present research will provide fresh insight into the problem of traffic safety.

2.13 Justification of selecting study area and theme

For a number of reasons, the geographical study of traffic accidents on National Highway-44 (NH-44) between Kundli and Panipat is pertinent and significant. First, traffic accidents still result in fatalities, serious injuries, and large financial losses. Determining high-risk areas and creating focused road safety initiatives are made easier by an understanding of the geographical distribution of accidents.

NH-44 is a major regional transportation route that holds strategic importance. A thorough investigation of incidents along this route is beneficial to the transportation community as well as local and regional authorities. It can enhance enforcement, traffic control, and infrastructure.

The geographical analysis of the study is pertinent to GIS technology and contemporary transportation planning. Spatial data analysis may be used to uncover hidden patterns and trends and make evidence-based judgments on accident preventive measures. The study's examination of accident spatial elements improves the field of transport geography. It demonstrates how human behaviour and vehicle dynamics are impacted by topography, junctions, and land use, resulting in accident

hotspots. This multidisciplinary method aids in our comprehension of the intricate relationships between accident causes.

The subject of the study is supported by its vital importance to road safety, possible advantages for local and regional stakeholders, compatibility with contemporary analytical techniques, and contribution to the geography of transportation. This study might result in evidence-based tactics that increase safety and lower accident rates on NH-44 while also acting as a template for other areas.

2.14 Limitations of the research

The traffic police department and the local Police Chowki will be the sources of the accident statistics. Every piece of information gathered for the study will be registered. For this reason, the study used only incidence data that was properly recorded.

2.15 Statistical Technique used

The term statistical refers to a mathematical method used to describe, arrange, analyze, and interpret numerical data. In order to provide a comprehensive and understandable view of the entire set of data, statistical techniques are employed. The current study used the following statistical techniques for analysis:

- To understand the level of various variables techniques of mean, standard deviation, percentile, Mean, Median, Mode, Standard Deviation andcorrelation technique was used.
- An annual growth rate (AGR) will be calculated to observe the percentage change in accidents of each year and the compound annual growth rate (CAGR) will be analysed.

2.16 Data Collection:

Data collectionmeans using a methodical approach to gathering and analyzing data for a subset of variables in order to evaluate and interpret the outcomes of a study. Surveys are a frequent way to gather data from a large population. However, a survey consists of a question and an answer

- Questions

  Responses

“We've got questions ready on how the data we collected was arranged and kept in a database. There are four options for each objective type question (yes, no, does not matter, cannot say)”.

2.17 Data collection methods:

The process of gathering and analyzing data on particular variables in order to evaluate research objectives and outcomes is referred to as "data collection." The humanities, business, and the physical and social sciences all share a lot of similarities when it comes to data collecting. The goal is always to collect data in an ethical and comprehensive way, regardless of the exact technique employed. Gathering enough information to create a compelling and impressive case is the ultimate goal of every data collecting endeavor.

2.18 Importance of data collection

Regardless of the research topic or the kind of data used—qualitative or quantitative—accurate data collecting is crucial to guaranteeing the validity of studies. One possible way to lower the number of mistakes is to employ freshly built or preexisting instruments in conjunction with comprehensive instructions on how to use them correctly. Methodical data collection boosts trust in the results and the reliability of any inferences made from them. In certain situations, the process offers both a beginning points and a finish. One of two approaches will be used in this study to gather data. Here, we'll use the phrases main and secondary data interchangeably.

- **Primary data:**

“Primary data was collected with an aid of a Questionnaire. Questionnaire contains a series of questions arranged in a proper order. Questionnaire was made in order to collect data regarding **“*Saptial Analysis of Road Accidents on National Highway-44, From Kundli to Panipat: A Study In Transport Geography*”**

- **Secondary data:**

For “quantitative data, secondary data analysis may save a lot of time that would otherwise be spent gathering data and generate bigger and higher-quality databases that would be impossible for any one researcher to obtain on their own. Secondary data can be obtained from different sources:

1. Information collected through censuses or government departments like housing, social security, electoral statistics, tax records
2. Internet searches or libraries
3. Progress reports

It is difficult to conduct a fresh survey which can fully capture previous changes and/or advancements, hence secondary data is considered crucial by analysts of socio-economic change. The internet, academic publications, and books were used to gather secondary data.

2.19 Data Analysis:

An analysis of data is the process of looking through, cleaning, transforming, and modeling data in order to find relevant information, draw conclusions, and support decision-making. The business, scientific, and social science domains all have a variety of unique data analysis processes and approaches, each with unique features and approaches.

Analysis is the process of dissecting a whole into its component parts for further study. Analyzing raw data and turning it into information that can be used by people is called data analysis. Answering questions, testing hypotheses, or disproving ideas requires the collection and analysis of data. As shown in the next sections, there are a number of distinct stages to consider.

2.20 Data requirements:

Analytical input data are given based on needs from individuals who conduct the analysis or clients who employ the completed analysis output. An experimental unit is a general sort of entity upon which data is gathered, such as a person or a group of individuals. A population's age and income may be defined and retrieved. For example, integers may be labeled with a written description.

2.21 Data collection:

. A wide “range of sources are used to get information. Analysts may convey requirements to data custodians, such as IT staff, inside a company. Various sensors in the surroundings, such as traffic cameras and satellites, may also provide valuable information. Interviews, downloads from internet sources, or reading documentation may also provide it.

2.22 Data processing:

Data must be processed or structured before it can be used for analysis. A spreadsheet or statistical program may need data to be organized into rows and columns in a table format.

2.23 Exploratory data analysis:

Analyzing data is possible once it has been cleansed. To begin deciphering the information contained inside data, analysts might use a range of methodologies together referred to as "exploratory data analysis. These activities may be iterative in nature because of the nature of the exploration process itself. Using descriptive statistics like average and median, data may be explained better. Additional information about the messages in data may also be gained by data visualization" techniques.

2.24 Confusing fact & opinion:

Accurate analysis requires exhaustive exploration of pertinent facts that may be used to test hypotheses, validate claims, or provide evidence in support of a position. Everyone involved in the analysis must be able to agree on the incontrovertible facts. A public company auditor, for instance, must provide an opinion on whether or not a publicly traded company's financial statements are "fairly stated, in all important respects." Their argument has to be supported by a lot of data and evidence. When making an immediate leap from data to conclusions, there is always the risk of making a mistake.

CHAPTER - III
TREND IN THE GROWTH OF VEHICLES AND ROAD ACCIDENTS

In India, the road is the most common means of transportation for both passengers and commodities, and it also contributes significantly to the country's economy. However, given the high frequency of accidents on Indian roads, the phrase "death road" may not be entirely accurate. The only comprehensive system that provides transportation to the final destination is road transport. It provides an essential conduit between source and consumer. In India, road transportation has grown significantly throughout the years, both in terms of system output and distance traveled. The Ministry of Road Transport and Highways (MoRTH) is focused on improving efficiency and transparency in addition to providing a safer and more accessible road network nationwide (**MoRTH, 2019**). The Ministry's sector-specific policies have made a substantial contribution to both the expansion of India's road network and the enhancement of its public transportation infrastructure. After independence, the road transport industry in India has grown significantly in both capacity and reach.

Over time, there has been a notable rise in both the quantity of passenger and freight traffic handled by road transport as well as the number of registered cars on the road. The number of registered motor cars per thousand people grew from 128 in 2010 to 281 in 2019, showing that public transportation is now more accessible. The automotive sector is expanding quickly; in 2019, approximately 26.4 million automobiles were produced annually. The road transportation industry makes a substantial contribution to exports, employment creation, and gross value added (**Road Transport Year Book, 2011**).

The current edition of the "Road Transport Year Book 2010–11 and 2019–20" offers extensive data on registered motor vehicle segments in addition to supplementary data on vehicle production, sales, export, vehicle tax structure, and revenue realized by the Center and States from road transport.

Over the past ten years, India has seen a sharp rise in the number of registered motor vehicles in the nation. In India, there were over 142 million registered motor cars in 2011; by 2019, that number had risen to almost 281 million. This amounts to a about 8.4% compound annual growthRate. Numerous causes, including an expanding

middle class, increased disposable incomes, and population growth, are responsible for this increase in car registration. Furthermore, the nation's rising car ownership rate may be attributed to the expanding availability of simple financing choices and low-cost loans.

Methodology

The flow diagram, which clearly describes the entire process, displays the study's selected methodology. As you can see, this study made use of both primary and secondary data. As a result, we start by gathering primary data through the questionnaire schedule and secondary data from the police station and SP office in the research area. In a GIS, the complete set of data was tabulated, examined, and produced as a spatial map. A variety of graphs and diagrams were also created using statistical approaches. These techniques and strategies have produced a very presentable result. All of these data are linked to and contrasted with primary and secondary data in order to achieve the best outcomes.

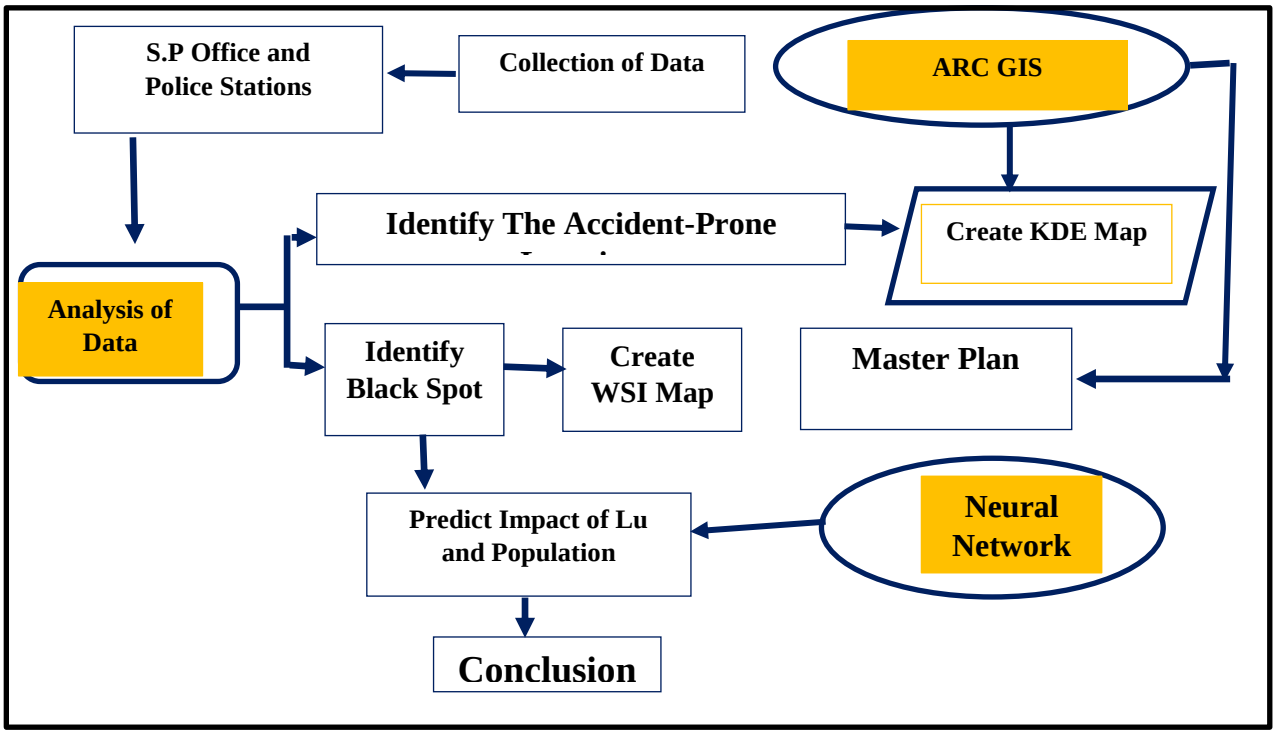


Fig.3.1. Schematic diagramof themethodologyfor thestudy.

Accident data was analyzed year-over-year for month of occurrence, accident location, number of fatalities, and injured (severe & moderate injuries) using data from the Haryana police website. the processing of FIR data, the development of

KDE maps, and the identification of accident-prone zones in study sites having two or more events (Cepni, et al., 2017). The locations of the accidents and the separations between different locations have been ascertained or estimated using Google Earth Pro.

Moreover, to determine the positions of the blackspots based on the Weighted Severity Index (WSI), assign a rank to each blackspot, and produce theme maps using the WSI score's dot density. Following the identification of the study areas' accident locations and blackspots, an attempt was made to forecast how the land use and population patterns between two cities would affect the blackspots, using a neural network approach that weighted the characteristics associated with road prioritizing.

Site Selection Criteria:

The goals of research objectives were taken into consideration when choosing the study locations, the characteristics were taken into consideration:To predict the impact of LU & population where the number of accidents could be distributed to whole city The research locations were chosen so that the data such as the population of the city, land use, physical features of the roads, and FIR data, etc., are easily available.

Result and Discussions

We demonstrated in this research that various factor involved in road accidents and contributes to the occurrence of accidents in its own way, and that there may be many more situation-specific elements that are unexplored. But one of the most important factor may rapid growth of registed vehilces or increasing in number of vehicle which shown though given table no.

Table 3.1: Growth of Registered Vehicles in India

Year	Registered Vehicles (Millions)	Year	Registered Vehicles (Millions)
2010	128	2016	230
2011	142	2017	253
2013	176	2018	272
2014	191	2019	281
2015	210	2020	309

Source: Data-Road transport year book 2019-20 (MoRTH)

Table 3.2: Road Accidents and Fatalities in India

year	Accidents	Fatalities
2010	489,400	134,513
2019	449,002	151,113

Source of data- Road accidents in India,(MoRTH Research Wing 2019)

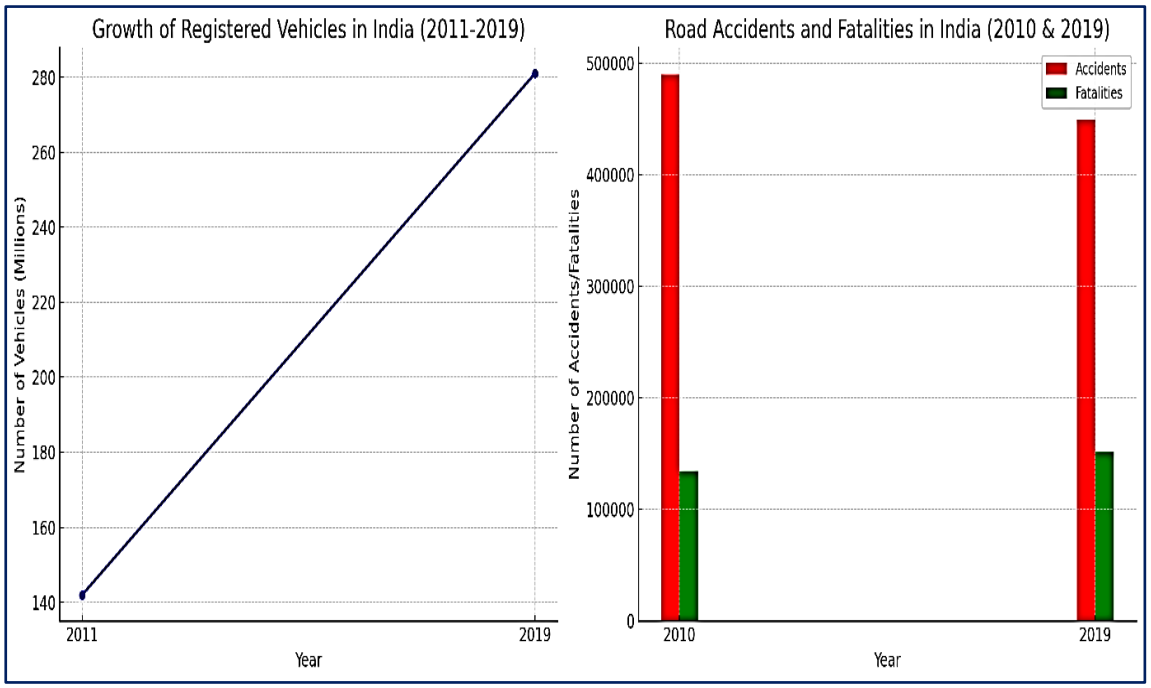


Fig 3.2.Growth of registered Vehicles in India (2011-19) Fig 3.2 Road Accidents and Fatalities (2011-19)

1. India's Vehicle Registration Growth (2011-2019): This graph shows the country's vehicle registration growth, which increased from around 142 million in 2011 to over 281 million in 2019.
2. Road Accidents and Fatalities in India (2010 & 2019): The number of road accidents and fatalities in 2010 and 2019 is displayed in this comparison chart. During this time, there was a minor decline in the overall number of accidents, but an increase in the number of deaths.

Road Accidents:

Unfortunately, as the number of cars on the road rises, so does the frequency of traffic accidents in India. The Ministry of Road Transport and Highways reports that 449,002 traffic accidents claimed 151,113 lives in India in 2019. The number of road

accidents has increased in comparison to 2010, when there were 489,400 accidents and 134,513 fatalities (G Gururaj, and MS Gautham, 2017). Road accidents in India are caused by a number of factors, including poor road conditions, inadequate infrastructure for road safety, poor traffic management, and human error, including reckless driving, speeding, and drunk driving. Crash data is not made publicly available at the national level.

The official statistics on road traffic fatalities may be quite accurate, but the data on injuries is wildly understated5. Only fatality statistics are analyzed in this paper since non-fatal data may contain a variety of biases. It is significant to remember that despite an increase in traffic accidents generally, the government has taken action to lower the number of fatalities and injuries. For example, the government has invested in the development of road safety infrastructure, implemented harsher fines for traffic violations, and launched a number of road safety campaigns to raise awareness about safe driving practices.

In conclusion, there is no evidence that the economic advantages of India's expanding car population outweigh the hazards posed by a rise in traffic accidents. The government and other pertinent parties must keep funding road safety infrastructure, educating the public about safe driving habits, and enforcing traffic rules in order to safeguard the safety of all users of the roads.

When we analysed the accidents data of National Highway-44 monthly wise accidents scenario show that most of accidents were occurred in the months of January 2010 to2020.

Table 3.3 Monthly wise distributions of accidents on N.H-44 Kundly to Panipat

Month	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
January	12	13	11	14	16	15	17	17	16	18	19	168
February	08	11	12	09	13	14	09	08	08	11	10	113
March	09	08	11	10	08	11	10	13	09	08	07	104
April	09	10	08	07	11	08	10	10	12	12	12	109
May	11	10	13	13	09	09	12	07	07	12	09	112
June	07	11	10	12	12	12	09	12	09	07	12	113
July	11	09	07	08	09	07	14	09	10	12	11	107
August	10	10	12	12	11	09	10	12	09	10	12	117
September	09	10	09	11	13	10	07	11	08	11	14	113
October	12	12	11	08	07	09	11	12	17	13	15	127
November	11	09	09	10	05	08	12	15	17	16	13	125
December	13	14	14	15	16	17	18	16	18	17	16	174
Total	**122**	**124**	**127**	**129**	**130**	**133**	**139**	**142**	**144**	**147**	**150**	

Source of Data- S.P Office Panipat, Sonipat

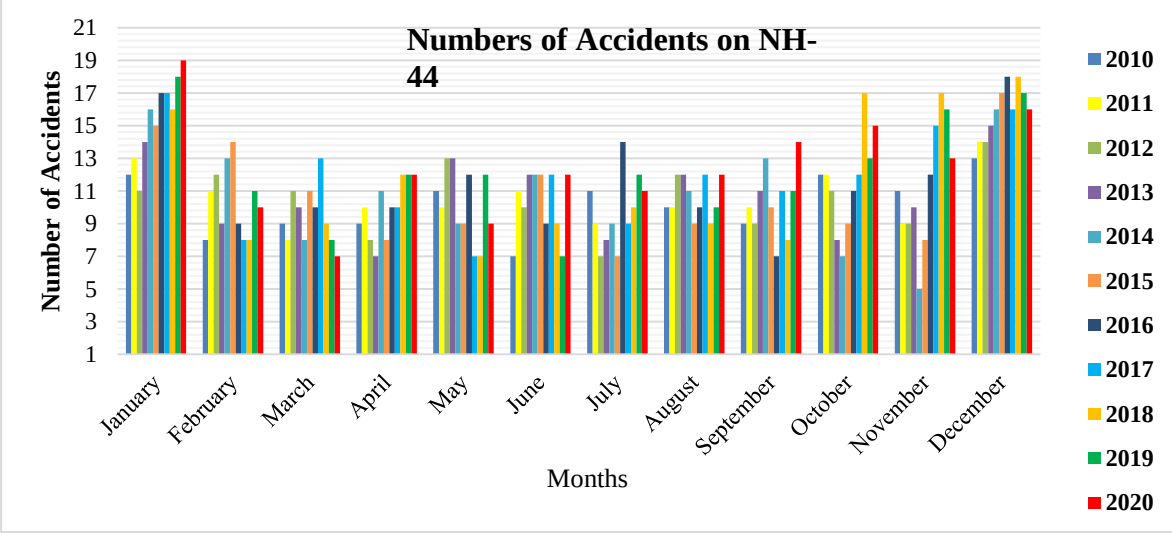


Fig.3.3. Show month wise accidents in different years from 2010 to 2020.

Figure and table 3.3 show the distribution of road traffic Accidents in 2010 by month wise in different years. It is revealed that 168 and December 174 maximum because of in this month's fog and bad weather conditions are may be responsible.

CHAPTER - IV
IDENTIFICATION OF BLACK SPOTS

4.1 Identification of Black Spots

The primary dark area on National Highway-44 from Kundly to Panipat is identified in this chapter. Finding black spots on national roadways is crucial to guaranteeing everyone's safety. The term "black spots" describes sections of the road where traffic accidents and fatalities are more common than in other places. Finding these locations and taking the appropriate action to fix them will help lower the amount of accidents and increase everyone's safety on the roadways.

4.2 Definition of black spot according to (MoRTH) – A black spot on a national highway is a 500-meter section of road where at least five traffic accidents, including fatalities or serious injuries, have occurred in the previous three years. Furthermore, the detection, investigation, and management of road accident black spots are among the most successful methods for preventing traffic accidents. Accidental black spots on national highways are defined as sections of the road where there is a significant chance of an accident or where accidents occur regularly. One of the main causes of traffic accidents and fatalities on highways is speed.

4.3 Methodology

The document outlines a methodology for identifying black spots on National Highway -44 between Kundli and Panipat in India. Key steps include:

- Conducting a road safety audit to review road infrastructure and operating conditions.
- Analyzing accident data to identify frequent accident locations.
- Performing site investigations at accident locations to understand contributing factors.
- Engaging with local stakeholders like police, transport authorities, and community groups for insights.
- Primary and secondary data is used to identify Black spot on NH-44 and primary data collected different police stations, S.P office and secondary data is collected from field investigation with the help of schedule and other sources.
- Implementing remedial measures such as improving road infrastructure, traffic management, and raising road safety awareness.These steps are crucial for identifying black spots and enhancing road safety.

Police stations along with N.H-44 Panipat to Kundly are following

1. Police Station Sector 13, 17 Panipat

2. City Police station

3. Chandni Bag Police Station

4. Chandni Bag Police Station

5. Police Station Samalkha

6. Police Station Ganaur

7. Police Station Murthal

8. Police Station Rai

9. Police Station Kundli

Fig.4.1. Different police stations picture which are situated on GT Road from Kundli to Panipat.

4.4 Result and discussion

The trends analysis of various characteristics related to road traffic accident has been presented in this section graphically occurred between 2010 to 2020.There are six black spots in my study area on NH-44 from Kundly to Panipat district. These are shown below given table are following: -

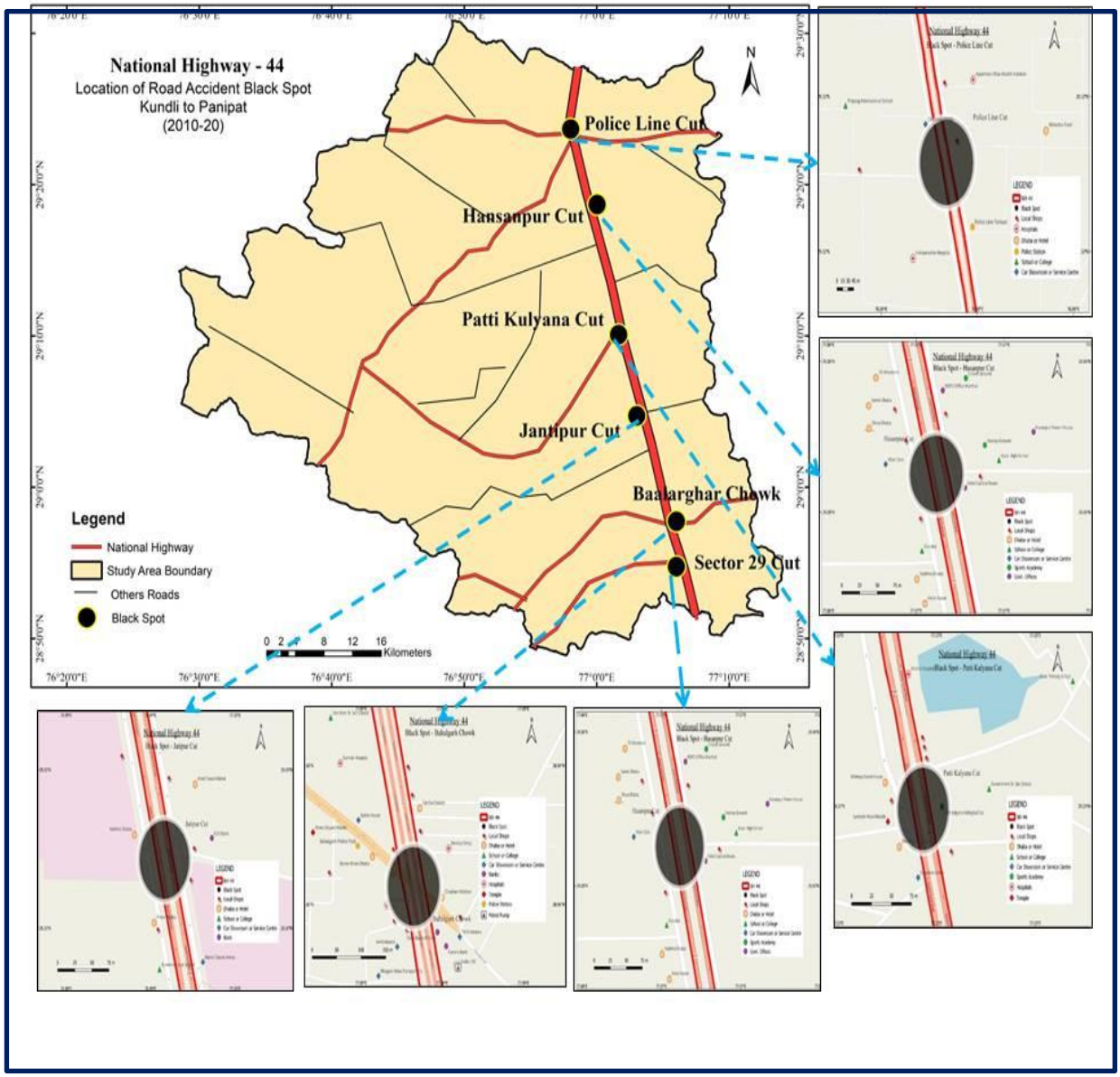
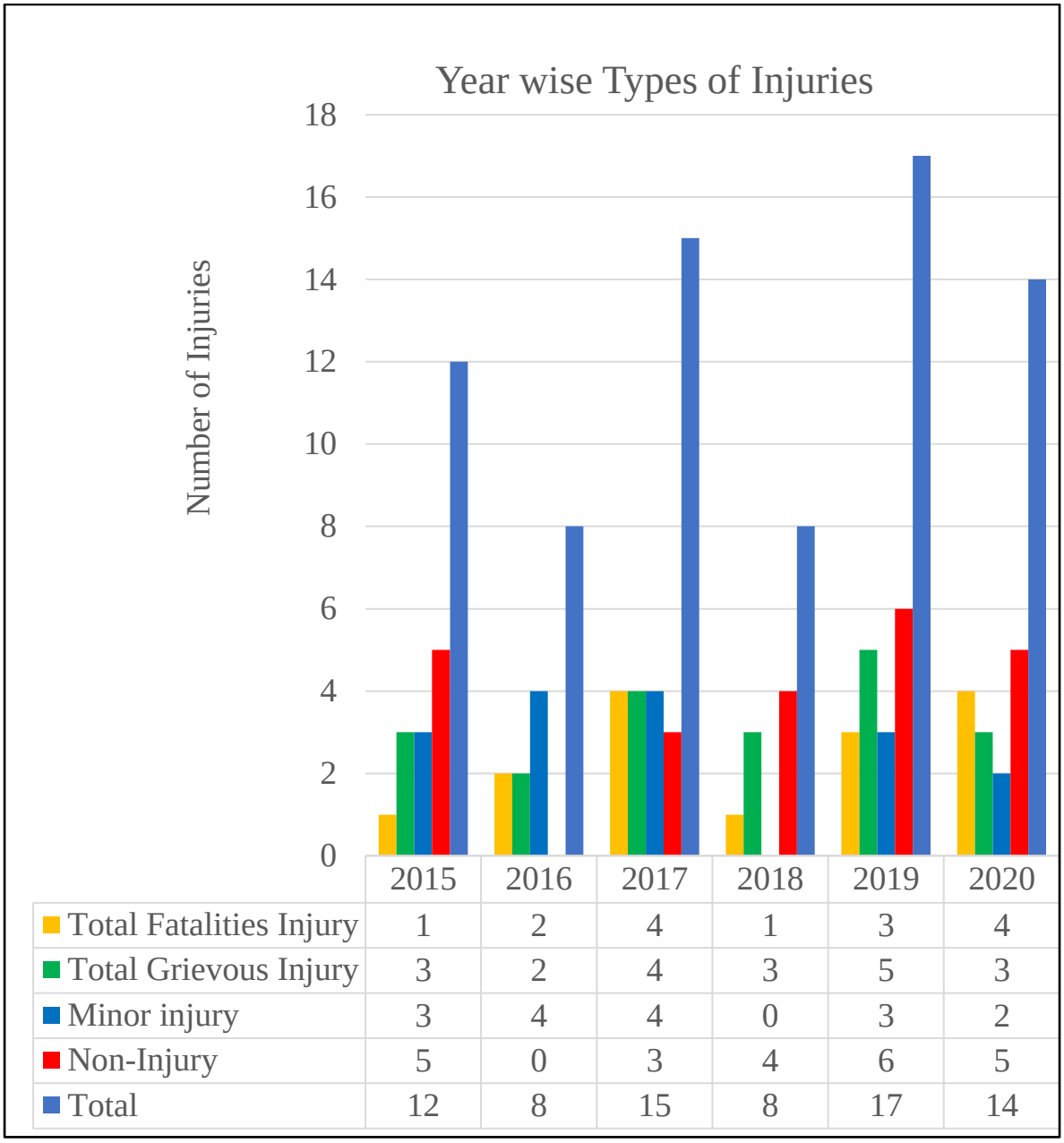


Fig.4.2. All black spots showing in map on the National highway are Accidents Points.

1. Black Spot Hansapur Cut 2. Black Spot Police Line Cut
1. Black Spot Patti Kulyana Cut 4. Black Spot Jattipur Cut
4 Black Spot Bahalgarh Chowk 6. Black Spot Sector 29 Cut

Details statics of Injuries onBlack Spot Hansapur Cut.

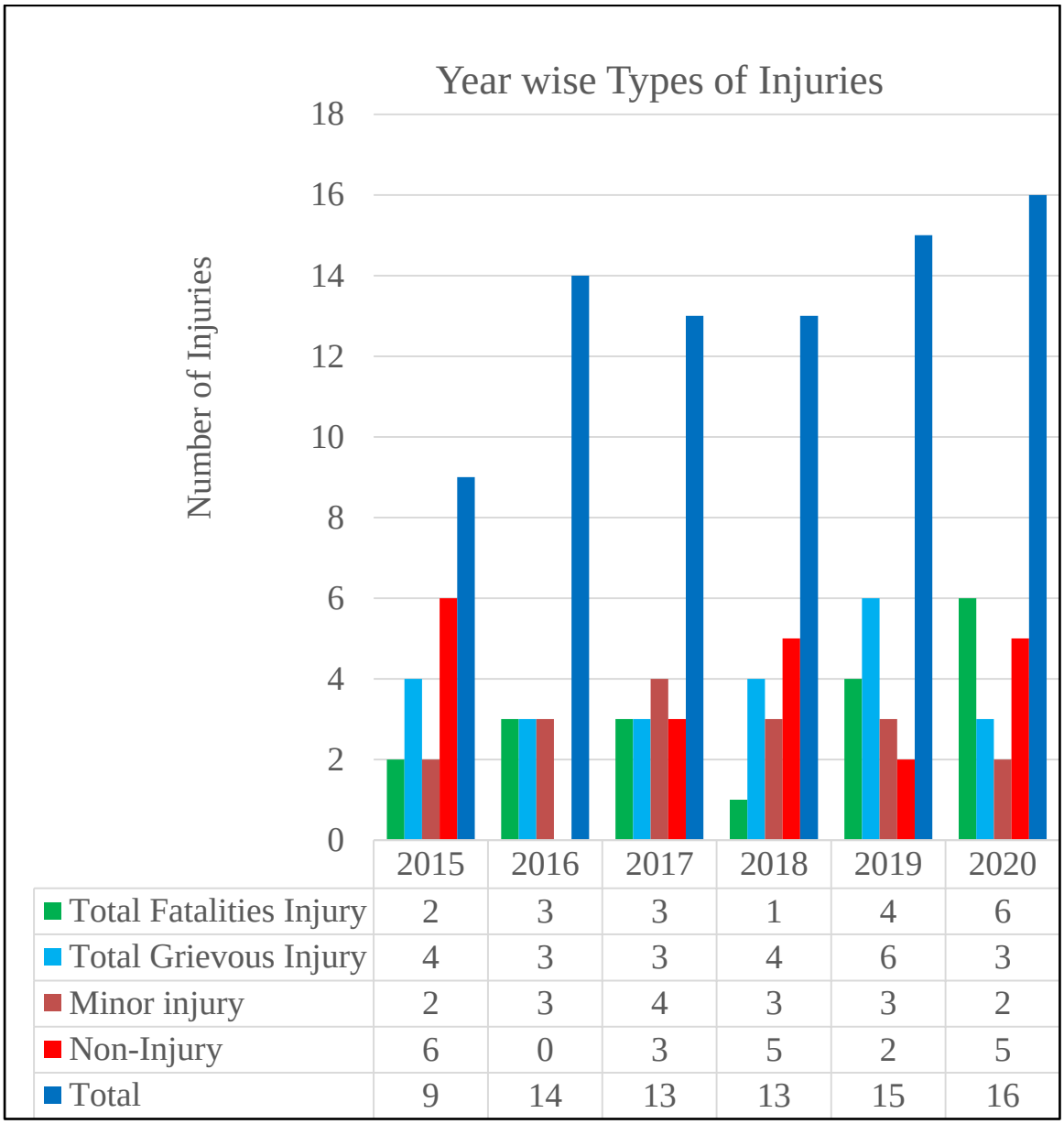


	2015	2016	2017	2018	2019	2020
Total Fatalities Injury	1	2	4	1	3	4
Total Grievous Injury	3	2	4	3	5	3
Minor injury	3	4	4	0	3	2
Non-Injury	5	0	3	4	6	5
Total	12	8	15	8	17	14

Fig. 4.3. Different types of injuries shown year wise in the graph base on secondary data collected from Office of Superintendent of Police and Police Stations.

The details of accidents which occurred at Black spot Hansapur Cut can be understand by see the graph and data given above figure. It is revealed by the analysis of the different type'sinjuries data thatthe total 74 accidents occurred at Hansapur cut 2015 to 2020 and maximum 17 accidents occurred in the year 2019 and minimum 8, 8 accidents in two years 2016, 2018.

Details statics of Injuries onBlack Spot Police Line Cut.

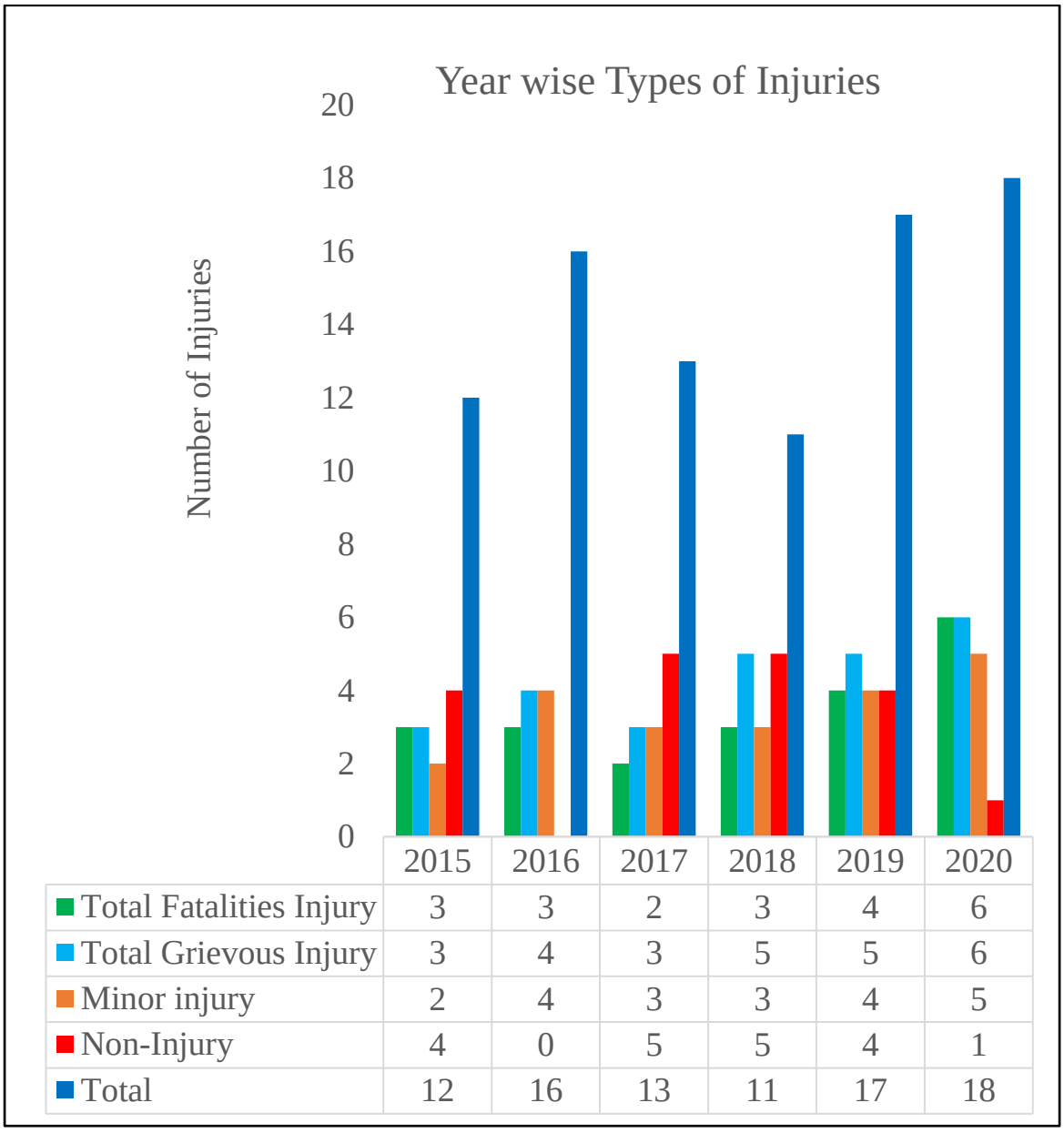


	2015	2016	2017	2018	2019	2020
Total Fatalities Injury	2	3	3	1	4	6
Total Grievous Injury	4	3	3	4	6	3
Minor injury	2	3	4	3	3	2
Non-Injury	6	0	3	5	2	5
Total	9	14	13	13	15	16

Fig.4.4. Different types of injuries shown year wise in the graph base on secondary data collected from Office of Superintendent of Police and Police Stations.

The details of accidents revealed through the figure given above, which occurred at Black spot Police Line Cut. It is concluded after analysed the different types injuries data that the total 80 accidents occurred at Police line cut 2015 to 2020 and maximum 16 accidents occurred in the year 2020 and minimum 9 accidents in two years 2015.

Details statics of Injuries onPatti Kalyana Cut



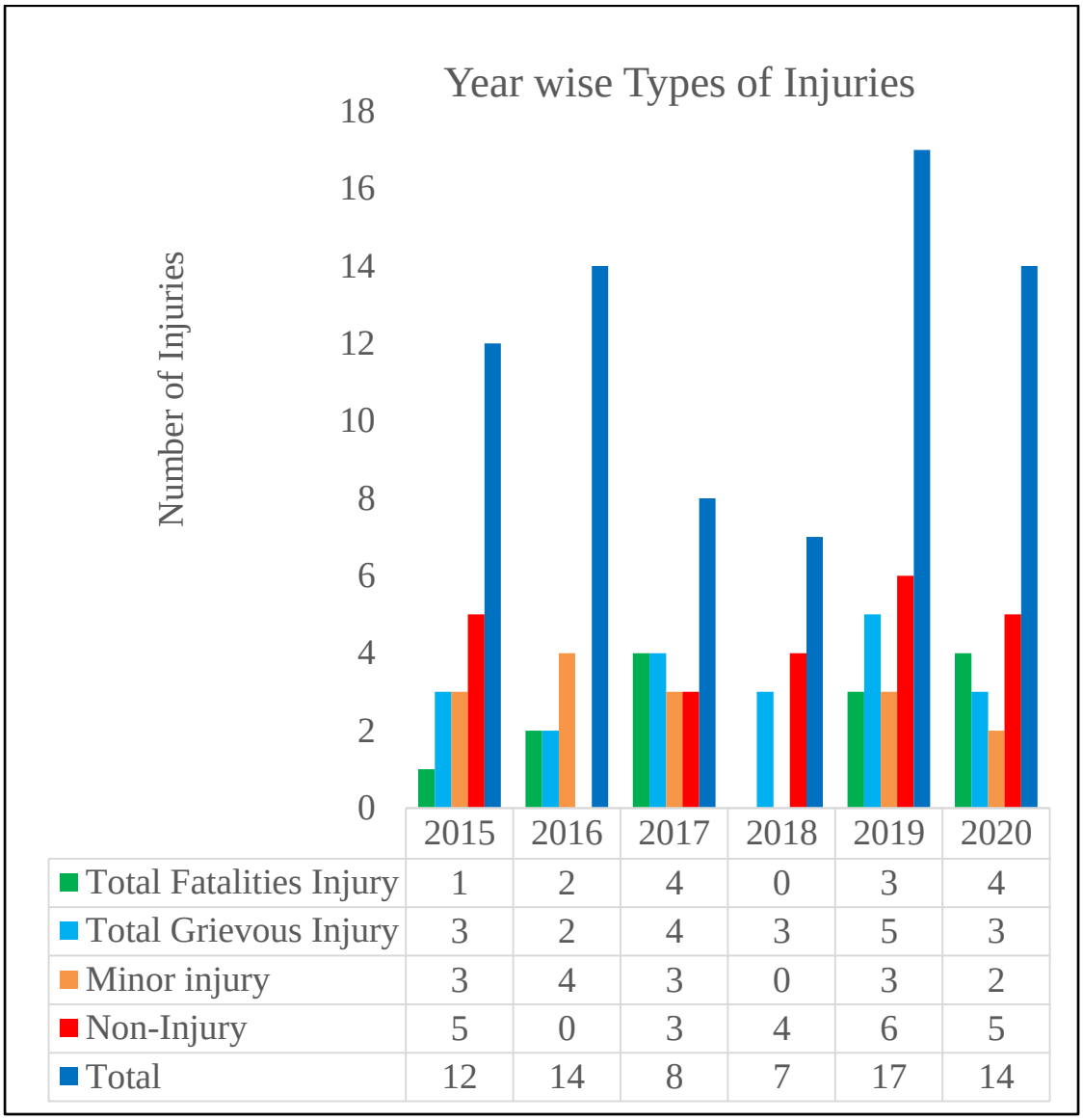
	2015	2016	2017	2018	2019	2020
Total Fatalities Injury	3	3	2	3	4	6
Total Grievous Injury	3	4	3	5	5	6
Minor injury	2	4	3	3	4	5
Non-Injury	4	0	5	5	4	1
Total	12	16	13	11	17	18

Fig.4.5. Different types of injuries shown year wise in the graph base on secondary data collected from Office of Superintendent of Police and Police Stations.

The following describes the specifics of the incidents that happened at Patti Kalyana Cut's Black Spot.

After data analysis, we discovered that there were 87 incidents at Patti Kalyana Cut between 2015 and 2020, with the highest number of accidents occurring in 2020 and the lowest number occurring in 2018.

Details statics of Injuries onBlack Spot Jattipur Cut.

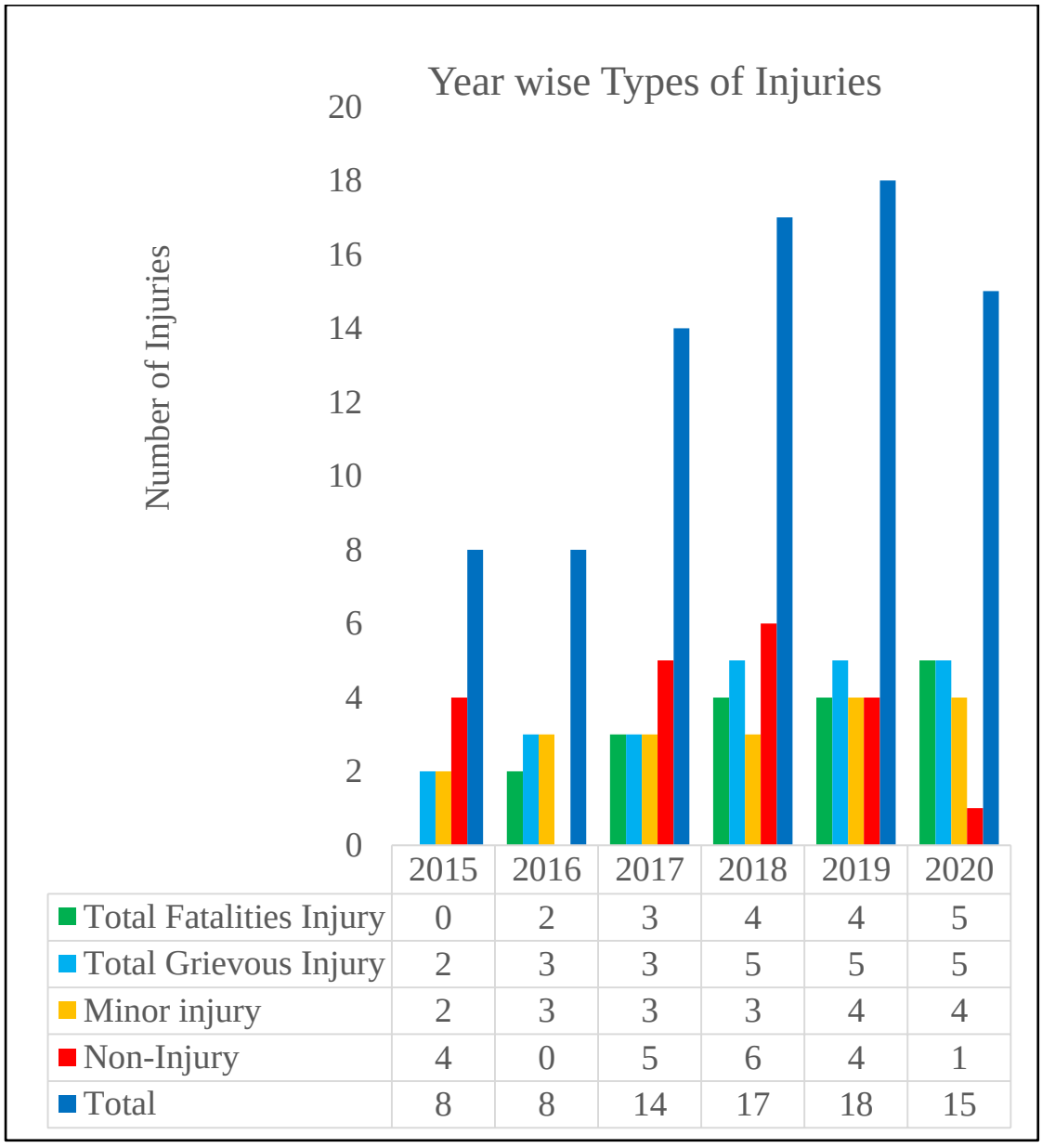


	2015	2016	2017	2018	2019	2020
Total Fatalities Injury	1	2	4	0	3	4
Total Grievous Injury	3	2	4	3	5	3
Minor injury	3	4	3	0	3	2
Non-Injury	5	0	3	4	6	5
Total	12	14	8	7	17	14

Fig.4.6. Different types of injuries shown year wise in the graph base on secondary data collected from Office of Superintendent of Police and Police Stations.

The following describes the specifics of the incidents that happened in Black Spot Jattipur Cut. After data analysis, we discovered that there were 72 incidents at Jattipur Cut between 2015 and 2020, with the highest number of accidents occurring in 2019 and the lowest number occurring in 2018.

Details statics of Injuries on Black Spot Bahalgarh Chowk



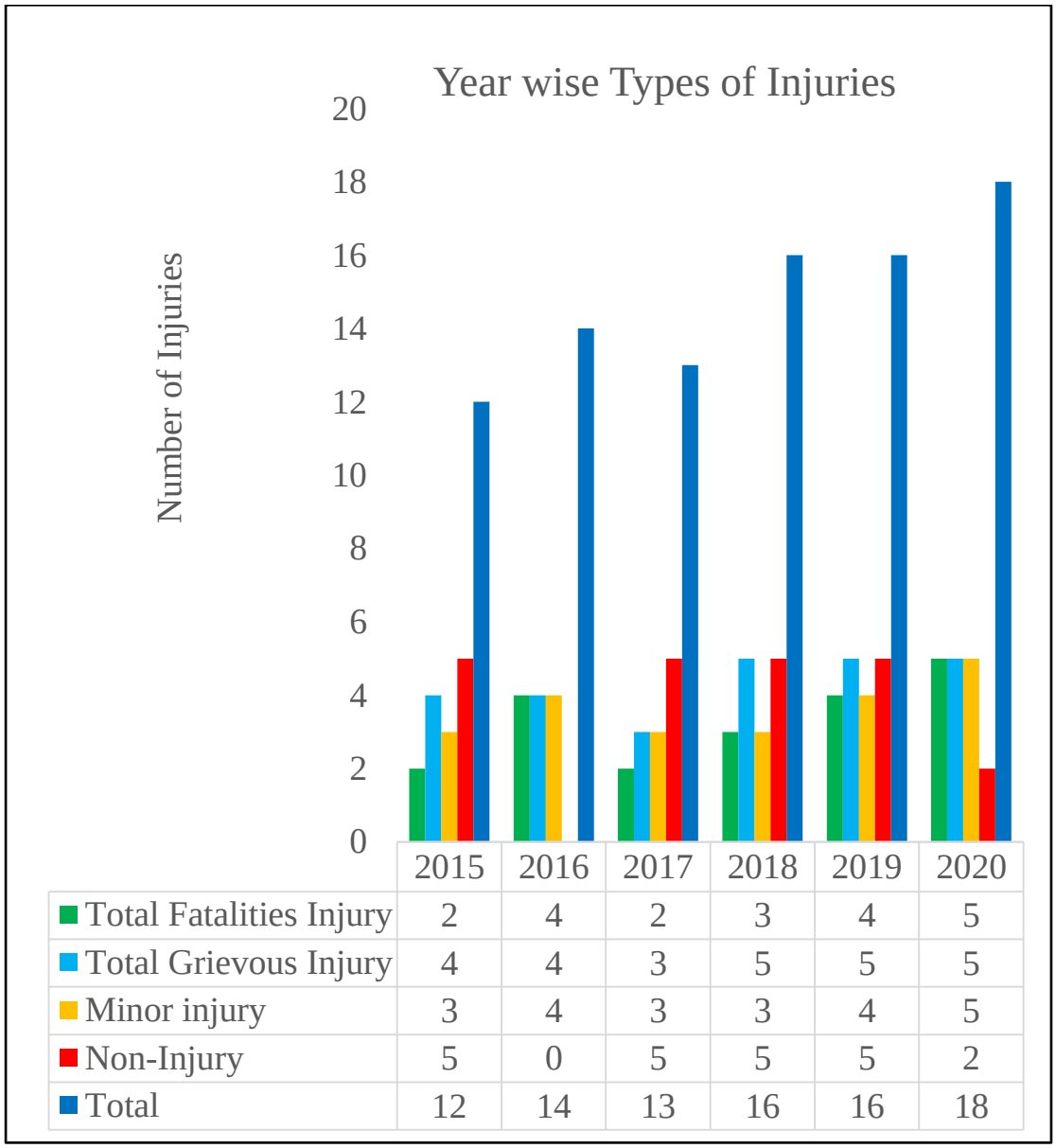
	2015	2016	2017	2018	2019	2020
Total Fatalities Injury	0	2	3	4	4	5
Total Grievous Injury	2	3	3	5	5	5
Minor injury	2	3	3	3	4	4
Non-Injury	4	0	5	6	4	1
Total	8	8	14	17	18	15

Fig.**4.7.** Different types of injuries shown year wise in the graph base on secondary data collected from Office of Superintendent of Police and Police Stations.

The details of accidents which occurred at Black spot Bahalgarh chowk are following

When we analysed the data we find that, the total 80 accidents occurred at Bahalgarh chowk 2015 to 2020 and maximum 18 accidents occurred in the year 2019 and minimum 8,8 accidents in two years 2015, 2016.

Details statics of Injuries onBlack Spot Sector 29 Cut



	2015	2016	2017	2018	2019	2020
Total Fatalities Injury	2	4	2	3	4	5
Total Grievous Injury	4	4	3	5	5	5
Minor injury	3	4	3	3	4	5
Non-Injury	5	0	5	5	5	2
Total	12	14	13	16	16	18

Fig.4.8. Different types of injuries shown year wise in the graph base on secondary data collected from Office of Superintendent of Police and Police Stations.

The details of accidents which occurred at Black spot Sector 29 Cut are following

When we analysed the data we find that, the total 89 accidents occurred at Sector 29 Cut 2015 to 2020 and maximum 18 accidents occurred in the year 2020 and minimum 12 accidents in in the years 2015.

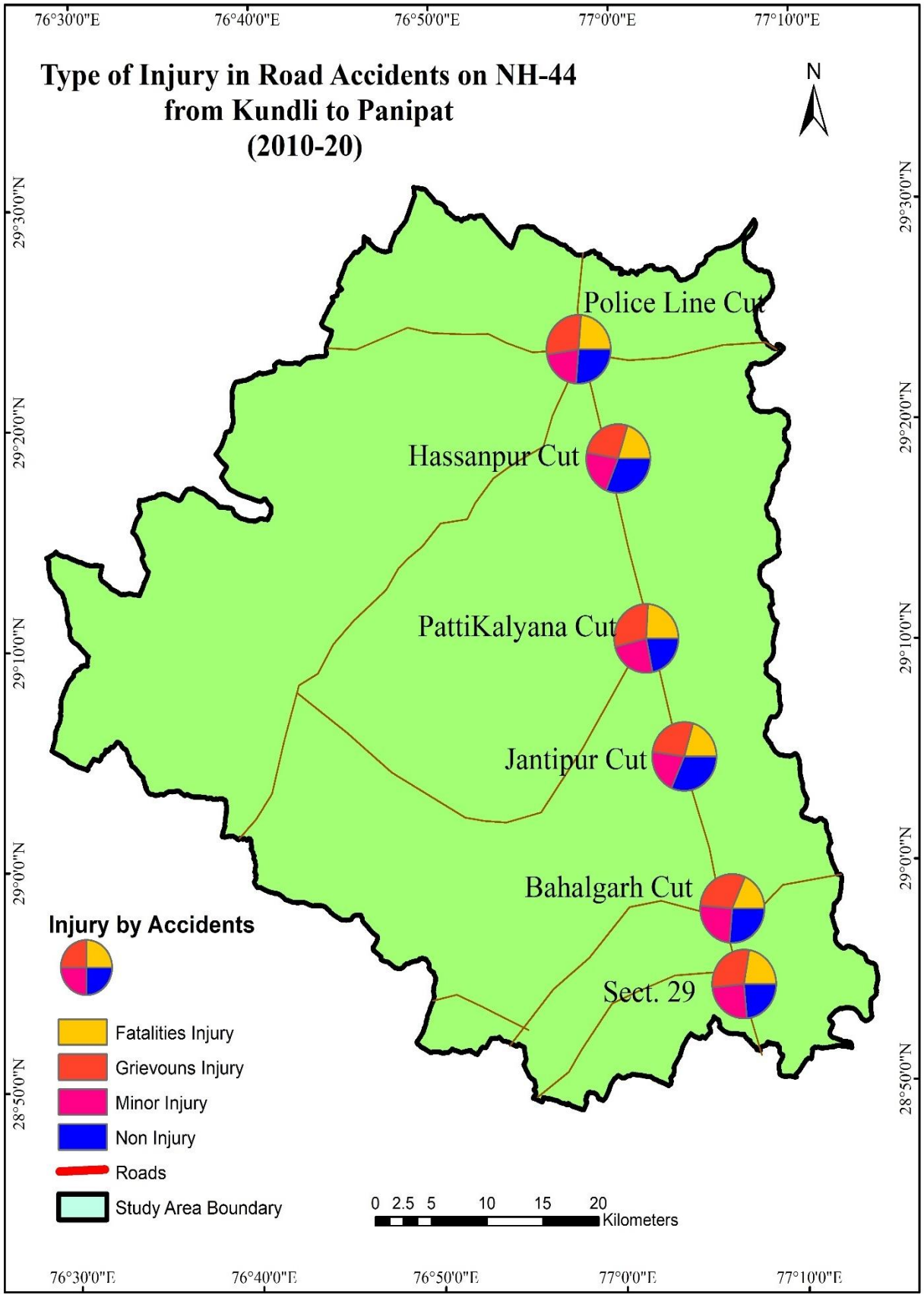


Fig. 4.9. Spatial presentation of Injury on all Accidents Black spots**.**

To identify black spots on National highway, here are some steps that can be taken:

Identify possible road safety issues by conducting a road safety audit, which is a methodical examination of the working environment and road infrastructure. It include determiningpossible risk factors, evaluating and detecting traffic hazards, and examining accident data. This may be useful in locating the dark areas on the road.

Examine accident data: Examining accident data is an additional method for locating black spots. Locations where accidents are happening frequently can be found by looking through accident reports. By using this data, black spots can be found and plans for lowering accidents there can be created.

Conduct a site investigation: A site investigation involves visiting locations where accidents have occurred and examining the road infrastructure and operating conditions. This can help in identifying factors contributing to the accidents and developing remedial measures to reduce the risk of future accidents.

Engage with local stakeholders: Local stakeholders such as the police, transport authorities, and community groups can provide valuable insights into road safety issues in their area. Engaging with these stakeholders can help in identifying black spots and developing appropriate strategies to address them.

Implement remedial measures: Once black spots have been identified, appropriate remedial measures can be implemented. These may include improving road infrastructure, traffic management, and road signage, as well as implementing road safety education and awareness campaigns.

In conclusion, identifying black spots on National highways is crucial for ensuring road safety. By conducting a road safety audit, analyzing accident data, conducting site investigations, engaging with local stakeholders, and implementing remedial measures, it is possible to reduce the number of accidents and make the roads safer for everyone.

In the chapter, we explored the study methods in depth; this chapter will focus on the analysis and interpretation of the data. Following data collection, it is necessary to process and evaluate the data in accordance with the strategy developed at the outset of the research. This is crucial for a scientific investigation since it ensures that we have all the information we need to draw the appropriate conclusions from our data.

this is true. As a matter of precision, processing means modifying, classifying, categorising, and tabulating the information that has been gathered.

Analyzing data entails calculating a number of different metrics and looking for commonalities between different sets of information. "Therefore, statistical tests of significance should be used to the data to establish the reliability with which any inferences may be drawn from the connections or differences supporting or contradicting original or new hypotheses

- **Primary data:**

"Primary data was collected with an aid of a Questionnaire. Questionnaire contains a series of questions arranged in a proper order. Questionnaire was made in order to collect data regarding **(*Saptial Analysis of Road Accidents on National Highway-44, From Kundli To Panipat: A Study in Transport Geography*)"**

The main purpose of Questionnaire to obtain more and more information regarding road accidents, causes, drivers behaviours, public opinion. The questionnaire study was conducted on N.H-44 and total random sample 350 in which data collected from traffic police, Home guards, divers, road side shop keeper and general public. The results of questionnaire are following

Table 4.1* Accident classification on the basis of type of vehicle

		Type of vehicle	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Fatal	Truck/Bus/Car/Van Taxi/ Jeep	16	4.6	4.6	4.6
	Grievous Injury	Light Goods Vehicle	153	43.7	43.7	48.3
	Minor Injury	2 Wheelers (Bikes,Scooty)	166	47.4	47.4	95.7
	Non-Injury	3 Wheelers and others	15	4.3	4.3	100.0
	Total		**350**	**100.0**	**100.0**	

Source: Data acquired through field survey and question schedule

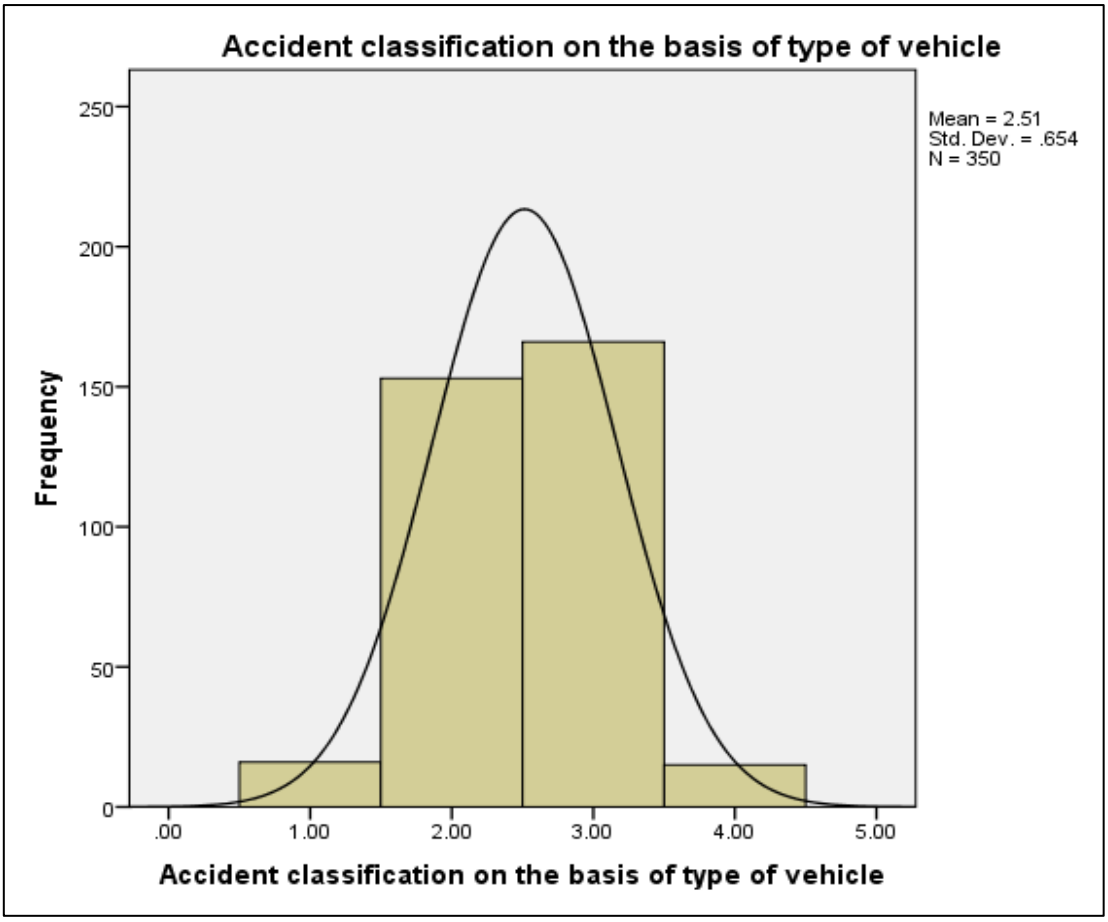


Fig. 4.10. Accident Classification on the basis of types of vehicle.

From the analysis as discussed randomly with people as respondents, we observed their opinion and the details mentioned in the above graph and table is concerned about 350 respondents. It was observed about "Accident classification on the basis of type of vehicle" 16(4.6%) respondents responded Fatal, (Truck/Bus/Car/Van Taxi/ Jeep) 153(43.7%) respondents responded Grievous Injury (Light Goods VehicleLight Goods) Vehicle and 166(47.4%) respondents responded Minor Injury2 Wheelers (Bikes, Scooty) whereas 15(4.3%) respondents responded non-injury. (3 Wheelers and others). These items were also displayed using a spatial map and spatial analysis. The provided graphic makes it evident that truck, bus, van, and jeep types of wheels caused the most accidents at all the dark locations. The second level of the Jantipur Black Spot had the highest number of three-wheeler accidents. But two wheeler recorded low number of accident in comperision to other types of vhicles. Based on observation, respondent data was used to validate secondary data included in this map.

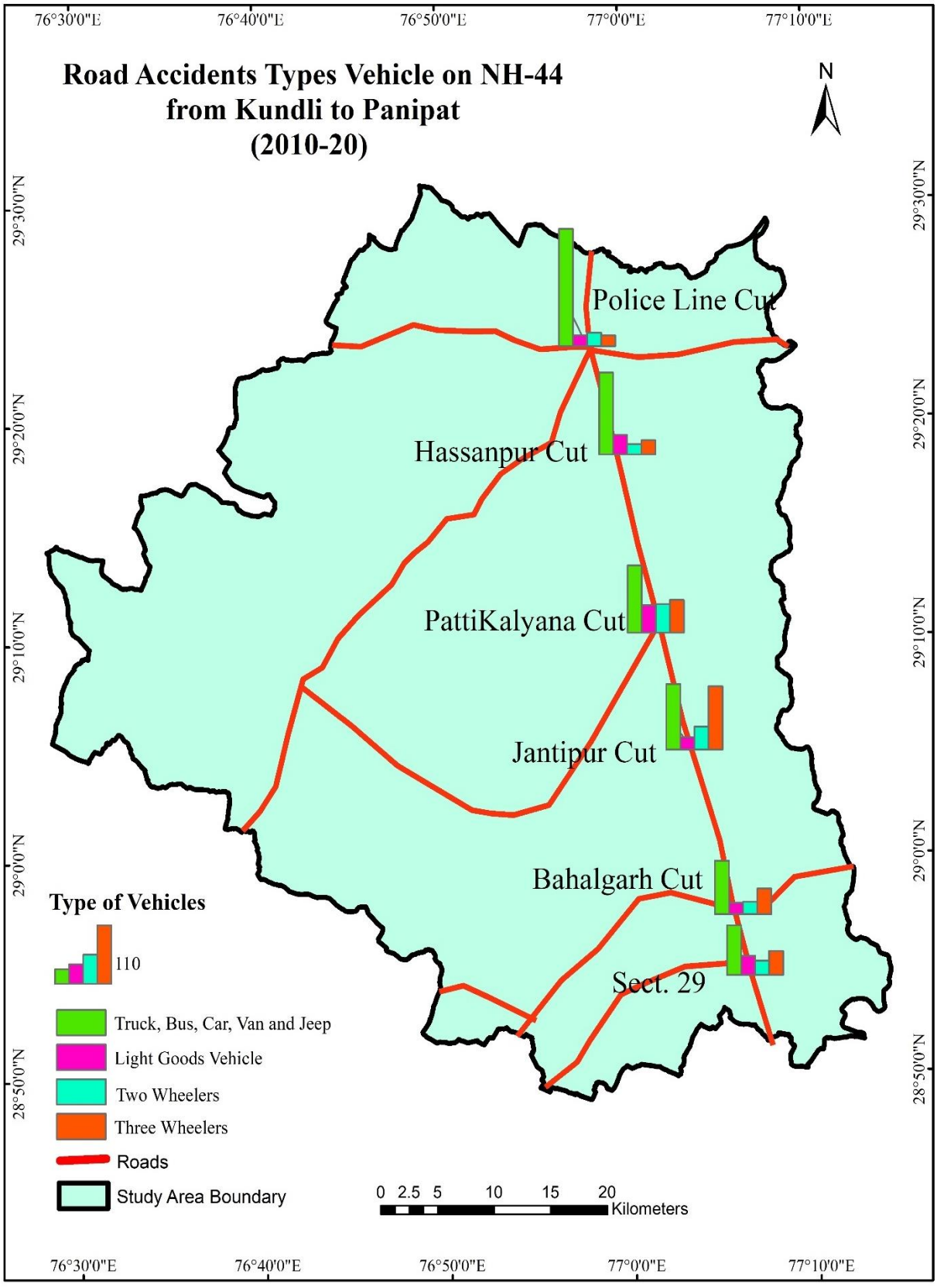


Fig.4.11. Classification of Vehicles in Road Accidents on NH-44.

Table -4.2* Do you follow the road signs and signal?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	190	54.3	54.3	54.3
	No	160	45.7	45.7	100.0
	Total	350	100.0	100.0	

Source: Data acquired through field survey and question schedule

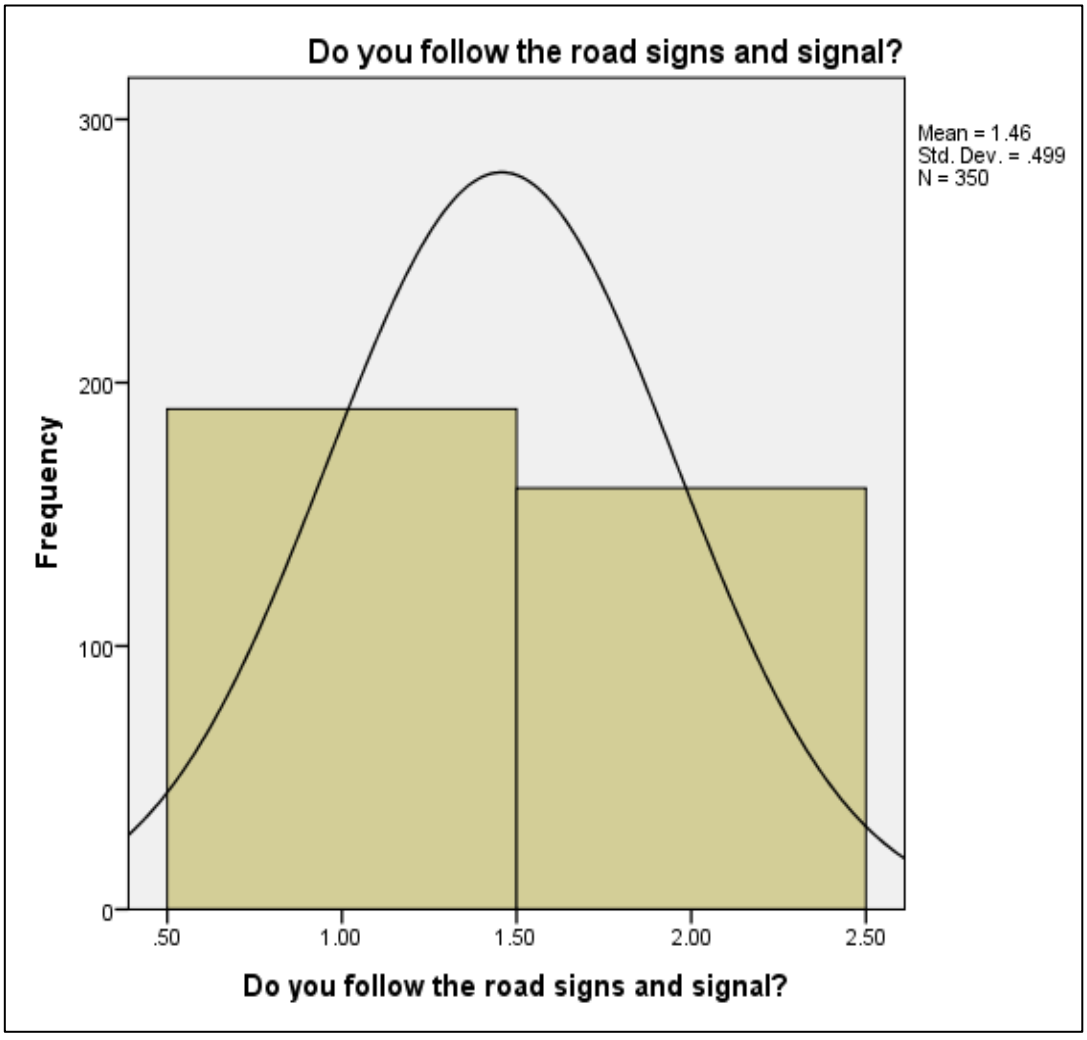


Fig. 4.12. Shows follow the roads signs and signal.

The above graph and table, which show the sample data that comprises 350 tourist respondents, were used to aid with the study. In response to the question, "Do you follow the road signs and signals?" 190 respondents (or 54.3% of the sample) said "yes," while 160 respondents (or 45.7%) said "no."

Table -4.3* Have you met any road accident while driving?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	230	65.7	65.7	65.7
	No	120	34.3	34.3	100.0
	Total	**350**	**100.0**	**100.0**	

Source: data acquired through field survey and question schedule.

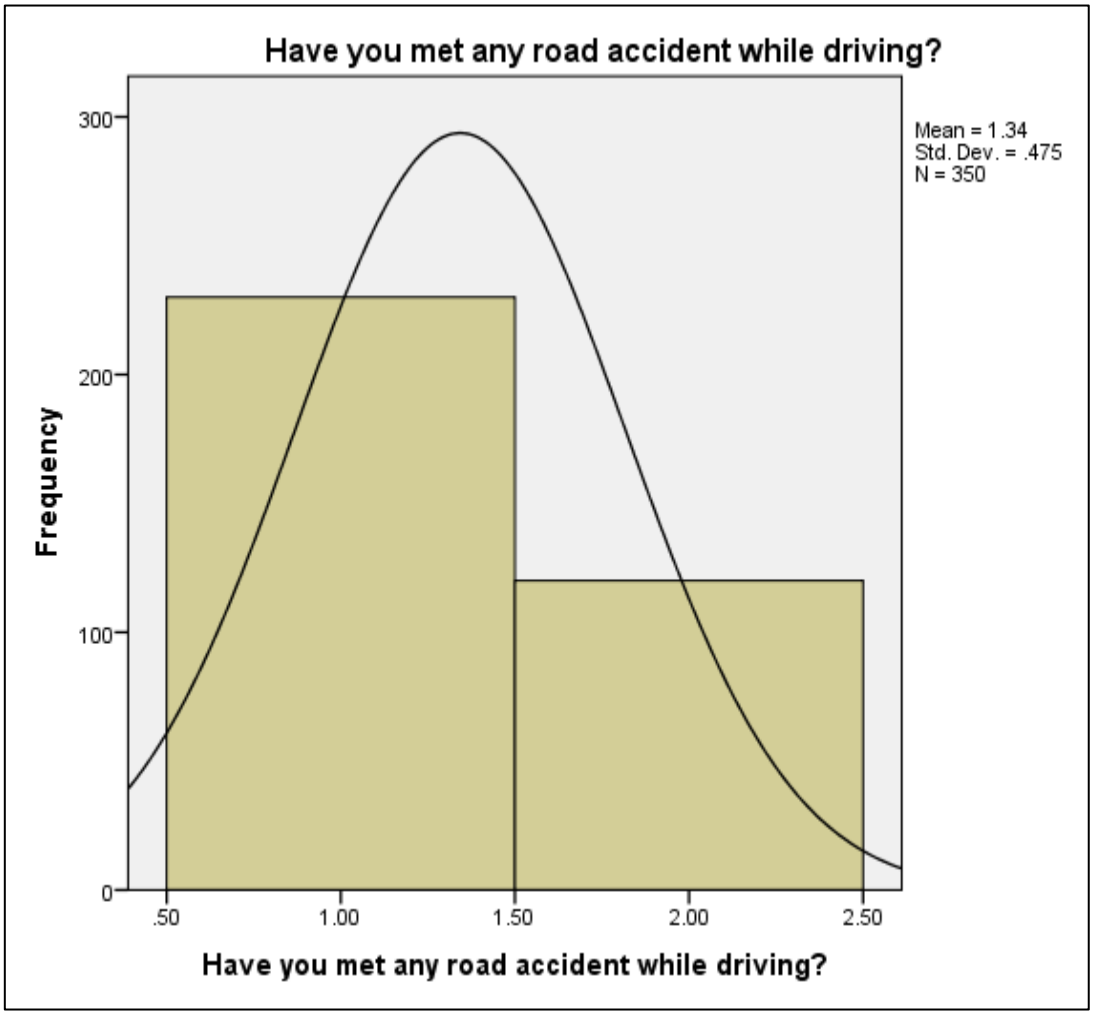


Fig. 4.13. Shows met any road accident while driving.

The following graph and table, which show the sample data that comprises 350 tourist respondents, were used to aid with the study. When the question "Have you met any road accident while driving?" was posed, 230 respondents (or 65.7%) said "Yes," whereas 120 respondents (or 34.3%) said "No."

Table -4.4* Age wise accident frequencies and percentage.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	20-30 Years	12	24.0	24.0	24.0
	30-40 Years	14	28.0	28.0	52.0
	40-50 Years	8	16.0	16.0	68.0
	50-60 Years	16	32.0	32.0	100.0
	Total	**50**	**100.0**	**100.0**	

Source: data acquired through field survey and question schedule

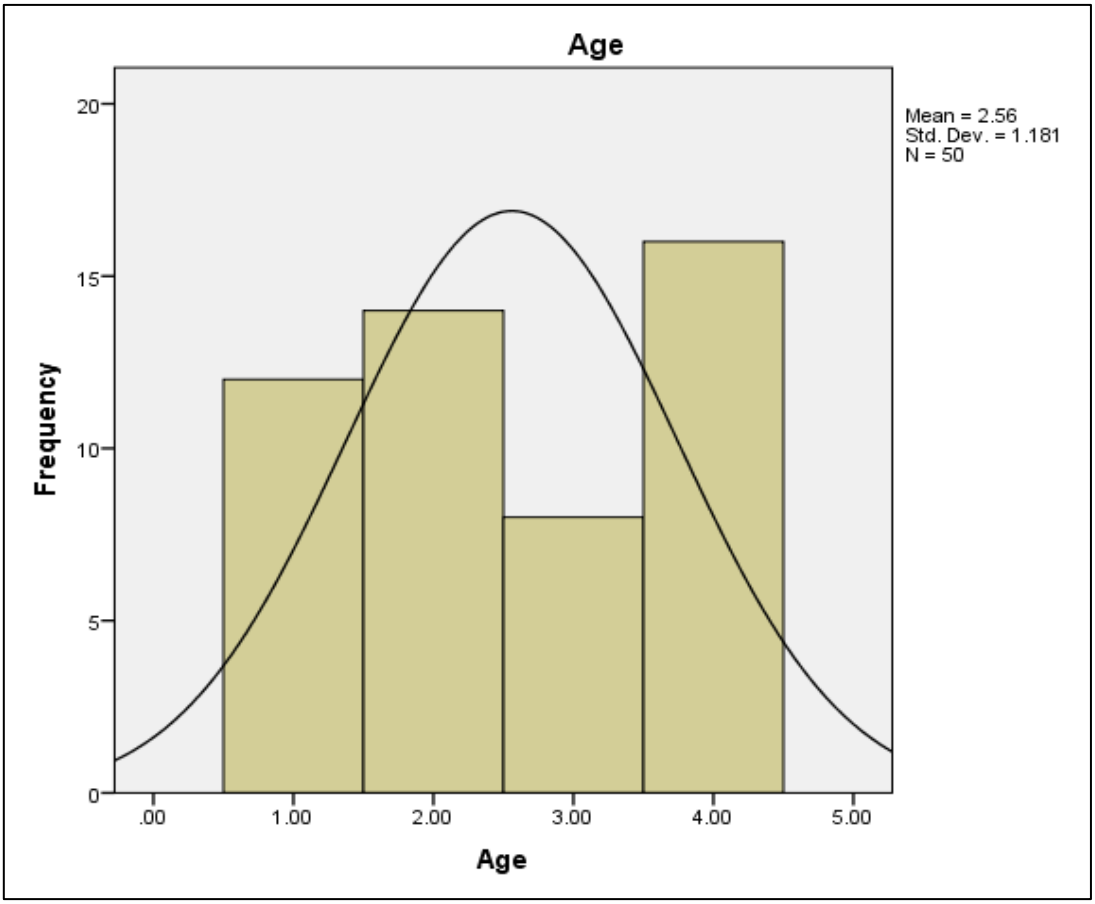


Fig. 4.14. Shows age wise frequency of raod accident.

From the analysis of the graph and table aboveit was observed that display the sample data including 50 respondents from, it was noticed from the analysis. "Age" was a topic of discussion. Twelve (24%) of the respondents said they were 20–30 years old, fourteen (28%) said they were 30–40 years old, eight (16%) said they were 40–50 years old, and sixteen (32) said they were 50–60 years old.

Table -4.5* frequencies and percentage of Position duties

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Constable	14	28.0	28.0	28.0
	Sub-Inspector	13	26.0	26.0	54.0
	Inspector	13	26.0	26.0	80.0
	Others	10	20.0	20.0	100.0
	Total	50	100.0	100.0	

Source: data acquired through field survey and question schedule

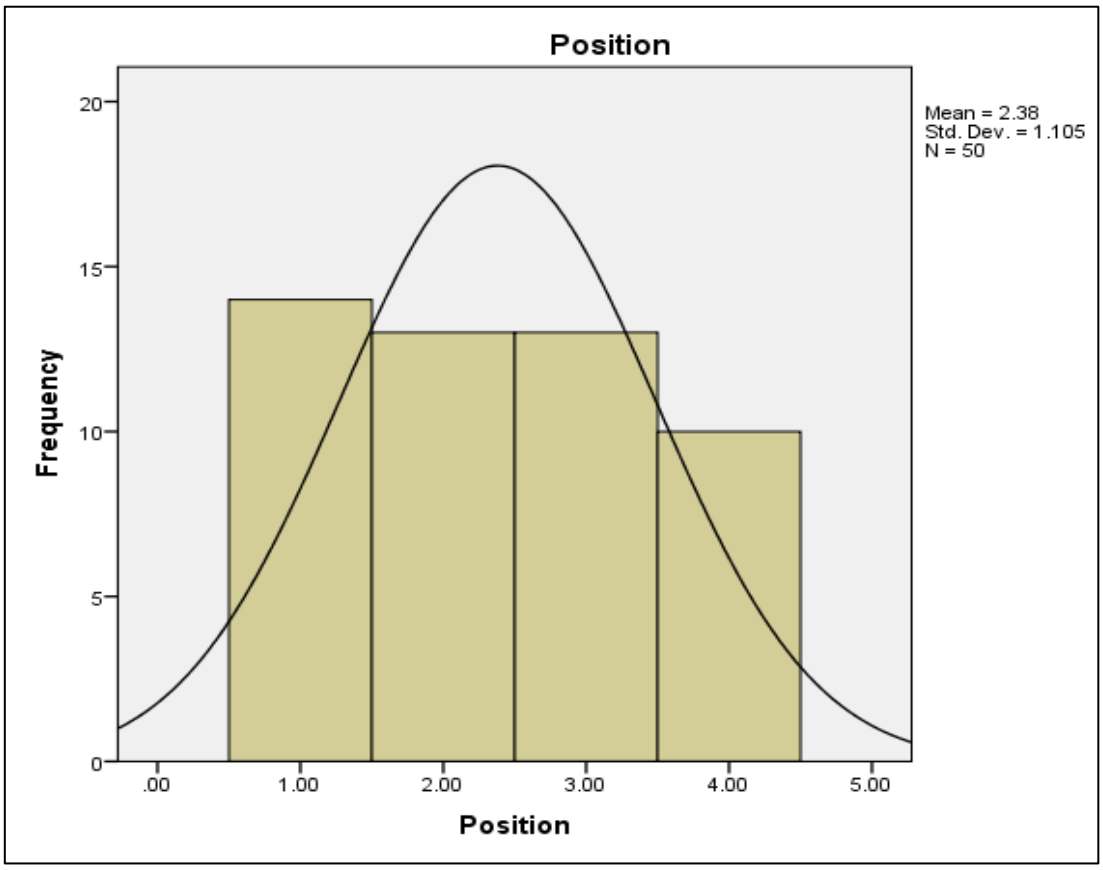


Fig. 4.15. Shows poition frequency.

With the help of the graph and table above, which show the sample data that consists of 50 respondents from, it was noticed from the analysis. "Position" was the topic of discussion. Ten (20%) respondents selected Others, whereas 14 (28%) respondents selected Constable, 13 (26%) respondents selected Sub-Inspector, and 13 (26%) respondents selected Inspector.

Table -4.6* frequencies and percentage of Location of accidents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Chandnibag	11	22.0	22.0	22.0
	Samalkha	7	14.0	14.0	36.0
	Gannaur	7	14.0	14.0	50.0
	Murthal	4	8.0	8.0	58.0
	Rai	7	14.0	14.0	72.0
	Kundli	14	28.0	28.0	100.0
	Total	**50**	**100.0**	**100.0**	

Source: Data acquired through field survey and question schedule

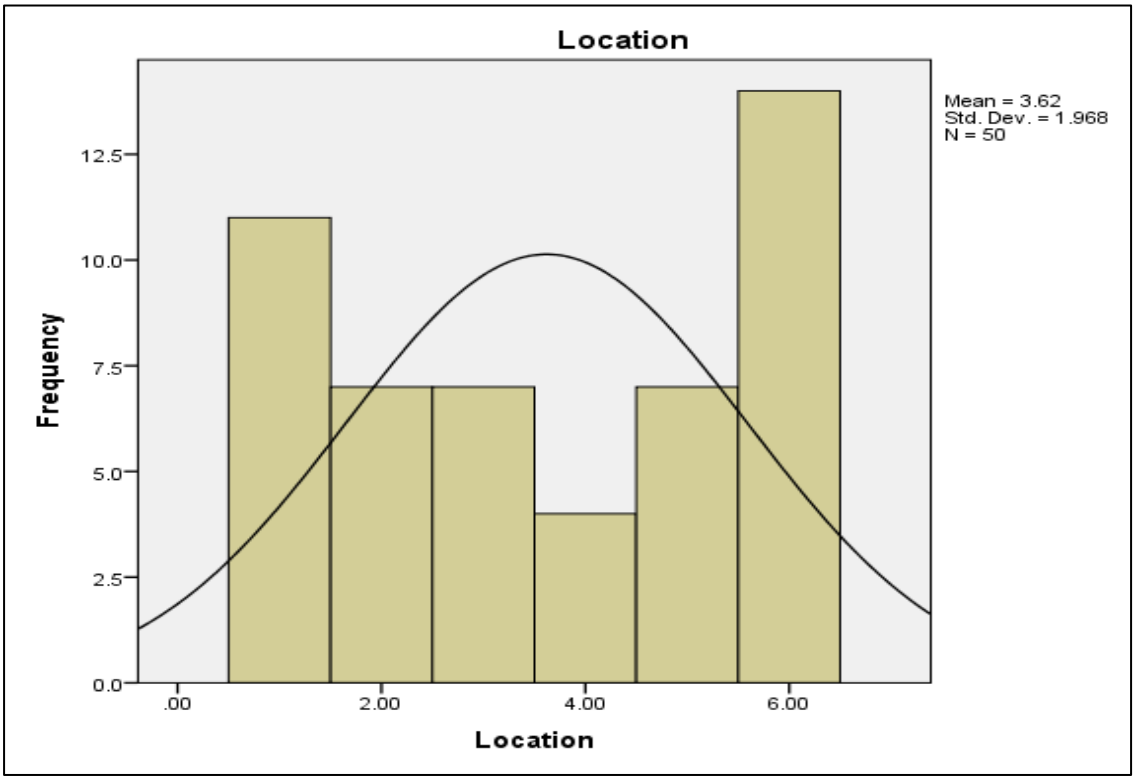


Fig.4.16. Shows location and frequency.

From the analysis it was observed with the help of graph and table above, which show the sample data of 50 respondents, it was noted from the analysis. "Location" was the topic of discussion. 11 respondents (22%) answered Chandnibag, 7 respondents

(14%), Samalkha, 7 respondents (14%), Gannaur, 4 respondents (8%), Murthal, and 7 respondents (14%), Rai.

Table -4.7*Types of Accidents Observed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Fatal	11	22.0	22.0	22.0
	Grievous injury	12	24.0	24.0	46.0
	Minor injury	14	28.0	28.0	74.0
	No Injury	13	26.0	26.0	100.0
	Total	**50**	**100.0**	**100.0**	

Source: Data acquired through field survey and question schedule

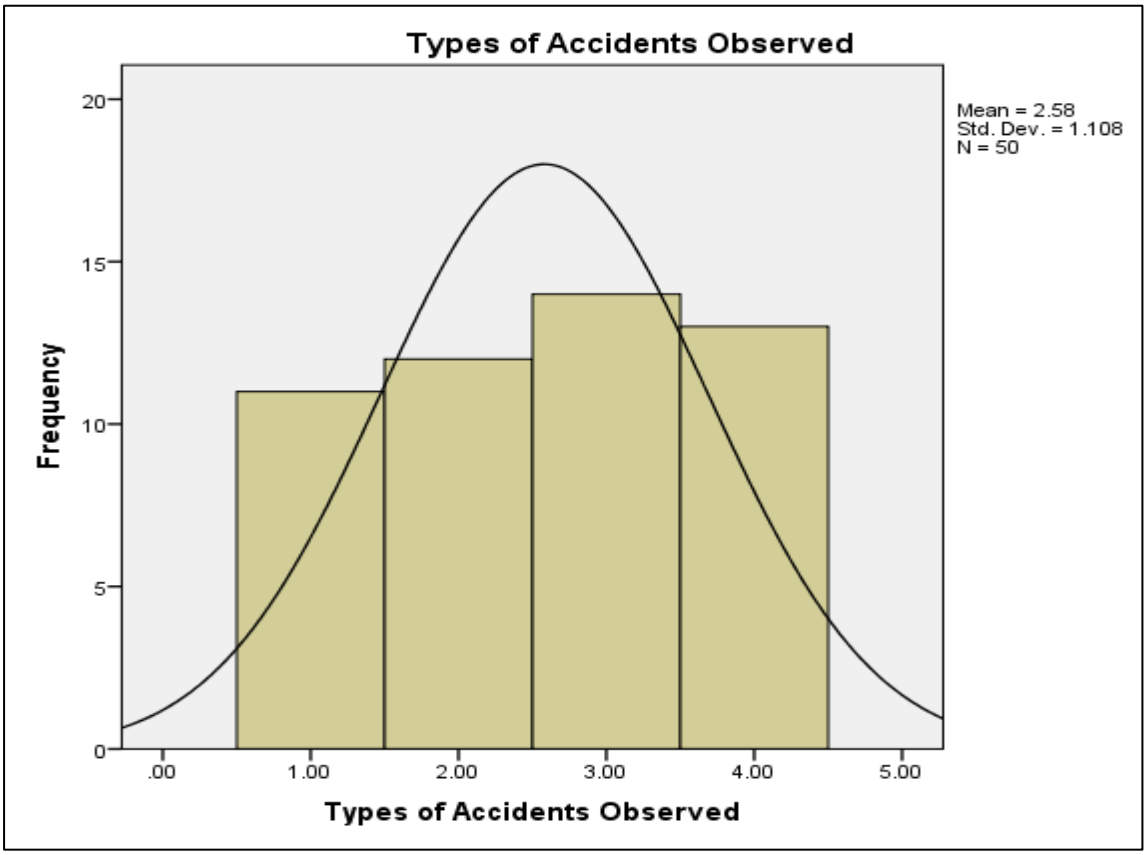


Fig. 4.17. Shows types of accidents observed frequency.

By the help of the graph and table above, which show the sample data that consists of 50 respondents from, it was noticed from the analysis. The topic of "Types of

Accidents Observed" was covered. Eleven (22%) respondents said they had suffered a fatal injury, twelve (24%) said they had suffered a grievous injury, fourteen (28%) said they had suffered a minor injury, and thirteen (26%) said they had no injury.

Table-4.8 Number of Accidents occurred daily

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 5	15	30.0	30.0	30.0
	5 to 10	9	18.0	18.0	48.0
	10 to 15	12	24.0	24.0	72.0
	more than 15	14	28.0	28.0	100.0
	Total	**50**	**100.0**	**100.0**	

Source: Data acquired through field survey and question schedule

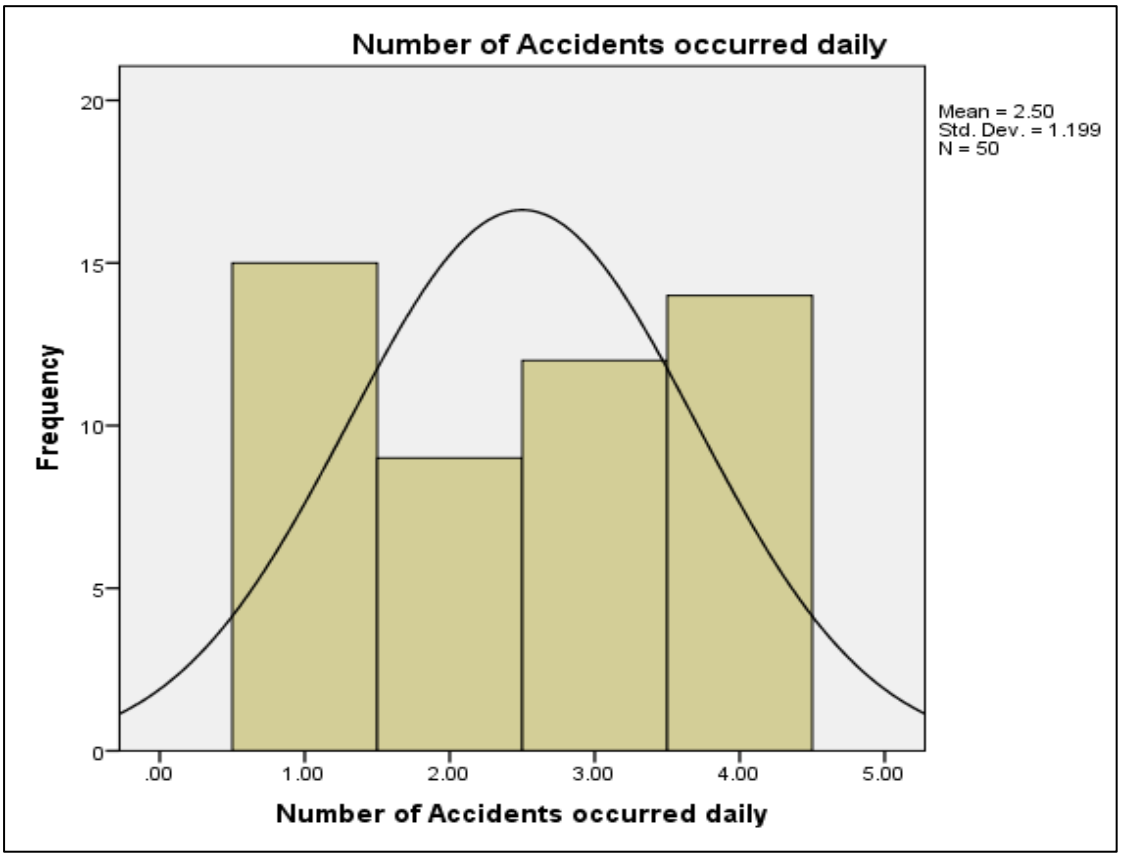


Fig. 4.18 . Shows number of Accidents occurred daily frequency.

Through the help of the graph and table above, which show the sample data that consists of 50 respondents from, it was noticed from the analysis. The topic "Number

of Accidents occurred daily" was covered. Thirty-five (15%) of the respondents replied. Less than five, nine (18%), five to ten, and twelve (24%), ten to fifteen, while fourteen (28%), more than fifteen, respondents said.

Table-4.9 What types of vehicles usually involve in accidents in your duty location.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**Two-wheeler**	6	12.0	12.0	12.0
	Three-wheeler	10	20.0	20.0	32.0
	Four- wheeler	12	24.0	24.0	56.0
	Six-wheeler	10	20.0	20.0	76.0
	Other vehicles	12	24.0	24.0	100.0
	Total	**50**	**100.0**	**100.0**	

Source: Data acquired through field survey and question schedule

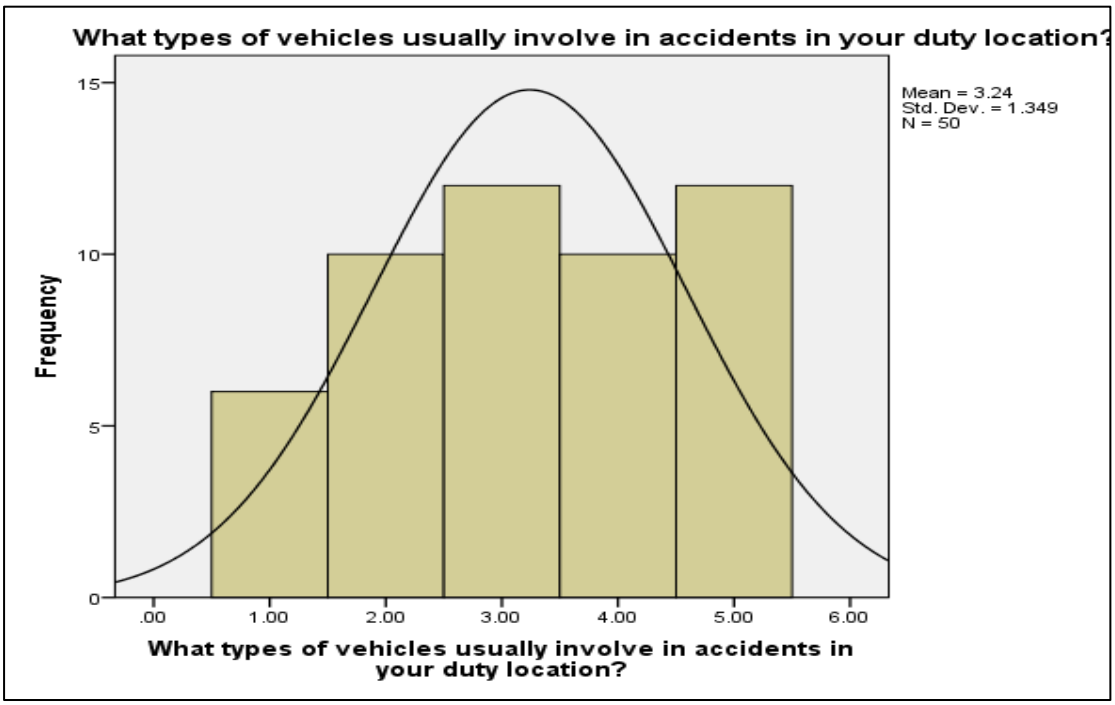


Fig. 4.19. Shows vehicle usually involve in accidents in duty location.

With the help of the graph and table above, which show the sample data of 50 respondents, it was noted from the analysis. "What types of vehicles usually involve

in accidents in your duty location?" was the topic of discussion. Six(12%) of the responders gave a response. Ten (20%) of the responders mentioned two-wheelers. Twelve(24%) of the responders mentioned three-wheelers. Among the responders, 10 (20%) had four-wheelers. Twelve(24%) responders and six-wheelers Different cars.

Table-4.10 Classification of Accidents on the basis of Type of other vehicle/object

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Fatal	6	6.0	6.0	6.0
	Grievous Injury	44	44.0	44.0	50.0
	Minor Injury	49	49.0	49.0	99.0
	Non- Injury	1	1.0	1.0	100.0
	Total	**100**	**100.0**	**100.0**	

Source: Data acquired through field survey and question schedule

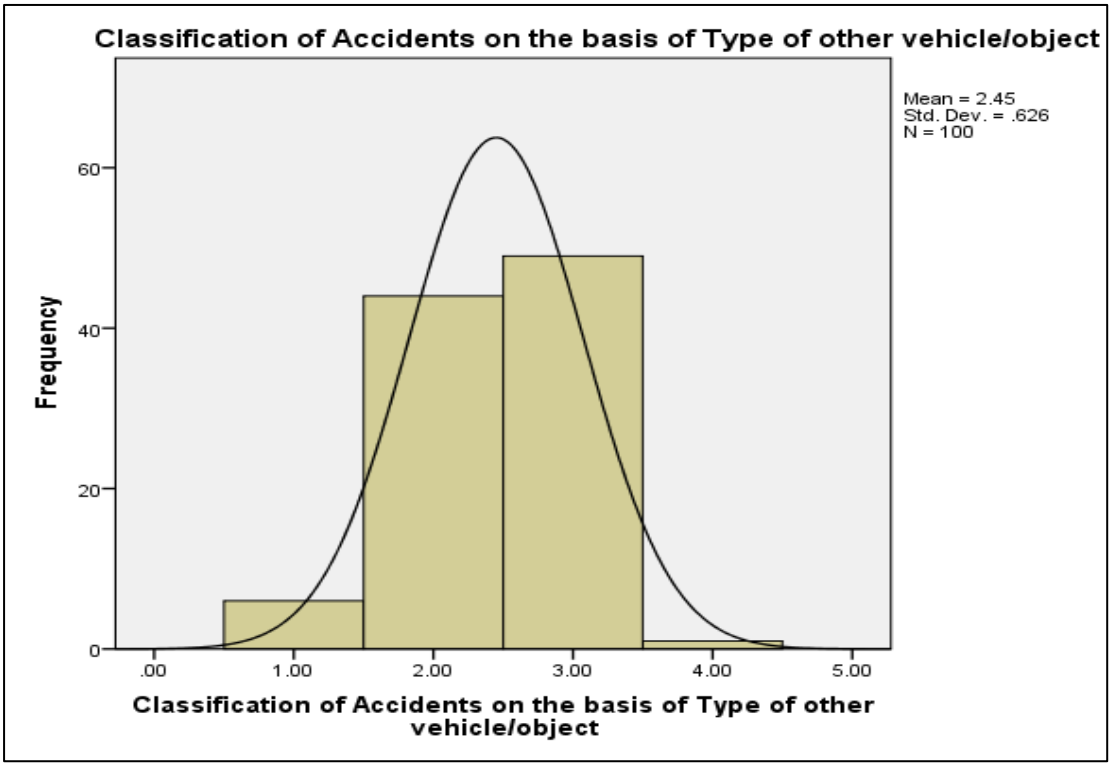


Fig. 4.20. Show classification of accidents on the basis of types of ther vehicle/objects. We saw their openness from the analysis that was conducted in a random manner with respondents, and the information shown in the above graph and table pertains to

around 100 respondents. "Classification of Accidents on the Basis of Type of Other Vehicle/Object" was noted. Six percent of respondents said "fatal," forty-four percent said "grievous injury," fifty-nine percent said "minor injury," and one percent said "non-injury."

Table-4.11 Classification of Accidents on the basis of Type of Vehicle

			Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Fatal	Truck/Bus/Car/Van Taxi/ Jeep	7	7.0	7.0	7.0
	Grievous Injury	Light Goods Vehicle	34	34.0	34.0	41.0
	Minor Injury	2 Wheelers (Bikes,Scooty)	51	51.0	51.0	92.0
	Non-Injury	3 Wheelers and others	8	8.0	8.0	100.0
	Total		**100**	**100.0**	**100.0**	

Source: Data acquired through field survey and question schedule

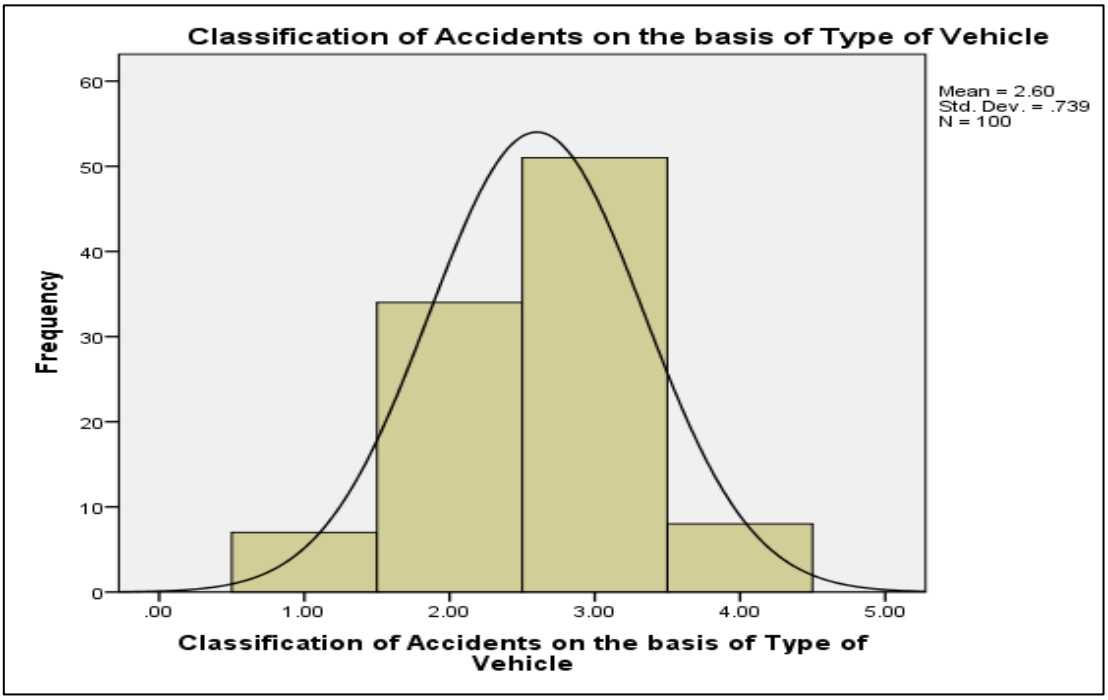


Fig.4.22. Shows classification of accidents on the basis of type of vehicle.

We noticed respondents' opinions based on the analysis that was conducted at random with them, and the information in the above graph and table pertains to around 100 respondents. "Classification of Accidents on the Basis of Type of Vehicle" was noted. Of the responders, 7 (7%), said "fatal" (truck, bus, car, van, taxi, Jeep). Respondents gave the following answers: 34 (34%) said "Grievous Injury (Light Goods Vehicle)," 51 (51%) said "Minor Injury (2 Wheelers Bikes, Scooty), and 8 (8%), "Non-Injury." (3 Wheelers plus additional individuals)

4.4. Conclusions

It makes collisions more serious and, in most cases, has fatal consequences. Therefore, it is advisable to drive within the law, even if you are running late. It is a serious offense that can result in fatal traffic accidents and injuries for persons to use drugs or alcohol before or while operating a motor vehicle. Road Conditions: Unsafe roads increase the chance of collisions. One major cause of accidents on the roads at night and when driving fast is potholes. Other factors that contribute to accidents and fatalities include wet roads during the rainy season and foggy, low visibility throughout the winter.

CHAPTER - V

SOCIAL AND ECONOMIC COSTS DUE TO ROAD ACCIDENTS

5.1 Introduction

Road accidents have significant social and economic costs, affecting individuals, families, and society as a whole. Evaluating these costs is essential for understanding the impact of road accidents and developing strategies to reduce their occurrence.

Most of countries s accidental cost is 3% of their GDP and low-income, middle-income countries GDP is more than 5% of their GDP according to W.H.O. According to international road assessment program (IRAP) the total cost accidents at world level is more than 2.2 trillion US dollar per year.

In India social economic cost of road accidents was 15.71 to 38.81 billion dollar per year and this is the amount of 0.55 ti 1.35% GDP of Indian economic. (BOSCH)

The number of accidents in the Haryana state 9933 in 2021 and which rose 10430 in 2022 which rise 5% of the year. (MoRTH)

Social costs:

Loss of life: Road accidents can lead to the loss of life, causing significant emotional trauma and pain to the victim's family and friends.

Injuries and disabilities: Even when accidents do not result in fatalities, they can cause severe injuries, disabilities, and long-term medical problems that can affect the victim's quality of life and result in substantial medical expenses.

Psychological impact: Road accidents can have a significant psychological impact on the victims and their families, leading to depression, anxiety, and post-traumatic stress disorder.

Reduced productivity: Accidents can also result in lost workdays, reduced productivity, and a decline in the quality of life of the victims.

Economic costs:

Medical expenses: Accidents can result in significant medical expenses, including hospitalization, surgery, and rehabilitation costs. These expenses can be a substantial burden on the victim's family and the healthcare system.

Property damage: Accidents can also result in property damage, such as damage to vehicles, buildings, and other infrastructure. Repairing these damages can be costly.

Loss of income: Road accidents can result in lost income for victims and their families, affecting their ability to make ends meet and meet their financial obligations.

Increased insurance costs: Insurance costs can increase due to accidents, affecting the affordability of insurance for individuals and businesses.

Overall, the social and economic costs of road accidents are substantial, impacting individuals, families, and society as a whole. By understanding and evaluating these costs, policymakers can develop strategies to reduce the number of accidents and their impact. These strategies may include investing in road safety infrastructure, promoting safe driving practices, and implementing stricter traffic rules and penalties for violators. By reducing the number of accidents, we can reduce the social and economic costs associated with road accidents and make our roads safer for everyone.

5.2 Social and Economic Costs Due to Road Accidents

Numerous people, families, and the larger society are profoundly impacted by the huge social and economic losses that are incurred as a result of traffic accidents. The most significant effect on society is the loss of life, which leaves the victim's family and friends with a lifelong emotional trauma and suffering. This is the most deep impact on a social level. Furthermore, accidents often result in serious injuries and impairments, which may lead to long-term medical problems that significantly impact the quality of life for the victims. Not only may these injuries result in significant medical costs, but they also often lead to psychological effects such as sadness, anxiety, and post-traumatic stress disorder (PTSD). Accidents often result in missed workdays, decreased productivity, and a deterioration in quality of life, which are all consequences that reach beyond the realm of health.

At the same time, the repercussions are quite severe economically. A large financial strain is placed on families and the healthcare system as a result of the medical expenditures that are incurred as a result of accidents. These charges include hospitalisation, surgical procedures, and rehabilitation fees. Accidents may cause damage to cars, buildings, and infrastructure, which might result in costly repairs. Property damage is another economic expense that can be incurred as a result of accidents. The victims and their families typically experience a loss of income, which has a negative impact on their capacity to maintain their financial stability and fulfil their commitments. Furthermore, accidents on the road are a contributor to rising insurance premiums, which has an effect on the affordability of insurance packages for both people and companies.

Table 5.1 year wise estimated economic loss due to accidents on NH-44 from Kundli to Panipat (Crores)

Year	No. of Accidents	Estimated Cost (Economic loss)
2010	122	12.47
2011	124	13.02
2012	127	13.14
2013	129	12.16
2014	130	13.16
2015	133	13.54
2016	139	13.47
2017	142	13.70
2018	144	13.66
2019	147	13.82
2020	150	14.02

Source; Office of Superintendent of Police and Police Stations

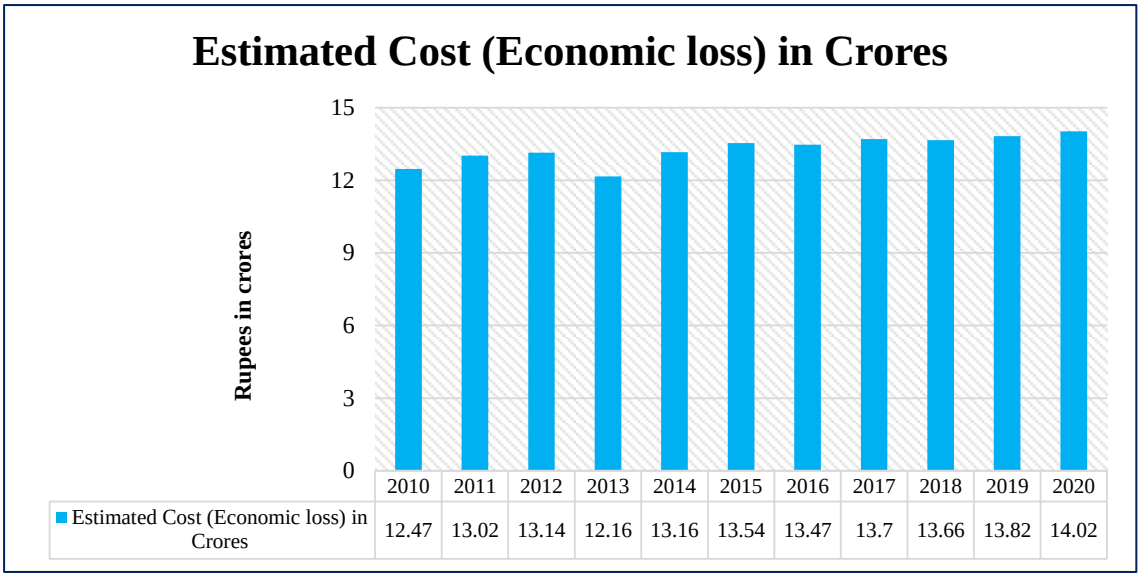


Fig. 5.1. shows estimated cost (Economic loss) in crores claims of accidents.

The graph and table above demonstrate that, in 2010, the largest economic losses of all claims—from both government and commercial agencies—were made at 14.02 crore, while the minimum was 12.47 crore. Additionally, it was shown that the year-over-year rise in economic claims or losses indicates an upward tendency in economic losses.

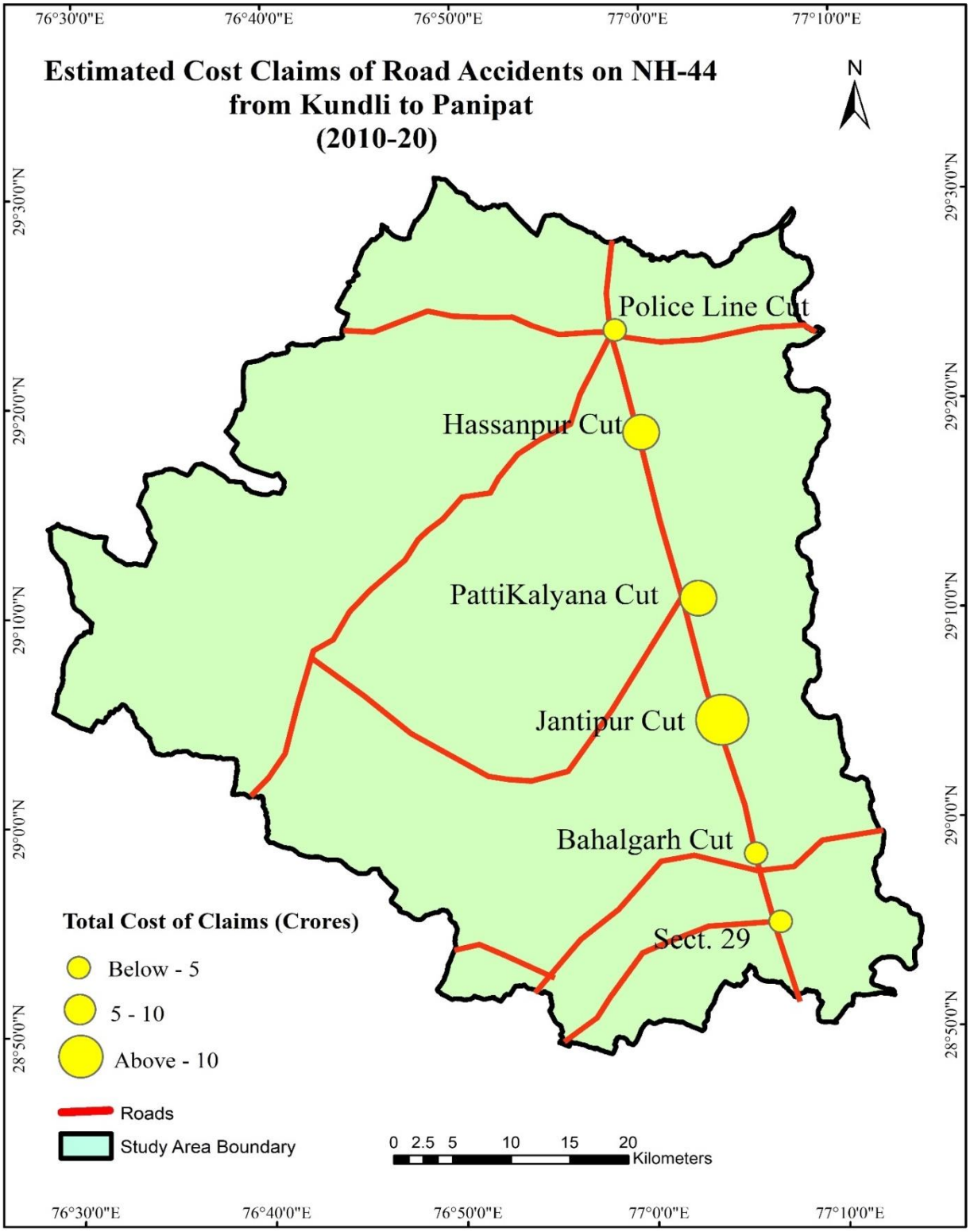


Fig.**5.2.** Estimated cost clain due to accidents on different accidents black spots on NH-44.

These all-encompassing social and economic consequences highlight the need of designing and implementing efficient measures to minimise the number of accidents

that occur on the roads. It is thus strongly recommended that policymakers make investments in road safety infrastructure, encourage safe driving behaviours, and enact more stringent traffic laws and consequences for those who violate them. It is possible to greatly reduce the related social and economic costs of road accidents by lowering the number of accidents that occur on the roads. This would result in safer roads for everyone.

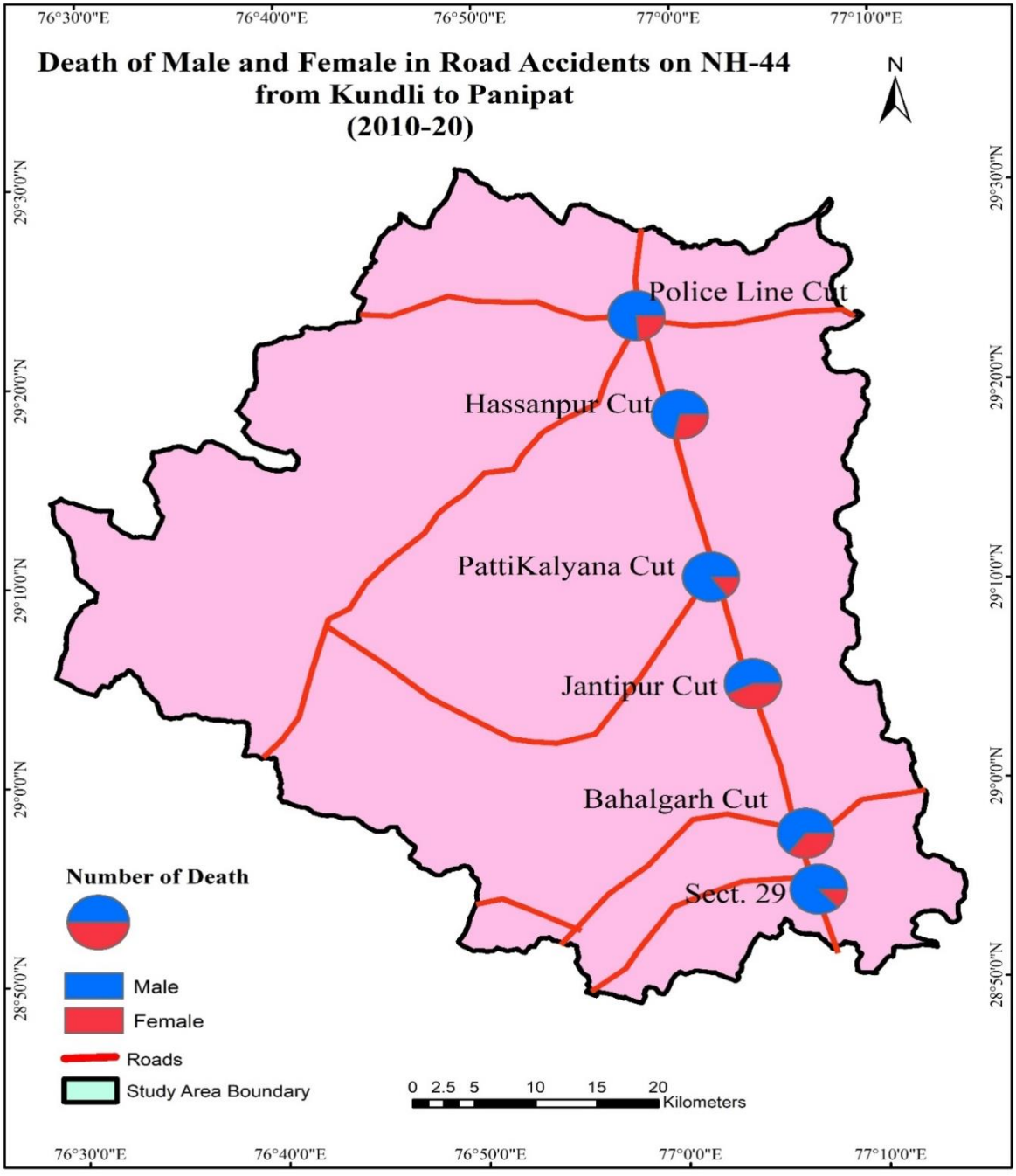


Fig.5.3. Total number of male and female lost his life due to road accidents on NH-44.

5.3 Extended Impact of Road Accidents on Society and Economy

Road accidents have ramifications that extend well beyond the immediate aftermath, causing a ripple effect that may be felt throughout a variety of elements of society as well as the economy. On a social level, these accidents have a domino effect on communities and the larger social fabric as a whole.

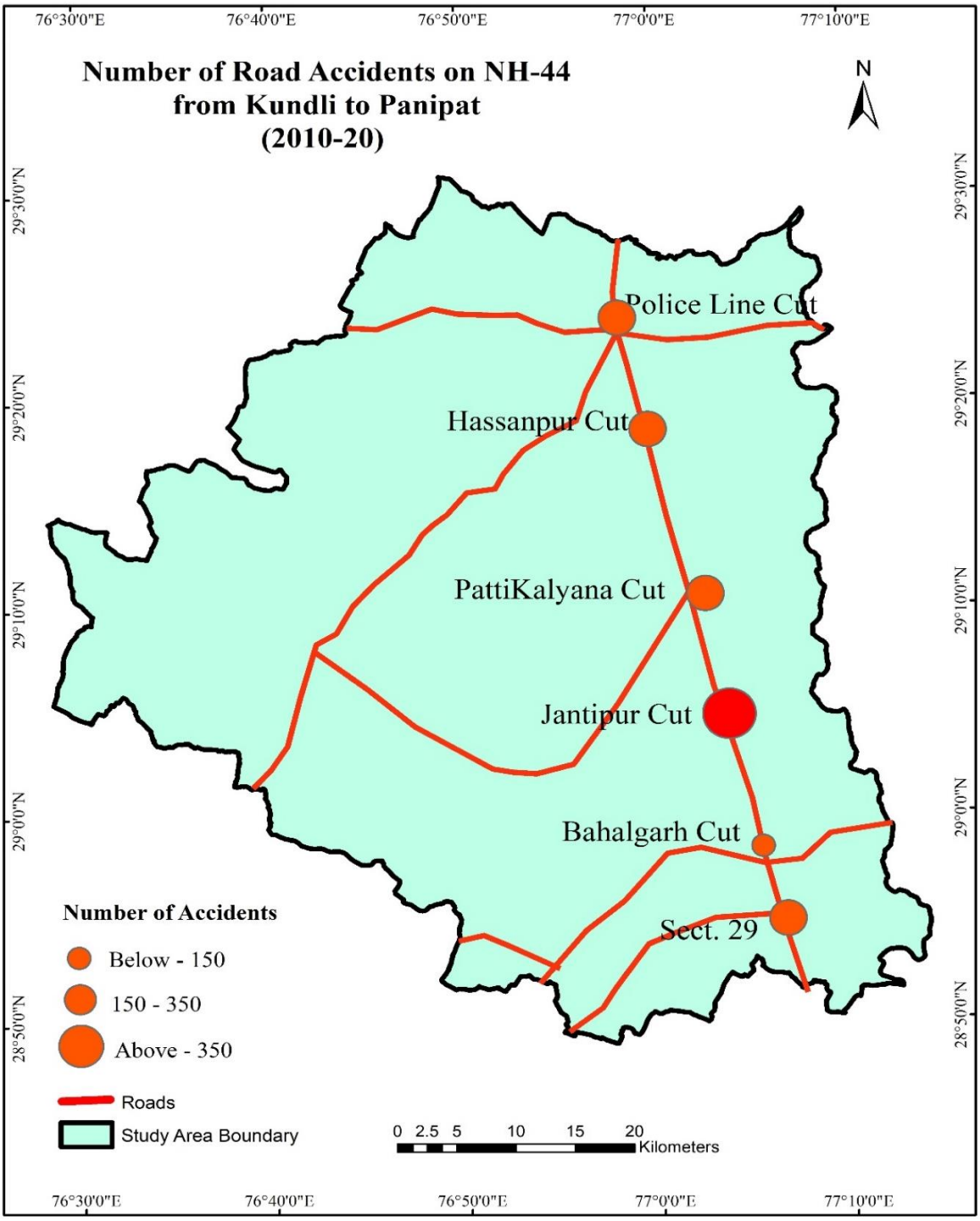


Fig.5.4. Number of Accidents on NH-44 at black spots.

Families who suffer the loss of their major breadwinners as a result of a car accident are not only subject to emotional anguish, but they may also face possible financial difficulties. Especially in situations when the dead was the primary source of income for the family, this loss has the potential to plunge families into poverty. The effects may be especially severe for children and dependents, having an influence on their capacity to learn, their overall health, and their chances for the future.

Accidents on the roads are a substantial contributor to the load that is placed on healthcare systems, which is a concern for public health. It takes a significant amount of money to provide accident victims and their families with emergency assistance, long-term rehabilitation, and mental health care. The entire effectiveness and capabilities of the healthcare system is negatively impacted as a result of this load, which often causes resources to be diverted away from other essential healthcare services. The larger effect on the economy includes the loss of productivity that occurs as a result of individuals being injured or killed, as well as the indirect expenses that are linked with traffic interruptions and delays that are brought about by accidents. Businesses often suffer as a consequence of lower production and absenteeism in the aftermath of an accident, which may have a domino effect on the economy at both the local and national levels. Additionally, there is a significant expense connected with the legal processes and the processing of insurance claims that occur after a car accident.

Accidents have a considerable influence on the environment, despite the fact that this aspect is less often highlighted. It is common for accidents to result in the release of hazardous materials, the destruction of vehicles, and other types of pollution, all of which have the potential to have a negative impact on the environment. At the policy level, the costs of road accidents need higher expenditure on road safety measures, law enforcement, and emergency response systems. This is because of the fact that roadway accidents are expensive. The distribution of finances may put a burden on government budgets, which may result in resources being diverted away from other essential sectors such as education, social services, and the development of infrastructure. The social and economic consequences of road accidents are enormous and diverse. Not only do they have an effect on the victims who are immediately affected, but they also have far-reaching repercussions for families, communities, healthcare systems, economies, and policies implemented by the government. It is

clear from this that there is an urgent need for comprehensive road safety measures and initiatives in order to reduce the disastrous effects of accidents on society and hence prevent them from occurring.

5.4 Methodology

The method that would be used in order to determine the social and economic expenses that are incurred as a consequence of accidents that take place on National Highway 44 between Panipat and Kundli would be to perform a comprehensive analysis of the various repercussions that are incurred as a result of the accidents. This would be done in order to determine the consequences that are incurred as a result of the accidents. One of the components of this strategy is an exhaustive investigation on the total number of deaths, injuries, and disabilities encountered. Furthermore, an investigation of the psychological effects on victims and the family members of those who were affected is also included in this report. In terms of the things that are taken into consideration in terms of economic expenses, some of the things that are taken into consideration include medical expenses, property damage, loss of income, and increased insurance premiums. These are just some of the things that are taken into consideration. Among the other factors that are taken into account is the possibility of increased insurance prices. As an additional point of emphasis, the article highlights the need of establishing effective road safety measures, safe driving behaviours, and more strict traffic rules in order to limit the amount of money that is spent on these expenses and to make roads much safer. This holistic approach is the most important thing that can be done for the purpose of acquiring a comprehensive knowledge of the consequences that are caused by road accidents and for the purpose of developing methods to minimise the severity of the effects that are caused by those accidents. This is the most important thing that can be done.

5.5. Limitations of the study

Limitations of socio-economic cost of road accidents, it is difficult to get the addresses of those who have met with an accident and even if found they do not give proper information about the accident and socio economic lose because they think we are from insurance company if they gives correct information they will be get in to some trouble.it is difficult to measure social cost, how much pain they have suffered, what they are going through?

Conclusions

It is concluded that Accidents have a significant impact on the environment, even if this fact isn't as frequently mentioned. Accidents frequently result in the damage of cars, the discharge of dangerous materials, and other forms of pollution, all of which have the potential to harm the environment. The expenses of traffic accidents need increased investment in emergency response systems, law enforcement, and road safety measures at the policy level. This occurs as a result of the high cost of traffic accidents. The allocation of funds has the potential to strain government budgets, leading to the possible reallocation of resources from other crucial areas including infrastructure development, social services, and education.

There are many different and significant social and economic repercussions from traffic accidents. Estimating the socioeconomic cost from accidents on Indian roads has been motivated by the lack of data about losses resulting from road accidents in recent times. Casualties from road accidents cause a considerable deal of misery for people because of the financial, medical, and social expenses. The amount of loss sustained has been computed using information from comprehensive accident databases, police reports, medical records, insurance, and government reports.

CHAPTER - VI

PLANNING MODEL FOR THE MINIMIZING THE ROAD ACCIDENTS

6.1 Introduction

A comprehensive strategy including several stakeholders, including the government, traffic authorities, road safety specialists, and the general public, is necessary to reduce traffic accidents. A planning model can assist in determining the most important tactics that must be used in order to lower the number of traffic accidents. (A.Shalom Hakkert, David Mahalel, 1978). Here is a planning model that can be used for minimizing road accidents: Identify the problem: The first step in the planning model is to identify the problem, which in this case are road accidents. The problem should be defined in terms of the number of accidents, fatalities, injuries, and economic costs associated with them.Collect and analyze data: Data collection and analysis are essential for developing effective strategies (AASHTO, 2010). This involves collecting data on the causes and factors of road accidents, such as driver behavior, road infrastructure, vehicle defects, weather conditions, and non-adherence to traffic rules. The data can be analyzed to identify the main causes and factors that contribute to road accidents (Aditya Medury, Offer Grembek, 2016).

6.2.Methodology

Measures to reduce accident sources cannot be completely defended by means of the present methods of identifying accidentally hazardous locations based on the relevant quantitative characteristics. Dinges and Sologian (2008) state that it is necessary to identify the volumes and terminology under which, in order to establish strategies for financing initiatives to minimize the rate of traffic accidents with specified optimality criteria.

Factors	Description
Education and	Promoting safe driving practices and raising awareness of the risks associated with distracted driving, speeding, driving under the influence of drugs or alcohol, and other dangerous behaviors.
awareness	Conducted through various mediums such as billboards, TV, radio, social media, and public events.
Infrastructureand engineering	Improvements such as improving road markings, providing adequate lighting, constructing speed breakers, and building overpasses or underpasses at high-risk areas such as intersections. Proper design and construction of roads.
Enforcement of	Effective enforcement of traffic laws and regulations, such as increasing the number of police officers on the roads, imposing stricter penalties for traffic violations, and installing speed cameras and other monitoring equipment.
laws andregulations	Presence of law enforcement can act as a deterrent for reckless driving behavior.
Vehicle safety	Measures such as mandating regular vehicle maintenance, ensuring that vehicles meet safety standards, and promoting the use of safety features such as airbags and anti-lock brakes. Car manufacturers can play a significant role in promoting vehicle safety by incorporating advanced safety features in their vehicles.
Emergency	Effective emergency response systems such as training emergency responders to handle road accidents, providing emergency medical services, and establishing protocols for transporting accident victims to hospitals.
response	The response time can be critical in saving lives and reducing the severity of injuries.
Data collection	Collecting data on the causes and factors of road accidents, analyzing accident data to identify trends, and sharing this data with stakeholders to inform decision-making. For example, analyzing data on accidents can help to identify high-risk areas, and targeted interventions can be developed to minimize the incidence of accidents in those areas.

Set goals and objectives: Based on the analysis of the data, goals and objectives should be set for reducing road accidents. These could include reducing the number of accidents, fatalities, and injuries by a certain percentage within a specific timeframe.

Develop strategies: Once the goals and objectives have been defined, strategies should be developed to achieve them. The strategies should address the main causes and factors of road accidents identified during the data analysis. Strategies may include improving road infrastructure, educating drivers about safe driving practices, enforcing traffic rules and regulations, promoting public awareness about road safety, and ensuring regular maintenance of vehicles.

Implement and monitor: The strategies should be implemented, and their impact should be monitored to ensure that they are effective in reducing road accidents. Regular monitoring and evaluation should be conducted to assess the effectiveness of the strategies and make necessary adjustments.

Evaluate and improve: The final step is to evaluate the overall impact of the strategies and identify areas for improvement. This involves assessing the effectiveness of the strategies in achieving the goals and objectives, identifying any gaps or challenges, and developing new strategies or modifying existing ones to improve road safety (Benoit Flahaut, Michel Mouchart, Ernesto San Martin, Isabelle Thomas, 2003).

Minimizing road accidents is an essential goal for any society. Road accidents can cause significant human and economic losses, and it is essential to develop effective strategies to reduce them. A theoretical model that takes into account different factors contributing to road accidents can be an effective way to achieve this goal (D. Mahalel, A.S. Hakkert, J.N. Prashker, 1982).

Education and awareness campaigns are critical components of any strategy to minimize road accidents. These campaigns can be aimed at different groups, including drivers, pedestrians, and other road users. The focus of these campaigns can be on promoting safe driving practices and raising awareness of the risks associated with distracted driving, speeding, driving under the influence of drugs or alcohol, and other dangerous behaviors (Elvik, R., 2008). Education and awareness campaigns can be conducted through various mediums such as billboards, TV, radio, social media, and public events.

Infrastructure and engineering improvements can also play a vital role in minimizing road accidents. These improvements can include measures such as improving road markings, providing adequate lighting, constructing speed breakers, and building overpasses or underpasses at high-risk areas such as intersections (Hauer, Ezra, Ng, Jerry C N, Lovell, Jane,1988). Proper design and construction of roads can also help to minimize accidents. For example, roundabouts can be constructed at intersections to reduce the incidence of accidents.

Effective enforcement of traffic laws and regulations can also help to minimize road accidents. This can include measures such as increasing the number of police officers on the roads, imposing stricter penalties for traffic violations, and installing speed cameras and other monitoring equipment. The presence of law enforcement can act as a deterrent for reckless driving behavior.

Vehicle safety is also a critical factor in minimizing road accidents. Ensuring that vehicles are safe to drive is essential in reducing the number of accidents. This can include measures such as mandating regular vehicle maintenance, ensuring that vehicles meet safety standards, and promoting the use of safety features such as airbags and anti-lock brakes. Car manufacturers can play a significant role in promoting vehicle safety by incorporating advanced safety features in their vehicles.

Effective emergency response systems can help to reduce the severity of accidents and save lives. This can involve measures such as training emergency responders to handle road accidents, providing emergency medical services, and establishing protocols for transporting accident victims to hospitals. The response time can be critical in saving lives and reducing the severity of injuries.

Data collection and analysis can also play a crucial role in minimizing road accidents. This can involve collecting data on the causes and factors of road accidents, analyzing accident data to identify trends, and sharing this data with stakeholders to inform decision-making. For example, analyzing data on accidents can help to identify high-risk areas, and targeted interventions can be developed to minimize the incidence of accidents in those areas.

In conclusion, a theoretical model for minimizing road accidents should take into account various factors contributing to accidents. These factors include education and awareness, infrastructure and engineering, enforcement of laws and regulations,

vehicle safety, emergency response, and data collection and analysis. By addressing these factors, it is possible to develop effective strategies that reduce the incidence of road accidents and make our roads safer for everyone. It is crucial to work collaboratively with different stakeholders, including the government, traffic authorities, road safety experts, and the public, to implement these strategies effectively.

6.3 Planning Model for Minimizing Road Accidents

Reducing the number of traffic accidents calls for an all-encompassing and multi-dimensional planning approach that includes many tactics and stakeholders. To reduce the occurrence and severity of traffic accidents, this approach recommends concentrating on a few specific areas for intervention and allocating resources wisely.

1. **Infrastructure and Road Design:** The improvement of road infrastructure is an essential part of the model for planning. Safer roadways with clear lane lines, sufficient signage, and effective traffic control systems are all part of this. Improved lighting, pedestrian crossings, and traffic calming measures are some of the current road engineering strategies that may greatly decrease accident rates in places that are prone to them.

Many time it seen that after 4 lines, a two line road start and driver faces problem and sudden changes in curve causes of accidents,

2. Vehicle Safety Standards: Another important factor is raising the bar for car safety. Airbags, anti-lock braking systems (ABS), and crash-resistant designs are all part of the strict safety standards that must be met by automobiles. Additionally, it is essential to examine and maintain automobiles on a regular basis to guarantee that they are safe to drive.

3. Enforcement of Traffic Laws: It is critical to strictly enforce traffic regulations. This encompasses the punishment of careless actions such as driving under the influence of alcohol or drugs. Deterring traffic offences may be achieved by the use of automated technologies such as breathalysers and speed cameras, in conjunction with a strong regulatory framework.

4. Public Awareness and Education: Driving safely and responsibly should be a top priority, and the public must be educated on the subject. Road safety education in

schools, driver education programmes, and public awareness campaigns may make a big difference in how people think and act on the road.

5. Emergency Response and Medical Services: It is of the utmost importance to enhance medical services and emergency response systems in order to successfully manage accident scenarios. This involves making sure that accident victims are transported to medical facilities quickly, providing them with urgent medical treatment, and minimising response times.

6. Data-Driven Approaches: More precise interventions may be achieved via the use of data analytics to learn about accident trends and risk variables. To do this, we need to gather and analyse data on accident rates, road conditions, and driver actions to pinpoint times and places with a high risk of accidents.

7. Stakeholder Collaboration: A unified strategy for road safety requires cooperation between governmental entities, NGOs, traffic authority, healthcare professionals, and community groups. Working together in this way may make it easier to share information, combine resources, and execute plans in a coordinated manner.

8. Poor planning and forecasting and budget: Many projects were not completed on the time due to poor planning, forecasting and lack of budget by Construction Company. The Construction companies must be confirming that they have access to up to date information about time line of project and material cost and labourer cost e.t.c in details.

9. Weather conditions –When construct a road never ignore local weather conditions and here some effects of weather on construction of road are 1.delays of project, 2. Safety risk of workers life. 3. Effect on quality of work. 4. Material and equipment damages. 5. Less resource management and many more of effect of weather condition in construction of roads.

10. Policy and Legislative Measures: The development and implementation of thorough laws and regulations to ensure road safety is of the utmost importance. Some examples of this include allocating sufficient funds for road safety programmes, doing research on the topic, and establishing national objectives for road safety.

6.4 Comprehensive Strategies in Road Safety Planning

Improving the planning model to reduce road accidents requires using several tactics that go beyond conventional methods, including larger elements of road safety and community involvement. It is essential to actively interact and participate in the community. Road safety is made a collective duty when local communities are involved in activities that raise awareness, such school-based education programmes and awareness campaigns. Sustainable and culturally appropriate interventions that strike a deeper chord with the people they are designed to protect may be achieved via community-led activities, such as local patrols and education programmes. When it comes to revolutionising road safety, technological advancements are also crucial. Accident prevention may be greatly enhanced with the use of state-of-the-art traffic management systems, real-time monitoring, and predictive analytics powered by artificial intelligence. Revolutionary improvements to road safety, perhaps lowering accidents caused by human error, are on the horizon thanks to emerging technology like vehicle-to-vehicle communication and autonomous driving systems. Another important consideration is the incorporation of public health viewpoints. By expanding the focus to include victims' and their families' emotional health, as well as their physical injuries, road safety becomes a public health problem. For a more all-encompassing solution, this all-encompassing method allows for plans that take into account the emotional and social health of those impacted by traffic accidents. Equally important is the role of the commercial sector and corporate social responsibility. Significant gains may be achieved by urging corporations to engage in road safety via corporate social responsibility (CSR) programmes, research financing, and public awareness allocation of resources. One further thing that businesses can do is to make sure their drivers are safe, especially those who work in logistics and transportation.

In order to tackle road safety, which is a worldwide issue, collaboration across regions and countries is crucial. A lot may be learned from other nations' successes and failures, as well as by exchanging best practises and following global standards. When it comes to shared transportation corridors and cross-border traffic safety, regional collaboration is crucial. The efficacy and continued relevance of road safety programmes are guaranteed by constant monitoring and assessment. To keep

interventions relevant to current requirements, a solid mechanism for continuous evaluation must be in place to permit strategy change in response

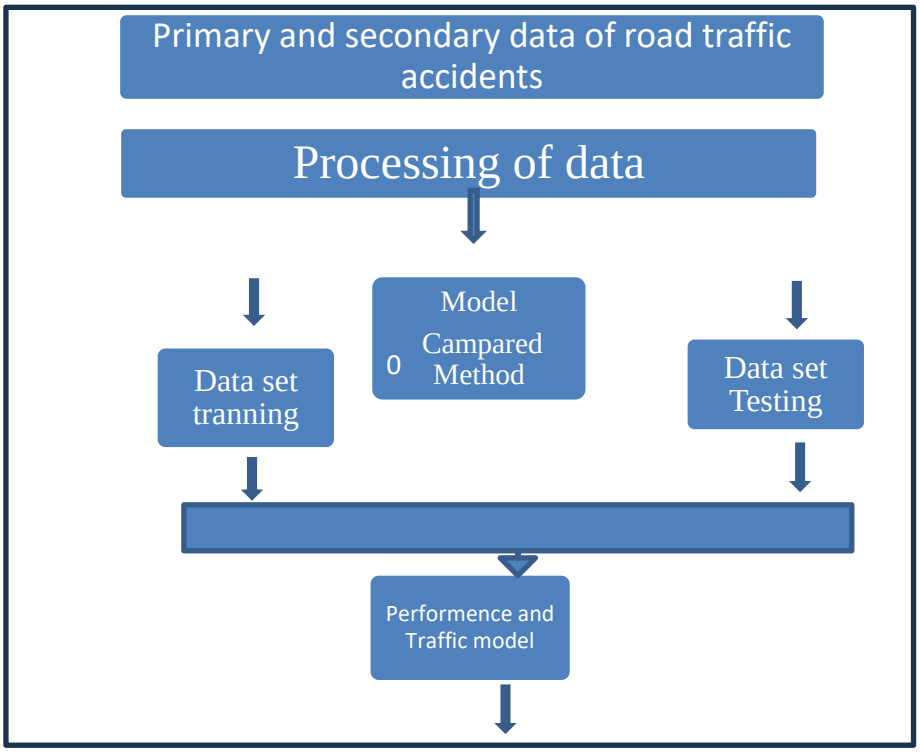


Fig. 6.1 shows model of data assessment in regading accidents.

to changing conditions and new data. Pedestrians, bikers, and motorcyclists are particularly susceptible road users and need extra caution. Important measures to guarantee the protection of these groups include making roads that are safe for all users, establishing designated lanes, and launching safety campaigns specifically for them. Community involvement, technology innovation, public health integration, business accountability, international cooperation, constant review, and safeguarding vulnerable road users are all essential components of an all-encompassing strategy to reduce road accidents. This comprehensive strategy may greatly aid in lessening the frequency and severity of traffic accidents.

Designing a model to minimize road accidents on National Highway -44 between Kundli and Panipat in India involves several key components. This model will focus on a multi-faceted approach that includes improvements in infrastructure, implementation of advanced technology, enforcement of traffic laws, and public awareness campaigns. Here's a detailed plan:

1. Infrastructure Improvements

- Road Quality Assessment and Maintenance: Regularly assess and repair road surfaces to prevent accidents caused by potholes, uneven surfaces, and other road damages.

- Effective Signage and Road Markings: Ensure clear and visible signage and road markings, especially at critical junctions, bends, and intersections.

- Installation of Barriers and Guardrails: Erect barriers and guardrails at accident-prone spots to prevent vehicles from veering off the road.

- Pedestrian and Cyclist Safety: Create designated pedestrian crossings and cycle lanes, with proper lighting for night safety.

2. Technology Integration

- Intelligent Transportation Systems (ITS): Implement ITS for real-time traffic monitoring and management, including the use of CCTV cameras and sensors.

- Speed Detection Cameras: Install speed cameras to deter speeding and automated number plate recognition (ANPR) systems to identify and penalize violators.

- Emergency Response Systems: Set up quick-response systems for accidents, including emergency call boxes and GPS-enabled ambulances.

3. Law Enforcement and Compliance

- Strict Enforcement of Traffic Laws: Regular patrolling by traffic police to enforce laws related to speeding, drunk driving, and helmet/seatbelt usage.

- Checkpoints for Drunk Driving: Set up regular checkpoints to deter drunk driving, especially during nights and weekends.

- Heavy Vehicle Regulation: Implement specific time windows for heavy vehicles to reduce congestion and risk of accidents during peak hours.

4. Public Awareness and Education

- Road Safety Campaigns: Launch regular awareness campaigns about road safety, the importance of following traffic rules, and the dangers of drunk driving.

- Driver Training Programs: Promote advanced driving courses and road safety education in driving schools.

- Community Engagement: Involve local communities in road safety initiatives and gather feedback for continuous improvement.

5. Data Analysis and Policy Formulation

- Accident Data Analysis: Collect and analyze accident data to identify patterns and high-risk zones.

- Policy Formulation: Based on data, formulate targeted policies to address specific issues unique to the NH44 Kundli-Panipat stretch.

6. Monitoring and Evaluation

- Regular Audits and Assessments: Conduct regular audits of road safety measures and their effectiveness.

- Feedback Mechanism: Establish a system for receiving and incorporating public feedback on road safety issues.

Implementation and Collaboration

- Collaboration between the National Highways Authority of India (NHAI), local law enforcement, transportation departments, and other stakeholders is crucial.

- Secure funding through government grants, public-private partnerships, and other sources.

6.5 Conclusion

The success of this model depends on the integration of these components and the cooperation of various stakeholders. Continuous monitoring, evaluation, and adaptation of strategies based on emerging trends and technologies will also play a crucial role in minimizing accidents on NH-44 between Kundli and Panipa.Designing a model to minimize road accidents on National Highway 44 between Kundli and Panipat in India involves several key components. This model will focus on a multi-faceted approach that includes improvements in infrastructure, implementation of advanced technology, enforcement of traffic laws, and public awareness campaigns. Here's a detailed plan:

Its also submitted that Driving on Vizianagaram's roads is exceedingly dangerous. The application of traffic engineering expertise on roadways is extremely lacking. Poor traffic engineering techniques have reduced road users' understanding of traffic

laws, which is the primary cause of accidents. Poor traffic engineering will remain unless it is incorporated into the planning, designing, building, and maintaining of roads.

CHAPTER - VII

MAJOR CAUSES AND FACTORS OF ROAD ACCIDENTS

7.1 Introduction

In the last chapter, we explored the study methods in depth; this chapter will focus on the major cause and factors of road accidents and analysis interpretation of the data which is collected in the field by using schedule. The major causes and factors are following

Human error: One of the main reasons for traffic accidents is this. A number of things can lead to human mistake, including driving while intoxicated or distracted, speeding, irresponsible driving, and exhaustion. Driving while not paying attention to the road is known as distracted driving. Using a cell phone, eating, drinking, or conversing with other passengers are some of the possible causes of this (Long Tien Truong and Sekhar V. C. Somenahalli, 2011).

Speeding is also a common human error that could cause accidents as it reduces the time a driver has to react to sudden changes on the road (McGuigan, D.R.D., 1981.). Reckless driving includes behaviors such as changing lanes frequently, tailgating, and ignoring traffic signals.

Poor road conditions: Poor road conditions such as potholes, uneven surfaces, and inadequate road markings can lead to accidents, especially when drivers are not familiar with the road. For example, potholes can damage the tires or cause the driver to lose control of the vehicle (McGuigan, D.R.D., 1982). Inadequate road markings or faded road markings can also confuse drivers, leading to accidents.

Vehicle defects: Vehicle defects such as faulty brakes, tires, and steering can lead to accidents, especially at high speeds. Regular maintenance of the vehicle is essential to ensure that all systems are functioning properly. Worn-out tires or faulty brakes could lead to accidents if not replaced or repaired on time.

Weather conditions: Adverse weather conditions such as heavy rain, fog, and snow can reduce visibility and make it difficult for drivers to control their vehicles, increasing the risk of accidents (Oh Hoon Kwona, Min Ju Parka, Hwasoo Yeoa, and Koohong Chungb, 2013). For example, rain can make the road surface slippery, reducing the grip of the tires, and making it difficult for drivers to control the vehicle.

Inadequate road infrastructure:Inadequate road infrastructure, such as lack of signage, inadequate lighting, and narrow roads, can lead to accidents, especially in

areas with high traffic volumes. For example, narrow roads can make it difficult for two vehicles to pass each other safely, leading to accidents.

Non-adherence to traffic rules:Non-adherence to traffic rules such as jumping red lights, improper lane usage, overtaking from the wrong side, and using mobile phones while driving can cause accidents. Disobeying traffic rules can lead to collisions and accidents.

Lack of awareness: Lack of awareness among drivers about safe driving practices, traffic rules and regulations, and road safety measures can also lead to accidents. For example, some drivers may not be aware of the importance of wearing seat belts or the dangers of driving under the influence of drugs or alcohol.

7.2 Result and Discussions

Table 7.1 Monthly wise distributions of accidents on N.H-44 Kundly to Panipat

Month	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
January	12	13	11	14	16	15	17	17	16	18	19	168
February	08	11	12	09	13	14	09	08	08	11	10	113
March	09	08	11	10	08	11	10	13	09	08	07	104
April	09	10	08	07	11	08	10	10	12	12	12	109
May	11	10	13	13	09	09	12	07	07	12	09	112
June	07	11	10	12	12	12	09	12	09	07	12	113
July	11	09	07	08	09	07	14	09	10	12	11	107
August	10	10	12	12	11	09	10	12	09	10	12	117
September	09	10	09	11	13	10	07	11	08	11	14	113
October	12	12	11	08	07	09	11	12	17	13	15	127
November	11	09	09	10	05	08	12	15	17	16	13	125
December	13	14	14	15	16	17	18	16	18	17	16	174
Total	**122**	**124**	**127**	**129**	**130**	**133**	**139**	**142**	**144**	**147**	**150**	

Source of Secondary Data- S.P Office Panipat&Sonipat.

When we analysed the accidents data of National Highway-44 monthly wise accidents scenario show that most of accidents were occurred in the months of January 2010 to2020 168 and December 174 because of in this month's fog and bad weather conditions are may be responsible and remaining are occurred in table 7.1 in this chapter.

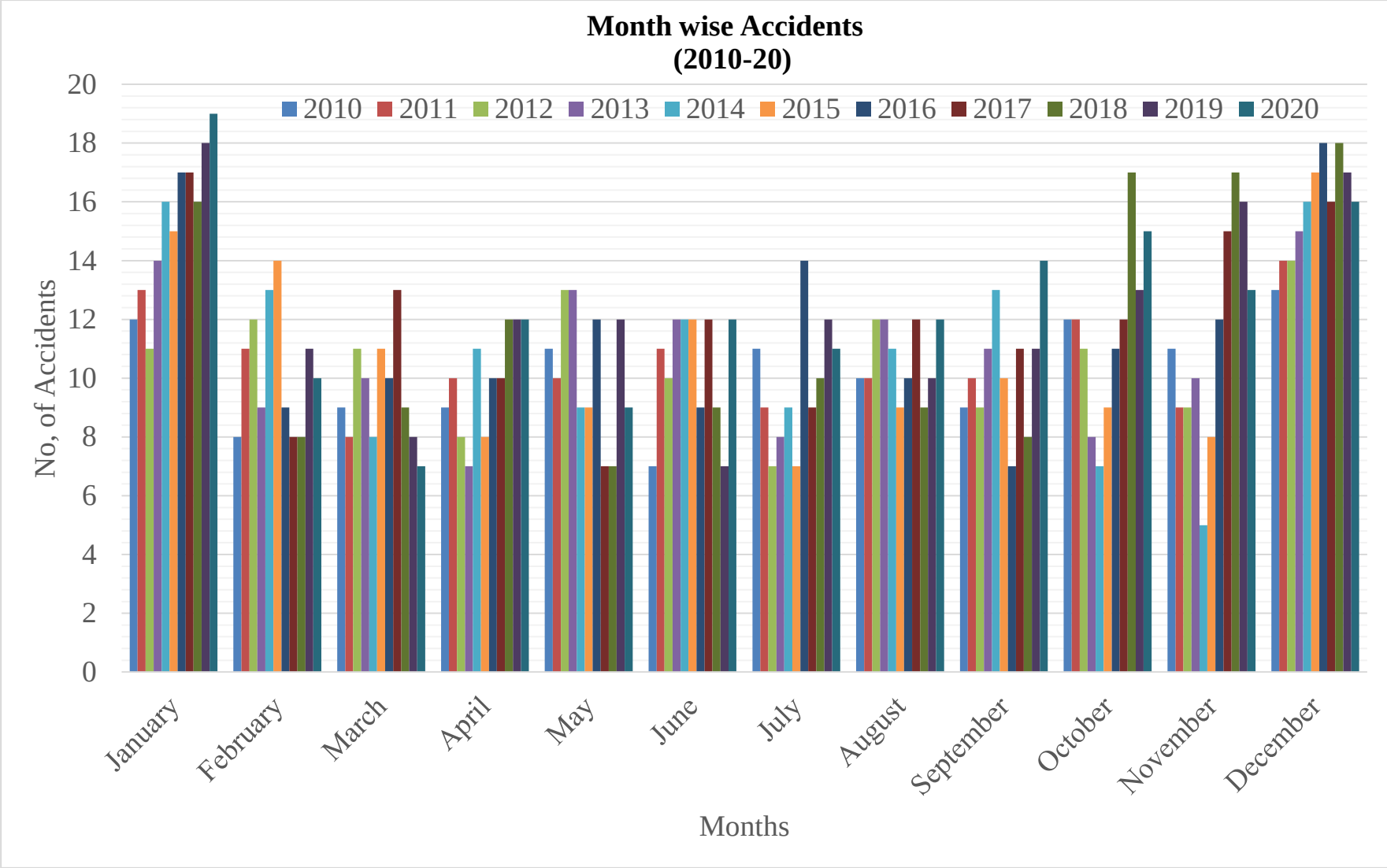


Fig. 7.1. Month wise accidents in different years shown in this graph.

Table 7.2 Road Accidents by Type of Traffic Rules Violation

Category	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Over Speed	81.00	75.00	71.00	77.00	72.00	68.00	69.00	75.00	68.00	76.00	73.00
% Share in Total	66.39	61.47	58.19	63.11	59.01	55.73	56.55	61.47	55.73	62.29	59.83
Drunken driving/ consumption of alcohol & drug	4.00	6.00	2.00	7.00	5.00	8.00	4.00	3.00	9.00	3.00	9.00
% share of total	3.27	4.91	1.63	5.73	4.09	6.55	3.22	2.45	7.73	2.45	7.73
driving on wrong side/Lane indiscipline	7.00	6.00	10.00	8.00	9.00	11.00	8.00	6.00	7.00	5.00	10.00
% share of total	5.73	4.91	8.19	6.55	7.37	9.01	6.55	4.91	5.73	4.09	8.19
Jumping red light	4.00	3.00	2.00	2.00	3.00	5.00	4.00	6.00	3.00	2.00	7.00
% share of total	3.27	2.45	1.63	1.63	2.45	4.09	3.27	4.91	2.45	1.63	5.73
Use of mobile phone	3.00	1.00	2.00	4.00	3.00	5.00	4.00	2.00	3.00	1.00	6.00
% share of total	2.45	0.81	1.63	3.27	2.45	4.09	3.27	1.63	2.45	0.81	4.91
Others	23.00	31.00	35.00	24.00	30.00	25.00	33.00	30.00	32.00	35.00	17.00
% share of total	18.85	25.40	28.68	19.67	24.59	20.49	27.04	24.59	26.22	28.68	13.93
Total	122.00	124.00	127.00	129.00	130.00	133.00	139.00	142.00	144.00	147.00	150.00

Source of Data- S.P Office Panipat to Sonipat.

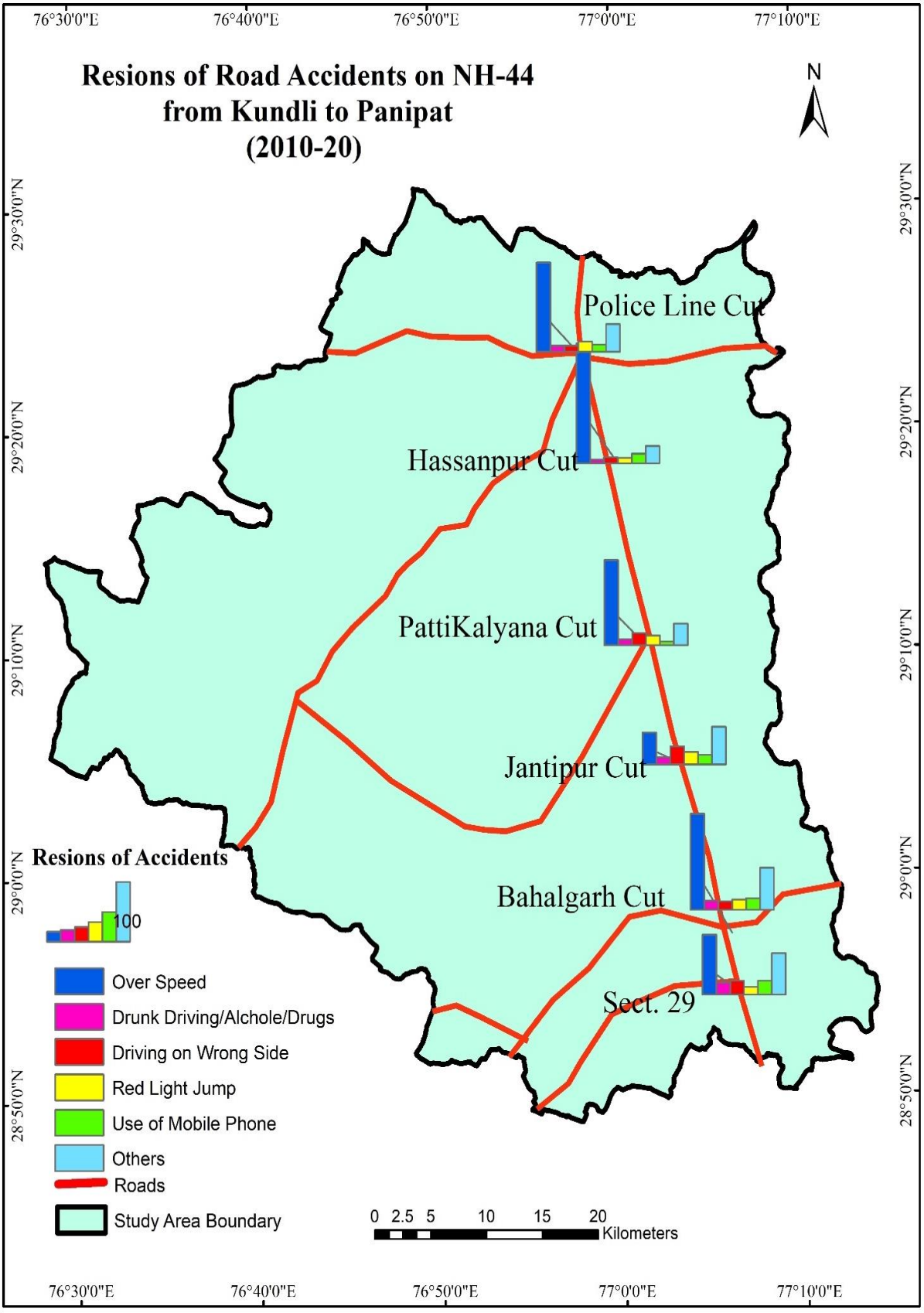


Fig.7.2. Resions behind the Road Accidents on NH-44 at different Blact Spots.

Distributions of road accidents on N.H-44 Kundly to Panipat

When we analysed the accidents data of National Highway-44-month wise accidents scenario shows that minimum 122 accidents occurred in 2010 and maximum accidents 150 2021. The accidents of over speed were 81 in 2010 with the 66.39% and 75 accidents in 2017 with the 61.47%. The accidents due to use of alcohol or drugs were minimums 2 (1.63%) in the year 2012 and maximum 9 in 2020 with the percentage 7.73% and minimum 2 cases in 2012 with percentage 1.63%.The maximum cases of wrong sides accidents 11 in the year 2015 (9.01%) and minimum 05 accidents in the year 2017 with the percentage of 4.09%.

Jumping the red-light maximum cases were 07 in the year 2020 with 5.73% and minimum in 02, 02, 02 cases the year 2012, 2013, 2019 respectively. The minimum 1, 1 accident occurred in the year 2011 and 2019 with percentage 0.81 and maximum 6 cases in 2020 (4.91). 5.73. The other causes of road accidents maximum 35, 35 in the year 2012 and 2019 and minimum 17 in the year 2020 with the percentage of 13.09%.

The main purpose of Questionnaire to obtain more and more information regarding road accidents, causes, drivers behaviours, public opinion. The questionnaire study was conducted on N.H-44 and total random sample 350 in which data collected from traffic police, Home guards, divers, road side shop keeper and general public. The results of questionnaire are following .

Table- 7.3 show Age wise Driver percentage and frequencies.

Age		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18-25 years	105	30.0	30.0	30.0
	25-40 years	75	21.4	21.4	51.4
	40-60 years	105	30.0	30.0	81.4
	Above 60 years	65	18.6	18.6	100.0
	Total	**350**	**100.0**	**100.0**	

Source: Data acquired through field survey and question schedule

Fig.7.3 Shows age and frequncy of accidents.

Based on the study, the graph and table above show the sample data, which consists of 350 respondents. When the topic of "Age" was raised, 105 respondents (30%) said they were 18–25 years old, 75 respondents (21.4%) said they were 25–40 years old, 105 respondents (30%) said they were 40–60 years old, and 65 respondents (18.6%) said they were above 60.

Table -7.4 Education level of accidental people.

		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Illiterate	45	12.9	12.9	12.9
	Primary	90	25.7	25.7	38.6
	Matric	55	15.7	15.7	54.3
	Secondary	60	17.1	17.1	71.4
	Graduate	35	10.0	10.0	81.4
	Post Graduate	35	10.0	10.0	91.4
	Professional	30	8.6	8.6	100.0
	Total	**350**	**100.0**	**100.0**	

Source: Data acquired through field survey and question schedule

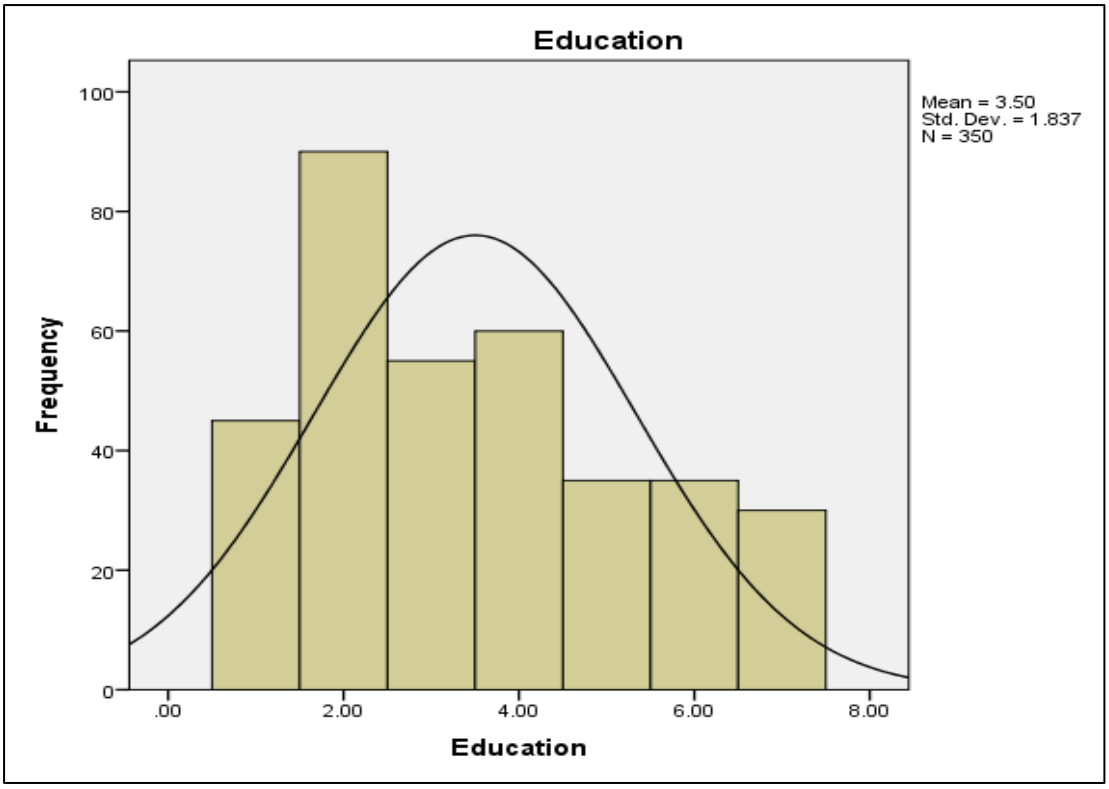


Fig.7.4. Shows education and accident frequecy.

According to the study, both the table and graph above show the sample data, which consists of 350 respondents. "Education" was the topic of conversation. Of the respondents, 45(12.9%) said they were illiterate, 90(25.7%) said they were primary, 55(15.7%) said they were matriculated, 60(17.1%) said they were secondary, and 35(10%) said they were graduate.

Table-7.5 Types Vehicle based on number of wheels driven by people.

		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Two Wheelers	120	34.3	34.3	34.3
	Three Wheelers	60	17.1	17.1	51.4
	Four Wheelers	100	28.6	28.6	80.0
	Heavy Vehicles	70	20.0	20.0	100.0
	Total	**350**	**100.0**	**100.0**	

Source: Data acquired through field survey and question schedule

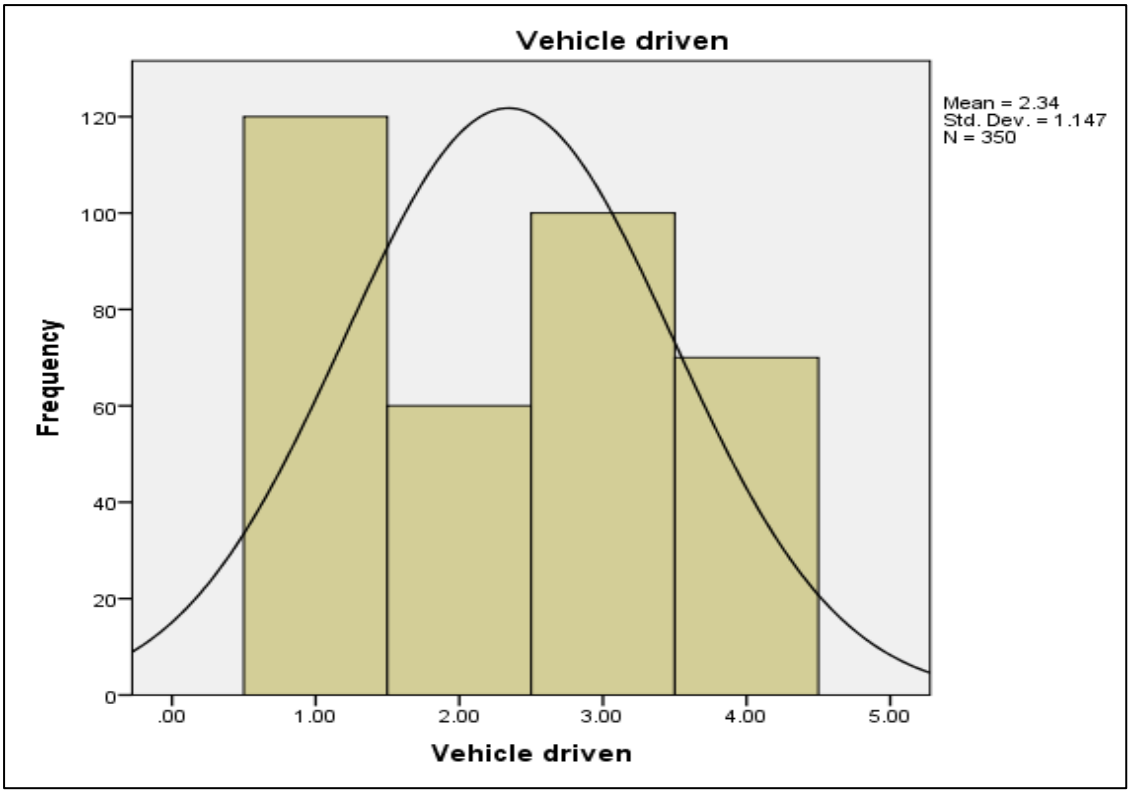


Fig.7.5. Shows vehicle driven and frequency.

With the support of the graph and table above, which show the sample data including 350 respondents, it was observed from the analysis. The topic of "vehicle driven" was discussed. 120 respondents, or 34.3%, replied 60 people, or 17.1%, replied about two wheelers. 100 responses, or 28.6%, and three wheelers replied. Four-wheelers, compared to heavy vehicles, which 70 respondents (20%) said.

Table- 7.6 Have you undergone driving Training?

		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Yes	180	51.4	51.4	51.4
	No	170	48.6	48.6	100.0
	Total	**350**	**100.0**	**100.0**	

Source: Data acquired through field survey and question schedule

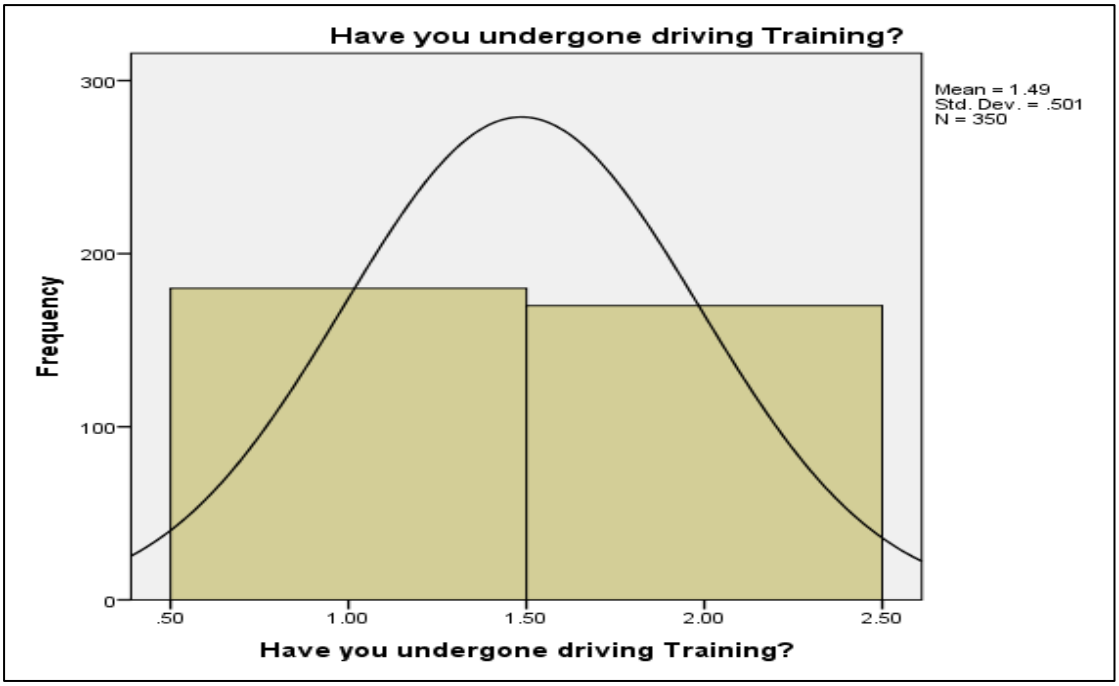


Fig.7.6.Show driving training and frequency.

The following graph and table, which show the sample data that comprises 350 tourist respondents, were used to aid with the study. When the question "Have you undergone driving training?" was raised, 180 respondents (51.4%) said "Yes," while 170 respondents (48.6%) said "No."

Table- 7.7 Which time did you observe the maximum traffic congestion at this road?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	6:00 AM	70	20.0	20.0	20.0
	10:00 AM	70	20.0	20.0	40.0
	2:00 PM	85	24.3	24.3	64.3
	6:00 PM	55	15.7	15.7	80.0
	10:00 PM	70	20.0	20.0	100.0
	Total	350	100.0	100.0	

Source: Data acquired through field survey and question schedule

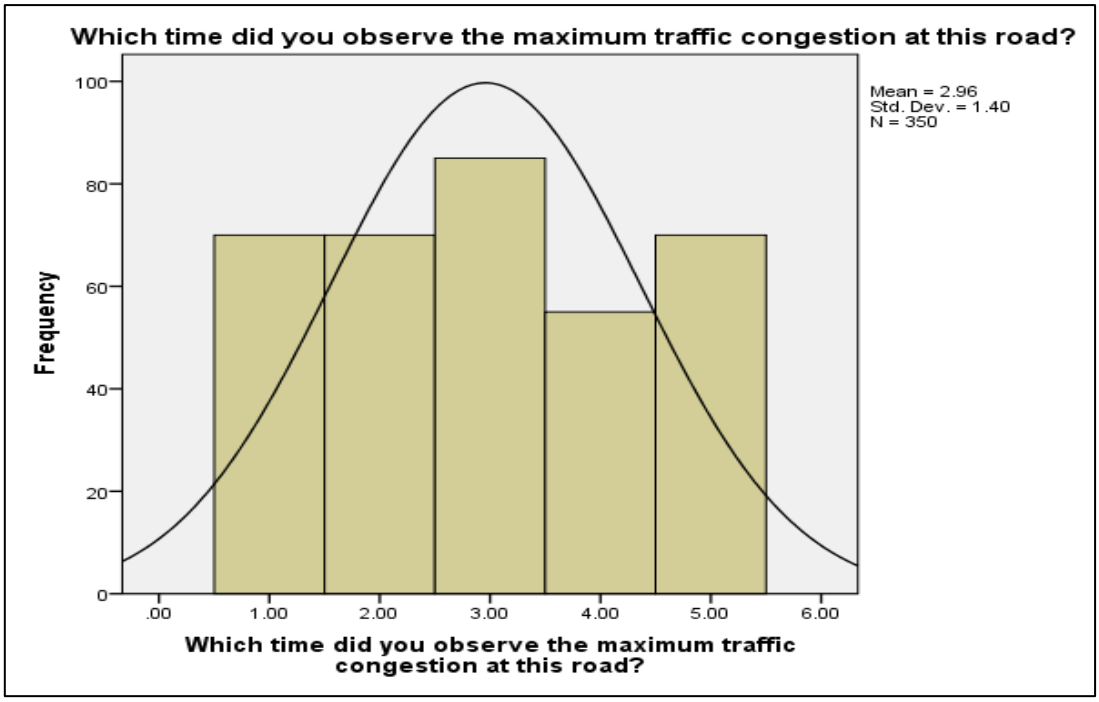


Fig. 7.7. Shows maximumtraffic congestion at the road.

From the analysis both the table and graph aboveit was observed that the show the sample data including 350 respondents, it was observed from the analysis. "Which time did you observe the maximum traffic congestion at this road?" was the topic of discussion. Twenty percent of the respondents gave a response of 0.25, twenty percent gave a response of 0.41, twenty-five percent gave a response of 0.583, fifteen percent gave a response of 0.75, and twenty percent gave a response of 0.916.

Table-7.8 Factors involving accident: Driver

		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Strongly Agree	4	1.1	1.1	1.1
	Agree	20	5.7	5.7	6.9
	No Idea	301	86.0	86.0	92.9
	Disagree	4	1.1	1.1	94.0
	Strongly Disagree	21	6.0	6.0	100.0
	Total	**350**	**100.0**	**100.0**	

Source: Data acquired through field survey and question schedule

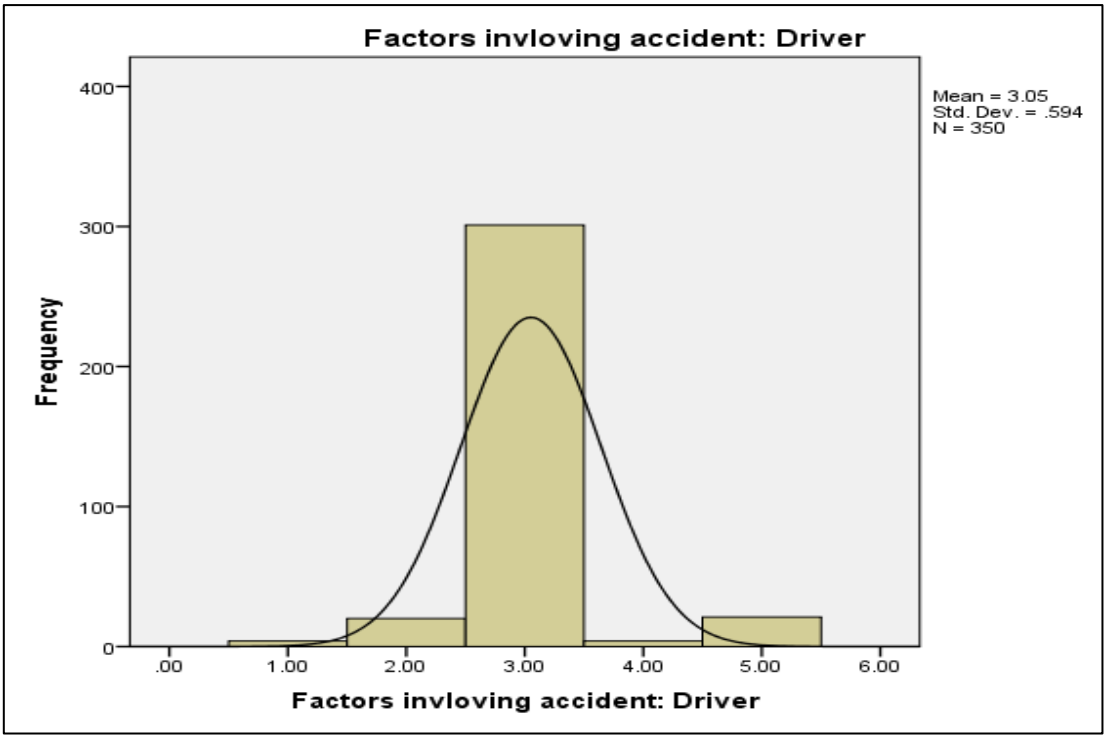


Fig.7.8 Shows factors involving accident: Driver.

According to our study, the information presented in the above graph and table indicates that the sample data includes around 350 respondents. "Driver is one of the accident's factors." 4 (1.1%) of the respondents gave a response. firmly 20 (5.7%) of the respondents said they agreed. 301 (86%) of the respondents said they agreed. 21(6%) respondents said they had no idea, 4(1.1%) said they disagreed, and firmly Contrary to.

Table -7.9 Factors involving accident: Road Conditions

		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Strongly Agree	11	3.1	3.1	3.1
	Agree	91	26.0	26.0	29.1
	No Idea	184	52.6	52.6	81.7
	Disagree	59	16.9	16.9	98.6
	Strongly Disagree	5	1.4	1.4	100.0
	Total	**350**	**100.0**	**100.0**	

Source: Data acquired through field survey and question schedule

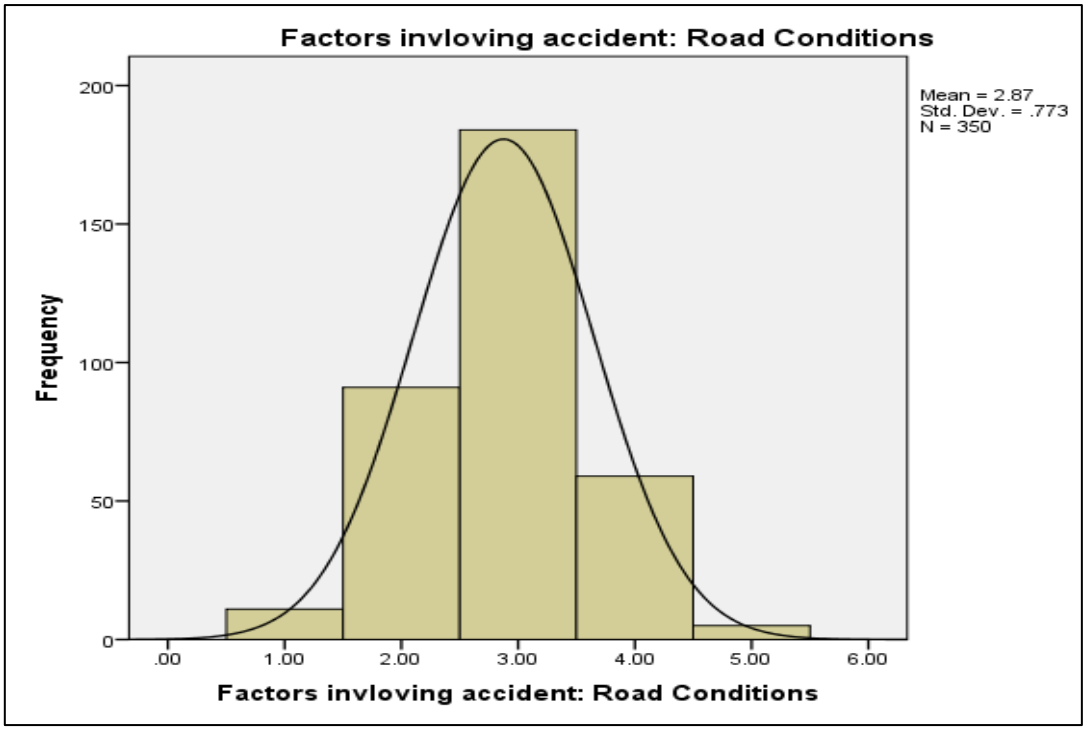


Fig. 7.9. Show factor involving accident: Road conditions.

In accordance with our study, the information displayed in the above graph and table indicates that the sample data includes around 350 respondents. When asked "Factors involving accident: Road Conditions," 11(3.1%) respondents said they strongly agreed, 91(26%) said they agreed, 184(52.6%) said they had no idea, 59(16.9%) said they disagreed, and 5(1.4%) said they strongly disagreed.

Table 7.10 Factors involving accident: Vehicles

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	8	2.3	2.3	2.3
	Agree	59	16.9	16.9	19.1
	No Idea	203	58.0	58.0	77.1
	Disagree	69	19.7	19.7	96.9
	Strongly Disagree	11	3.1	3.1	100.0
	Total	350	100.0	100.0	

Source: Data acquired through field survey and question schedule

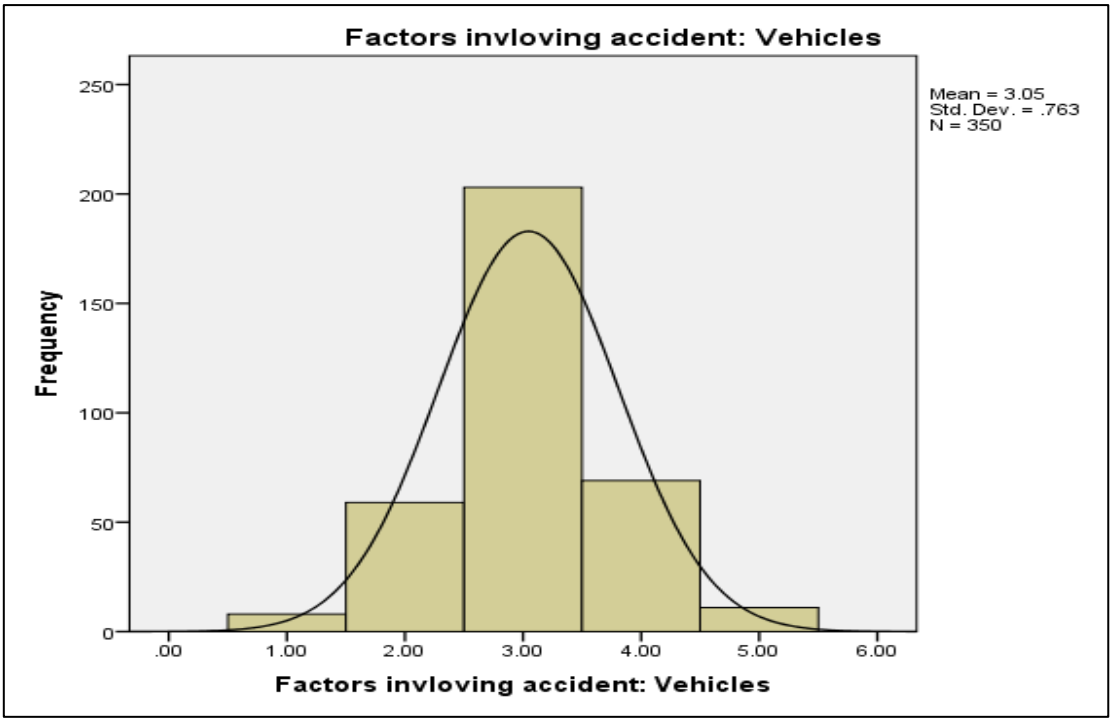


Fig. 7.10. Shows Factor involving accident:Vehicles.

From the results of our research, the information presented in the above graph and table indicates that the sample data includes around 350 respondents. "Vehicles: A factor in accidents" Eight(2.3%) respondents said they strongly agreed, 59(16.9%) said they agreed, 203(58%) said they had no idea, 69(19.7%) said they disagreed, and 11(3.1%) said they strongly disagreed.

Table -7.11 Factors involving accident: Weather Conditions

		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Strongly Agree	5	1.4	1.4	1.4
	Agree	103	29.4	29.4	30.9
	No Idea	178	50.9	50.9	81.7
	Disagree	53	15.1	15.1	96.9
	Strongly Disagree	11	3.1	3.1	100.0
	Total	**350**	**100.0**	**100.0**	

Source: Data acquired through field survey and question schedule

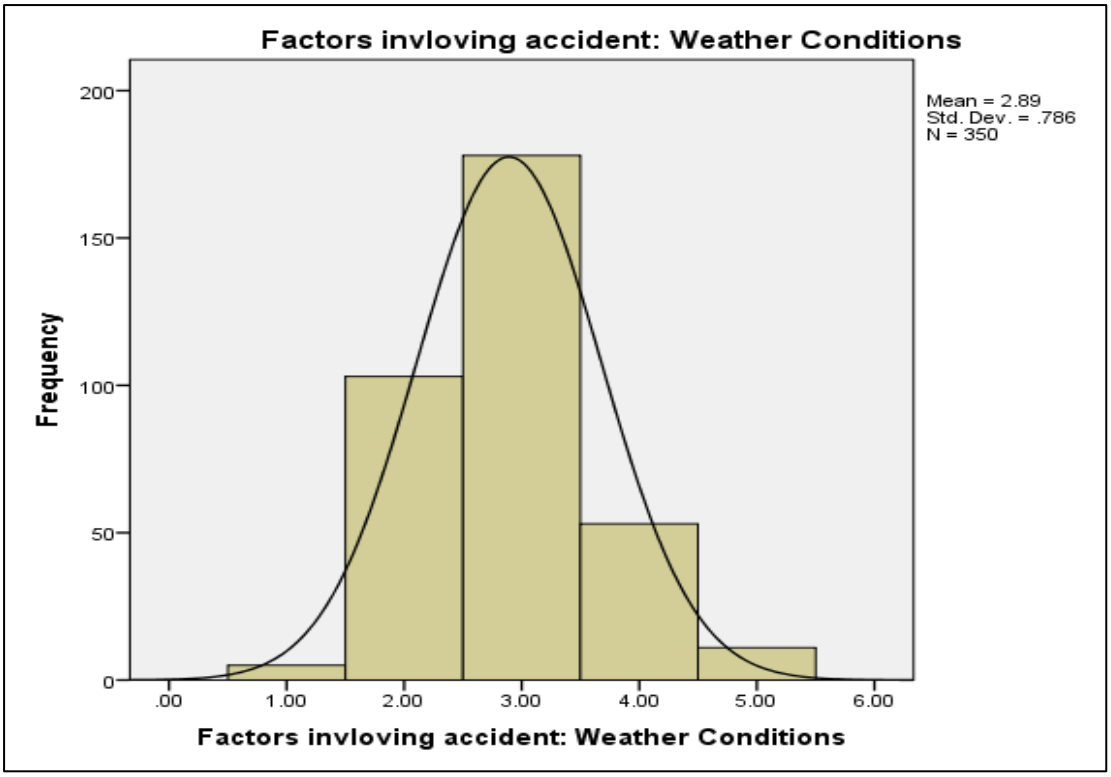


Fig. 7.11. Shows factors involving accident:weather conditions.

Based on our study, the information presented in the above graph and table indicates that the sample data includes around 350 respondents. "Weather conditions are a contributing factor in accidents," 5 (1.4%) respondents strongly agreed. Agree was the response from 103 respondents (29.4%), followed by No Idea from 178 respondents (50.9%), Disagree from 53 respondents (15.1%), and Strongly Disagree from 11 respondents (3.1%).

Table-7.12 Factors involving accident: Pedestrian

		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Strongly Agree	5	1.4	1.4	1.4
	Agree	65	18.6	18.6	20.0
	No Idea	170	48.6	48.6	68.6
	Disagree	95	27.1	27.1	95.7
	Strongly Disagree	15	4.3	4.3	100.0
	Total	**350**	**100.0**	**100.0**	

Source: Data acquired through field survey and question schedule

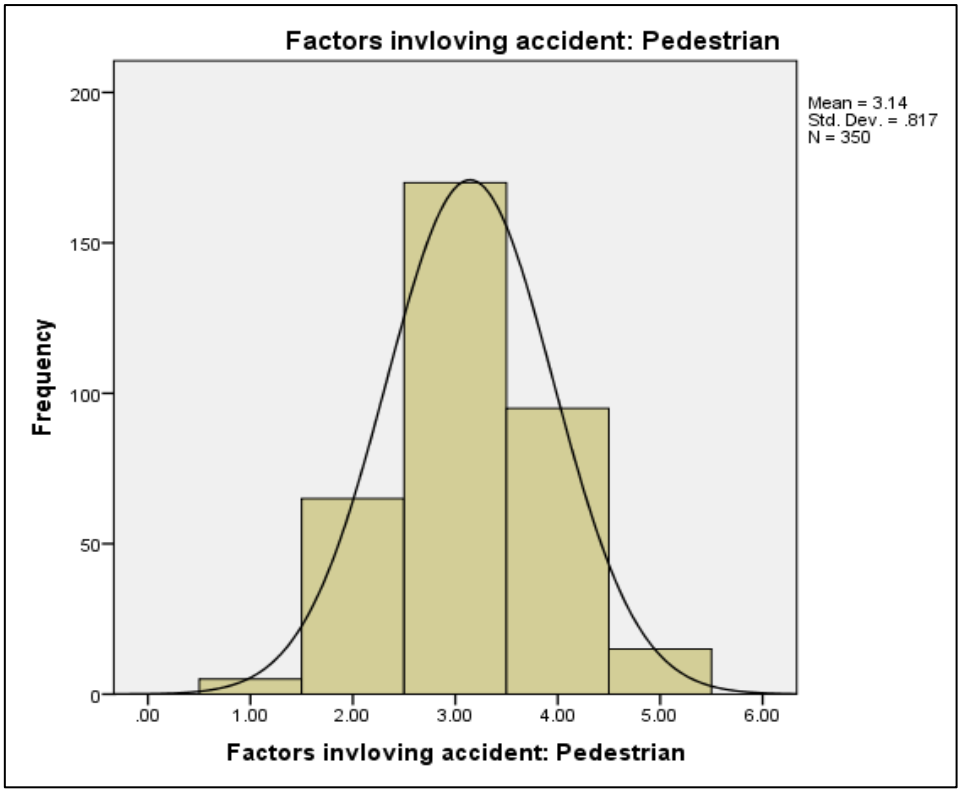


Fig.7.12. Shows factors involving accident:Pedestrian

Based on our study, the evidence presented in the above graph and table indicates that the sample data includes around 350 respondents.5 (1.4%) respondents strongly agreed, 65 (18.6%) respondents agreed, 170 (486.6%) respondents said they had no idea, 95 (27.1%) respondents disagreed, and 15 (4.3%) respondents strongly disagreed with the statement "Factors involving accident: Pedestrian.

Table -7.13 Sactors involving accident: Government Actions

		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Strongly Agree	8	2.3	2.3	2.3
	Agree	66	18.9	18.9	21.1
	No Idea	219	62.6	62.6	83.7
	Disagree	47	13.4	13.4	97.1
	Strongly Disagree	10	2.9	2.9	100.0
	Total	**350**	**100.0**	**100.0**	

Source: Data acquired through field survey and question schedule

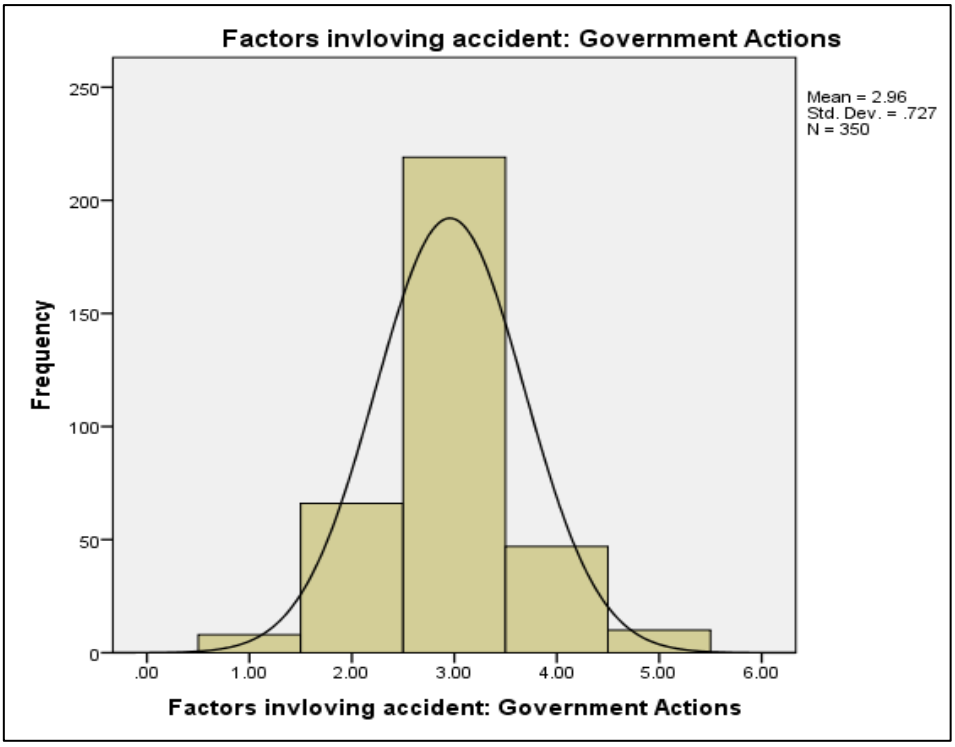


Fig. 7.13.Shows factors involving accident:Government actions.

According to our study, the details presented in the above graph and table indicates that the sample data includes around 350 respondents. “Factors involving accident: Government Actions" Eight(2.3%) respondents said they strongly agreed, 66(18.9%) said they agreed, 219(62.6%) said they had no idea, 47(13.4%) said they disagreed, and 10(2.9%) said they strongly disagreed.

Table-7.14 Specify the reasons according to you for road traffic accidents in your location:

		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Over Speeding	12	24.0	24.0	24.0
	Drunken Driving	8	16.0	16.0	40.0
	Distraction to Driver	11	22.0	22.0	62.0
	Red Light jumping	10	20.0	20.0	82.0
	Others	9	18.0	18.0	100.0
	Total	**50**	**100.0**	**100.0**	

Source: Data acquired through field survey and question schedule

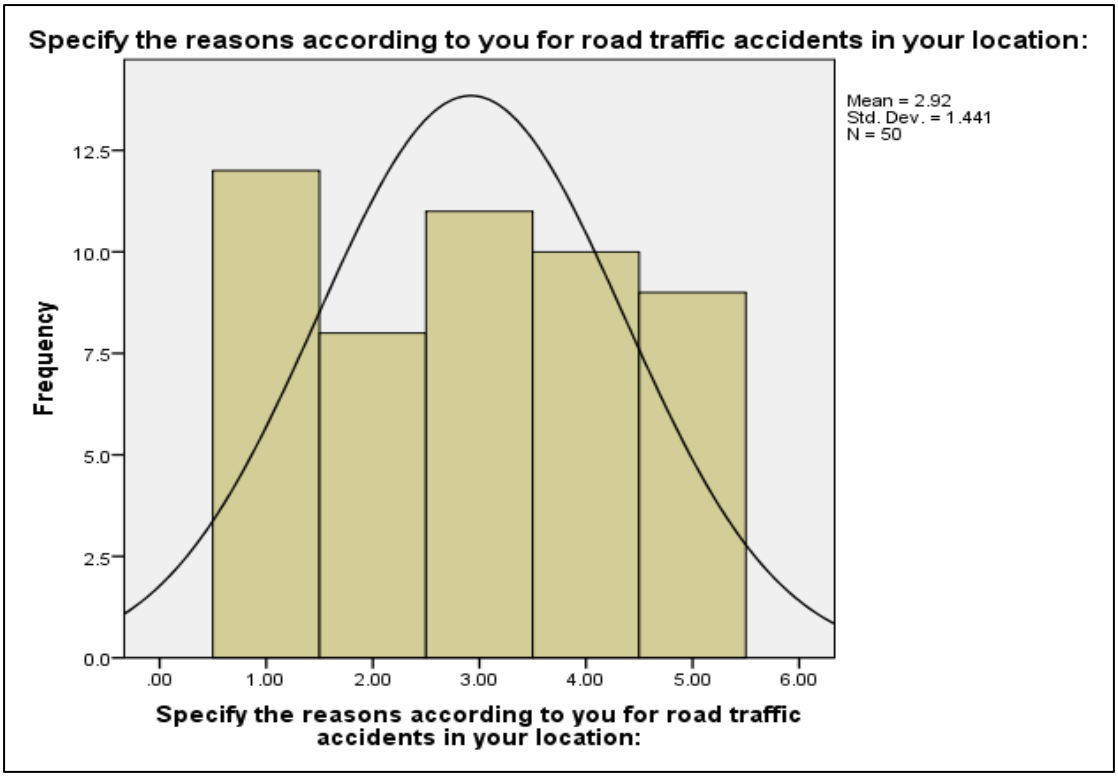


Fig. 7.14. Shows traffic accidents in specific location.

With the help of the graph and table above, which show the sample data of 50 respondents, it was noted from the analysis. "Specify the reasons according to you for road traffic accidents in your location:" was the topic of discussion. Twelve respondents (24%) said they were overspeeding, eight (16%) said they were driving while intoxicated, eleven (22%), said they were distracted from their driving, ten (20%) said they were jumping red lights, and nine (18%) said they were responding to other questions.

Table-7.15 Do you observe traffic congestion in your duty location?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	30	60.0	60.0	60.0
	No	20	40.0	40.0	100.0
	Total	50	100.0	100.0	

Source: Data acquired through field survey and question schedule

Graph-7.15

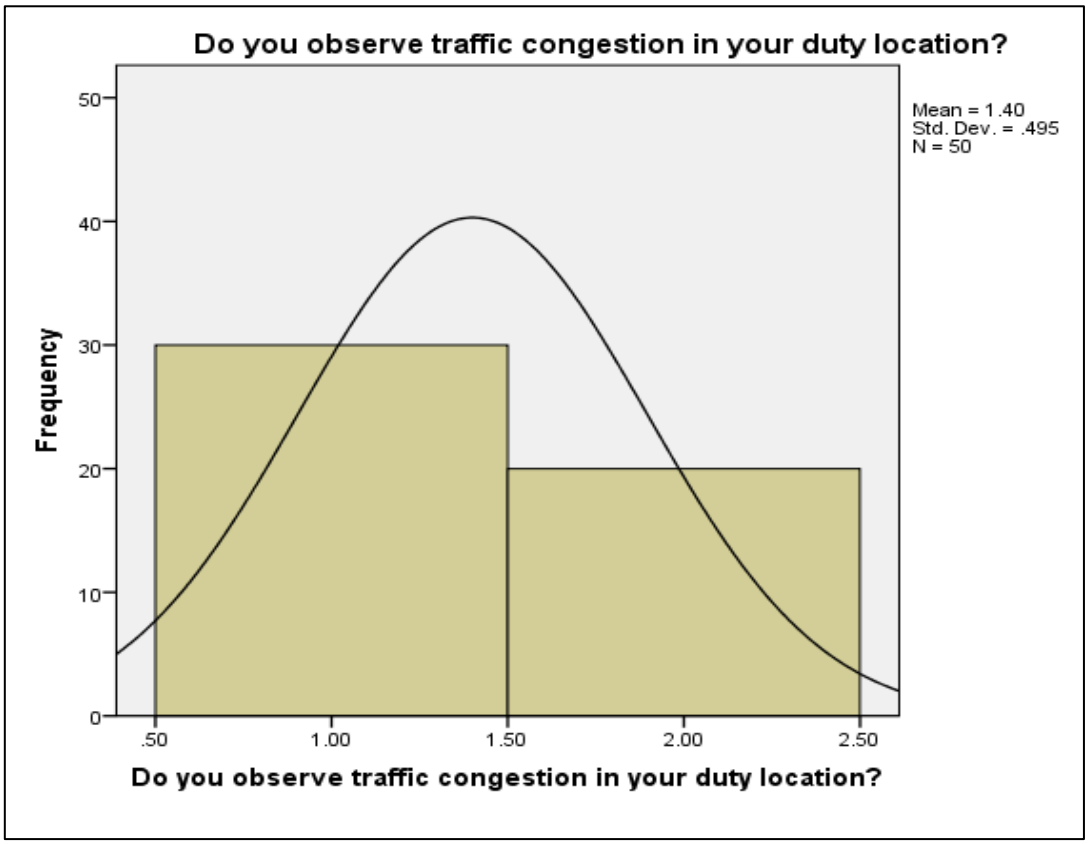


Fig.7.15. Shows traffic congestion in duty location.

With the help of the graph and table above, which show the sample data of 50 respondents, it was noted from the analysis. When the question, "Do you observe traffic congestion in your duty location?" was posed, 30 (or 60%) of the respondents said "yes," while 20 (or 40%) said "no."

Table-7.16 Specify the timing you observed HIGH traffic congestion?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	6:00 AM	14	28.0	28.0	28.0
	10:00 AM	12	24.0	24.0	52.0
	4:00 PM	11	22.0	22.0	74.0
	8:00 PM	13	26.0	26.0	100.0
	Total	**50**	**100.0**	**100.0**	

Source: Data acquired through field survey and question schedule

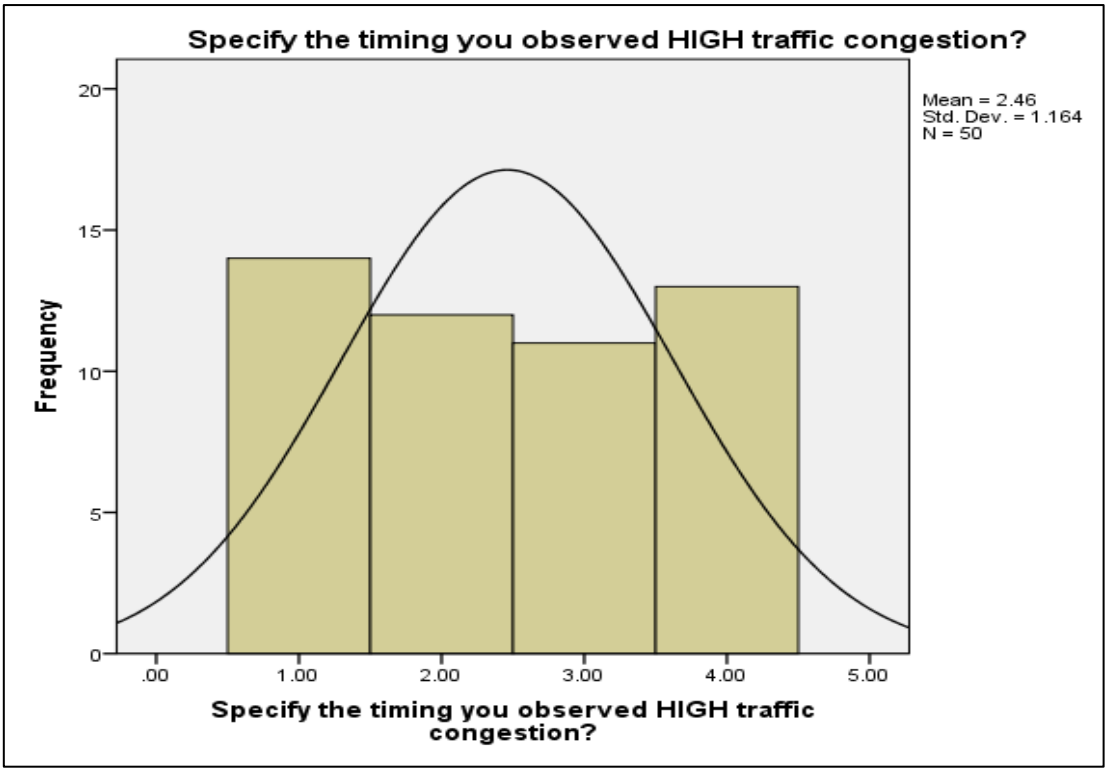


Fig. 7.16. Shows specify the timing you observed high traffic congestion.

From the analysis as discussed randomly with people as respondents, we observed their opinions and the details mentioned in the above graph and table is concerned about 50 respondents. It was observed about "Specify the timing you observed HIGH traffic congestion?" 14(28%) respondents responded 0.25, 12(24%) respondents responded 0.416666666666667 and 11(22%) respondents responded 0.666666666666667 whereas 13(26%) respondents responded 0.833333333333333.

Table-7.17 How many traffic signals in your duty location:

		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Less than 5	11	22.0	22.0	22.0
	5 to 10	15	30.0	30.0	52.0
	More than 10	24	48.0	48.0	100.0
	Total	**50**	**100.0**	**100.0**	

Source: Data acquired through field survey and question schedule

Graph-7.17

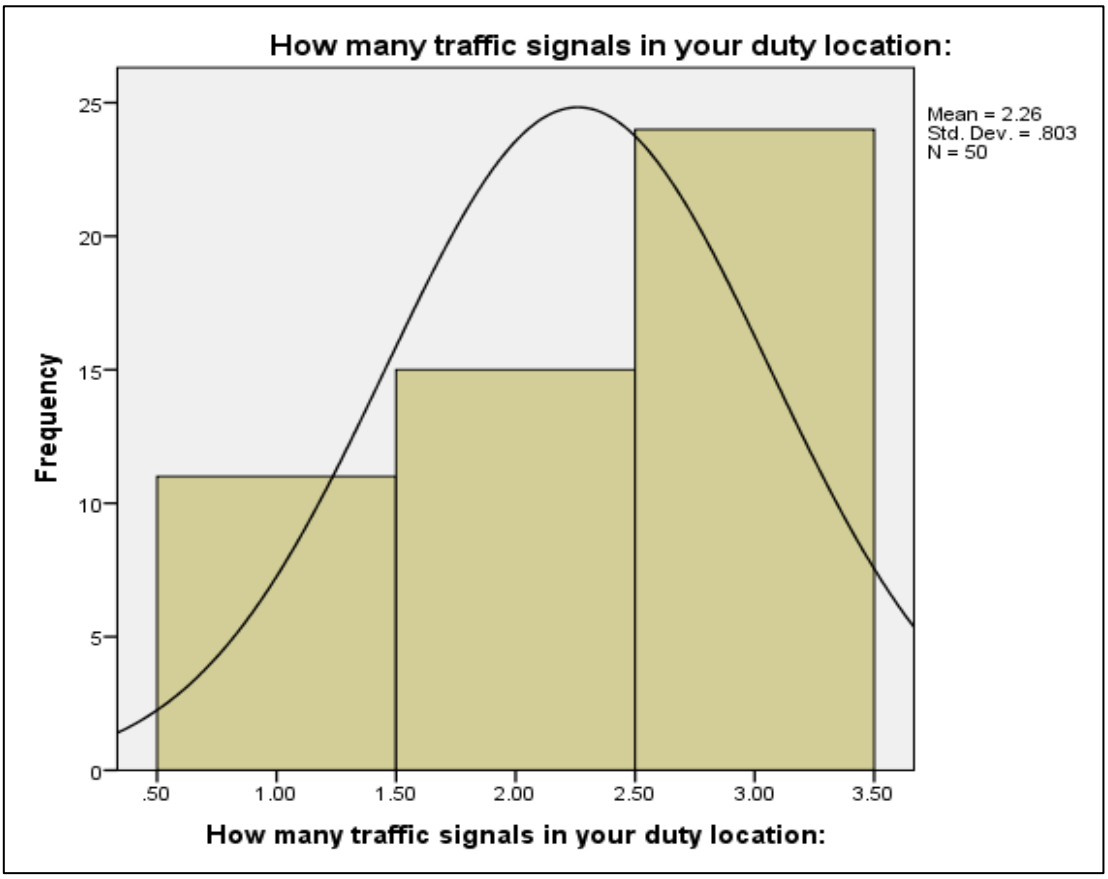


Fig. 7.17. Show how many traffic signals in duty location.

Through the help of the graph and table above, which show the sample data of 50 respondents, it was noted from the analysis. "How many traffic signals in your duty location:" was the topic of discussion. Twenty-four (22%), fifteen (30%), and twenty-four (48%), of the respondents said they were less than five, five to ten, and more than ten.

Tale-7.18 Are all the traffic signals in your duty locations working

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	32	64.0	64.0	64.0
	No	18	36.0	36.0	100.0
	Total	**50**	**100.0**	**100.0**	

Source: Data acquired through field survey and question schedule

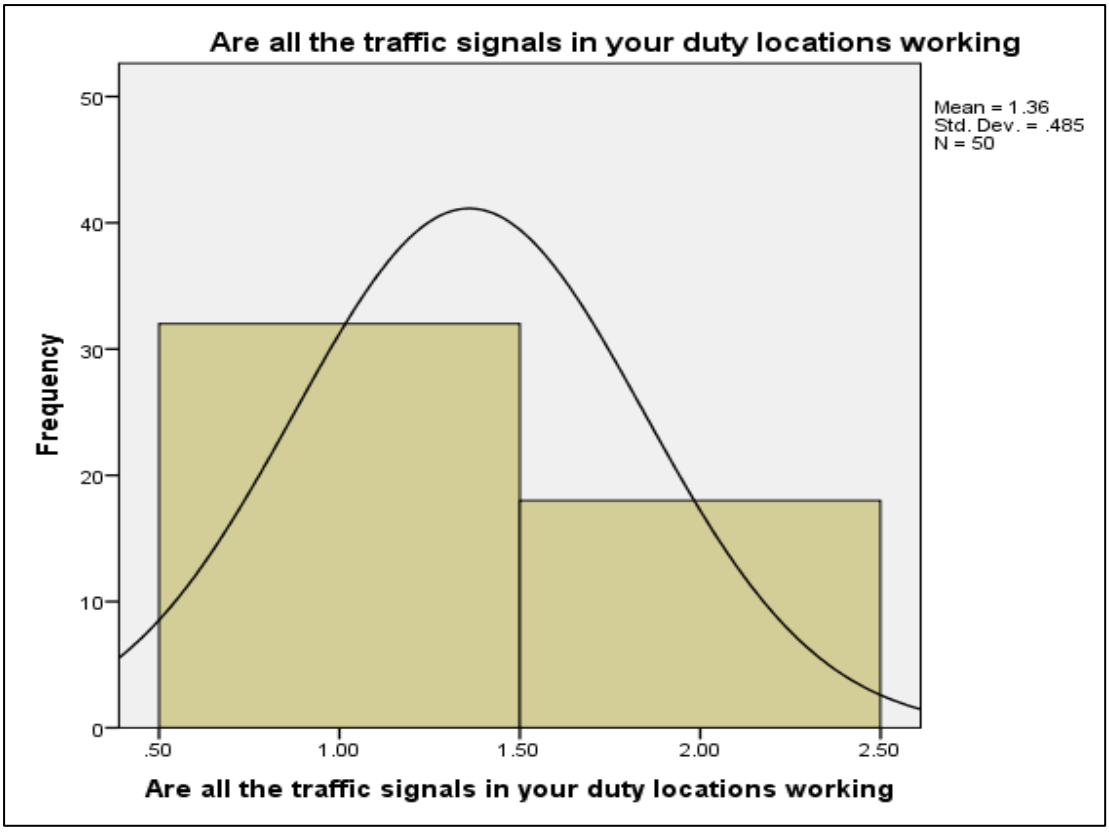


Fig. 7.18. Shows traffic signals in duty locations working.

From the analysis it was observed with the help of graph and table that the sample data of 50 respondents, it was noted from the analysis. When the question, "Are all the traffic signals in your duty locations working?" was posed, 32 (64%) of the respondents said "Yes," while 18 (36%) said "No."

Table-7.19 Factors Involving Accidents: Road Conditions

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	8	8.0	8.0	8.0
	Agree	9	9.0	9.0	17.0
	No Idea	63	63.0	63.0	80.0
	Disagree	13	13.0	13.0	93.0
	Strongly Disagree	7	7.0	7.0	100.0
	Total	**100**	**100.0**	**100.0**	

Source: Data acquired through field survey and question schedule

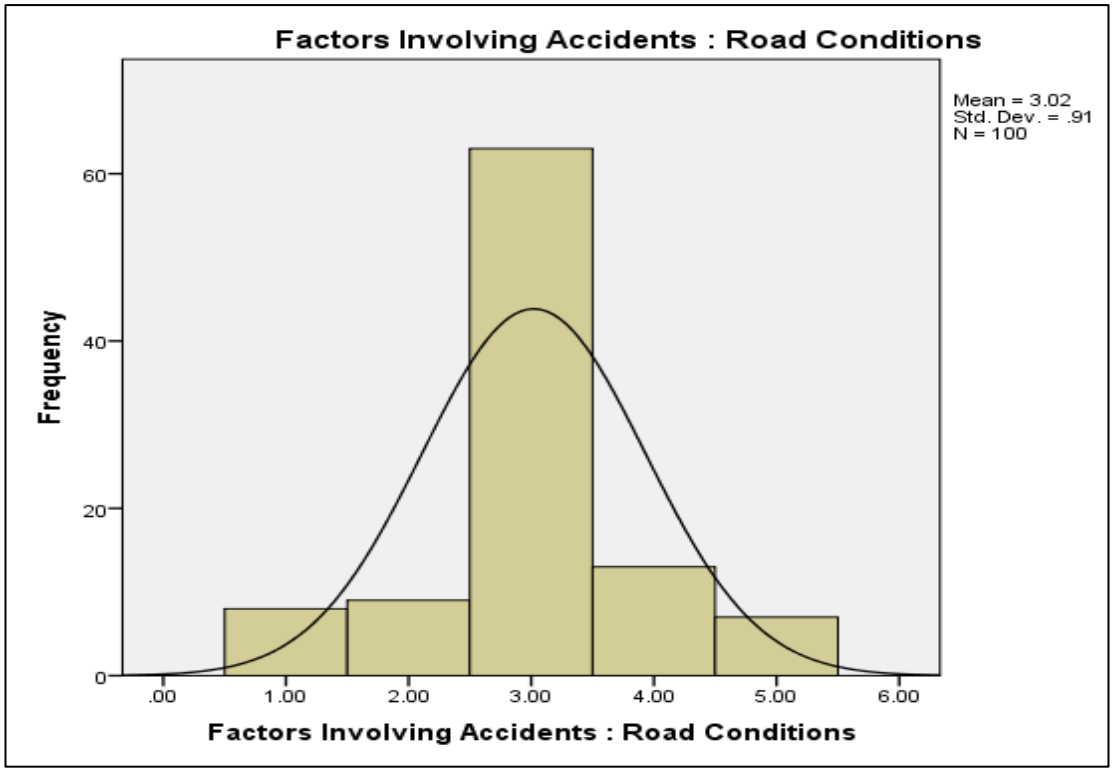


Fig. 7.19. Shows factors involving accidents:Road conditions.

Based on our study, the information presented in the above graph and table indicates that the sample data includes around 100 respondents. "Factors Involving Accidents : Road Conditions" Eight(8%) respondents said they strongly agreed, nine(9%) said they agreed, sixty-three(63%) said they had no idea, thirteen(13%) said they disagreed, and seven(7%) said they strongly disagreed.

Table -7.20 Factors Involving Accidents: Vehicle

		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Strongly Agree	7	7.0	7.0	7.0
	Agree	20	20.0	20.0	27.0
	No Idea	47	47.0	47.0	74.0
	Disagree	19	19.0	19.0	93.0
	Strongly Disagree	7	7.0	7.0	100.0
	Total	**100**	**100.0**	**100.0**	

Source: Data acquired through field survey and question schedule.

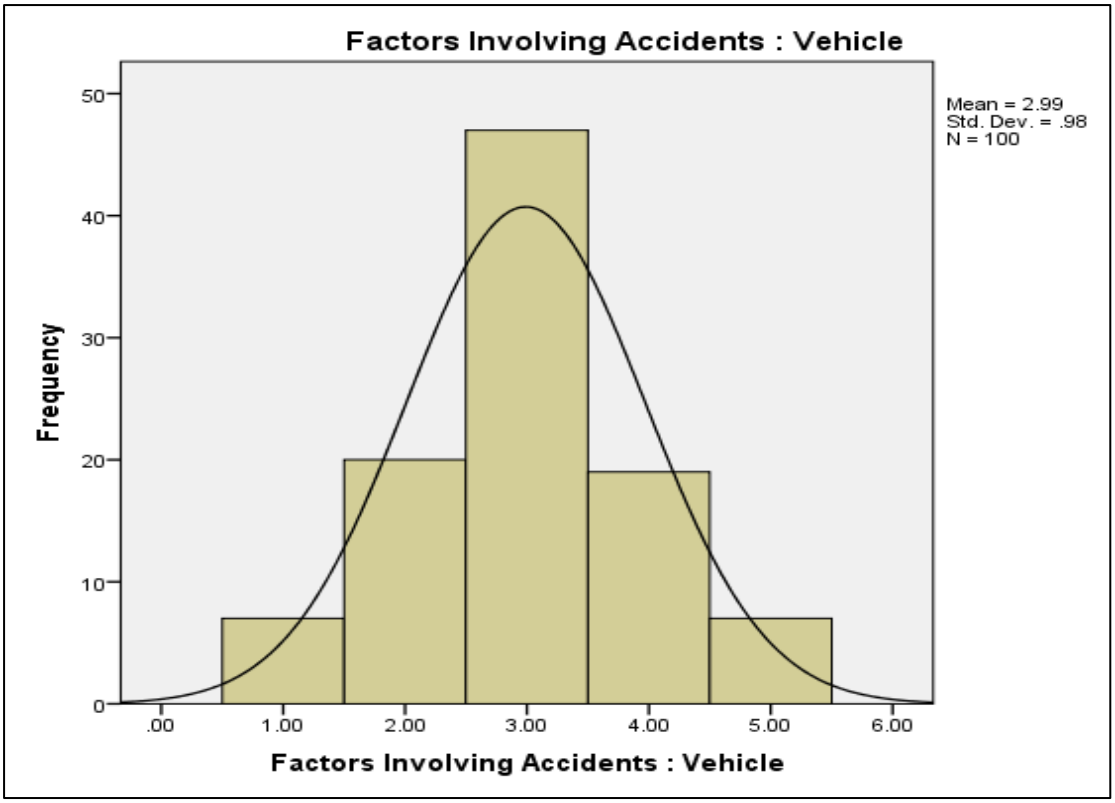


Fig.7.20. Shows factors involving accidents: vehicle.

Based on our study, the information presented in the above graph and table indicates that the sample data includes around 100 respondents. "Factors Involving Accidents : Vehicle" Seven percent of respondents said they strongly agreed, twenty percent said they agreed, forty-seven percent said they had no idea, nineteen percent said they disagreed, and seven percent said they strongly disagreed.

Table-7.21 Factors Involving Accidents: Weather Conditions

		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Strongly Agree	7	7.0	7.0	7.0
	Agree	29	29.0	29.0	36.0
	No Idea	48	48.0	48.0	84.0
	Disagree	10	10.0	10.0	94.0
	Strongly Disagree	6	6.0	6.0	100.0
	Total	**100**	**100.0**	**100.0**	

Source: Data acquired through field survey and question schedule

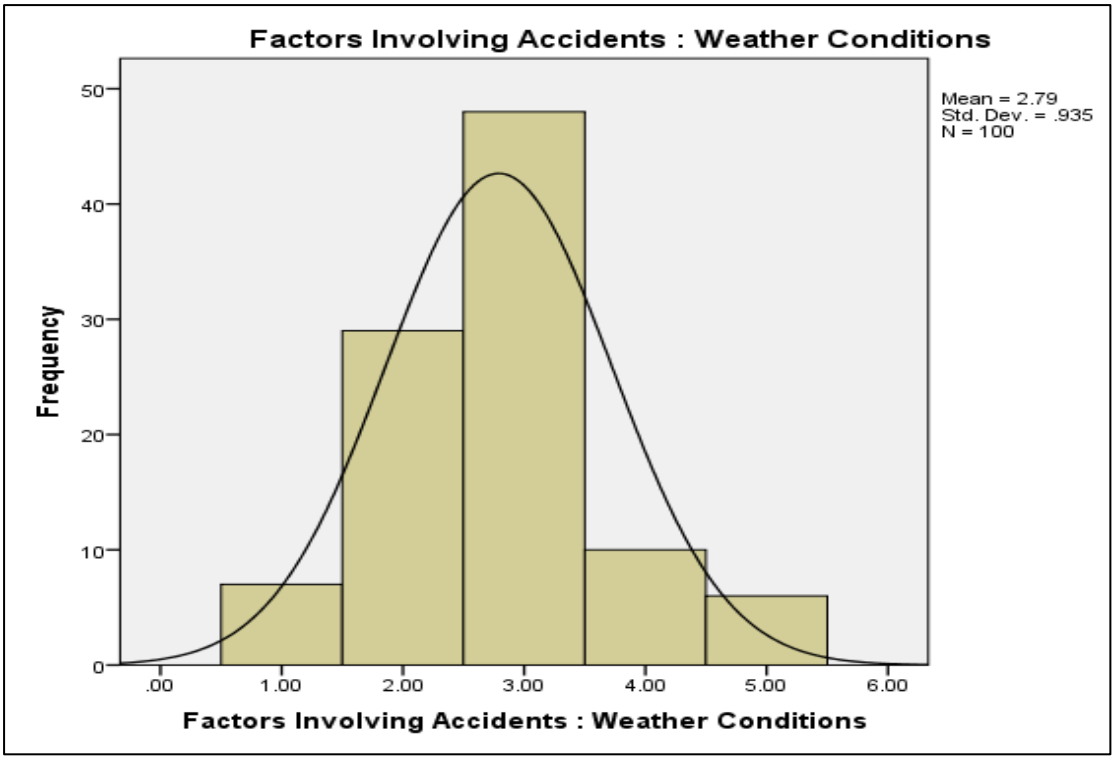


Fig. 7.21. Shows factors involving accidents: weather conditions.

In accordance with our study, the details provided by the above graph and table indicates that the sample data includes around 100 respondents. "Weather Conditions: A Factor in Accidents" Seven percent of respondents said they strongly agreed, twenty-nine percent said they agreed, forty-eight percent said they had no idea, ten percent said they disagreed, and six percent said they strongly disagreed.

Table-7.22 Factors Involving Accidents: Pedestrians

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	2	2.0	2.0	2.0
	Agree	28	28.0	28.0	30.0
	No Idea	52	52.0	52.0	82.0
	Disagree	11	11.0	11.0	93.0
	Strongly Disagree	7	7.0	7.0	100.0
	Total	100	100.0	100.0	

Source: Data acquired through field survey and question schedule.

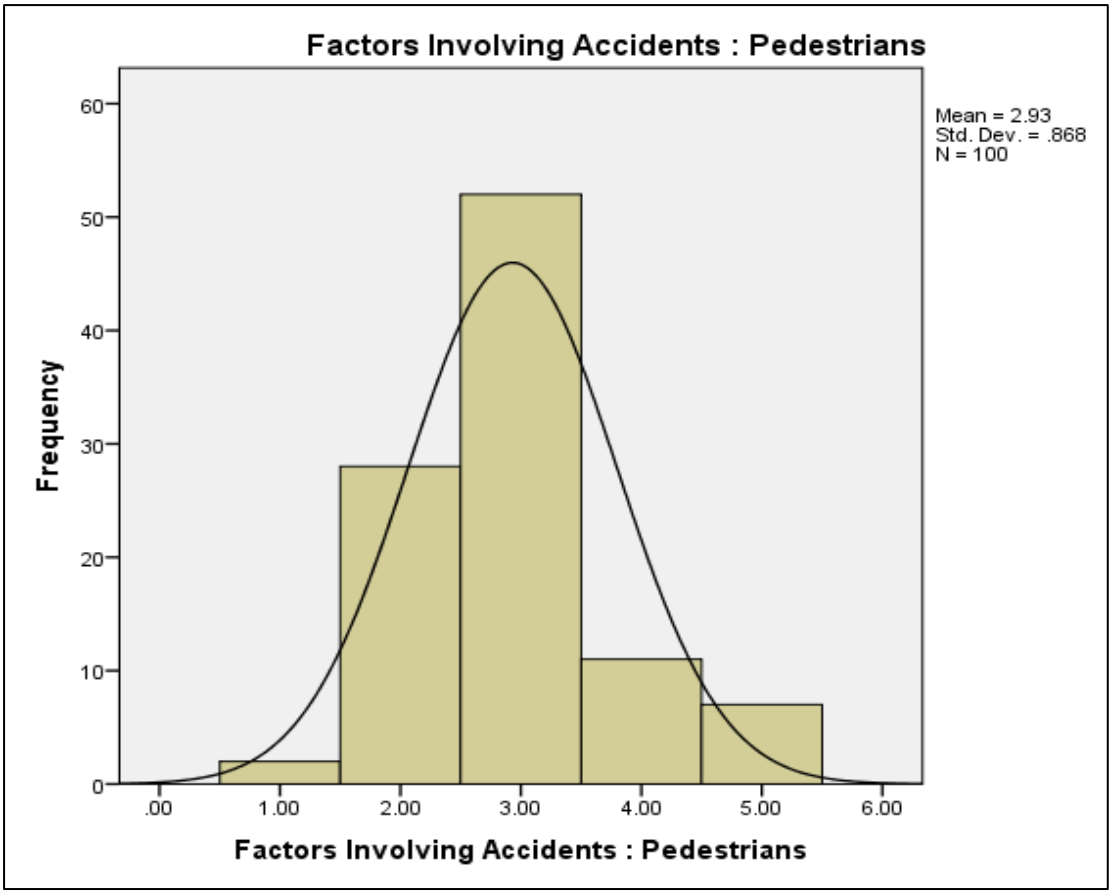


Fig. 7.22.Shows factors involving accidents:pedestrians.

From the results of our study, the evidence presented in the above graph and table indicates that the sample data includes around 100 respondents. “Factors Involving Accidents : Pedestrians" 52 respondents said they had no idea, 2 respondents said they strongly agreed, 28 respondents said they agreed, 11 respondents said they disagreed, and 7 respondents said they strongly disagreed.

Table -7.23 Do you follow the road signs and signal?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	190	54.3	54.3	54.3
	No	160	45.7	45.7	100.0
	Total	**350**	**100.0**	**100.0**	

Source: dAta acquired through field survey and question schedule

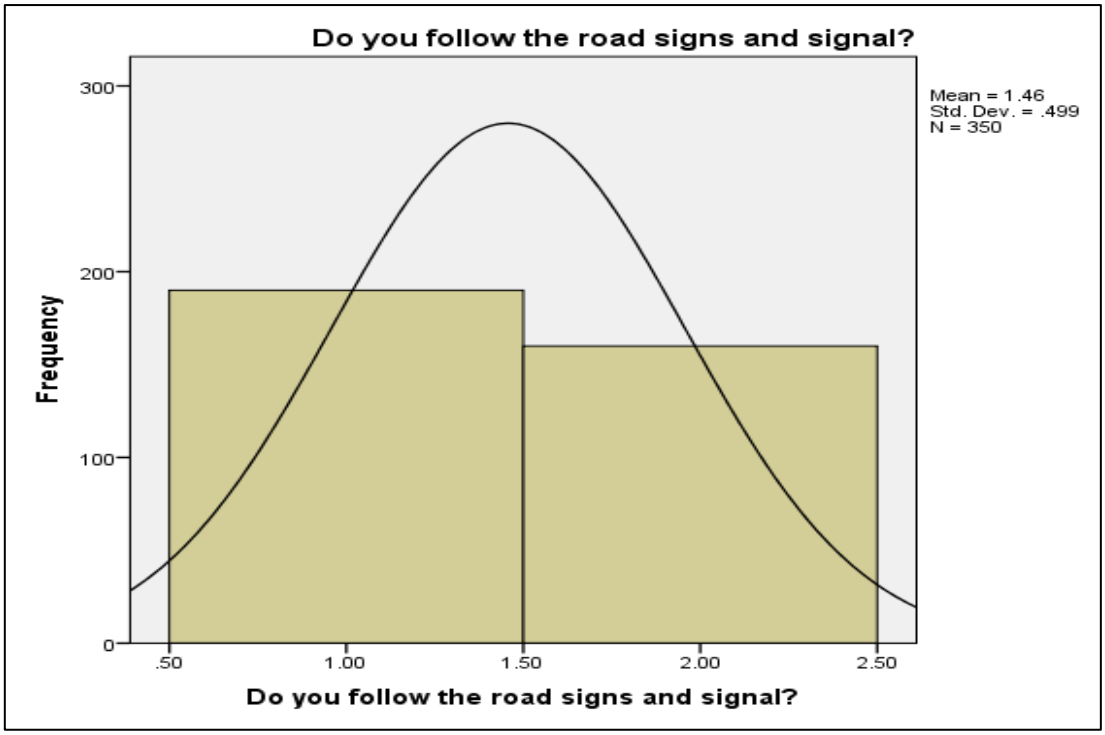


Fig. 7.23. Shows follow the road signs and signal.

The following graph and table, which show the sample data that comprises 350 tourist respondents, were used to aid with the study. When the question "Do you follow the road signs and signals?" was put out, 190 respondents (or 54.3% of the sample) said "yes," whereas 160 respondents (or 45.7%) said "no." Red light jumping was answered by 10(20%) respondents as distraction to the driver, and 9(18%) respondents as

Spatial Analysis of Road Accidents

There are substantial societal expenses associated with road users, such as increased congestion and the frequency of automotive accidents. Everyone who uses the roads eventually pays the price for traffic congestion: less mobility, worse quality of life, and wasted time and money. The financial stability of many individuals has taken a hit because of road accidents. Everyone from victims and their families to the general public is a part of this. Reducing the societal costs of accidents and traffic jams should be a top priority. It would be ideal if we could simultaneously decrease both, but because traffic and road safety are likely inversely related, that may not be possible. According to the hypothesis put forward by Shefer and Rietveld, the typical traffic speed would be greater on a congestion-free road system, which in turn would increase the probability of serious injuries or fatalities. There may be fewer serious

injuries and fatalities if traffic moves more slowly in a heavily populated area. However, "the severity of such occurrences may be mitigated" if roads are less congested, even if more accidents may occur as a result of increased traffic. The total external cost of accidents may be reduced if congestion is a factor. Despite the apparent improvement in road safety, traffic actually decreases mobility, which has an effect on economic productivity. Because of this, transportation officials may be in a jam. It is critical to comprehend the relationship between traffic congestion and road safety in order to tackle both issues simultaneously. Research on this topic is scant, and what little there is usually relies on an analytical approach and on an unreliable proxy for traffic congestion levels. As a result, we must collect data from bigger scientific studies and find reliable estimates of the

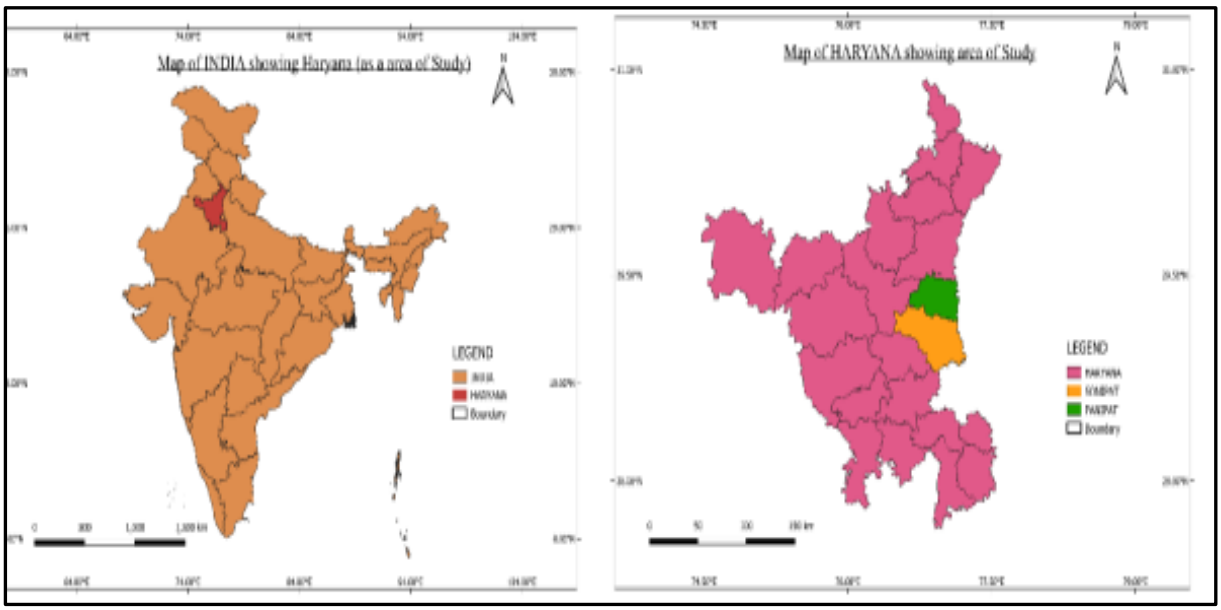


Fig. 7.24. Show location of study area in India**.**

amount of congestion. In this article, we investigate the link between traffic congestion and driver safety using a spatial analytic approach. We also consider all the other factors that can have an impact. As an example, we took the M25 London circular expressway and split it into seventy different segments. An algorithm was developed to properly distribute M25 collisions along the seven highway lengths using data obtained from the STATS19 national road accident database. We got in touch with the UK Highways Agency to get information on traffic metrics for the whole route, including average speed, flow, and delay (UKHA1). A congestion index was developed and put into use to precisely measure the amount of congestion along each portion of the route. For each stretch of road, a number of factors are considered

before arriving at the accident rate. Index of congestion, traffic flow, speed, road layout (including gradient and radius of curves), and segment length are some of the factors that undergo such considerations. A number of statistical models are used in this investigation. These models include the Poisson-gamma model, the Poisson-lognormal model with conditional autoregressive (CAR) priors, and other others. The remaining sections of the article are structured as follows: First, we will survey the research on statistical models and the impact of traffic congestion on road safety. The data from the research and the method used to accurately identify accidents on the M25 will be discussed next. Analysis of the statistical techniques used in this study follows the presentation and discussion of the research findings. This final part will include our findings, a summary of the data, and suggestions for further research. The concept of personal mobility has undergone a dramatic change with the growth of the middle class. Regardless matter how far away their locations may be, practically everyone nowadays owns a vehicle and likes to drive alone. While it's annoying that people can't stand to wait for public transit, it might also be an indication of how far we've come as a culture. As an alternative to school buses or carpools, most families drive their children to and from school. Shortcomings in transportation infrastructure and the inappropriate positioning of several organisations exacerbate the congestion problem. When there are more vehicles on the road than there are spaces available for them, a situation called traffic congestion occurs. There are a lot of negative outcomes that may result from traffic congestion, including, but not limited to, worry, lost opportunities, reduced company operations, and postponing of certain activity. When roads are congested, getting from point A to point B takes more time and costs more money. Everybody residing in Shillong is starting to feel the pinch as the traffic on the city's highways continues to surge. Extra time spent stuck in traffic is bad for everyone's health, including the productivity of companies and commuters. Major crossroads may have traffic bottlenecks at any time of day. The amount of commerce and other activities that occur during rush hour varies greatly throughout cities. Beginning the academic year at A Geographical Study of Traffic Collisions on National Highway-44 From Kundli to Panipat The rise of 2,373 educational institutions has led to an enormous surge in traffic, making it very difficult for travellers to reach their destinations within the allotted time. While traffic congestion affects the whole city, it seems to be disproportionately affecting some areas, such as schools, businesses, and government facilities. As a result, we need to look at what

triggers traffic congestion and how it impacts the neighbourhood. Jams in traffic are a worldwide issue that affects city life and the economy to a significant degree. The capital of Meghalaya, Shillong, has a lot of traffic congestion because of its fast growing population, economy, and number of cars on the road. Because it is increasing at an exponential pace, traffic congestion is starting to have more negative impacts than transportation in certain regions. This is made possible by the increasing transit costs. That is to say, the road congestion and other negative externalities caused by a growth in car traffic are becoming worse at a frightening pace.

7.3 Conclusions:

In conclusion, road accidents can occur due to various reasons such as human error, poor road conditions, vehicle defects, weather conditions, inadequate road infrastructure, non-adherence to traffic rules, and lack of awareness. By addressing these factors, it is possible to reduce the number of accidents on our roads and make them safer for everyone. This can be achieved through measures such as educating drivers about safe driving practices, enforcing traffic rules and regulations, improving road infrastructure, and ensuring regular maintenance of vehicles.

CHAPTER - VIII

DISCUSSION, CONCLUSION AND SUGGESTIONS

8.1 Introduction

Transportation is essential to nearly every facet of the economy, culture, and society's development. Using their essential necessities is a part of people's daily lives. To go from one location to another, people need some kind of conveyance (Oh Hoon Kwona, Min Ju Parka, Hwasoo Yeoa, and Koohong Chungb, 2013). Automobiles, trucks, buses, trains, motorbikes, boats, and airplanes are just a few of the many forms of transportation that people utilize today. Motorcycles, buses, and cars are the most popular forms of transportation.

As such, the domain of road transportation is of paramount importance to the advancement of any country. "The efficiency of the surface transportation system is critical to the movement of people and goods. Due to their important role in both starting and accelerating the development process, roads are widely acknowledged as one of the essential components of any infrastructure. India's economy is said to be based mostly on road transportation, and the degree of connectivity in the nation is considered a barometer of its level of development. (Qu, X., Meng, Q., 2014) An assessment and categorization of some national highway segments Following World War II, the Indian government shifted its focus to the growth of the nation's road infrastructure.which, under the British occupation of India, had lagged well behind the nation's railroads. Following that, larger-scale road sector planning was initiated based on recommendations made by many Indian Road Development Committees. The catalyst for the ongoing acceleration of growth in the road sector was the National Roads Development Project (NHDP), which was launched in 1998 with the aim of updating, repairing, and extending major roadways in India to a higher level. This growth in the road sector was greatly accelerated in 2015 with the introduction of the Bharatmala Pariyojana.(Mal n.d.) Transport Operational Plan for the National Capital Region until 2032 Building a road and rail network inside the area was suggested by the Regional Plan 2021 as a means of creating effective and financially sustainable rail and road-based transportation networks, which would include mass transit systems (AASHTO, 2010). Together with the growth of intra-city urban transportation, these networks would be properly linked with the land-use patterns to

enable balanced regional development in the Region for the goal of sustainable development. It recommended creating and improving a primary road network that would comprise major state roads, expressways, and federal highways; a secondary road network,

This would comprise important district highways; also, there would be a network of tertiary roads that would give access to every hamlet, workplace, employment hub, residential area, and so on (Smith, J., Bekker, H., Cheater, F, 2011). The road networks in this suggested system would be arranged hierarchically. It also recommended the establishment of orbital rail, a Mass Rapid Transit System (MRTS) for towns in the CNCR and in Delhi, and a Regional Rapid Transit System (RRTS) to connect regional towns with Delhi and with Sub-regional Centers. The various ways that transportation functions affect how we live our daily lives (Suryavanshi, S, 2020). It affects the economy's growth, population distribution, urban shape, energy usage, and market accessibility, among other things.

It brings in large sums of money, employs millions of people, and contributes significantly to the gross domestic product of the nation. The NCR offers a variety of levels and forms of transportation and is a high-intensity transit area. There is a great deal of travel inside the National Capital Region (NCR) between Delhi and the several regional and sub-regional centers, as well as within these centers (Deb, P, 2020). In light of this, section 16 of the NCR Planning Board Act, 1985 mandates the preparation of an integrated transportation plan, also known as a functional plan of transport for the NCR, and the elaboration of the Regional Plan-2021's recommendations based on traffic movement research studies following the completion of pertinent surveys.

8.2 Result and discussion

This action was taken in order to meet the section's criteria. "A statistical study of the incidents that occurred along the chosen section road" (Khurshid and Hussain, no date of publication) Road professionals and the general public alike are becoming more conscious of the significance of safety because vehicle accidents remain one of the greatest causes of mortality. Furthermore, billions of rupees are thought to be lost annually in economic damages as a result of injuries and fatalities. These losses might manifest as a reduction in the number of working days or as property damage. The

ideas of sustainable safety and quality management have been more popular during the past 20 years.

It might have been one of the factors that made project managers and legislators realize that, in order to reduce the accident rate, they need instruments that are entirely focused on safety. Research has demonstrated that driving is one of the main factors contributing to accidents, injuries, and fatalities. Furthermore, because to unique features of the high terrain, severe traffic accidents have occurred in the mountainous portions of the state of Jammu and Kashmir, which make up the bulk of the state's geographical area. The state government's records show that up until November 2018, there were 5,529 car accidents in the state that left people dead were hurt in the attack. Based on information gathered over the past eight years, there are, on average, fifteen accidents recorded daily. Furthermore, the project aims to develop a simplified method for identifying critical accident-causing factors on US four-lane national highways. Multiple linear regression analysis allowed us to identify the critical accident causation elements. Consequently, the characteristics that most influence the likelihood of an accident happening on a roadway have also been found to be the ones that are most accountable for causing these kinds of events.A multiple linear regression exercise was conducted for modeling purposes and to identify the elements influencing safety. The leftover data from the calibration process was utilized to validate the developed model. The model's value is 0.695 throughout the calibration process; however, following the validation phase, it rises to 0.70. The aforementioned research indicates that road markings, shoulder conditions, traffic volume, cross drainage, and spot speed are the variables that most affect driver safety. If the relevant parameters that were identified are taken into consideration. It might be feasible to improve the National Highway System's overall safety. (Idaho n.d.) Capacity increases are necessary to meet the projected expansion as well as the current demand. A highway's capacity to handle vehicle traffic may be increased in two ways: by widening the route and by strengthening access control. Installing Intelligent transit System (ITS) infrastructure, upgrading crossings, or enhancing public transit are more ways to increase capacity. Large-scale improvements to the highways or transit system are not now possible due to a lack of funding. On the other hand, creating an access control plan is a tactic that can be used immediately to improve operations, capacity, and safety in both current and future scenarios.

The single most important design factor that will affect the standard of transportation service along the highway is the management of access to US 20/26, which includes the placement and layout of private driveways, grade separations, and crossings. The quantity of grade separations and lanes in each direction are other variables that will be taken into account while making this decision. Numerous studies show that access management solutions may reduce total collisions by sixty percent, boost capacity by twenty to forty percent, and reduce travel times by around forty percent in terms of delay reduction.

In the event that access control and transportation planning are not properly execute,the capacity to provide sufficient long-term capacity, travel times, and safety levels will be diminished. Furthermore, there would be a detrimental effect on the effectiveness of future highway expansion attempts. (Burke and others, 1992) Transportation-related aspects of the maquiladora business in the Texas–Mexico border region the volume of commerce between the United States and Mexico has increased significantly, particularly in the maquiladora industry and other industries. The rise in truck traffic along the US-Mexico border, which has been growing quickly over the last five years, is mostly due to this boom in trade.

Because of the magnitude of this expansion, questions have been raised about whether the border's current transportation infrastructure is enough. To effectively promote economic growth, long-term planning of transportation networks needs precise data on the type of goods being moved, their volume, and their ultimate destination. This research covers some of the key elements of the maquiladora program, how it operates, and some significant parts of the transportation issues that the maquiladora sector faces, most of which are land-based.

At the international crossings, primary data were collected to track the movement of commodities and traffic. Furthermore, a follow-up study was carried out among the maquilas situated along the border to get comprehensive data concerning the transportation of the goods generated by maquila operations. The final section of this article provides an early examination of some potential impacts that the proposed North American Free Trade Agreement (NAFTA) may have upon cross-border transportation. GIS-based system for the location and investigation of accidents (gis-alas), by Souleyrette and Strauss (2000). An overview of the developments made during Phase I of the project to create a GIS-based Accident Location and Analysis

System (GIS-ALAS) is given in this document. The GIS-ALAS project is based on the numerous, protracted efforts of the Iowa Department of Transportation (DOT), law enforcement, Iowa State University, and several other organizations to create a location-referenced highway accident database for Iowa. The most notable of these efforts is the development of a personal computer-based accident location and analysis system (PC-ALAS) by the Iowa Department of Transportation. Since it was initially made accessible in 1989, people have embraced this system with great enthusiasm.

Because of the pull-down menu mechanism in PC-ALAS, it is more portable and easier to use than its mainframe counterpart. Users are able to view accident data for the locations and times of their choice. You can target specific types of accidents or those involving drivers with specific attributes by limiting the search parameters. The result may be seen on a computer screen, saved to a file, or printed in a variety of formats that have already been pre-defined. While PC-ALAS has many benefits, it can also be quite difficult to use.

It is necessary to employ time-consuming node tables or paper/CAD maps to determine the node numbers of places, which correspond to features such as crossroads, bridges, highway/rail crossings, and other similar features. Furthermore, because PC-ALAS is a text-based system, it is unable to benefit from the most recent developments in spatial analysis and computer graphics. Rao and Rao (2014) have developed models to measure the free flow speed of urban arterials in Delhi. They found that a variety of factors significantly affected free speed, including the overall count of automobiles, friction points, access points, junctions, flyovers, and access points. Patel and Gor (2013) looked at the relationship between flow, density, and speed along the bus route.Both directions of the road were the focus of their investigation. They concluded that the reasons for the capacity loss were pedestrian mobility, on-street parking, and encroachment. On NH-8 with four lanes, Patel and Kumawat (2014) studied the speed-flow modeling equation. They found that several different types of cars had average and maximum speeds that are far greater than what is allowed in cities. Research on Nagpur City's diverse traffic patterns was done by Dhapudkar (2014). He pointed out that the heterogeneous traffic they are attempting to represent is not suitable for the traffic stream equations that are currently in use. Scholars from Bainsa and colleagues.

(2012) carried out studies on traffic flow modeling on Indian expressways in Rajasthan, India. They found that increasing the v/c ratio led to a drop in the PCU of any given vehicle type. This applied to every kind of vehicle. Joshi and Patel (2014) found that the effects of side friction, lane width, and the presence of non-motorized vehicles greatly affects the capacity of an urban arterial road based on their study of a six-lane split urban arterial road.

. Doshi (2015) has created a regression model that uses the make-up of the cars on the road to predict travel speed. Additionally, he has calculated the increase in travel time resulting from the impact of slow-moving cars and their influence on the traffic density along the route (slow-moving, fast-moving). As per his findings, there is a sudden decrease in speed corresponding to an increase in the proportion of SMV above 40–50 percent.

The kinetics and equilibrium of metal release into the liquid phase, and therefore, the probability of remobilization and bioavailability, are dependent on the binding form in the solid phase (Tack and Verloo, 1995). Several investigations have demonstrated that certain heavy metals gradually distribute across the solid-phase soil constituents upon introduction. Numerous variables influenced this protracted process, some of which are mentioned below: metal species, organic matter, leaching, ion exchange, pH, temperature, and redox potential (Eh). (Han et al., 2001 and Kabra et al., 2007)". [Han et al., 2001 and Kabra et al., 2007] The soil moisture regime is one of the most important factors in controlling the physical, chemical, and biological properties of the soil.The redistribution of metals is greatly influenced by the soil moisture regime; soils under a wetting-drying cycle regime and a saturated paste regime exhibited greater metal reactivity than soils under a field capacity regime. As a result, metals moved toward stable fractions more thoroughly, especially in loessal soiland for Ni, Zn, and Cu (Han et al. 2001) DTPA extractant was used to extract soil samples over the length of and 1440 minutes, respectively. According to Ghasemi-Fasaei et al. (2012b), the general patterns of copper extraction were characterized by a quick release response in the first two hours, followed by a more progressive release reaction. The majority of research on heavy metal concentrations in roadside plants and soil has been conducted in industrialized nations with a history of industrialization and widespread use of leaded gasoline, despite the fact that there have been a significant number of studies on the subject.In developing nations like

India, where information on the distribution and concentration of heavy metals in roadside soils is lacking, very few research has been conducted. While a significant amount of research has been done on the concentrations of heavy metals in plants and soil along roadsides, the majority of studies have been carried out (Ipingbemi 2008) under the heading "Spatial analysis and socio-economic impact of road collisions." The results of research like these indicate that a significant portion of the fatalities and injuries in the US are caused by traffic accidents.

The number of people who have perished in car crashes or sustained injuries has steadily increased throughout time. "During the same period in 1970, the overall mortality rate increased from 5.3 percent to 12.7 percent. This article will examine the patterns of and socioeconomic challenges faced by victims of traffic accidents. 438 individuals who had been hurt in vehicle accidents and were receiving treatment at public and private hospitals were given questionnaires by the researchers in order to conduct the study. Descriptive statistics were employed to show the data. Buses and motorbikes made up the bulk of the vehicles involved in the collision, but pedestrians were responsible for 40% of the deaths. Every victim paid an average of US$17 in daily medical bills while in the hospital, and at least one companion accompanied them the whole time. This has important implications for both the well-being of the country's families and the economy as a whole. The survey's conclusions suggest that preventing road accidents and using post-crash management strategies might lessen the detrimental consequences that these incidents have on society. Effects of Traffic Volumes on Accidents is the title of a research.Technica (2016) carried out the Case of Romania's National Road Found and Examined. Every single vehicle collision is a serious worry. Throughout the stages of preventative and predictive measures, the single most important thing that can be done is to conduct investigations into traffic incidents and the causes that led to them. The main objective of this article (EU) is to look at the reasons behind road fatalities in Romania, which is frequently listed as one of the riskiest countries in the EU.

It was found that the nation's research was untrustworthy, with few studies completed in a range of subjects and a dearth of accident prediction methods. This study has verified a worldwide model that might be used for accident prediction in Romania. The aim of this study is to examine the relationship between traffic volume and the overall number of accidents. The National Road Infrastructure Management Company

produced these traffic statistics and made them available for use in this report (CNAIR).The data on traffic accidents collected in 2015 on Romania's major highways was submitted to the General Inspection of the Romanian Police (GIRPTD), according to the Traffic Department of the General Inspection of the Romanian Police (GIRPTD). Making the database as simple as feasible for the purposes of this study was essential. Only data directly related to the accident, the cars involved, and the occupants of the vehicles should have been recorded. The initial assessments were conducted using a program called Geographic Information System (GIS). Using power regression, researchers were able to show the relationship between the overall volume of traffic and the number of accidents.

The study's findings indicate that, while to a limited extent, traffic congestion may have a significant effect on the frequency of accidents. The necessity for a national research plan is underscored by the fact that an investigation into road safety is more important than the stated objectives. To ensure that Romania's roads have a better future, it is imperative that the data that is now accessible be updated, that new tactics and expertise be put into practice, and that the unique characteristics of the sites concerned be taken into account. (Guo, Shi, and Li 2013) looked into the International Conference of Transportation Professionals and discovered that the temporal distribution of freight transportation exhibits several fascinating features. The study's findings are presented in this article.

SQL and other computer languages made it easier to simplify and filter GPS data in this specific inquiry. The study employed Mathematica for data validation and smoothness checks, while Excel was utilized to investigate the temporal features of freight traffic in Shenzhen City. Subsequently, the traffic wave theory model was employed to provide a numerical evaluation of its influence. It served as a metaphor for the congestion that results from combining passenger and freight traffic during rush hour. By examining the freight traffic in Shenzhen City from a macro-level viewpoint and examining the temporal and spatial dynamics of freight transit, researchers were able to extract key characteristics from the phenomena.

The researchers were able to comprehend the phenomena better as a result. The study's findings are crucial to the advancement of both traffic conditions and social amenities. This is a result of resources being allocated appropriately, which is a result of resources being allocated correctly. It's feasible that this will help with the city's

modernization process and enhance the transportation system's overall effectiveness. In the context of globalization, the research's findings are expected to significantly and favourably affect Shenzhen City's core competitiveness. (Bassani, Rossetti, and Catani 2020) discovered in the research titled "Spatial analysis of road accidents involving vulnerable road users in" that they would be vulnerable road users (VRU) in the case of a collision since they lacked physical protection. To create a setting that is more dependable and safer Roughly three-quarters of all deaths on urban roadways are caused by crashes involving vulnerable road users (VRUs), which include motorcyclists, pedestrians, and cyclists. For this user group, suitable safety countermeasures must be put in place in order to make the road transportation system more secure and ecologically friendly.

In order to ensure the long-term viability of the road transportation system, action must be taken to safeguard this particular group of road users. The overall amount of money and resources that may be used to increase safety in high-hazard locations is limited, though. This limits the amount that may be spent. This study focused on certain areas inside the city and examined the geographical distribution of traffic crashes in Turin, which included VRU, between 2006 and 2016. The Italian National Institute of Statistics (ISTAT) traffic-related crash database was checked.

Using Geographic Information Systems (GIS) capabilities, the investigators were first able to pinpoint the exact sites of the crashes. Using a cluster analysis and a kernel density estimate, spatial patterns were created as part of the investigation of VRU incidents. It was concluded that there was a threat in several areas of the region. Because the researchers limited their focus to only those places where accident rates were continuously high over the course of the analysis (eleven years), they were able to avoid the normal faults that arise from studies that are only undertaken for a brief period of time.

The data indicates that many of the crossings where clusters form is found on routes with high traffic volumes and wide cross-sections. A closer examination of the arrangement of the most dangerous parts and intersections was conducted in order to determine the degree to which the geometric configuration (layout) contributed to the severity. As to the results of the research study Traffic Accident Analysis For, carried out by Ghosh, Parida, and Uraon (2004), there is reason for concern over the percentage of road accidents that take place in India globally. Technological

advancements have led to the availability of increasingly complex car models, with the quantity of these models increasing daily.

A traffic accident can be caused by a variety of circumstances. GIS technology has become so widely used that it is now an essential part of a thorough investigation into a traffic accident. The investigation is going to be conducted in Dehradun, the northern Indian state capital of Uttaranchal. Over two-thirds of all cases in the previous five years have resulted in a death or major injury to someone. Most collisions occur between the hours of 2:00 pm and 10:00 pm, and most of them involve cars, trucks, or vans.

The analysis's conclusions indicate that the city would require a dependable system for traffic control in order to reduce the amount of accidents brought on by traffic. Ecological Impacts from Transportation was the name of the research that Navin Gupta conducted in 2014. Corridor NH-44 Furthermore, roads are the most prevalent type of human infrastructure, and there is constant contact between them and the wild animal habitat. Because they split up the areas that animals call home and because they kill or injure people when they collide with automobiles, roads have a direct impact on the populations of wild animals.Collisions between wild animals are a severe issue that require widespread adoption of prevention measures. Jammu and Katra are connected by National Highway 44, and it is feasible to travel to the sacred site of Vaishno Devi, a well-known Indian temple situated in the Trikuta Hills (50 kilometers away). The research area is 30 kilometers long along NH-44 between the Nagrota and Domel interchanges. The organizations in charge of building and maintaining the roads are the Border Roads Organization and the NHAI. Road construction work on Jammu and Kashmir's National Highway 44 (NH-44) has been extensive lately.

This road has added strategic significance because it is a vital link between Srinagar, Kargil, Leh, and Ladakh. We conducted a thorough inspection and review of the whole research site. It was determined that certain feeding grounds, crossing areas, confrontations, and locations where monkeys lost their lives after being hit by cars were factors in vehicle accidents. Because of habitat fragmentation, movement restrictions, injury and death, soil erosion and hydrological changes, and environmental contamination—all of which contribute to ecosystem pollution—primate populations suffered as a result of NH-44 construction.A tiny portion of the

natural environment has been destroyed as a result of NH-44's construction. Ecologists and civil engineers will need to create evaluation techniques that can be applied in the planning and construction of transportation infrastructure in order to meet the public's growing demands for the mitigation and avoidance of harmful impacts on the environment. Thuluthiyil Manoj, Vajjarapu, and Verma (2020) conducted research This article is protected by copyright because of recent advancements in the field of traffic engineering.All rights are retained by the publisher, including the ability to translate, reprint, reuse illustrations, recite, broadcast, reproduce on microfilms or in any other physical way, and transmit or store and retrieve information via computer software, electronic means, or by analogous or different methods that are either known at this time or will be created in the future. These rights cover the translation, publication, reuse of the drawings, public performance, broadcasting, microfilm reproduction, and physical reproduction of the work. This publication does not suggest, even in the absence of an explicit statement, that generic descriptive names, registered names, trademarks and service marks, etc. are free for widespread usage as they are not subject to the applicable protective laws and restrictions. They may be certain that the information and advice offered here was created using the best judgment available at the time of publishing. The publishers, writers, and editors of this book disclaim any guarantees, explicit or implied, that may be connected to the content of this publication and are not liable for any errors or omissions that may be discovered within its pages. Regarding the institutional links and jurisdictional assertions made on published maps, the publisher upholds objectivity.Epni and Arslan 2017, The elements that contribute to the occurrence of traffic accidents were identified and examined in a study titled "A GIS Approach to Evaluate Infrastructure Variables Influencing the Occurrence of Traffic Accidents on Urban Road." Worldwide, a large number of research have been conducted to look at the causes of traffic incidents from a variety of angles. The study examined the road system's users from a number of angles, including technological and legal issues as well as psychological, behavioral, and economical aspects.

These days, a lot of analytical processes use geographic information systems (GIS), which has allowed for the creation of models, risk assessments, and maps of spatial distribution. When analyzing vehicle crashes, quantitative statistical methods—which emphasize the sequence of events—are frequently employed. Studies have indicated

that conventional statistical models may not always be sufficient in assessing the frequency of traffic accidents due to the possibility of erroneous results. This is among the causes of the situation as it stands.

Patterns of vehicle accidents and important contributing elements have been found through the use of a Geographic Information System (GIS) as a management system for accident analysis and the identification of hot zones, or spatial and temporal visualisation technologies. Numerous elements, such as traffic volume, road infrastructure, and surrounding environment, are included in this study of urban traffic accidents. Kocaeli's GIS technology can focus on certain areas that are more likely to be engaged in auto accidents.

The fact that accidents occur on Kocaeli's urban roads is a major source for concern, with many people blaming poor infrastructure for the situation. An inquiry was conducted in an attempt to determine a relationship between the frequency of traffic accidents in urban areas and the state of various components of the city's road system. The study's conclusions suggested that some places could be more dangerous in the case of an accident. Numerous vehicles and motorbikes may be seen on Indonesia's roads, according to a 2018 study by Wandani et al. titled Automobile and Motorcycle Traffic on Indonesian National Roads.

The spatial lag model and the spatial error model are employed in this study to explore the spatial relationships between the several cities that comprise Indonesia with regard to the features of private vehicle travel on public roads. Vehicle kilometers travelled (VKT), which applies to both private motorcycle riders and private car drivers, is a measure of the quantity of travel or use. Nevertheless, the models employed in this work show only extremely weak spatial relationships across neighbouring cities, despite the fact that automobile trips often cross municipal boundaries. There isn't much data to support a relationship between motorbike travel and the surrounding cities.

Numerous factors, such as road capacity and gas prices, worker density, city size, population density, and the quantity of public buses, might influence the Vehicle Kilometers Travelled (VKT) statistic. This figure is true for both cars and motorbikes. These results demonstrate the need for simpler urban transportation legislation on national routes in Indonesian cities, taking into account the possibility that local

remedies might help ease traffic issues in particular towns. (Bedi 2014) conducted research and found in their Background Paper on Land Economics-Related Issues

The public sector actively participated in maintaining the supply of housing above the demand for it, which was the tactic used to contain the rise in housing costs until the year 2000. N.C. People in Delhi with middle-class and upper-class income levels can now afford to buy a home thanks to this technique, which has helped to keep housing prices stable. Still, there was a chronic shortage of housing for EWS and lower-class residents. The ability to construct on a variety of different sized parcels of land is one of the factors that may be connected to the massive expansion of illegal building.

After the year 2000, the DDA ceased to participate in significant land development, which gave builders the opportunity to fully capitalize on the situation and turn single-story homes into multi-story structures. While the population of NCT Delhi grew at a slower pace between 1991 and 2001, the number of residences supplied increased at a significantly faster rate between 2001 and 2011 than it did between 1991 and 2001. This is because in the next decade, development in other NCR regions also occurred considerably more quickly.

Stronghold interest groups that supported price increases benefited greatly from the cheap and favorable access to home loans, tax breaks for buyers, and vigorous public sector initiatives to improve infrastructure like the metro and road traffic. The combination of all these elements allows price increases to happen. The public sector should not have delayed in making sure that the laws of a free and fair market mechanism were not broken because land, transportation, and other resources were made available to developers (and were subsequently allowed to be acquired) at prices that were much lower than their market value.

This is especially true when you take into account how important it is to make sure that affordable housing alternatives are available to the majority of people in order to improve society as a whole. It is a bit of a shock to hear that, as part of the land pooling strategy plan, builders would get supply control over future construction after going through this process. The large-scale growth plans for 2011–21 will result in a significant decrease in property prices after the builders have received the majority of the agreed-upon sum for their large housing and commercial projects that are

currently under construction; however, this will only occur after the plans have been fully implemented.

Conversely, there can always be a scarcity of some goods in specific markets. In their 2018 study, "Assessment of Roadway Capacity For A Four-Lane Divided Road Under," Feroz Ahmed Khan, Iqbal Faheem, and Minhaj Uddin Aquil discovered and presented the findings. Any country's overall economic development is dependent on having sufficient transportation. India's roads include a significantly more varied selection of various traffic patterns as compared to those in other nations.

This directly means that the models used in other nations to assess a highway's carrying capacity are inapplicable not India. Two distinct sixty-meter-long portions of National Highway 44 will be examined as part of this assessment to determine the roadway's capacity. Many elements of the road, such as its geometry and pavement surface characteristics, as well as the probable traffic circumstances that would exist on an average workday, were taken into account while selecting the components.

The study employed videography to gather traffic data, which included categorized traffic volumes, space mean speeds, and free vehicle speeds. The data was collected in four-hour blocks, spanning 10 to 12 hours each day. This was done in order to record the effects of heavy traffic during the night as well as peak morning and evening traffic. The free flow speed technique is the methodology used in this investigation. Flow studies will be the next two stages of this process when the vehicle dynamics unit is finished.

Study sections were used to establish speed-flow relationships, and capacity flow was defined as the volume of traffic moving at the half-way free flow speed of a segment. VISSIM 7.0 was used to model the traffic on the study sections, allowing for a high degree of realism. The simulation was used to calibrate and validate the model based on observed volumes and spatial mean speeds. Following this, the capacity was computed using the speed and flow data from the simulation model.

It is projected that a divided national highway with four lanes may accommodate up to 4100 passengers per hour per lane in each direction. A four-lane highway's lane change behavior may be assessed by enhancing the model and using field data. The societal costs of traffic congestion, which include lost time and money as well as a decline in mobility and quality of life, are ultimately borne by road users.

Reducing the negative effects that accidents and traffic congestion have on society requires collecting more accurate and rigorous scientific data as well as accurately assessing congestion. These impacts specifically include a higher chance of accidents. The present study employed a spatial analytic approach to examine the correlation between traffic congestion and road safety, while accounting for many other variables. The STATS19 national road accident database was mined for accident data, and a system was created to accurately allocate M25 collisions to each of the 70 different motorway segments.

. For every part of the road, data on traffic metrics including average speed, flow, and delay was obtained from the UK Highways Agency (UKHA1). A congestion index was created in order to precisely evaluate the degree of congestion on every single route segment. provides a succinct overview of earlier studies on the relationship between traffic congestion and statistical models and road safety. Several statistical models are used to calculate the accident rate for each road segment. These models include the Poisson-lognormal model, the Poisson-gamma model, and the Poisson-Lognormal model. All of these models rely on conditional autoregressive (CAR) priors. An explanation of the information utilized to precisely attribute

M25 incidents to specific highway portions are given, and the outcomes are both discussed and shown. There are several definitive findings and suggestions for more investigation. Shillong traffic congestion has gotten out of control and is now a major issue for all residents, negatively impacting worker productivity, business health, and commuters' general quality of life. The neighbourhoods around businesses, educational institutions, and government buildings are the worst. Meghalaya's capital, Shillong, has been experiencing more traffic because to its growing population, socioeconomic activity, and vehicle traffic. Urban congestion is a global issue that significantly affects cities' social and economic aspects. Pathways.

The goal of this project is to create traffic flow models, or the relationships between flow, density, and speed, for different types of urban highway traffic on specific sections of those routes. The research's observed volume count, spot speed study analysis, and density may be used as a guide for similar studies in the future and facilitate the process of allocating traffic on comparable lines. Motor vehicles, including cars and motorbikes, are crucial to the advancement of motorization in many developing nations.

With 85,000 fatalities and 300,000 injuries from traffic accidents annually, India has a serious problem with these incidents.

This is a result of both individual choices and government policies that encouraged the building of highways, the acquisition of automobiles, urbanization, and suburbanization. 1 shows the total number of individuals who died in road accidents in India between 1971 and 1998. Any nation's economic prosperity depends on its ability to connect via road, rail, and air; however, other drivers' safety on the road must also be taken into account. Sadly, the design of our contemporary transportation networks has contributed to a rise in the number of fatalities and serious injuries from auto accidents.

To ascertain whether or not the use of traffic control systems and safe road design can reduce the incidence of traffic accidents and the impact of those accidents, a thorough analysis of traffic accident statistics is necessary. This will help determine whether or not such control systems and design requirements are successful. Access management systems have been shown to minimize delays by 40 percent, enhance capacity by 20–40 percent, and reduce overall crashes by up to 60 percent. Inadequate access management and transportation planning will limit the ability to provide sufficient long-term travel times together with safety and security.

New routes for transportation are frequently constructed next to existing ones in an effort to decrease their detrimental impact on the environment. The Indian government oversees and maintains the country's National Highway System in addition to keeping an eye on it. The vast National Highways Development Project (NHDP) aims to enhance and expand the nation's road network. Approximately 15,000 of the 71,000 kilometers of national roads have four or six lanes. The objective of this initiative is to expand the number of four- or six-lane roads throughout the nation.

It affects the environment directly and indirectly by causing noise pollution and chemical pollution, altering natural processes and habitats, changing hydrological dynamics, and creating new borders for ecosystems. Infrastructure and transportation also provide dispersal barriers for non-aviating terrestrial species, and these factors result in millions of animal deaths per year from collisions with cars. The transportation sector is often to blame for the majority of infrastructure's detrimental effects on the local wildlife and environment.

The direct, immediate, and obvious impacts that single road causes are the subject of the great bulk of empirical research on the consequences infrastructure has on animals. These include pollution, increased mortality, habitat degradation, and the addition of a corridor. Highway planning frequently ignores wetlands and riparian ecosystems, even though construction of new roads may alter soil density, landscape relief, and surface and ground water flows. It is also possible for external disturbances, such highway noise, to cause an environment to become disrupted.

Since May through December is when most pilgrims are in the region, there is a lot of traffic on NH-44, which increases the likelihood of catastrophic animal-vehicle incidents. Research on dose-effect thresholds in wildlife is essential to understanding the pattern and developing methods for quantifying and assessing the impacts of perturbations.

Primate victims of auto accidents include monkeys and langurs, since they typically wait along the road in hopes of scavenging food from passing automobiles. They are at risk because of this behaviour. Numerous elements, such as the species' biology, the features of the traffic and the roads, the composition of the terrain and the habitat, can all have an impact on the geographical and temporal pattern of road deaths. Geographic information system (GIS) analysis is used by researchers to track the sites of traffic deaths and the paths that animals travel through the environment. This enables the researchers to assess the need for mitigation at the local level and to create and execute suitable solutions.

Different traffic flow patterns can have a variety of unfavourable side consequences, such as fuel and time waste, as well as an increase in the amount of carbon dioxide and air pollutants in the environment. During an emergency, it becomes more difficult for rescue vehicles to navigate the region when traffic is blocked. This study examines the present state of urban road transportation in Indonesia using data from the Indonesian Road Management System database (IRMS). The Ministry of Public Works' Directorate General of Highways is in responsible of overseeing the IRMS system.

The National Road Capacity and Lane Count are calculated using inventory data, roughness data is used to calculate the International Roughness Index (IRI) variables, and VKT values are measured for cars and motorbikes using this approach. The IRMS

system is responsible for carrying out each of these measures. The average VKT for motorcycles on Java is three times higher than that of bikes on outer Java, however this difference has no statistically significant effect. The Ministry of Road Transport and Highways is the primary body in charge of the National Highway System's growth.

Once the effects on tourism, trade, strategic, tribal, remote, and border areas have been considered, work on National Highways is approved by a number of government initiatives, including the Bharatmala Pariyojana (Phase-I), the Development of Road in Left Wing Extremism affected areas, the Special Accelerated Road Development for North Eastern Region, and others. Within its authority, the Ministry of Road Transport and Highways (MoRTH) is in charge of the establishment, upkeep, and management of National Highways, as well as any related matters.

The National Highways Administration, Inc. (NHAI) was founded by the National Highways Authority of India Act of 1988, and the National Highway Traffic Safety Administration didn't start carrying out passenger transportation until February of 1995. Established in 1983 to address a major need, the Indian Academy of Highway Engineers (IAHE) is a government-approved organization. The Ministry of Road Transport, Highways, and Shipping was divided into two distinct Ministries in 2009. India's Ministry of Road Transport and Highways is in charge of constructing and maintaining national highways as well as managing the Central Motor Vehicles Rules of 1989, the Motor Vehicles Act of 1988, and the National Highways Act of 1956.

To keep up with the expansion of the industrial sector, the nation's roads must be able to accommodate more traffic. Planning urban land uses, safeguarding young people and the elderly, building and managing transportation infrastructure, and equipping cars with safety features are just a few of the many sectors that work to make roads safer. Ensuring the safety of highway staff and the general public while they are on the job is the duty of several government agencies, organizations, and private citizens.

A multitude of factors can contribute to an accident on the road, such as driver error, driving experience and education, mental illness, age, gender, and physical state, traffic conditions, vehicle components like brakes, lights, tyres, and steering, road hazards, and meteorological elements like precipitation, dust, fog, and snow. To reduce the frequency of accidents, a thorough examination of the road safety

infrastructure must be done, and road safety research must be conducted to determine the elements that lead to collisions on the highway.

The goal of this study is to give a thorough review of the current state of road safety and traffic injuries (RTIs) in India, with an emphasis on public health problems. It gathers and examines all accessible data from India, both publicly available and privately held, in order to create a national profile and patterns of traffic accidents. The plan is to start with basic information on a limited number of critical metrics and work your way up to more detailed status updates over the next few days. The India Motor Vehicles Act has lately been the subject of reforms suggested by the Indian government.

Furthermore, the Ministry of Health has implemented certain modifications to improve the treatment given to those who have experienced trauma. Since there isn't a national centralized report on road safety, a number of organizations have resorted to the WHO Collaborating Center for both general and targeted data. Understanding the many risk factors for road collisions, identifying the features and distribution of road traffic incidents (RTIs), assessing the present burden of RTIs in terms of death, morbidity, and disability, and identifying the burden and trend in all Indian states; examine methods and intervention tactics; comprehend current RTI prevention mechanisms and policies; track worldwide advancements and lessons learned; and offer a framework for putting RTI preventive initiatives into practice. Furthermore, it looks on the effectiveness of automated speed enforcement devices that were put in place on Italian roads. The number of serious and horizontally-curving accidents decreased once the automated enforcement system was installed. Montella et al. claimed that automated enforcement technology should take over as the police force in light of the significant decline in accident frequency. They also recommended increased enforcement levels in order to sustain the system's effectiveness over time.

Variable speed limits (VSL) have been the subject of recent research as a means of regulating highway speeds in response to varying traffic volumes and environmental conditions. A necessity in the transportation sector led to the completion of this study. Santiago-Chaparro et al.'s results indicate that speed-actuated signs have a higher chance of working when erected in specific areas where a slowdown in speed is desired.Weikl and colleagues' findings indicate that around one third of the Autobahn has a permanent speed limit, while the remaining third has a speed limit that is either

temporary or susceptible to change. When they examined the data collected with and without the VSL system, they discovered that shock velocities were significantly reduced and there was a significantly higher chance of running into periods of stop-and-go traffic. They also found that drivers generally reported feeling happier. Researchers looked at the potential impact of raising the speed limit on the frequency of accidents on certain California roadways using a range of statistical techniques.

Researchers found that nighttime accidents happened at a much higher incidence on roads where the speed limit was raised from 55 to 65 miles per hour. Network screening might be used to find road segments where speed limits could be implemented to enhance them. The study's conclusions indicate that US transportation authority's select potential locations and/or road segments for safety improvements using a wide range of network screening techniques. Azam and colleagues compared a plethora of various network screening techniques and found that the efficacy estimates varied substantially.

Sliding window network screening was shown to be an effective tool for assessing potential facilities when combined with a coefficient of variation (CV) performance metric. The goal of this research is to create a statistical model that uses a directed road network design that accounts for traffic flow to predict the probability of accidents happening on specific route lengths.

The purpose of this study is to analyse the relationships between various geographic factors, such as geometry and land use, and the outcomes of events. Using route inventory, incident information from the year 2006 from Hampton Roads, Virginia, and a queue-based approach, it determines which occurrences happened in the same direction as the initial event and which occurred in the opposite direction. According to the findings, a relatively high risk of non-secondary incidents was not necessarily associated with a relatively high risk of secondary incidents along certain stretches of roadway. In order to explore the reasons of secondary occurrences, Poisson, zero-inflated Poisson, and negative binomial regression models were computed. These models aided in the correct allocation of incident management resources and gave support for regionally based strategy planning. This study looks at both secondary and non-secondary occurrences in the broader Hampton Roads area in Virginia, which has a population of close to 1.7 million people. On the nation's roadways in 2006, there were an average of 105 incidents needing roadside help each day, and an additional

two to three incidents each day required secondary assistance. The region around Hampton Roads has developed operational strategies to deal with this kind of congestion, but there are still a lot of vehicles, which results in a lot of traffic jams and delays. Planning experts have always taken a holistic approach to the topic of road safety, and the design of community roads in the first half of the 20th century was based on improving functionality and serving a specific purpose. Local roads, collector roads, arterial roads, and highways are the usual subdivisions of urban road networks. Local roads provide access to residential areas and a high level of connection between communities that are located in close proximity to one another. Urban collector roads are very reliant on signalised intersections, despite the fact that they significantly slow down traffic and contribute to congestion. It is the main purpose of arterial thoroughfares, which are high-speed and high-volume road networks that run through a town, to restrict access to individual residences and commercial establishments. In order to convey huge amounts of traffic between cities and regions in a timely and effective manner, limited-access roads, which often include several lanes or a configuration similar to that of an interstate, are used. The place where two or more routes meet and cross is known as an intersection, and it plays an important role in all types of transportation networks. The state of Tennessee employs established rules on traffic monitoring and forecasting, in addition to collecting data on highway conditions and performance (HPMS), so that it may contribute to the Highway Performance Monitoring System that is administered by the Federal Highway Administration. The study of traffic data is an integral part of the decision-making process since it is essential to the achievement of transportation objectives. The location of highways and traffic control systems, as well as financing for and design of these features, are all heavily influenced by traffic data. The evaluation of traffic data is necessary for determining how successful safety measures are and for ensuring users continue to comply with regulations. Traffic safety professionals identify high injury and fatality accident hotspots using criteria such as traffic volume, accident frequency, road classification, collision type, and proximity to traffic control equipment. These criteria are used to determine which roads are most likely to result in a fatality or serious injury. When it comes to traditional engineering procedures and processes, accident reports are the major source of information that are used. The National Highway Traffic Safety Administration (NHTSA) publishes a

variety of publications that describe accident data on a national and state level. These reports may be found on the NHTSA website.

Together with the Federal Highway Administration, the state of Tennessee is working to eliminate hazardous areas along roadways. As part of a countrywide initiative to reduce the number of people injured or killed in motor vehicle collisions, the United States of America compiles yearly statistics on automobile accidents for the majority of the states and makes this information available to the general public. Road Safety Audit is a systematic, methodical, and comprehensive evaluation of a road project that is carried out by a team of professional and trained auditors. The purpose of the assessment is to identify and describe any possible safety concerns associated with the project. The inquiry is going to take a long time, and it is going to demand knowledge, experience, insight, depth, and attention to detail. During a road safety audit, all types of road users, including pedestrians, cyclists, motorcyclists, drivers of trucks and buses, drivers of three-wheeled vehicles, and drivers of vehicles pulled by animals, are taken into consideration. The Indian traffic police are the ones responsible for compiling the official government data on the number of people injured in road traffic accidents in India. First Information Reports, often known as FIRs, are compiled whenever an accident involving several vehicles is reported to a police station. The First Incident Report (FIR) comprises information about the collision as witnessed by the individual making the report, and the investigation into the collision is started by the police. After the inquiry has been finished, a case file is prepared, and the offending party is charged with crimes under the provisions of the Indian Penal Code and the Motor Vehicles Act of India, 1988. These laws govern motor vehicles in India. Because of this method, eighty percent or more of the incidents are always ascribed to 'human error,' and there is no room for analysing collisions as a consequence of variables like the design of vehicles, roads, and other infrastructure. In the case that a major injury or death happened at the scene or before medical assistance could be reached, it is required that a First Information Report (FIR) be filed with the police. Motor Accident Claims Compensation claims resulting from road traffic incidents that cause death, physical injury, or property damage are heard and decided by special tribunals that have been set up specifically for this purpose. The Internet of Things (IoT) is the foundational concept that enables smart trac systems to become a reality. This concept makes it possible for remote decision-

making based on data acquired by improved devices or for enhanced devices to gain capabilities that were not previously available. Both of these benefits are made possible by the IoT. In India, third-party liability insurance is obligatory for any and all vehicles used on public highways. The Raspberry Pi is a single-board computer that runs Linux and is used to send signals to trac lights. These signals enable dynamic modifications to be made to the length of time that each light cycle is on.

Its more affordable price point and its adaptability as web servers have contributed to its widespread adoption. Additionally, it features GPIO pins, which stand for general purpose input/output pins, and these pins may be customised to meet the needs of each particular user.The duration of a specific green LED is altered via the usage of GPIO pins in this work. The authorities are able to modify the length of time that green lights are on in the direction that is experiencing the most traffic congestion by using a Raspberry Pi, GPIO pins, and a camera on each of the traffic lights at a junction. Images obtained from a camera that was installed on the northbound trac signal of a typical four-way intersection would demonstrate to law enforcement personnel that there is an abnormally large number of traffic travelling in the direction of the north. The Raspberry Pi would be the one to receive the signal that was sent by the authorities; it would then convert the signal into a voltage that could be used with its GPIO pins. Until it got another signal from the authorities telling it to change, the traffic light would continue to operate according to the green light period that had been established by the government.

The use of RFID technology to monitor and keep a record of flow is essential to the operation of this system. Sensors are spaced at intervals ranging from 500 metres to 1000 metres (3280.84 ft) to guarantee accurate data collecting. The priority of ditch sites was determined by whether or not they were surrounded by a wetland that remained constantly wet, and each lawn had to have been mowed in 2003. The area requires a Metropolitan Planning Organization for the El Paso Area, in addition to municipal and state transportation agencies, the PDNRMIS, and a Metropolitan Planning Organization for the region. The mountain range known as the Himalayas surrounds the whole state of Jammu and Kashmir (also known as J&K), which is located in the most northern part of India. The National Highway-44 that connects Jammu and Srinagar is the only road that can take travellers to both the Kashmir valley and the Ladakh region of India. The National Highway 44 (NH-44) is often

shut down during the rainy season, cutting off the Kashmir valley from the rest of India. The roadways need to be widened as a top priority in order to enhance the flow of traffic. Due to the possibility of hill slope collapse, the Udhampur road portion is now being analysed for serious geological hazards. A moderate to severe hill slope, colluvium deposits at the toe of the slopes are some of the geomorphologic characteristics of the project area. Other geomorphologic features of the project region include a small river valley and several minor perpendicular tributaries. As a component of the Murree formation, these sediments comprise semi-consolidated to cemented sandstones, siltstone, mudstone, shales, conglomerates, and clay layers. The Main Boundary Fault (MBF) in the outer Himalayas is the most well-known example of the succession of thrusts that may be seen in the regional geology. Quartzite bands may be anything from a light grey to a pure white tint, and their thickness can reach up to one metre. During the course of the investigation of the site, several geological discontinuities were subjected to shearing movements, which resulted in the formation of a fractured character in the rocks, established continuity, and related geological phenomena. The poor geology that the civil team encountered in Jammu and Kashmir, which is located in Seismic Zone IV and Zone V, has caused a number of unexpected problems, including the collapse and cracking of residential buildings, agricultural land, a high-tension electricity tower, and the more common landslide. The implementation of preventive measures and an awareness of the potential causes of landslides and ground collapse should be mandatory for all government construction projects in the future. This would help save both time and money.

Landslides are a typical occurrence in the area around NH-44, and the stretch of road that connects Udhampur and Rambam is situated in a tectonically uns region. The geology is mostly soft and composed of mud stone, clay stone, and siltstone with alternating bands of sandstone. There are a number of teeny-tiny water bodies, including Nallas and Major River, which are all in Ta wi. In the area that is the focus of this research, the factors that contribute to the occurrence of landslides include natural characteristics such as topography and geology, as well as the actions of humans and the construction of buildings, and aspects related to hydrology. It has been shown that the likelihood of landslides increases with parameters such as the slope angle, the presence of alternating bands of uns rocks, and the natural slope of the sides of valleys. According to findings from kinematic study, rock slopes are

susceptible to a number of different types of failure, including debris flows, rock falls, rotational slides, and circular slides."

On the thick colluvium deposits, sliding has been seen, primarily in the section that is before Km 145. It's possible that the composition of slides, as well as their size, will change based on the mother rock they come from. The highway rating for 19,000 kilometres of finished four- or six-lane national highways and expressways has been completed and is based on 39 criteria, including Highway Efficiency (45 points), Highway Safety (35 marks), and User Services (35 marks) (20 marks). The rating of highways is a dynamic activity, and one may anticipate that it will become better with each new iteration that is performed. Because of this endeavour, standards will be developed for the benchmarking and evaluation of highway corridors in India, and actions to enhance the ratings of corridors will be able to be done.

This thesis evaluates the potential of spatial analysis to improve corridor efficiency by identifying and prioritising crash clusters, assessing the current burden of road traffic injuries in terms of mortality, morbidity, and disability, understanding the various risk factors for road crashes, examining the outcomes and impact of road traffic injuries, reviewing intervention strategies and approaches, tracing global developments and lessons learnt, and providing a framework for implementing road safe practises. The scope of the investigation is restricted to only 45 kilometres along NH-44 in the district of Gurugram. The techniques used for network screening need to be able to make use of collision data in order to identify highway segments that suffer an abnormally high number of collisions and thus have room for improvement in terms of safety. They must readily take into consideration a particular contributing element, produce statistically sound analysis findings at both the segment and network level, and be implemented in publicly accessible and/or frequently used commercial geographical information system software packages. Analysis of spatial data is put to use in the investigation of sequences of occurrences, and area analysis is the approach that is employed most often in the investigation of traffic accidents. "It's possible that implementing speed control countermeasures including education, engineering, and law enforcement might make these regions safer.

Before identifying issue spots along roadways, the research conducted by Bailey and Gatrell addresses the need of aggregating geographical data and performing the proper amount of event analysis. Visualization, exploratory analysis, and model

building are the three main methods of analysis that they provide for spatial data. When it comes to the environment of dealing with road traffic incidents and road policing, spatial analysis has three primary goals: providing a careful and accurate description of road accidents in geographic space, conducting a systematic exploration of patterns of accidents and the association between the accidents in space and time, and enhancing one's ability to predict and control accidents that take place in geographical space. This section focuses on how the regulations surrounding today's traffic enforcement need to be improved to adopt a more spatial and locational oriented approach in order to keep up with modern times.

This section provides an overview of the main policy measures that the government has undertaken towards the prevention of traffic accidents and the enforcement of traffic laws. It is essential to acknowledge that road policing is an essential aspect of the job that police do and to include it into the broader objectives and methods of policing. There is a broad variety of organisational models available for law enforcement on the road, ranging from a centralised command to a decentralised network. One of the primary challenges, however, is instructing law enforcement officers to understand and analyse the data. In order to determine the efficacy of the police, it is important to devise some form of measurement or standard that is applicable everywhere and serves as a benchmark against which different police agencies may be evaluated. The idea that there is a rising need for proactive and problem-oriented police is shared by analysts and researchers, and it was underlined in a recent government study on road policing that was carried out.

It is vital to have road policing in order to enhance the finances of the police department and to build public trust in their abilities to minimise crime and accidents on the roads. It is essential to approach the task of road policing as a spatial one, and to do so with an eye toward theory and the effective utilisation of resources. The management of hot spots, the management of behaviour, the management of recognised offenders, and the implementation of preventative measures are the four most critical things to undertake. Improving the tools used to gather data and focusing more emphasis on the need of traffic policing are both necessary initial stages in developing a solution to the problem. According to the findings of the HMIC study, many police departments approach road-policing intelligence in a piecemeal, ad hoc

fashion, and it is emphasised that there is a need to discern between a link and a partnership with other authorities.

It can be difficult to determine which police departments in the field of road policing are under-achieving due to the fact that one department may be successful in reducing the number of fatal accidents while another department may have similar success in reducing the number of accidents caused by excessive speed. In order to find a solution to this problem, law enforcement officials need to establish fruitful working relationships with municipal planners and/or roadway engineers. Over seventy percent of people who are injured on the roads in this country are of working age, and sixty percent of those people are living in poverty. This poses a danger to the nation's overall public health. Because of this, they are now forced to beg for money, and it is essential to combine pre- and post-crash efforts in southwest-specific traffic victim care in order to reduce the severity of the trauma and the number of injuries sustained. According to the findings of this research, which studied data from GPS devices that were used to monitor the movement of freight in Shenzhen, the peak hours for transit and foreign traffic on Shenzhen's western traffic channels are abnormally long. These peak hours stretch from 9:30 am to 17:00 pm. The interchange's effect on the horn traffic congestion on Binhai Avenue is directly responsible for the inadequate throughput that occurs at the crossroads. The purpose of this study is to investigate the changes that occurred in the spatial distribution of urban freight routes in Valencia (Spain) between the years 2005 and 2017. It was discovered that the planned roadway did not have any kind of traffic separation in place, and that there was a possibility of injury as a result of trees, por concrete crash barriers, missing or damaged kerbs and footpaths, disrepair of road signs and line painting, limitations on the ability to see different gantry and shoulder-mounted traffic signage, lack of retroreflective raised pavement markings and traffic impact attenuators along the route, and poor condition of metal beading along the route. The study highlights how important it is to take into consideration road intersections and to use a variety of statistical methodologies. An structured, methodical, and comprehensive evaluation of a road project carried out by qualified and trained auditors; the outcome of such an evaluation is a summary of the project's potential threats to public safety. This kind of evaluation is known as a road safety audit (RSA). Producing a road safety audit report that identifies and suggests solutions to road safety concerns takes a significant amount of effort, expertise,

knowledge, judgement, depth, and attention to detail. Audits of the road's safety may be conducted at any point in the construction process, including before, during, and after the work. Researchers in the Indian state of Haryana conducted a study to investigate the geographical distribution of nickel and chromium concentrations in roadside agricultural soils and how these concentrations were affected by varying traffic density, moisture levels, and varied incubation times. The Global Positioning System (GPS) was used in the process of collecting soil samples from six different locations along each traffic route.

It is well-liked because of the more affordable price tag and the adaptability it offers as web servers. In addition to this, it has GPIO pins, which stand for general purpose input/output pins and may be customised to meet the needs of each specific user.

This work modifies the duration of a certain green LED by making use of GPIO pins. The length of time that green lights are on in the direction of traffic congestion may be adjusted by the authorities using a Raspberry Pi, GPIO pins, and a camera mounted on each traffic light at a junction in order to do this. Images obtained by a camera that was installed on the northbound trac light of a typical four-way intersection would demonstrate to law enforcement personnel that there is an abnormally large number of traffic travelling in the direction of the north. The Raspberry Pi would act as the receiver of the signal sent by the authority, and it would convert the signal into a voltage so that it could be used with the GPIO pins on the Raspberry Pi. The traffic light would continue to operate according to the green light time that had been established by the authorities until it got another signal from the authorities ordering it to change.

The use of RFID technology to monitor and keep track of flow is essential to the operation of this system. Sensors are spaced at intervals ranging from 500 to 1000 metres (3280.84 ft) to guarantee accurate data collecting. The sites of ditches were ranked in order of priority according to whether or not they were surrounded by a permanently wetland, and each lawn needed to have been mowed in 2003. The municipal and state transportation agencies, the PDNRMIS, and a Metropolitan Planning Organization for the El Paso Area are some of the stakeholders whose demands must be met in this area. The mountain range known as the Himalayas surrounds the whole state of Jammu and Kashmir (also known as J&K), which is located in the very far north of India. National Highway 44, which travels from

Jammu to Srinagar, is the only road that provides access to both the Kashmir valley as well as the region of Ladakh. During the rainy season, National Highway 44 is often closed, cutting off the Kashmir valley from the rest of India. In order to facilitate better flow of traffic, widening the roadways should be a top priority. The hill slope collapse that threatens the Udhampur road stretch is the source of severe geological issues that are being investigated. A moderate to severe hill slope, colluvium deposits at the toe of the slopes, and a narrow river valley are some of the geomorphologic features of the project area. The valley is home to several smaller tributaries that run perpendicular to the main river. The Murree formation contains these sediments, which may be classified as semi-consolidated to cemented sandstones, siltstone, mudstone, shales, conglomerates, and clay layers, respectively. The Main Boundary Fault (MBF) in the outer Himalayas is the most well-known example of the succession of thrusts that may be seen in the local geology. Quartzite bands may be up to one metre thick and can vary in colour from a light grey to a pure white. During the course of the investigation of the site, several geological discontinuities were subjected to shearing movements, which resulted in the creation of a fractured character within the rocks, established continuity, and related geological phenomena. The poor geology that the civil team encountered in Jammu and Kashmir, which is located in Seismic Zone IV and Zone V, has caused a number of unexpected problems, including the collapse and cracking of residential buildings, agricultural land, a high-tension electricity tower, and the more common landslide. Jammu and Kashmir is located in India. In order to save both time and money, government agencies have to exercise extreme caution in future building projects and put into place preventive measures as well as probable causes of ground collapse and landslides.

The region around National Highway 44 is prone to landslides, and the stretch of highway that runs between Udhampur and Ramban is located in a tectonically active zone. There are several small bodies of water, the Nallas and Major River is Ta wi, and the rock is primarily soft, consisting of mud stone, clay stone, and siltstone with alternating bands of sandstone. Ta wi is an aboriginal word that means river. The factors that contribute to the occurrence of landslides in the area that is the subject of this research include natural characteristics such as topography and geology, as well as the actions of humans and the construction of buildings, and hydrological factors.

Slope angle, alternating areas of uns rocks, and the natural slope of valley sides are all characteristics that have been demonstrated to increase the likelihood of landslides occurring. The findings of kinematic study indicate that rock slopes are susceptible to a variety of failure mechanisms, such as debris flows, rock falls, rotational slides, and circular slides.Sliding has been seen on the thick colluvium deposits, particularly in the section that is located before Km 145. There is a possibility that the composition of slides, in addition to their size, may change depending on the mother rock. The highway rating for 19,000 kilometres of finished four- or six-lane national highways and expressways has been finished and is based on a total of 39 criteria, such as Highway Efficiency (45 points), Highway Safety (35 marks), and User Services (35 marks) (20 marks). The process of assigning ratings to highways is a dynamic activity that is supposed to become more accurate with each new iteration. Because of this programme, standards will be developed for the benchmarking and evaluation of highway corridors in India, and actions will be able to be done to enhance the ratings of corridors.

This thesis evaluates the potential of spatial analysis to improve the corridor efficiency by identifying and prioritising crash clusters, assessing the current burden of RTIs in terms of mortality, morbidity, and disability, understanding the various risk factors for road crashes, examining the outcomes and impact of RTIs, reviewing intervention strategies and approaches, tracing global developments and lessons learnt, and providing a framework for implementing road safe practises. The scope of the investigation is restricted to a 45-kilometer section of NH-44 in the Gurugram area. Methods of network screening need to be able to utilise collision data to identify highway segments that encounter a higher number of collisions than usual and, as a result, have an opportunity to enhance safety. They need to provide statistically sound analysis results at both the segment and network level, they need to be implemented in freely available and/or commonly used commercial geographical information system software packages, and they need to easily take into consideration a particular contributing factor. Investigations into sequences of occurrences often make use of spatial data analysis, and area analysis is by far the most common approach to studying collisions on the road. The use of speed control countermeasures in several areas, including as engineering, education, and law enforcement, may improve overall safety.

The research conducted by Bailey and Gatrell emphasises the need of aggregating geographical data and doing the proper amount of event analysis before identifying trouble locations along roadways. They provide three separate methods of analysing spatial data, which are visualisation, exploratory, and modelling respectively. When it comes to the environment of dealing with road traffic incidents and road policing, spatial analysis has three primary goals: providing a careful and accurate description of road accidents in geographic space, conducting a systematic exploration of patterns of accidents and the association between the accidents in space and time, and enhancing one's capacity to predict and control accidents that take place in geographical space. This section focuses on how the regulations surrounding today's traffic enforcement need to be upgraded to adopt a more spatial and locational-based approach in order to keep up with modern times.

In the following section, the main policy actions that the government has undertaken in regard to highway collisions and highway police are outlined. It is essential to acknowledge that road policing is an essential component of overall police activity and to include it into overall policing aims and tactics. When it comes to organising law enforcement on the road, there is a broad variety of alternatives available, ranging from a centralised command to a decentralised network. One of the most important challenges, however, is teaching officers to understand and grasp the data. In order to determine the efficacy of the police, it is important to devise some form of measurement or standard that is applicable everywhere and serves as a basis for comparison between different police agencies. A opinion that was recently reflected in a government study on road policing was that there is an increasing demand for proactive and problem-oriented police. This view is shared by analysts and academicians.

Road policing is crucial if the police are going to improve their finances and raise public trust in their abilities to prevent both crime and accidents on the roads. It is essential to approach the task of road policing as a spatial one, and to do so with an eye toward theory and the effective utilisation of resources. Hot spot management, targeting offenders who have been identified, behaviour management, and preventative actions are the four most critical things that should be done. Improving the ways in which statistics are collected and placing a greater emphasis on the need of traffic policing are necessary first steps in finding a solution to the problem.

According to the findings of the HMIC study, the majority of police departments approach road-policing intelligence in a piecemeal, ad hoc fashion. The study also highlights the need of differentiating between a partnership and a link with other authorities.

It is difficult to determine which police departments in the field of road policing are under-achieving due to the fact that one department may be successful in reducing the number of fatal accidents while another department may have similar success in reducing the number of accidents that were caused by excessive speed. In order to find a solution to this problem, law enforcement agencies need to engage in fruitful collaboration with transportation engineers and/or municipal planners. With almost 70 percent of victims being of working age and 60 percent of them living in poverty, injuries incurred on the nation's roadways constitute a danger to public health. As a result of this, they are now engaging in panhandling, and it is essential for southwest-specific traffic victim care to combine pre- and post-crash activities in order to reduce the severity of the trauma and the number of injuries sustained. According to the findings of this research, which studied data from GPS devices that were used to monitor freight movement in Shenzhen, the peak hours for transit and foreign traffic on Shenzhen's western traffic channels are abnormally long. These peak hours stretch from 9:30 am to 17:00 pm. It is a direct result of the interchange's impact on the horn traffic congestion on Binhai Avenue because the throughput at the junction is insufficient. In this study, the spatial distribution of urban freight routes in Valencia (Spain) between the years 2005 and 2017 is analysed from a temporal perspective. It was discovered that the planned roadway did not have any kind of traffic separation in place, and that there was a possibility of injury due to trees, por concrete crash barriers, missing or damaged kerbs and footpaths, disrepair of road signs and line painting, limitations on the ability to see different gantry and shoulder-mounted traffic signage, a lack of retroreflective raised pavement markings and traffic impact attenuators along the route, and poor condition of metal beading along the route. The study highlights how important it is to take into consideration road intersections as well as combine a variety of statistical methodologies. An structured, methodical, and comprehensive evaluation of a road project carried out by licenced and trained auditors, a road safety audit is a process that ultimately results in a summary of the project's future safety risks (RSA). Producing a road safety audit report that identifies

and suggests remedies to road safety concerns takes considerable amounts of time", expertise, knowledge, judgement, in-depth research, and attention to detail. Audits of the road's safety may be carried out at any point, including before, during, and after construction. In the Indian state of Haryana, researchers investigated the geographical distribution of nickel and chromium concentrations in agricultural soils along roadsides, focusing on how these concentrations were affected by varying traffic density, levels of moisture, and varied incubation times. The Global Positioning System (GPS) was used in order to gather soil samples from a total of six different places located along each traffic route.

8.3 Key finding and conclusions

Numerous conclusions from the study are provided, each with a detailed explanation based on a point. All of the concepts are related, but in order to grasp them simply, they must be mentioned briefly in each stanza. Thus, the following explanations apply to everybody.

- "As can be seen from the analysis, the graph and table above show the sample data, which consists of 350 respondents. Age was examined, and 105 respondents (30%) said they were 18–25 years old, 75 respondents (21.4%) said they were 25–40 years old, and 105 respondents (30%) said they were 40–60 years old, while 65 respondents (18.6%) said they were above 60.
- Based on the study, the graph and table above show the sample data, which consists of 350 respondents. When the topic of sex was raised, 155 respondents (44.3%) identified as male and 195 respondents (55.7%) as female.
- • Based on the study, it was discovered with the use of the above table and graph, which show the 350 sample data points. When asked about their marital status, 160 respondents (45.7%) said they were married, 130 respondents (37.1%) said they were single, and 60 respondents (17.1%) said they were divorced.
- On the basis of on the study, it has been found that the graph and table above, which show the sample data made up of 350 respondents, are accurate. There was talk about occupation. 40 respondents (11.4%) said they were employed, 95 respondents (27.1%) said they had their own business, 50 respondents

(14.3%) said they were retired, 60 respondents (17.1%) said they were students, and 60 respondents (17.1%) said they were unemployed.

- It was determined on the research conducted, it became apparent with the use of the above table and graph, which show the sample data consisting of 350 respondents. When the topic of vehicles was brought up, 120 respondents (or 34.3%) said they drove two-wheelers, 60 respondents (17.1%) said they drove three-wheelers, 100 respondents (or 28.6%) said they drove four-wheelers, and 70 respondents (20%) said they drove heavy vehicles.
- The study revealed what was noticed with the aid of the above table and graph, which show the sample data, which consists of 350. When asked about fuel, 120 respondents (34.3%) said they used gasoline, 130 respondents (37.1%) said they used diesel, and 100 respondents (28.6%) said they used CNG.
- Based on the study, it was discovered with the use of the above table and graph, which show the sample data consisting of 350 respondents. Brand was the topic of discussion. Maruti Suzuki was mentioned by 60 (17.1%) respondents, while 55 (15.7%) respondents replied. Tata, 65 respondents (18.6%), Ashok Leyland, 50 respondents (14.3%), Hyundai, and 55 respondents (15.7%) were the responses received.
- The study revealed that the sample data, which consists of 350 respondents, is shown in the above graph and table. Vehicle Model 80(22.9%) was brought up for discussion, to which respondents replied. 85 responders, or 24.3%, who were two years old 100 respondents, or 28.6%, who are five years old, replied. Ten years old, whereas 85 (24.3%) of the participants answered older than ten years.
- The study showed that the sample data, which consists of 50 respondents, is shown in the graph and table above. Age was examined, and 12 (24%) respondents said they were 20–30 years old, 14 (28%) said they were 30–40 years old, and 8 (16%) said they were 40–50 years old, while 16 (32%) said they were 50–60 years old.
- The study demonstrated that the sample data, which consists of 50 respondents, is shown in the graph and table above. When asked about their position, 14 (28%) respondents said they were constables, 13 (26%) said they

were sub-inspectors, and 13 (26%) said they were inspectors, while 10 (20%) said they were others.

- Based on the study, it was discovered with the use of the above table and graph, which show the sample data consisting of 50 respondents. Location was mentioned, and 11 respondents (or 22%) said Chandnibag, 7 respondents (or 14%) said Samalkha, 7 respondents (or 14%) said Gannaur, 4 respondents (or 8%), said Murthal, and 7 respondents (or 14%) said Rai.
- From the research, it was discovered with the use of the above table and graph, which show the sample data consisting of 50 respondents. The subject of working timing was covered. 14 (28%) of the respondents said they were in the 10 am to 6 pm time frame, 17 (34%) said they were in the 6 pm to 2 am time frame, and 19 (38%) said they were in the 2 am to 10 am time frame.
- The study revealed that the sample data, which consists of 50 respondents, is shown in the graph and table above. The topic of accident types was covered. 11 (22%) of the respondents who were observed gave the response "fatal," 12 (24%) gave the response "grievous injury," 14 (28%) gave the response "minor injury," and 13 (26%) gave the response "no injury."
- The study discovered that the sample data, which consists of 50 respondents, is shown in the graph and table above. When asked how many accidents happened each day, 15 (or 30%) responders answered. Less than five, nine (18%), five to ten, and twelve (24%), ten to fifteen, while fourteen (28%), more than fifteen, respondents said.
- Based on the investigation, we have discovered the information shown in the table and graph above, which indicates that the sample data includes around 100 respondents.Factors Contributing to Accidents: Operator Thirteen percent(12%) of respondents said they agreed, seven percent(7%) said they disagreed, twelve percent(69%) said they agreed, and five percent(5%) said they strongly disagreed.
- Depending on the examination, we have discovered the information shown in the table and graph above, which indicates that the sample data includes around 100 respondents.Factors Contributing to Accidents: Road Conditions Eight(8%) respondents said they strongly agreed, nine(9%) said they agreed,

sixty-three(63%) said they had no idea, thirteen(13%) said they disagreed, and seven(7%) said they strongly disagreed.

- Based on our research, we have discovered the information shown in the table and graph above, which indicates that the sample data includes around 100 respondents.Factors Contributing to Accidents: Car Seven percent of respondents said they strongly agreed, twenty percent said they agreed, forty-seven percent said they had no idea, nineteen percent said they disagreed, and seven percent said they strongly disagreed.
- Throughout the investigation, we have discovered the information shown in the table and graph above, which indicates that the sample data includes around 100 respondents.Factors Contributing to Accidents: Weather Situations Seven percent (7%) of the respondents gave a response. firmly Indeed, 29 (29%) of the respondents said Yes, 48 (48%) of the respondents said Ten (10%) respondents said they had no idea, while six (6%), said they disagreed. vehemently disagree
- Based on the search, we have found the information shown in the table and graph above, which indicates that the sample data includes around 100 respondents.vFactors Contributing to Accidents: People on foot 52 respondents said they had no idea, 2 respondents said they strongly agreed, 28 respondents said they agreed, 11 respondents said they disagreed, and 7 respondents said they strongly disagreed.
- Based on our research, we found the information shown in the table and graph above, which indicates that the sample data includes around 100 respondents.How can the government minimize accidents? Strongly Agree was the response from 9 (9% of respondents), and 14 (14% of respondents) Agree was the response from 60 (60%) respondents, followed by No Idea, disagree (16%), and Strongly Disagree (1%).

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APPENDICES

a. Appendix 1-INTERVIEW SCHEDULE ON DOCTORAL RESEARCH

Questionnaire

Lovely Professional University
Department of Geography

Place_____ **Date**____/____/202__

Good Morning/Afternoon.

I am the research scholar of 'Lovely Professional University' and I am pursing Ph.D. on '**Spatial Analysis of Road Accidents on National Highways-44, From Kundli to Panipat: A Study in Transport Geography'.** It is observe that the road accidents are continuously increasing on NH-44. Today, I am conducting a survey and need of your 8-10 minutes from your precious time to make roads safer for all road users. Your opinion, observation and driving experience can be helpful to promote road safety research. Please be kind enough to fill in the appended questionnaire pertaining to my doctoral study and is conducted anonymously.

Demographic Information

1. **Name:** _____ **Contact :** _____
2. **Age :** _____ **(years)**
3. **Sex:** Male ☐ Female ☐
4. **Nationality:** Indian ☐ Other ☐
5. **Place:** Rural ☐ Urban ☐ Semi-urban ☐
6. **Religion:**
   Hindu ☐ Sikh ☐ Muslim ☐ Others ☐
   Caste group: _____ Caste: _____
7. **Education:**
   Illetrate ☐ Secondary ☐ Professional ☐
   Primary ☐ Graduate ☐
   Matric ☐ Post-Graduate ☐
   - *If any others, Please mention:*_____
8. **Marital status :** Married ☐ Unmarried ☐ Divorced ☐
9. **Types of Family :** Joint ☐ Separate ☐

10. Number of members in the family: _____

11. Language:

Hindi	☐	English	☐
Panjabi	☐	others	☐

- *If any others, Please mention:*_____

12. Occupation:

Govt. Job	☐	Retired	☐	Agriculture	☐
Pvt. Job	☐	Student	☐	Housewife	☐
Own business	☐	Unemployed	☐		

- *Which post, Please mention:*_____

13. Annual/Monthly income: _____ **(in Rupees)**

Below Rs.10,000	☐	Rs.10,001 to Rs.20,000	☐
Rs. 20,001 to Rs. 30,000	☐	Above Rs. 30,001	☐

Vehicle Information

1. **Vehicle driven**

   Two Wheelers ☐ Three Wheelers ☐ Four Wheelers ☐

   Heavy Vehicles ☐

   - *Which vehicle, Please mention:*_____

2. **Fuel**

   Petrol ☐ Diesel ☐ CNG ☐

   - *Other:*_____

3. **Brand**

   Maruti Suzuki ☐ Tata ☐ Ashok Leyland ☐

   Hyundai ☐ Honda ☐

   - *Which company, Please mention:*_____

4. **Vehicle Model**

   Two years old ☐ Five years old ☐ Ten years old ☐

   More than 10 years old ☐

   - *Which Model, Please mention:*_____

5. **Details of driving vehicle**

   Own vehicle ☐ Hired ☐ Driver ☐

6. **Insurance of Vehicle**

   Yes ☐ No ☐ Why_____

   - *Which company, Please mention:*_____

7. **Pollution of vehicle**

   Yes ☐ No ☐ Why_____

   - *Which company, Please mention:*_____

Driver's Characteristics

8. Do you hold a Driving License?

Yes ☐ No ☐

When had you make _____ State _____

9. **Have you undergone driving Training?** Yes ☐ No ☐

10. **How long your experience for driving?**

Less than 5 years ☐ 5 years to 10 years ☐ 11 years to 15 years ☐

16 years to 20 years ☐ Above 20 years ☐

11. **Do you follow the road signs and signal?** Yes ☐ No ☐

12. **How long are you using the road for driving?**

Less than 5 years ☐ 5 years to 10 years ☐ 11 years to 15 years ☐

16 years to 20 years ☐ Above 20 years ☐

13. Have you fined or warned earlier?

Yes ☐ No ☐

If yes, what is the reason _____

- *Which type, Please mention:*_____

14. **Daily working Hours:**

8 to 10 Hours ☐ 10 to 12 Hours ☐ 12 to 14 Hours ☐ More than 14 ☐

15. **Health Issues if any**

High BP ☐ Hyper Tension ☐ Diabetic ☐ Occupational Stress ☐

Nil ☐

- *Other issues, Please mention:*_____

16. Using vehicle since _____ (years)

17. Have you met any road accident while driving? Yes ☐ No ☐

If yes, please describe:

_____

_____

18. Which time did you observe the maximum traffic congestion at this road.

a. 06 am ☐
b. 10 am ☐
c. 02 pm ☐
d. 06 pm ☐
e. 10 pm ☐

Any other, Please mention_____

19. What are the solutions for the increasing traffic congestion?

- More One-way roads ☐
- More Signals ☐
- Proper location of public utility ☐
- More traffic police ☐
- More CCTV cameras ☐

Any other, Please mention _____

Factors Involving for Accidents

Driver Road conditions Vehicle Weather conditions Pedestrian Government factor

Opinion for the reasons of road mishaps						
Factors		Strongly Disagree	Disagree	No idea	Agree	Strongly Agree
		1	2	3	4	5
Driver						
1	Over speed driving					
2	Rough driving					
3	Make a cut in front of another driver.					
4	Follow another vehicle.					
5	Drive on wrong side.					
6	Wrong overtaking					
7	Follow speed limit.					
8	Change the lanes					
9	Violation of road rules					
10	Failure to understand signs					
11	Break traffic signal					
12	Follow traffic lane.					
13	Avoid the distraction.					
14	Disobey the stop sign					
15	Ignore traffic laws to get ahead in traffic.					
16	Violate traffic laws because of peer pressure or friends.					
17	Slow down but not stop completely at a stop sign.					
18	Overload vehicle.					
19	Sleeping					
20	Drunken drive					
21	Cell phone driving					
22	Smoking					

10

23	Eating					
24	Deal with children.					
25	Personal grooming (such as combing hair, putting on makeup).					
26	Change radio stations, CDs, or tapes.					
27	Talk to other passengers.					
28	Apply sudden brake.					
29	Stop vehicle before zebra crossing.					
30	Park the vehicle in authorized parking.					
31	Use safety accessories (Seat belt etc.)					
32	Lack of Awareness					
33	Make an angry, insulting or obscene gesture or comment another driver.					
Road condition						
1	Potholes					
2	Damaged road					
3	Eroded road merging of rural roads with highway					
4	Diversions					
5	Illogical speed breakers					
6	Signal lights on curve roads					
7	Red light on crossing					
Vehicle						
1	Improper maintenance					
2	Bad Tyre conditions					
3	Insufficient headlights					
4	Projection loads					
5	Avoiding safety gears like seat belt or helmet					
6	Mechanical fault					

Weather Conditions						
1	Fog					
2	Heavy rainfall					
3	Wind storms					
4	Fluid road					
5	Very hot					
Pedestrian						
1	Lack of Pedestrian Discipline					
2	Carelessness					
3	Crossing at wrong places moving on carriage way pedestrians					
4	Disobey walk along the pedestrian path & Zebra crossing					
Government should do for reducing accidents						
1	Driver should be penalized heavily					
2	People should be educated form driving school					
3	Road environment must be improved					
4	Bad condition vehicles should be restricted					
5	Installing more red light on crossing					

Remarks

_____

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Accidents Classified According To Type of Vehicles and Objects Involved

Type of vehicle		Number of accidents				
		Fatal	Grievous injury	Minor injury	Non-injury	Total
1	Motor cycle/scooter					
2	Moped					
3	Auto rickshaw					
4	Motor car					
5	Jeep					
6	Taxi					
7	Bus					
8	Truck					
9	Tempo					
10	Articulated Vehicle					
11	Tractor					
12	Other Motor vehicles					
Other vehicle and objects						
1	Cycle					
2	Cycle rickshaw					
3	Animal drawn vehicle					
4	Pedestrian					
5	Animal					
6	Tree					
7	Level crossing					
8	Other fixed objects					
Age of vehicle (In year)						
1	Less than 1 year					
2	1-2					
3	2-5					
4	5-10					
5	10 and above					

Questionnaire

Nearby shops or other assets

Lovely Professional University
Department of Geography

Place_____ **Date**____/____/202__

Good Morning/Afternoon.

I am the research scholar of 'Lovely Professional University' and I am pursing Ph.D. on '**Spatial Analysis of Road Accidents on National Highways-44, From Kundli to Panipat: A Study in Transport Geography'.** It is observe that the road accidents are continuously increasing on NH-44. Today, I am conducting a survey and need of your 8-10 minutes from your precious time to make roads safer for all road users. Your opinion, observation and driving experience can be helpful to promote road safety research. Please be kind enough to fill in the appended questionnaire pertaining to my doctoral study and is conducted anonymously.

Factors Involving for Accidents

Driver **Road conditions** **Vehicle** **Weather conditions** **Pedestrian** **Government factor**

Opinion for the reasons of road mishaps						
	Factors	**Strongly disagree**	**Disagree**	**No idea**	**Agree**	**Strongly Agree**
		1	**2**	**3**	**4**	**5**
Driver						
1	Over speed driving					
2	Rough driving					
3	Make a cut in front of another driver.					
4	Follow another vehicle.					
5	Drive on wrong side.					
6	Wrong overtaking					
7	Follow speed limit.					
8	Change the lanes					
9	Violation of road rules					
10	Failure to understand signs					
11	Break traffic signal					
12	Follow traffic lane.					

13	Avoid the distraction.					
14	Disobey the stop sign					
15	Ignore traffic laws to get ahead in traffic.					
16	Violate traffic laws because of peer pressure or friends.					
17	Slow down but not stop completely at a stop sign.					
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1	Potholes					
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1	Improper maintenance					
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3	Insufficient headlights					
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5	Avoiding safety gears like seat belt or helmet					
6	Mechanical fault					
Weather Conditions						
1	Fog					
2	Heavy rainfall					
3	Wind storms					
4	Fluid road					
5	Very hot					
Pedestrian						
1	Lack of Pedestrian Discipline					
2	Carelessness					
3	Crossing at wrong places moving on carriage way pedestrians					
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Government should do for reducing accidents						
1	Driver should be penalized heavily					
2	People should be educated form driving school					
3	Road environment must be improved					
4	Bad condition vehicles should be restricted					
5	Installing more red light on crossing					

Remarks

_____

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Type of vehicle		Number of accidents				
		Fatal	Grievous injury	Minor injury	Non-injury	Total
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6	Taxi					
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8	Truck					
9	Tempo					
10	Articulated Vehicle					
11	Tractor					
12	Other Motor vehicles					
Other vehicle and objects						
1	Cycle					
2	Cycle rickshaw					
3	Animal drawn vehicle					
4	Pedestrian					
5	Animal					
6	Tree					
7	Level crossing					
8	Other fixed objects					
Age of vehicle (In year)						
1	Less than 1 year					
2	1-2					
3	2-5					
4	5-10					
5	10 and above					

Questionnaire
Traffic Police and Guards

Lovely Professional University
Department of Geography

Place_____ **Date**____/____/202__

Good Morning/Afternoon.

I am the research scholar of 'Lovely Professional University' and I am pursing Ph.D. on '**Spatial Analysis of Road Accidents on National Highways-44, From Kundli to Panipat: A Study in Transport Geography'.** It is observe that the road accidents are continuously increasing on NH-44. Today, I am conducting a survey and need of your 8-10 minutes from your precious time to make roads safer for all road users. Your opinion, observation and driving experience can be helpful to promote road safety research. Please be kind enough to fill in the appended questionnaire pertaining to my doctoral study and is conducted anonymously.

Name: _____

Age: _____

Occupation: _____

Location: _____

Work timings: _____

Types of accidents you observed:

_____

_____

_____

_____

How many numbers of accidents occurred daily in your duty location?

_____

_____

What types of vehicles usually involve in accidents in your duty location?

Types of vehicles	Location of vehicle accident		
Two-wheeler			
Three- wheeler			
Four- wheeler			
Six-wheeler			
Other vehicles			

Specify the reasons according to you for road traffic accidents in your location:

a.	b.	c.
d.	e.	f.
g.	h.	i.

Do you observe traffic congestion in your duty location?

Yes ☐ No ☐

Specify the locations you observed traffic congestion?

Low traffic congestion and its locations Names timings

Location	Time From	Time To

Medium traffic congestion and its locations Names with timings

Location	Time From	Time To

High traffic congestion and its locations Names with timings

Location	Time From	Time To

How many traffic signals in your duty location: _____

Are all the traffic signals in your duty locations working? _____

Who manages the traffic signals: Manual ☐ Automatic ☐

Suggest new locations for installing new traffic signals in the city:

i.	ii.
iii.	iv.
v.	vi.
vii.	viii.
ix.	x.

What should be implemented to reduce road accident on NH-44

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b. **Appendix I1-"SPATIAL ANALYSIS OF ROAD ACCIDENTS ON NATIONAL HIGHWAYS - 44, FROM KUNDLI TO PANIPAT :A STUDY IN TRANSPORT GEOGRAPHY"**

MadhyaPradeshJournalofSocialSciencesISSN:0973-855X(Vol29 No1,Jan-June2024)
Journal of M.P.Institute of Social Science Research, Ujjain **UGC CARE Group 1**

Analysis the Causes of Road Accidents on National Highway-44, Panipat to Kunldy

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Abstract

The main objective of the paper is to analyse the main cause and factors of road accidents on National Highways-44. The numbers of vehicles are increasing day by day due to essay finance services and due to this number of accidents also increasing. There are many causes of road accidents like human errors, weather conditions, failure of machine, poor conditions of roads and so many reasons behind the accidents. The number of people are injured or killed in road accidents; this is main problem of any country. To analysis the causes of road accidents primary and secondary data will be collected and use appropriate statistical techniques are used to find the different causes of road accidentson the stretch of National Highway 44 in Haryana extending from Kundli to Panipat, totalling 60 kilometres in length, the statistics on road accidents have been subjected to a comprehensive study (India). The investigator discovered hot spot area of accidents but main focus on find the main causes of road accidents on National highways and based on the finding of the study countermeasure that how to minimise the road accidents, main causes behind the road accidents.

Key Words: Accidents, National Highways, Statistical Techniques, Causes.

Introduction

In this paper, we explored the study methods in depth; this paper will focus on the major cause and factors of road accidents androad users cause significant social costs in the form of traffic congestion and vehicle accidents.Shefer and Rietveld argue, regular traffic speeds would be higher, increasing the likelihood of major injuries or deaths.More accidents could occur as a result of when we ignore traffic rule regulation. Today is traffic congestion is main problem of road accidents and Congestion on the roads in Shillong has grown into a major issue for everyone there.Nearly 85,000

people are murdered and another 300,000 are wounded in traffic accidents in India each year. Every 10 minutes, a person is murdered on Indian roadways, while an accident occurs every 3 minutes.Despite having the second-lowest motorization rate in the world, India accounts for 6 percent of all road fatalities. The major causes and factors of road accidents are following

Human error: This is one of the leading causes of road accidents. Human errors can include various factors such as distracted driving, speeding, and reckless driving, driving under the influence of drugs or alcohol, and fatigue. Distracted driving is when a driver is not paying attention to the road while driving.

Poor road conditions: Poor road conditions such as potholes, uneven surfaces, and inadequate road markings can lead to accidents, especially when drivers are not familiar with the road.

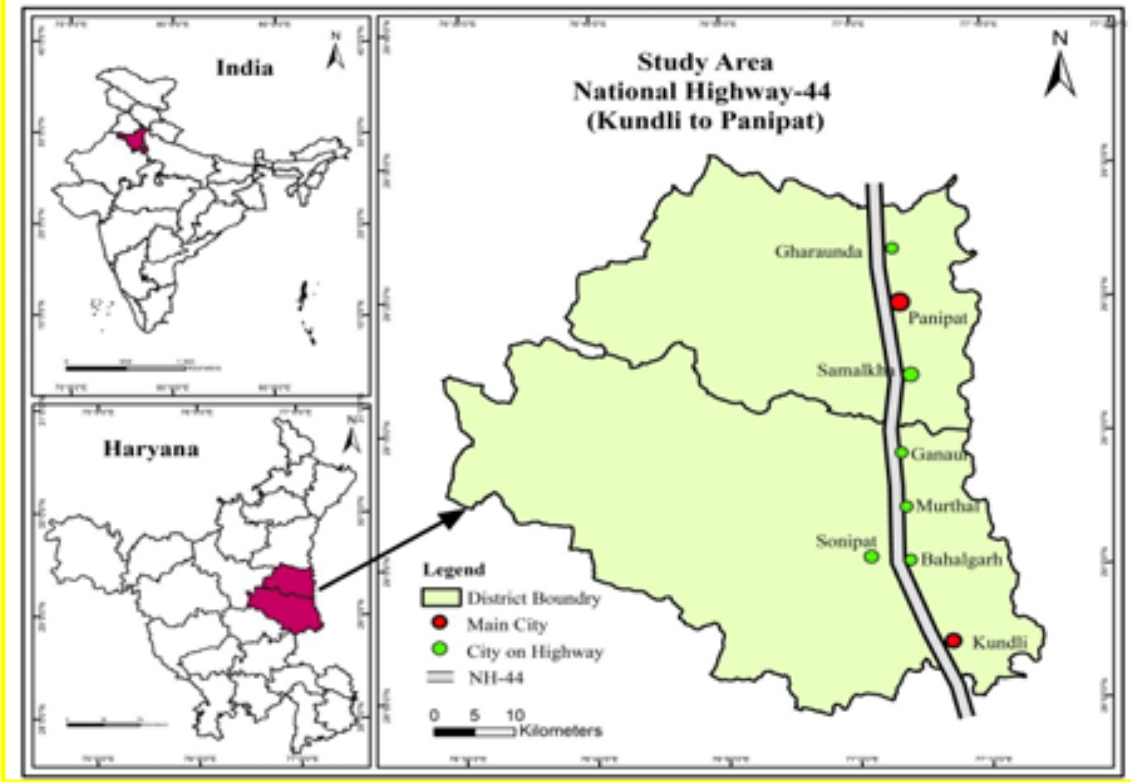
Vehicle defects: Vehicle defects such as faulty brakes, tires, and steering can lead to accidents, especially at high speeds. Regular maintenance of the vehicle is essential to ensure that all systems are functioning properly.

Weather conditions: Adverse weather conditions such as heavy rain, fog, and snow can reduce visibility and make it difficult for drivers to control their vehicles, increasing the risk of accidents. For example, rain can make the road surface slippery, reducing the grip of the tires, and making it difficult for drivers to control the vehicle.

Non-adherence to traffic rules:Non-adherence to traffic rules such as jumping red lights, improper lane usage, overtaking from the wrong side, and using mobile phones while driving can cause accidents. Disobeying traffic rules can lead to collisions and accidents.

Lack of awareness: Lack of awareness among drivers about safe driving practices, traffic rules and regulations, and road safety measures can also lead to accidents. For example, some drivers may not be aware of the importance of wearing seat belts or the dangers of driving under the influence of drugs or alcohol.

Map of Study Area



Study area

The study area is situated along National Highway 44 (NH-44), India's longest roadway, stretching from Srinagar in the north to Kanyakumari in the south. This national route holds immense significance as a pivotal transportation link connecting diverse regions and cultures across the country. However, our research narrows its focus to a specific segment of NH-44 located in the northern state of Haryana, spanning approximately 184 kilometers. The total length of study stretch is 65-kilometer between the Kundli border and Panipat. The study area lies between 29° 24' 06"N to76°58' 35"N latitudes and 28° 52' 03"E to 77° 07' 22"E longitudes.This stretch plays a crucial role in linking Haryana with the national capital, Delhi. Of historical importance, this Haryana section of NH-44 is a part of the illustrious Grand Trunk Road, renowned for connecting Attari in Punjab, near the India-Pakistan border, to Delhi. The historical relevance of this road network extends into the contemporary era, retaining its strategic importance.These endeavors aim to mitigate congestion, enhance road conditions, and facilitate smoother traffic flow along this vital corridor.

Panipat city presents distinctive challenges to travellers on NH-44. Encroachments on both sides of the highway have contributed to traffic congestion and driver frustration. Consequently, there's a pressing need to address these encroachments and implement effective traffic management strategies within the city, a significant concern within our study area.A central focus of this study revolves analysis the causes of road accidents. NH-44 in this region has gained notoriety for its safety challenges, with an alarming estimated 743 fatalities reported in a single year. This alarming statistic underscores the immediate need for comprehensive investigations and interventions to rectify safety issues within the study area.

Objective of Study

The main objective of the study

- To determine the major causes of road accidents on National Highway-44
- To observe the trend in the growth of accidents from the last ten years, 2010 to 2020.

Database and Methodology

The study is "empirical research based on the survey method. Both primary and secondary data were collected for the study.

1. The secondary data will be collected from the National Highway Authority of India (NHAI), Office of the Superintendent of Police.

2. The primary data collected threw a well-structured questionnaire will be prepared using closed and open-ended questions.

3. Use appropriate statistical techniques are used for obtaining meaning full and consider able picture of whole data so that it could be easily comprehended. To analyzedthe following statistical procedures were adopted in the present study.

4. To understand the level of various variables techniques of mean, standard deviation, percentile, Mean, Median, Mode, Standard Deviation andcorrelation technique was used.

Significance of the study

Present research will shed light on vehicle-related fatalities and accidents. Using a variety of statistical methods, we will investigate the root causes of traffic collisions and the widespread lack of road safety knowledge. The current research will shed new light on the issue of traffic safety for policymakers in the police department, the government, and the regional transport office, as well as drivers of all sorts of vehicles.

Results and Discussion

Table-1 Monthly wise distributions of accidents on N.H-44 Panipat to Kundly

Month	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
January	12	13	11	14	16	15	17	17	16	18	19	168
February	08	11	12	09	13	14	09	08	08	11	10	113
March	09	08	11	10	08	11	10	13	09	08	07	104
April	09	10	08	07	11	08	10	10	12	12	12	109
May	11	10	13	13	09	09	12	07	07	12	09	112
June	07	11	10	12	12	12	09	12	09	07	12	113
July	11	09	07	08	09	07	14	09	10	12	11	107
August	10	10	12	12	11	09	10	12	09	10	12	117
September	09	10	09	11	13	10	07	11	08	11	14	113
October	12	12	11	08	07	09	11	12	17	13	15	127
November	11	09	09	10	05	08	12	15	17	16	13	125
December	13	14	14	15	16	17	18	16	18	17	16	174
Total	122	124	127	129	130	133	139	142	144	147	150	

Source of Data- S.P Office Panipat,Sonipat

When we analysed the accidents data of National Highway-44 monthly wise accidents scenario show that most of accidents were occurred in the months of January 2010 to2020 168 and December 174 because of in this month's fog and bad weather conditions are may be responsible and remaining are occurred in table number -1 in this paper.

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Table-1 Monthly wise distributions of accidents on N.H-44 Panipat to Kundly

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January	12	13	11	14	16	15	17	17	16	18	19	168
February	08	11	12	09	13	14	09	08	08	11	10	113
March	09	08	11	10	08	11	10	13	09	08	07	104
April	09	10	08	07	11	08	10	10	12	12	12	109
May	11	10	13	13	09	09	12	07	07	12	09	112
June	07	11	10	12	12	12	09	12	09	07	12	113
July	11	09	07	08	09	07	14	09	10	12	11	107
August	10	10	12	12	11	09	10	12	09	10	12	117
September	09	10	09	11	13	10	07	11	08	11	14	113
October	12	12	11	08	07	09	11	12	17	13	15	127
November	11	09	09	10	05	08	12	15	17	16	13	125
December	13	14	14	15	16	17	18	16	18	17	16	174
Total	122	124	127	129	130	133	139	142	144	147	150	

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When we analysed the accidents data of National Highway-44 monthly wise accidents scenario show that most of accidents were occurred in the months of January 2010 to2020 168 and December 174 because of in this month's fog and bad weather conditions are may be responsible and remaining are occurred in table number -1 in this paper.

Table-2 Road Accidents by Type of Traffic Rules Violation

Category	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Over Speed	81	**75**	71	77	72	68	69	75	68	76	73
% Share in Total	66.39	61.47	58.19	63.11	59.01	55.73	56.55	61.47	55.73	62.29	59.83
Drunken driving/ consumption of alcohol & drug	04	6	2	7	5	8	4	03	09	03	09
% share of total	3.27	4.91	1.63	5.73	4.09	6.55	3.22	2.45	7.73	2.45	7.73
driving on wrong side/Lane indiscipline	07	06	10	8	09	11	08	06	07	05	10
% share of total	5.73	4.91	8.19	6.55	7.37	9.01	6.55	4.91	5.73	4.09	8.19
Jumping red light	04	03	02	02	03	05	04	06	03	02	07
% share of total	3.27	2.45	1.63	1.63	2.45	4.09	3.27	4.91	2.45	1.63	5.73
Use of mobile phone	03	01	02	04	03	05	04	02	03	01	06
% share of total	2.45	0.81	1.63	3.27	2.45	4.09	3.27	1.63	2.45	0.81	4.91
Others	23	31	35	24	30	25	33	30	32	35	17
% share of total	18.85	25.40	28.68	19.67	24.59	20.49	27.04	24.59	26.22	28.68	13.93
Total	122	124	127	129	130	133	139	142	144	147	150

Source of Data- S.P Office Panipat,Sonipat

When we analysed the accidents data of National Highway-44 monthly wise accidents scenario show that minimum 122 accidents occurred in 2010 and maximum accidents 150 2021.

The accidents of over speed were 81 in 2010 with the 66.39% and 75 accidents in 2017 with the 61.47%.

The accidents due to use of alcohol or drugs were minimums 2 (1.63%) in the year 2012 and maximum 9 in 2020 with the percentage 7.73% and minimum 2 cases in 2012 with percentage 1.63%.

The maximum cases of wrong sides accidents 11 in the year 2015 (9.01%) and minimum 05 accidents in the year 2017 with the percentage of 4.09%.

Jumping the red light maximum cases were 07 in the year 2020 with 5.73% and minimum in 02, 02, 02 cases the year 2012, 2013, 2019 respectively.

The minimum 1, 1 accident occurred in the year 2011 and 2019 with percentage 0.81 and maximum 6 cases in 2020 (4.91). 5.73

The other causes of road accidents maximum 35, 35 in the year 2012 and 2019 and minimum 17 in the year 2020 with the percentage of 13.09%.

Review of literature

1. (Erdogan 2009) Studied "Explorative spatial analysis of traffic accident statistics and road mortality among the provinces of discovered and for this research, we are attempting to understand the disparities in traffic accidents and deaths that occur across provinces in Turkey. The performance of Turkey's provinces in terms of road safety was assessed using two separate risk indicators.The mean annual rate of mortality and the number of fatal accidents obtained between 2001 and 2006 were analyzed in a spatial context. Since there are so few people in each province and so few accidents and deaths, empirical Bayes smoothing was employed to eliminate any unwanted noise from the raw mortality and accident rates. This might contribute to more effective administration of Turkey's road safety.

2.(Bennett 2010) Studied "Spatial Analysis of Motor Vehicle Accidents in Johnson City, Tennessee, as Reported to Washington County Emergency" discovered and Motor vehicle accidents that occurred inside the city boundaries of Johnson City, Tennessee, between January 1, 2000 and December 31, 2009, were analyzed in this research using 911 call-for-service data. For nearby houses, the kind of road, and the distance from a traffic light to check records were all taken into consideration. Nearby analysis, point pattern analysis and hotspot analysis were used to

analyze the data.. Roadway junctions account for 40 percent of injury accidents, with signalized intersections accounting for 22 percent. The Washington County Emergency Communications District is the primary source of information for this study's evaluation of motor vehicle accidents and there causes.

3.(Virginia 2018) Studied "Bayesian Spatio-Temporal Analysis of Road Traffic Crash" discovered and Death and severe injury caused by road traffic accidents in the United States is a substantial source of economic losses as well as human misery. There have been a number of studies in recent years aimed at determining the locations of hotspots and identifying the elements that contribute to traffic accidents causes. It is common for this kind of study to combine crash sites into geographical units at the macro- or micro-levels, such as counties. Multilevel data and random effects at the group level cannot be addressed by EB or spatial autoregressive approaches. It is more versatile and may be readily modified to incorporate random effect terms that can serve as proxies for unobserved or missing variables with spatial or temporal structure in the Bayesian framework.

4.(Khan, Singla, and Ahmad 2019)studied "Accident mitigation and management measures for NH-44(India)" discovered that and Accidents are not natural, but they are caused is a familiar cliché in the realm of road safety. In this way, if accidents occur, they may be traced back to the root causes and corrective actions can be devised and executed as far as possible. National Highway-1A (NH-44) from Khanabal to Qazigund, which is the primary route between Kashmir Valley and Jammu and the rest of the nation, is the focus of this investigation.

Conclusion

When we analysed the accidents data of National Highway-44 monthly wise accidents scenario show that minimum 122 accidents occurred in 2010 and maximum accidents 150 2021. National Highway-44 monthly wise accidents scenario show that most of accidents were occurred in the months of January 2010 to2020 168 and December 174 because of in this month's fog and bad weather conditions are may be responsible.The other causes of road accidents maximum 35, 35 in the year 2012 and 2019 and minimum 17 in the year 2020 with the percentage of 13.09%.

There is some important suggestion to reduced road accidents

1.Always stop at red light

2. Always wear helmets and seat belt for safety.

3. Avoid drinking and drugs

4. limits your passenger and speed also.

5. Limits your night driving

6. Cell phone used in only emergencysituation on the road.

7. Drive safe vehicles

8. Follow traffic rule regulation.

This study is very helpful to avoid the road accidents.

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c Publication work from present research

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c. Lists of Conference/ Presentations

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