Analyzing Fatality Rates in Road Accidents in Bangladesh.

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This thesis has been submitted to the Department of Civil Engineering as a requirement for the completion of the Bachelor of Science degree in Civil Engineering.

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DECLARATION

It is hereby declared that this thesis/project or any part of it has not been submitted elsewhere for the award of any degree or diploma.

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Dedicated

To

‘‘Our Parents’’

&

“Respectable Supervisor”

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ABSTRACT

Automobile accidents are a significant cause of fatalities and financial harm in Bangladesh, which raises substantial public health issues. To identify the main contributing factors and define doable mitigating steps to halt this terrible trend, this thesis investigates the alarming rise in accident mortality rates in Bangladesh. For every 10,000 registered cars in Bangladesh, were 62 fatalities in 1985 but just 45 in 2007. When on-road motor vehicles are considered instead of registered motor vehicles, the drop in this mortality rate is far more significant, going from 98 in 1985 to 56 in 2007, and the latter should be a better indicator of the actual situation. Between 1971 and 2007, the country's population doubled, and with a few blips in between, the fatalities and accidents increased from 0.41 to 2.98 and from 1.14 to 3.87 per 100,000 inhabitants, respectively. The frequency of accidents and deaths per 100 million vehicle kilometers decreased by 49.08% and 42.77%, respectively, between 1999 and 2004. In this study, an effort has been made to evaluate the rate of road traffic accidents and mortality trends in terms of total numbers, vehicle population, population, road length, and vehicle kilometers using police-reported accident data. A mixed-methods technique is used in the study, which includes both quantitative and qualitative data. To identify historical trends and patterns in accident fatalities over the previous ten years, the quantitative research thoroughly reviews official accident statistics acquired from various government agencies. Geospatial mapping and statistical modeling are also used to identify high-risk accident zones and comprehend the elements that increase accident rates in these locations. In-depth interviews and focus groups are held with various stakeholders, including traffic police, transportation authorities, road users, and public health and urban planning specialists, to supplement the quantitative study. Their observations help us comprehend the socioeconomic, physical, and behavioral factors that affect accident deaths. The findings point to several important causes for the increased accident fatalities in Bangladesh, including a lack of pedestrian safety measures, poorly maintained road infrastructure, ineffective traffic management, reckless driving behavior, and inadequate emergency response systems. The study also emphasizes how pedestrians and cyclists are disproportionately more vulnerable in traffic accidents than other vulnerable road users. The thesis suggests a diverse strategy to address the problem of accident deaths based on the analysis.

TABLE OF CONTENT

LIST OF FIGURES

Figure No. Caption Page

LIST OF TABLES

Table No. Caption Page

Chapter -1

INTRODUCTION

Road accidents and injuries are currently a serious and growing issue in Bangladesh. According to Hoque (2004), it has 1.6 million motorized vehicles and may have over 3 million non-powered ones. According to international standards, this circumstance is compelling. Worldwide, there are 500,000 fatalities and 10-15 million injuries due to traffic accidents each year (Odgen, 1996). However, among all transportation mishaps, policymakers and the general public place less emphasis on road accidents than on airline crashes. As a result, there are more traffic accidents (Odgen, 1996). Even less consideration is given to accidents brought on by poor driving. However, one of the main issues that contribute to traffic accidents, particularly in developing nations like Bangladesh, is going concern Bangladesh's Accident Research Centre reports 35,000 injuries and 12,000 fatalities annually from road accidents, with a fatality rate of 85.6 per 10,000 cars. Additionally, 50% of these fatalities involve buses, and 77% of pedestrian fatalities in traffic accidents involve pedestrians (Hoque, M. M., 2004). The majority of people, including media pundits, blame drivers for all traffic collisions. There is little question that negligent and inexperienced drivers are a greater contributor to the majority of traffic fatalities. Drivers are impeding efforts to improve traffic safety. This essay tries to present a thorough review of the traits and characteristics of drivers as well as the contributing elements to traffic accidents in Bangladesh.

1.1 Background of the problems:

One of the nations with the highest population density is Bangladesh. It is 1,47,570 square kilometers in size and home to 160 million people. Every day, more people are living on the planet. The country has experienced a rapid urbanization during the past few decades. So, in order to get from one place to another, individuals require transportation. The amount of cars used for transportation is rising daily. Vehicle numbers are rising quickly, and accidents are happening more often. As a result, an alarming rise in casualties has been seen. Accidents typically result from intoxicated driving or issues with driving. Today, the government grants permits to drivers without providing them with adequate instruction, and some of them even operate their vehicles alone. Road accidents are therefore becoming more frequent in Bangladesh.

According to the analysis of the literature, there are four main groups into which the causal elements can be divided: 1) driving habits, 2) road-related factors, 3) vehicle-related factors, and 4) socioeconomic environmental factors. In addition to these, drivers do not make an effort to follow traffic laws. Accidents frequently occur due to unfavorable driving conditions, hazardous roadside conditions, poorly detailed

junction and road section designs, overloading, risky overtaking, reckless driving, negligence on the part of other road users, disregard for the law, various vehicle flaws, etc. Accidents that result in death are caused by unsafe driving factors. Five factors among drivers are highlighted in the 2013 WHO worldwide assessment of road safety that contribute to traffic accidents:- i) driving too fast, ii) driving while intoxicated, iii) not wearing a motorbike helmet, iv) not wearing a seat belt, and v) not using kid restraints. Road mortality rates are among the highest in Bangladesh. The number of accidents is relatively low in contrast to many other developed nations.

2019 saw at least 7,855 fatalities and 13,330 injuries nationwide from 5,516 traffic incidents, according to the "Jatri Kalyan Samity" annual report. Every day, more than 4,000 people traverse the streets of Bangladesh. The country has 85 fatalities per 10,000 enlisted engine vehicles, which is likely the highest rate. That is much higher than the average rate in most Western nations.

Automobile accidents do severe harm to defenseless households and drain billions from Bangladesh's economy. According to the World Health Organization (WHO), road traffic injuries cost Bangladesh's economy 2% of its GDP, or over £1.2 billion, annually. This is comparable to our completely foreign guide during a financial year. The losses include direct and indirect costs, such as medical expenses, security losses, property damage, lost family income, and gridlock.

1.2 Scope of Research:

This thesis employs analysis of data to determine different kinds of connections to accident severity. This research determines how accident severity is correlated with various disaster functions or which indicators cause which types of accident severity. This thesis contains details about accidents in different circumstances, and by analyzing accident data from the past decade (2010–2020), we have attempted to identify multiple methods to reduce the severity of accidents in various positions. However, in-depth analyses of the information mining findings required for developing countermeasures and strategic decisions had been beyond the scope of that proposal.

The two paths will be selected based on the readily available accident data. The relevant data for this investigation will then be collected for the two selected routes. The Accident Research Institute (ARI), Bangladesh University of Engineering and Technology (BUET), Dhaka, will compile ten years' worth of data on accidents (2009 to 2018) on the Dhaka-Chittagong National Highway (N1) and Dhaka-Sylhet National Highway (N-2) from 2009 to 2018. The information will focus on collision severity, involved vehicle class, time period, accident location, etc. This information will be utilized to make a thorough diagnosis. Using the readily accessible black spot definition, roughly ten accident black spots based on collision casualty, total accidents, the hours of crashes, environmental conditions, etc., will be selected from the accident data. On each national highway, two nodes and two junctions will be chosen to compare

black spot nodes and connections. The Accident Research Institute (ARI) BUET, Dhaka-1000, will also supply the data for analysis.

ACCIDENTS TREND DUE TO DRIVING PROBLEMS IN BANGLADESH :

Accidents in Bangladesh are influenced by numerous driving-related factors, contributing to an alarming trend of roadway security issues. Accidents are frequently caused by reckless driving behaviors such as acceleration, aggressive overtaking, and disregarding traffic laws. Distracted driving, which is frequently associated with cell phone usage, diverts focus to the road and heightens disaster risks.

Driving under the age of the control of alcohol or narcotics remains a significant issue, as it impairs drivers' abilities and increases the likelihood of collisions. Overloaded vehicles compromise their equilibrium and maneuverability, making them accident-prone. Inadequate vehicle upkeep is an additional issue, as mechanical breakdowns can result in collisions.

Inadequate pedestrian infrastructure is also a concern for pedestrian safety, as it leads to collisions between pedestrians and vehicles. Inconsistent seatbelt use increases the severity of accident-related injuries. Inadequate road infrastructure, such as inadequately designed roads and inadequate signage, exacerbates the danger.

Common problems include disregard for traffic laws and insufficient instruction for drivers and licensing procedures. Additionally, inclement weather and traffic congestion contribute to the fatality trend.

To address these issues, comprehensive strategies are required. All necessary measures consist of bolstering law enforcement, enhancing driver training and education, boosting licensing procedures, conducting awareness campaigns, renovating road infrastructure, and enforcing more severe penalties for reckless driving. By fixing these driving-related issues comprehensively, Bangladesh can work regarding a secure road environment and reduce the escalating accident rate.

1.3 Research Objectives and Overview:

Using RTA data for N1 as well as N2 (2009–2018) to ARI, BUET, the purpose of the thesis was to investigate the viability and utility of statistical techniques for assessing the health of street traffic in Bangladesh.

We have endeavored to concentrate on N1 as well as N2, which are busy highways in Bangladesh. We must acquire information from ARI before we analyze each individual piece of data.

The primary aims of our research have been

- Determine the accident characteristics on two main national highways (N1 & N2).
- To compare accident analysis on two national highways (N1 & N2) using available accident data.
- Observe the association between approximate everyday traffic (ADT) as well as vehicle velocity in relation to collisions.
- To conduct a comprehensive analysis of accidents and to conduct detailed engineering investigations on various black spots in order to determine the likely causes of accidents and to implement corrective measures.
- To determine the total number of annual and monthly fatalities.
- Who is most responsible for time?
- Are there incidents because of the road conditions?
- How can we minimize accidents?
- Pedestrian participation.
- The economic devastation to the nation.
- Design and supervision of roads.
- Why do accidents continue to increase?
- To raise people's awareness.

The first stage is to conduct research into the pertinent sources to gain a better understanding of the various accident characteristics, especially as they affect pavement layout and structure. In addition, after evaluating prior research on the related topic of crashes, the methodology for these studies has been condensed in the following ways.

1.4 Organization of the Thesis:

This study's research is divided into various topics as well as laid out in five chapters.
Chapter 1: In the first chapter, a detailed introduction describes the background and problem, the motivation and objectives, and the scope of the research.

Chapter 2: The second chapter is a review of relevant literature. This chapter explains the definitions of all the associated terms, accident Studies in the nation of Bangladesh, guidelines for disaster analysis, accident factors, economic evaluation, etc., which have been used in comparable works previously.

Chapter 3: The methodology for this investigation is described in Chapter 3. In this research, the corridor's selection, data collection, processing of data, and framework development procedures were utilized.

Chapter 4: A comparative analysis of accidents of the Dhaka-Chittagong as well as Dhaka-Sylhet National Highways is presented in Chapter 4. The research is founded on the severity of accidents on the N1 and N2 highways.

Chapter 5: Key findings, Limitations, the potential of our work, and the conclusion makeup Chapter 5.

Chapter -2

LITERATURE REVIEW

2.1 Introduction

An extensive analysis of car accidents in Bangladesh looked at the typical factors that cause crashes. The study's goal was to track down and present recent traffic incidents. This data suggests that as the number of vehicles and other road users increases, so do traffic accidents. In 1985, there were 62 fatalities for every 10,000 automobiles, and in the forty years since, the population has increased by more than twice as much. The number of fatalities and traffic accidents increased by 1.14 to 3.87 and 0.41 to 2.98 per 1,000, respectively. Chowdhury used police-reported collision statistics and death to show the discrepancy between the study's findings and the actual situation. Another study examined the impact of sociological, economic and demographic factors on car crashes in Bangladesh. Blazquez et al. claim that a traffic collision constitutes more than just a wreck because it costs society a lot of money in missed output. However, Bangladesh's traffic accident situation is much worse than that of a wealthy nation. The study examined how road infrastructure affects auto accidents. The impact of load width, infrastructures and socioeconomic characteristics on regional crash rates in Bangladesh was examined using a negative binomial technique. Research in India examined the context, obstacles, and issues surrounding traffic accidents. According to this study, middle-aged people are the most susceptible and experience the greatest number of unintentional deaths and injuries.

In addition, men are involved in far more deadly car accidents than women. Big cities have an almost 50% higher rate of fatalities than small villages. Weather has an impact on traffic accidents as well; from December to January and from May to June, the frequency is often high. Road accident characteristics, dangerous road conditions, pedestrian circumstances, and safety priorities were highlighted in reports on traffic accidents, including the traffic safety situation in northeastern Bangladesh. Data were gathered through a questionnaire survey, specialized knowledge, and newspapers. The death index, which is calculated as the percentage of fatality divided by the total amount of road accident victims, has identified the hazardous route. According to Hossain and Khan, pedestrians routinely exceed vehicle capacity and are victims of collisions because they are not aware of their surroundings.

A few of the suggested safety solutions and recommendations are improved awareness, a change in government policy, training, the construction of pathways and footways, and others. Recently, a number of procedures and techniques for evaluating traffic occurrences on the road have been developed. Geographical information systems are unique because of their exceptional spatial analytical skills. Satria stressed the advantages of analyzing traffic events and their geographical distribution using GIS techniques. GIS allows for the creation of more accurate visual representations that are based on statistical analysis. Today's researchers can use it as a superior decision-making tool as well. Road accident hotspots are identified using statistical methods like estimation of kernel density techniques (KDE) and kriging.

Berger & Mohan (1996) defined an accident as an event that causes harm or has the capacity to do so. On an open road, there was at least 1 moving vehicle involved in a crash that resulted in injuries, fatalities, and property damage. Some people think that because accidents are unpredictable, random events, they cannot be prevented. Events that damage people are predictable, contain known risk factors, and involve interactions among individuals, machines, vehicles, and their physical and social environments. The term "accident" in this study refers to situations involving injury to people or damage to property brought on by moving vehicles.

Everyone is aware of how profoundly transportation influences the world economy today. It has provided benefits to employment, trade, personal life, and medical care that were unimaginable a century ago. However, the morbidity and mortality rate from road accidents is too high to justify the expense of these benefits. It is all too known fact that these tragedies cause shock and pain in people all across the world. 90% of traffic deaths take place in developing countries, where they have a substantially greater impact (Ahmed, 2007).

2.2 Definition of the Related Terms

Before delving into the intricacies of this study, it is imperative to get a comprehensive understanding of the terminologies associated with collisions, black spots, roadway characteristics, and the analysis of vehicle speed. This part provides a brief discussion on the basic elements of accident evaluation, black spot evaluation, flow of traffic analysis, and vehicle velocity analysis, given their significance and frequent utilization in this study.

National Highways:

According to the Road and Highways Department (RHD) in 1996, the national highways in Bangladesh encompass the routes connecting the nation's largest city with division headquarters, previous districts, port towns, and international roads. Based on the RHD categorization, it is determined that national roads categorized as type A possess specific dimensions. Specifically, these highways exhibit crest widths measuring 12.2 meters, surface widths spanning 7.32 meters, and sides extending to a breadth of 2.44 meters. Type B national highways are characterized by a crest width measuring 12.2 meters, with 5.5 meters dedicated to pavement and an additional 3.36 meters allocated for shoulder width.

Casualty:

Casualty refers to an individual who has suffered either deadly or non-fatal injuries as a result of an accident.

Fatal Accident:

A tragic occurrence leads to the swift occurrence of one or more fatalities.

Seriously/Grievous Accident:

Serious individual who sustains serious disability in a mishap and necessitates hospitalization, however does not succumb to those injuries within a 30-day period.

Non-collision type accident:

Non-collision incidents refer to accidents involving motor vehicles where no additional cars or equipment are implicated.

Collision type accident:

Accident involving collision: When a vehicle forcefully impacts an object or entity, such as a pedestrian, another vehicle, an animal, or a structure.

Passenger:

The term "passenger" refers to any individuals, excluding the drivers, who are entering, boarding, exiting, or disembarking from a motorized vehicle at the time of the occurrence.

Pedestrian:

In the context of collisions, a pedestrian is specifically defined as a human who is not present within a motor vehicle at the time of the incident, nor is involved in the process of entering or exiting such a vehicle.

Traffic Volume:

Traffic volume refers to the quantification of the total number of cars that traverse a designated area on a road or traffic lane within a specified time frame. The significance of traffic is typically assessed using metrics such as cars per hour and automobiles per daily (Zaman, 2006).

Spot Speed:

Spot speed refers to the factual velocity at which a vehicle traverses a pre-established point on a route.

Average Speed:

The concept of average speed pertains to the mean velocity at which all mobile vehicles traverse a specific point along a route.

Running Speed:

The running speed can be determined by calculating the distance traveled by the vehicle by the duration of its motion. The Average Everyday Traffic (AD7) refers to the mean quantity of vehicles that traverse a specific location throughout a time frame exceeding one day but shorter than twelve months. The calculation involves the division of the total number of cars by the total number of dates (Zaman, 2006). The Abstract Data Type (ADT) can be easily accessed in situations when there is a constant availability of traffic counts. The utilization of Average Daily Traffic (ADT) volumes proves to be advantageous in the economic analysis of roads as well as in the formulation of the structural components of roadways.

2.3 Accident Studies in Bangladesh

- Another study was undertaken along the characteristics of incidents on specific arterials in metro Dhaka in terms of accident type, severity, and means of transportation used by the victims, the weather, etc. by Rafuzzaman, M. (2003) for his M. Engineering thesis at BVET. Revealed that in his study of five arteries in Metro Dhaka city over a six-year period (1996–200), 1847 accidents had place. Hits on pedestrians and rear-end collisions account for the majority of collision types (39.2% and 32.54%, respectively). The involvement of motorized vehicles is 77.96%, while that of non-motorized vehicles is 22.04%. Deathly is 37.09%, Grievous is 40.06%, Simple is 10.18%, and Collision is merely 13.22% in terms of severity. In total, linkages accounted for 71.36% of incidents, while intersections saw 28.64% of accidents. Approximately 98.48% of accidents happened in good weather, and only 1.52% happened in bad weather. Additionally, his data indicates that 59.61% of injuries occurred during that time. After that, offer some corrective actions to cut down on accidents.

- Islam, 2004, in his MSc. The accident dark area on the Jamuna Multifunctional Bridge was thoroughly examined in a thesis at BUET. He applied the concept to an accident site map and pin diagram to determine the locations and degrees of cluster and non-clustering of incident events. For analysis, a collision diagram that details every accident occurrence was created. According to his data, 36% of accidents happened at night while 64% happened during the day. On the other hand, roughly 62% of accidents happened in good weather, 18% during rainy times, and 20% during foggy times. The study then conducted a financial assessment of accidents. The extensive investigation of accident causes and corrective modifications, which needed to be further clarified, is the study's main shortcoming.

- Hoque et al. (2005) carried out a second investigation on the Dhaka-Aricha Route. This report includes information on the corrective actions done in three problem areas. The purpose of this

study is to assess the efficacy of safety improvement strategies. By using the "before-after" as well as "control-site" procedures, their energy was evaluated. The analysis's results indicate that safety enhancement initiatives were very successful in lowering the frequency and seriousness of incidents. According to this study's economic estimates, the savings from fewer accidents more than offset the upfront expenses of safety upgrades. This study's drawback is the necessity for a precise description of the accident 28 evaluation based on the car involved, intensity index, or period of action. The contour drawing with the location picture is not considered for safety improvements in the chosen black spot detail.

- In his M. Engineering project at BUET, Hasan (2007) examined the role of vehicle variables in traffic accidents along the Jamuna Multifunction Bridge corridor and found that vehicle failure was a contributing cause in 16.6% of incidents, with a mortality rate of 31.9%. Tire blowouts are the most frequent vehicle faults that result in accidents, accounting for 42.5% of collisions and 83.7% of all collisions involving vehicles. These are closely followed by passengers collapsing from roof 7%, brake problems at 5.7%, jams at 2.6%, which is axles dropping at 0.9%, and malfunctioning lighting at 0.1%. According to a questionnaire survey, the main root causes of vehicular issues are overloading, inadequate vehicle specification, bad vehicle maintenance practices, and a lack of field vehicle fitness testing.

2.4 Accident Involving Factors

Basic components involving of the road transport system are following:

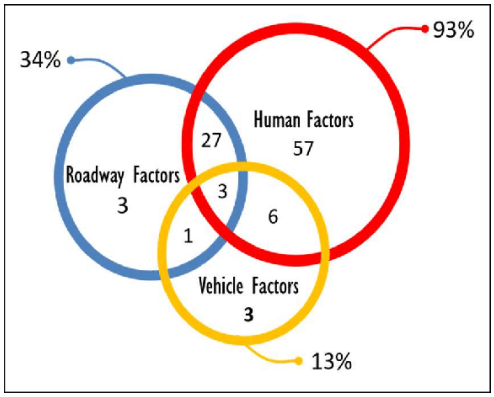


Figure 2.1: Accident Contributing Factors

Source: PIARC Road Safety Manual, 2003

- **Human factors:**

Sometimes accidents are the fault of the drivers of any or all of the cars that struck a pedestrian and its occupants.

- **Pedestrians:** The primary causes of traffic accidents include a lack of awareness about the laws and regulations governing other road users, rules infractions, and carelessness when utilizing the roadway. Accidents occur when there aren't appropriate facilities for pedestrians. To decrease accidents, it is important to appropriately construct pedestrian amenities including sidewalks, crosswalks, specific pedestrian obstacles, pedestrian rescue islands, pedestrian tunnels, and overpasses.
- **Drivers**: One of the key aspects of a road user that can cause an accident is the driver. So, a key component of safe driving is the driver's fitness. Road accidents are caused by a variety of factors, including excessive speed and hurried driving, negligence, breaking laws and regulations, failing to notice and grasp the conditions on the road and traffic signs and signals, transitory effects from sleep deprivation, alcohol use, or exhaustion, as well as physical and mental disorders.

➢ **Vehicle Factors:**

- Motorized vehicles are widely used for transportation in Bangladesh. Nighttime accidents are also brought on by the lack of lighting in vehicles like rickshaws, trucks, and push automobiles.
- Vehicles operating at different speeds and with different operational features in identical traffic produce dangers and conflicts, which can lead to accidents.
- Accidents are caused by brake failures, malfunctions in the steering mechanism and signaling devices, tire ruptures, and deviation from the specifications, like excess length and width.
- Another driving aspect that contributes to traffic accidents is the overloading of cargo and passengers.

➢ **Road Factors:**

- **Road Geometries:** Road conditions such as poor visibility, narrow shoulders, improperly designed curves, etc. can also contribute to accidents.
- **Road Condition:** The most frequent causes of car failures on roads include potholes, ruts, and other road surface defects.
- **Mixed Traffic:** Traffic hazards are created and accidents may result when a traffic stream contains cars with a wide variety of speeds and characteristics. Road accidents are frequently caused by slow moving vehicles blocking the passage of fast driving vehicles. Another significant factor in road accidents is the tendency of multiple traffic streams to move laterally.
- **Animal:** Unwanted animals on roadways annoy drivers and may result in accidents.

Chapter 3
METHODOLOGY

3.1 Introduction

A typical definition of an accident is an incident involving more than one motor vehicle that happened on an open road and caused injuries. This definition is applied as most nations have computerized systems in place to record such occurrences. The main foundation for all initiatives aimed at promoting road safety is accurate and complete data. A system for collecting, storing, evaluating, and sharing data on traffic accidents should create proper protocols. The details of the people involved during the accident, as well as other contributing elements including tram and road features, vehicle specifications, and vehicle parameters, must also be recorded.

This chapter will go over the topics we are studying, the ones we are conducting studies on, and the rationale behind our choice of those topics for our thesis. The National Highways N1 and N2 are then introduced as the areas under research.

3.2 Corridor Selection

1. Dhaka - Chittagong National Highway (N-I)
2. Dhaka-Sylhet National Highway (N-2)

This study chooses N-1 and N-2 as the two national highways for comparison accident analysis.

In this study, the Katchpur Bridge (Chittagong end) to Rajakhali Bazar Bus Stand (km post 270), before Karnofuli Bridge, section that comprises the Dhaka-Chittagong (N-I) National Highway is chosen.

The Katchpur Bridge (Chittagong end) is where the Dhaka-Sylhet (N-2) National Highway begins at kilometer post 13, and it ends at km post 330, near Tetli Bus Stand, just before Sylhet town.

According to research, 24% of fatal incidents take place in Dhaka, Chittagong, and Cox's Bazaar (N1). Additionally, 8% of all traffic accidents in Bangladesh occur on the Dhaka-Sylhet (N2) route.

Research in km should be done for the Dhaka-Chittagong and Dhaka-Sylhet National Highway accident black spot analyses. Post-stationing is typically used to identify areas with a high accident frequency, such as black patches. A red hue is displayed beneath the Bangladeshi road network to indicate the selected stretch as a result of comparative accident study among three national roads.

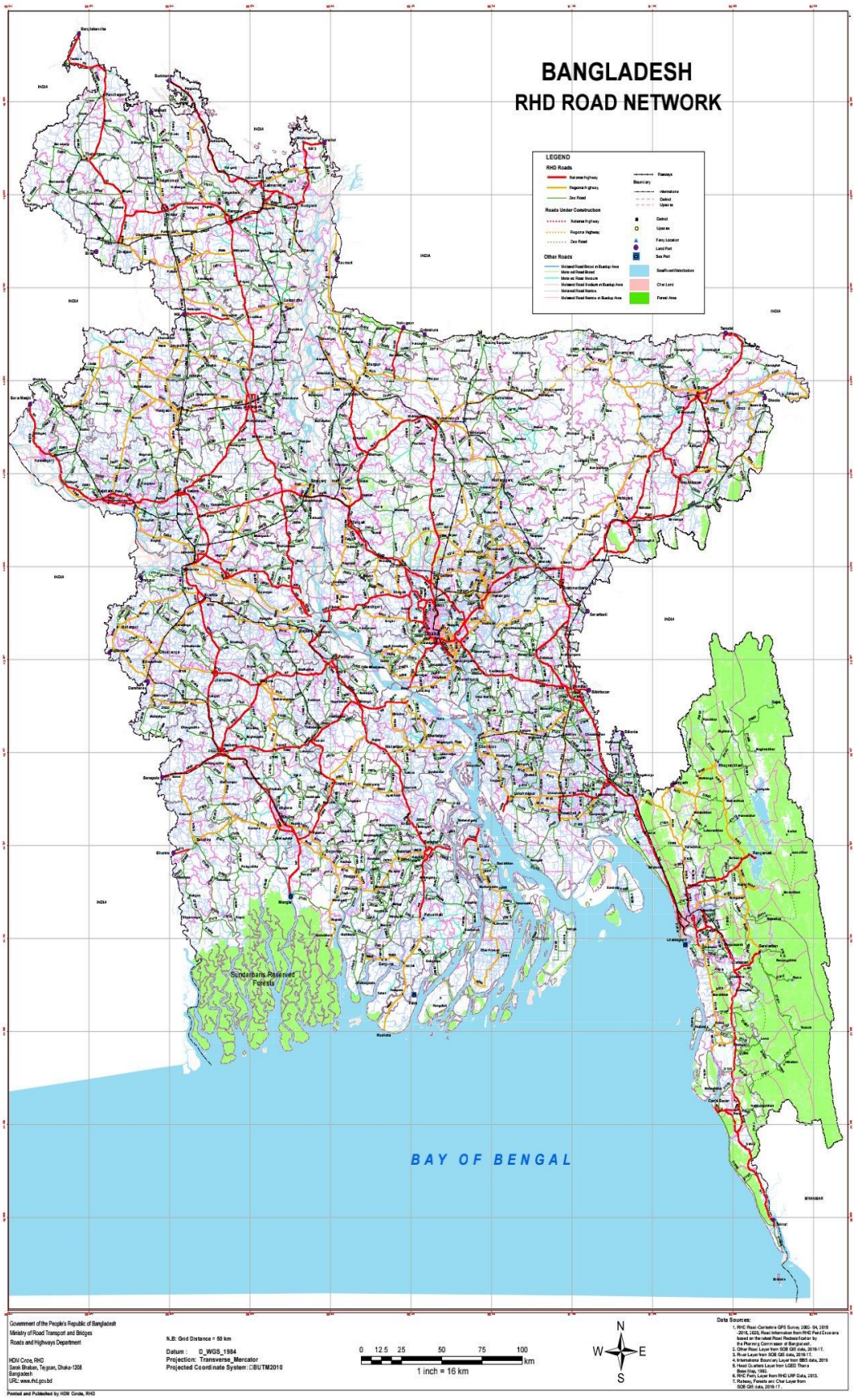


Figure 3.1 Bangladesh RHD Road Network

Dhaka–Chittagong National Highway (N1)

The main route for traffic between Chittagong and Dhaka in Bangladesh is known as the N1 or Dhaka-Chittagong Highway. The street, which is over 250 kilometres (160 miles) long, connects the two largest urban areas in the country, Dhaka and Chittagong.

Along various portions, the freeway is referred to as the Cox's Bazar-Teknaf Highway and the Chittagong-Cox's Bazar Highway. The N1 is the most traveled route in the country and has the greatest need for development at the moment. A pair of paths along a four-path expansion are now under construction.

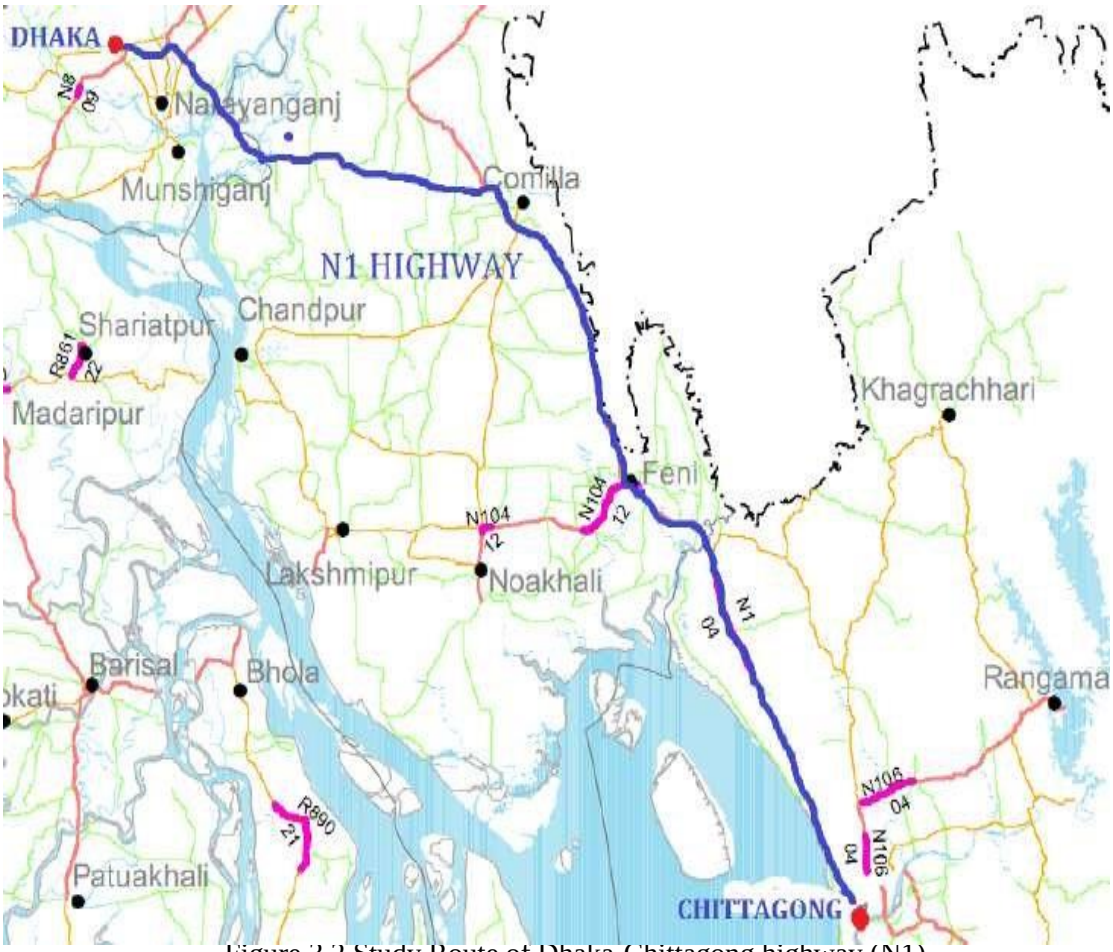


Figure 3.2 Study Route of Dhaka-Chittagong highway (N1)

Dhaka-Sylhet National Highway (N2)

The N2 is a public highway in Bangladesh that connects the nation's capital, Dhaka, to the city of Tamabil located in Sylhet Division.

The route passes through Sylhet and uses the Keane scaffold to bridge the Surma River. Portions of the route are referred to as the Dhaka-Sylhet Route or the Sylhet-Tamabil Highway.
For the Asian Highway Network's AH1 and AH2, it is crucial.

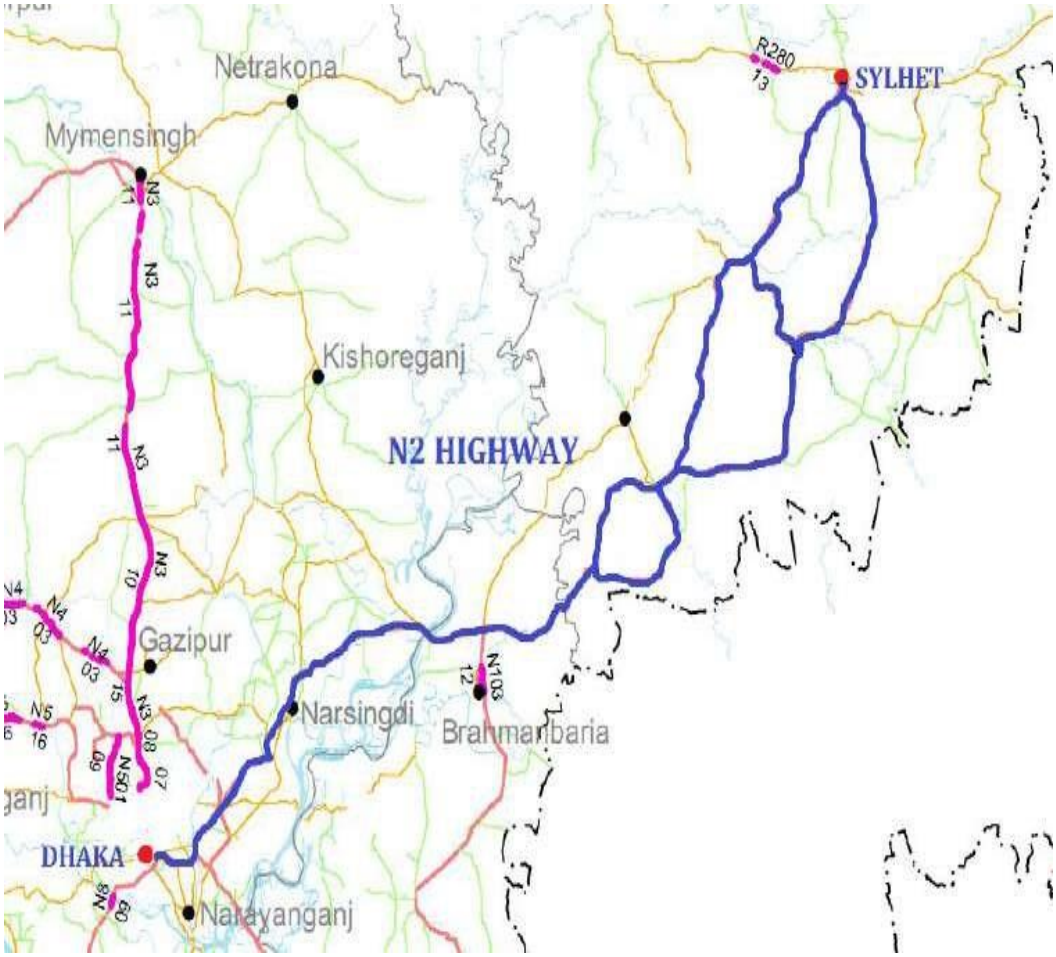


Figure 3.3 Study Route of Dhaka-Sylhet highway (N2)

3.3 Accident Data Reporting and Collection System in Bangladesh

An accident report form includes details on the accident, including its gravity, duration, date, highway class, traffic management system, the kind of a collision, road divider, surroundings, lighting conditions, classification of the road, and location, among other things. The following procedures apply in data recording as well as collection for any study, it can be concluded following a practical debate with the additional police officer that Rupgonj Thana along the Dhaka-Sylhet National 36 highways and another person in charge of accident data storing at the the superintendent of The police workplace in Narayangonj district.

- Any information about traffic accidents is documented in a police station on a FIR (First Information Report) form or in a generic journal. After that, recorded information about accidents is put into a khata called "Khatain Khata." For this job, a book is kept.
- The police officer's or the victim's relatives' "Ejher" application includes an entry copy of the FIR. This report is then forwarded to the concerned circle and the police office superintendent.
- In both the Circle and S.P. office, the crime index is created based on the FIR month by month. Both the FIR book and the criminal index report book contain information on subsequent developments in the investigation process. The court inspector receives the FIRS after that; the only source left is the crime index.
- Consolidated accident reports from the relevant police stations are sent each month by the deputy general inspector of police (DIG) within a specific range via the circle and Superintendent of Police (S.P.).
- After then, the Assistant General Inspector (AIG) crimes at police headquarters finally received the data.

An accident data unit (ADU) set up in the DIG office receives all the accident data and inputs it to the Microcomputer Analytical Package-5 software. The Assistant Inspector General (AIG) Crime at the police headquarters then submits this work to the Road Safety Cell (RSC), which has been in charge of maintaining the national accident database since 1977. Because of this, no separate sequencing is maintained and the aforementioned accident data must be entered carefully among all other offences.

3.4 Data Analysis in Transportation Engineering

In the domain of transportation engineering, substantial quantities of data are produced during investigations pertaining to traffic administration, accident analysis, pavement illnesses inventory of roadway features, traffic signals and their inventory, bridge maintenance, inventory of road characteristics, and so forth. Based on the available data, decision-makers reach a conclusion in order to address a specific situation. Decision-makers consistently seek strategies to alleviate the challenges associated with acquiring and utilizing diverse datasets. The fundamental prerequisites encompass the capacity to discern the availability of data, ascertain the attributes of the data, retrieve the data that is of relevance, and convert the data into forms that are essential for various applications. In the context of transportation in the real world, it is necessary to gather a wide range of data from several disciplines in order to combine them and develop effective solutions. The utilization of data mining methodologies has presented a novel opportunity for decision-makers within the field of transportation engineering [Barai, 2003]. Computational intelligence is increasingly becoming an integral component in numerous modern systems, as it addresses a wide range of technical challenges. Therefore, it is imperative to develop novel methodologies for effectively extracting significant insights from unprocessed data in order to successfully manage its constituents. Data mining plays a crucial role within the knowledge acquisition process. The fundamental

procedures of information mining and information discovery are illustrated in Figure 3.4 [Barai, 2003]. A comprehensive elucidation can be located in the work of Fayyad et al. (1996).

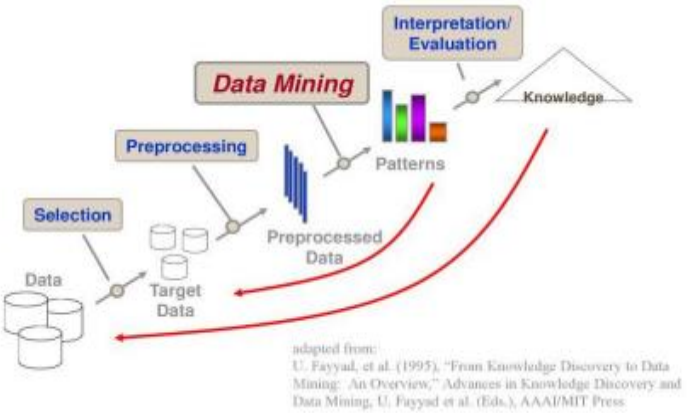


Figure 3.4: Data Analysis proccess

3.5 Accident Data Analysis

The accident data utilized in these analyses are initially compiled for the three designated national highways, namely Dhaka-Chittagong (N1) and Dhaka-Sylhet (N2), spanning the period from 2009 to 2018. This study examines accident data by analyzing many factors, including accident severity, vehicle class involved in the collision, accident duration, and accident region on the highway. The analysis is conducted in a detailed manner, and subsequent discussions are provided.

The process of data collection involves several sequential processes. The aforementioned items are as follows:

1. Accident data pertaining to N1 and N2 has been obtained from the Accident Research Institute (ARI) affiliated with Bangladesh University of Engineering and Technology (BUET). The Accident Research Institute (ARI) of the Bangladesh University of Engineering and Technology (BUET) has been collecting and analyzing data on documented accidents in Bangladesh. Law enforcement agencies and other entities collect and document this data.

2. For the purpose of this analysis, a dataset spanning a period of ten years, specifically from 2009 to 2018, was utilized. Only the data from N1 and N2 was obtained.

3. Additional data and information were incorporated into our study by consulting several external organizations and reputable websites.

4. The data is analyzed with a spreadsheet software, specifically Microsoft Excel. Microsoft Excel is a highly effective software tool for the comprehensive analysis of data across a wide range of methodologies and approaches. Microsoft Excel is utilized for the purpose of conducting data analysis in our work. Data analysis is employed as a means of comprehending the magnitude and underlying factors contributing to accidents, hence facilitating the identification of potential solutions for N1 as well as N2.

5. A variety of graphs and charts were utilized in order to analyze potential factors contributing to road accidents and identify strategies for mitigating their occurrence.

6. We conducted an investigation to determine the degree of severity in accidents across different scenarios, as well as the condition of both N 1 and N 2 and different vehicle kinds.

7. Subsequently, we employed significant discoveries to address road-related issues and put forth recommendations aimed at mitigating the incidence of fatalities resulting from road accidents.

3.6 Data Processing

The evaluation of a road network's safety level and the identification of accident-prone areas, commonly referred to as black spots, can be accomplished even with a minimal dataset. The initial phase of this project focuses on identifying high-frequency accident occurrence locations, sometimes referred to as "black sites," in order to prioritize road safety improvement activities. The handling of raw data constitutes a fundamental component of our investigation. In this study, the Accidents Research Institute (ARl) conducted a thorough examination of the accident data. Subsequently, the relevant data was organized, compiled, and utilized for a direct analysis of accident patterns and high-risk locations.

The data pertaining to the average daily traffic (ADT) was gathered from the toll plaza located at the Bhairab-Ashuganj section of the Bangladesh-UK Friendship Bridge. The data recording devices utilized in this study were computerized. It was observed that data collection occurred in three shifts per day, with each shift corresponding to a specific vehicle classification. Following the conclusion of each month, the Roads & Highways Ministry received a summary sheet with the total daily traffic flow data. The completion of the category of automobiles remains outstanding on the summary sheet. In order to assess the average daily traffic (ADT), data on total traffic categorized by vehicle class were collected for each of the three shifts in a day over a period of ten observation days. These data were subsequently sorted and tabulated to ensure the most suitable analysis for the study on ADT along the chosen Dhaka-Sylhet National Highway. In order to conduct a study on vehicle speed measurement along a designated national highway, a specific segment measuring 188 feet and 0 inches was chosen. The duration of time for each vehicle class was carefully recorded and analyzed. Upon the conclusion of the data processing for vehicle speed and detail inspection, the summary data is organized in a manner that optimizes the facilitation of the analysis tasks.

3.7 Data Mining

Data mining is a method used to discover patterns and relationships within data, with a focus on large observational databases. It is situated inside the conventional boundaries of several disciplines, including database management, artificial intelligence, machine learning, pattern recognition, and data visualization. From a quantitative perspective, it is viewed as the automated exploration and analysis of data, often consisting of large and intricate datasets. This field has a significant impact on the domains of industry, commerce, and science. In addition, it involves extensive research to facilitate the emergence of novel methodological advancements. Although there are evident connections between information mining and quantitative data analysis, it is worth noting that the majority of the methodologies employed in database mining have originated from disciplines other than statistics (Friedman, 1997). The interpretation of data mining is typically contingent upon the theoretical framework and viewpoints of the one defining it.

Here some definitions of data Mining

- From a database perspective, data mining refers to the process of extracting information that was previously unknown, comprehensible, and actionable from extensive databases. This extracted information is then utilized to make critical business decisions, as stated by Zekulin.

- Data Mining, as viewed through the lens of machine learning, encompasses a collection of techniques employed in the process of information discovery. Its primary objective is to discern hitherto unidentified links and patterns within datasets, as stated by Ferruzza.

- Data mining refers to the systematic procedure of identifying and extracting valuable patterns or insights from a given dataset, as stated by John.

- From the viewpoint of pattern recognition perspective, data mining can be defined as the complex task of discovering meaningful, innovative, potentially valuable, and ultimately comprehensible patterns within datasets, as described by Fayyad.

3.8 Development of Framework

The primary aim of this project is to establish a comprehensive framework that enables the systematic comparison of accident data across three different corridors, as well as the identification of black spots and the analysis of average daily traffic for a certain corridor.

- In this analysis, we aim to provide a concise overview of accident data according to several factors such as extent, motorist class, accident time, and region.
- The data sources utilized in this study encompass a compilation of incident and typical daily traffic flow statistics.
- The purpose of this study is to choose corridors for conducting a comparative analysis of accidents and black spots.
- The objective of this study is to conduct a comparative analysis of accident data from three different roadways in order to make a diagnosis of the situation
- The process involves the identification of locations with a high frequency of accidents, which are commonly referred to as black spots. This selection is based on the application of various criteria that are used to determine the severity and frequency of accidents at these locations.
- This study presents comprehensive geometric and geographic analysis data pertaining to areas with a high incidence of accidents.
- This analysis presents a summary of accident data pertaining to a specific time period. The data includes information on the total number of accidents, the classification of road users involved in these incidents, and the resulting casualties. The analysis focuses on selected locations.
- The objective of this study is to compile a comprehensive collection of essential images and investigate the potential reasons of the accident, while also proposing remedial measures to address identified dark spots.

- The present study focuses on conducting a direction distribution examination of typical weekly traffic.
- The present study focuses on collecting field survey data pertaining to the average speed of vehicles on designated national highways.

The framework should be designed in a manner that is conducive to achieving the desired objectives. Data obtained from different groups and interviews in the field can be inputted into the designated worksheet, where the formula is interconnected to the output tables and graphs. This study utilized Microsoft Excel, which is compatible with the MS Windows operating system. Nevertheless, it is advisable to employ the latter approach for subsequent research endeavors.

CHAPTER 4
RESULT AND DISCUSSION

4.1 Introduction

The main aims of the research are to conduct a comparative analysis of accidents by utilizing accident data from three key national highways in Bangladesh. The study is grounded in the examination of accident severity, the classification of vehicles involved in accidents, the time period during which accidents occur, and the specific location of accidents on the road. The current study is constrained in its scope due to a lack of adequate accident information, data, and factors related to accidents. In this chapter, a comparative analysis has been conducted and subsequent discussions have been made based on the available data, resulting in the preparation of several figures. To satisfy this element, a separate accident analysis is conducted for each highway, utilizing accident-based data. A comparative investigation of accidents is subsequently conducted on the Dhaka-Chittagong and Dhaka-Sylhet motorways in Bangladesh.

This chapter encompasses the methodology employed for data collecting, delineating the systematic approach utilized to gather the data under analysis. This chapter offers a comprehensive overview of the subject matter. In addition, a concise overview of our analysis of data and resulting consequences was provided. Let us now proceed to examine the data we collected and analysis.

4.2 Data Analysis

This section constitutes the central focus of our thesis. In this section, we shall undertake an examination of diverse data tables pertaining to distinct scenarios.

4.3.1 Analysis of Annual Incidents and Vehicle Accident Trends in the N1 Region over a Decade (2009-2018)

Initially, a Table of N1 was incorporated to document the occurrence of a vehicular collision.

ACCIDENT TABLE

CONDITIONS **ETD 2018**

SET **YEAR 2009-2018**

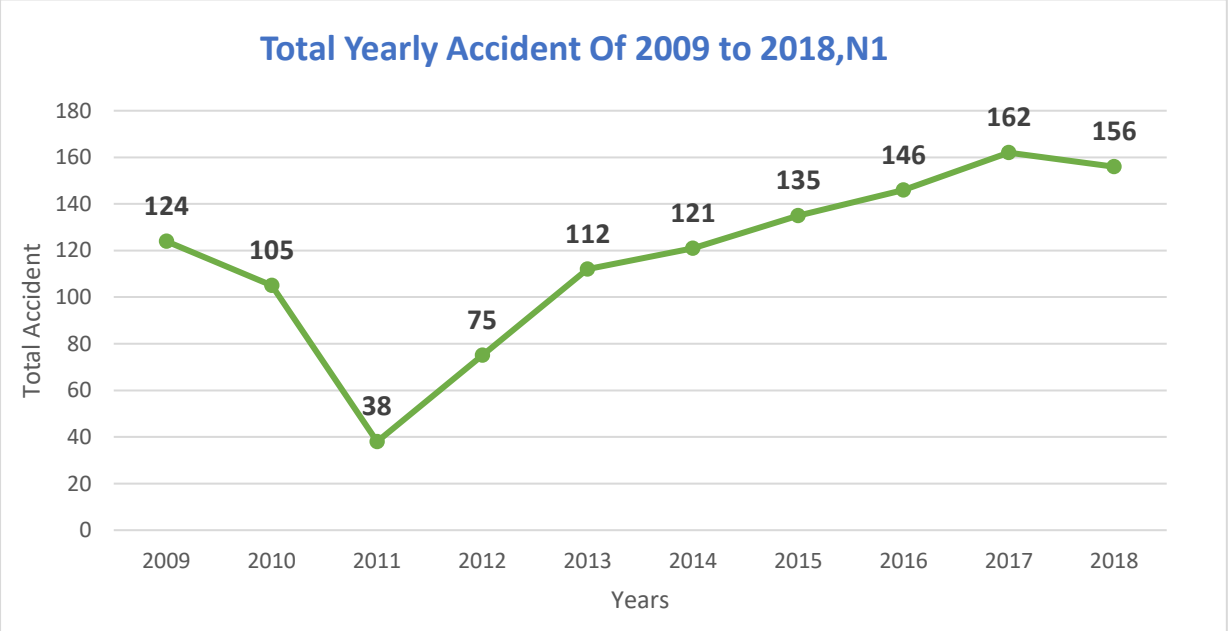
ROUTE NUMBER **N1**

NO. OF VEHICLES

YEAR	1	2	3	4	5	6	Total
2009	74	49	1	0	0	0	124
2010	60	45	0	0	0	0	105
2011	28	10	0	0	0	0	38
2012	29	46	0	0	0	0	75
2013	62	50	0	0	0	0	112
2014	60	60	0	0	1	0	121
2015	91	43	0	1	0	0	135
2016	97	48	1	0	0	0	146
2017	110	52	0	0	0	0	162
2018	105	49	1	1	0	0	156
Total	850	545	4	2	1	0	1402

Table 4.1: Vehicle Accident Table of N1

Note: 1 = Single Vehicle Accident; 2 = Double Vehicle Accident; 3 = Triple Vehicle Accident These represents the involvement of vehicles in any Accident.



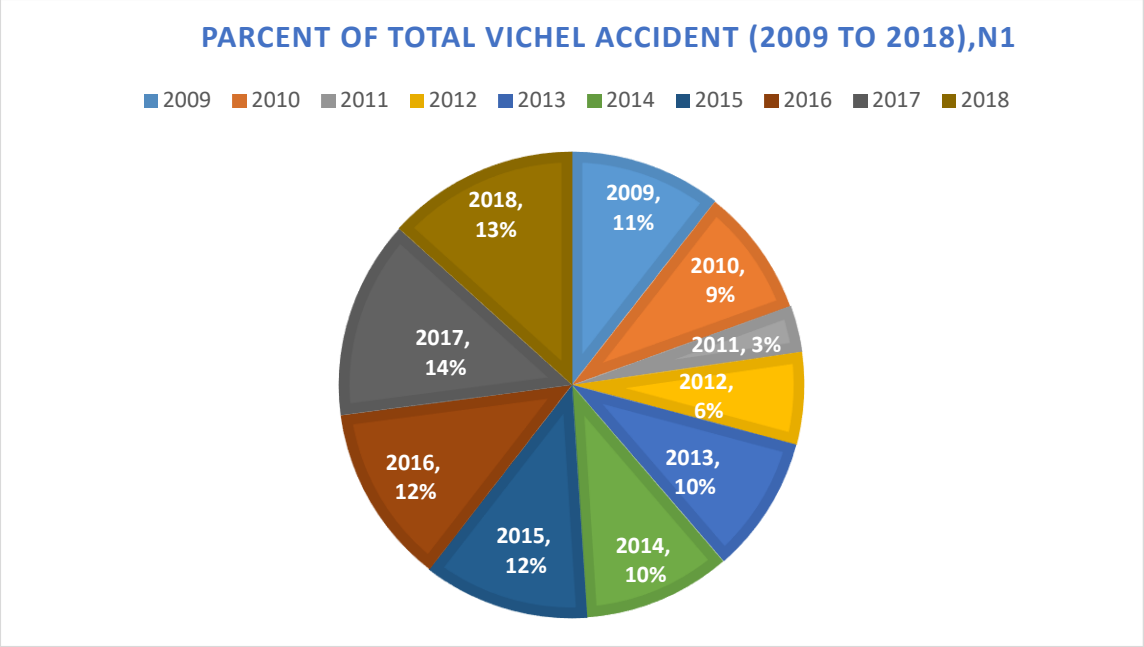


Figure 4.2.1: Total Yearly Accidents of N1 (2009 to 2018)

Based on the data presented on Figure 4.2.1, it's apparent that the calendar year 2011 exhibited the lowest incidence of accidents, whilst the year 2017 demonstrated the highest frequency of accidents within the temporal range including 2009 to 2018.

There has been an observable increase in the frequency of accidents since the year 2011.

Between the years 2017 and 2011, a decline in the incidence of accidents was seen, with the reduction rates fluctuating between 14% to 3%. During the period from 2011 to 2016, there has been a notable rise in the occurrence of accidents, with the percentage increase fluctuating between 3% to 12%.

Vehicle Accident Chart of N1

Table 4.1 displays an additional graphic labeled as "Vehicle Accident Chart." This analysis focuses on the occurrence rates of a single, double, triple, or numerous vehicle events that happened on the N1 motorway for the period spanning from 2009 to 2018.

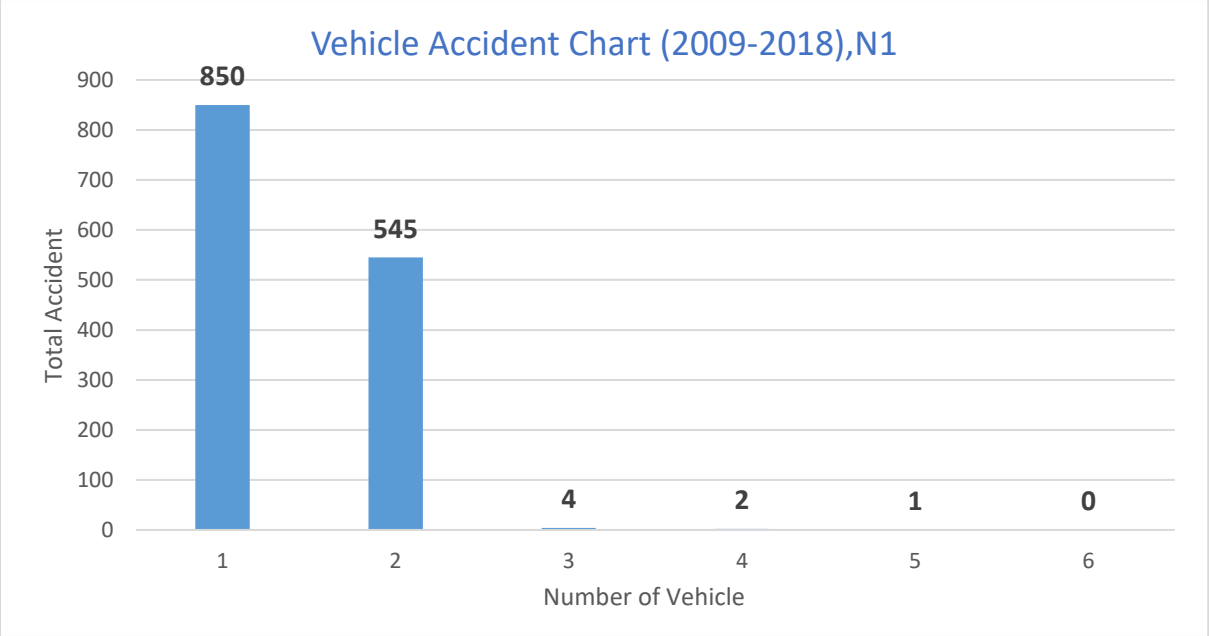


Figure 4.2.2: Vehicle Accident Charts of N1

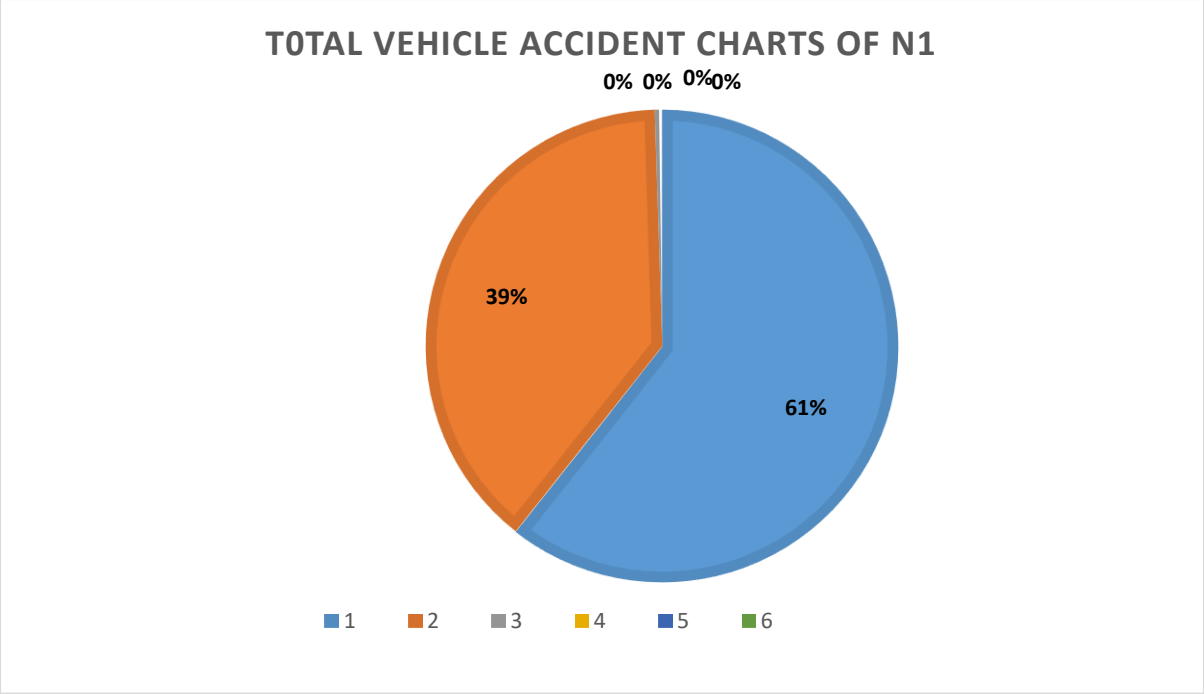


Figure 4.2.3: Vehicle Accident Charts of N1

Figures 4.2.2 and 4.2.3 illustrate the prevalence of single automobile crashes and double vehicle accidents respectively, along the Dhaka-Chittagong National Highway N1.

During the span of our examination, it was determined that 61% of all incidents under investigation included only one car, and the other 39 percent of events were categorized as collisions involving two vehicles.

ACCIDENT TABLE

CONDITIONS SET **EDT-2018**

YEAR- **2009-2018**

ROUTE NUMBER **N2**

NO. OF VEHICLES

YEAR	1	2	3	4	5	6	TOTAL
2009	78	77	0	0	0	0	155
2010	60	49	2	1	0	0	112
2011	20	20	1	0	1	0	42
2012	27	40	4	0	0	0	71
2013	2	0	0	2	0	0	4
2014	29	31	0	0	0	0	60
2015	6	13	2	0	0	0	21
2016	25	42	4	1	1	0	73
2017	13	21	1	0	0	0	35
2018	30	38	0	0	1	0	69
TOTAL	**290**	**331**	**14**	**4**	**3**	**0**	**662**

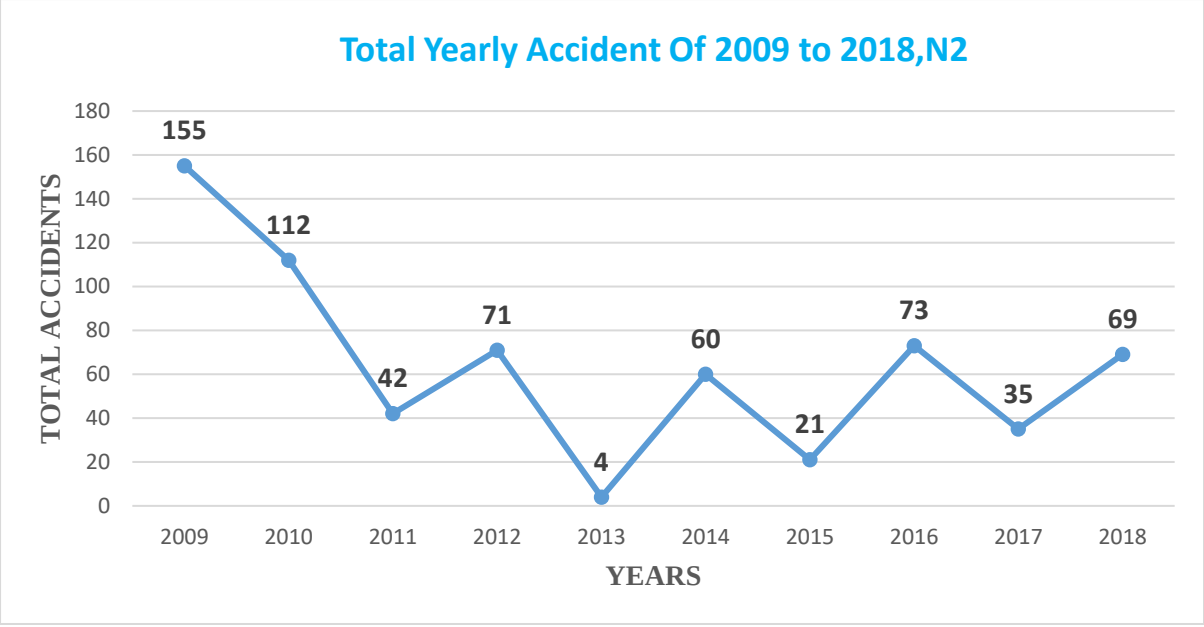
Table 4.2: Vehicle Accident Table of N2

Note: 1 = Single Vehicle Accident; 2 = Double Vehicle Accident; 3 = Triple Vehicle Accident. These represents the involvement of vehicles in any Accident.

From table 4.2, we see the total yearly accidents number and yearly accident percentage for N2 in figure 4.3.

Table 4.2 displays a comprehensive dataset encompassing the annual count of accidents and the associated vehicle incident chart on the N2 highway for a decade-long period, ranging from 2009 to 2018.

Building upon the preceding study, an additional component has been included in the form of a vehicle accident data specifically focused on N2. This data encompasses the identical 10-year timeframe.



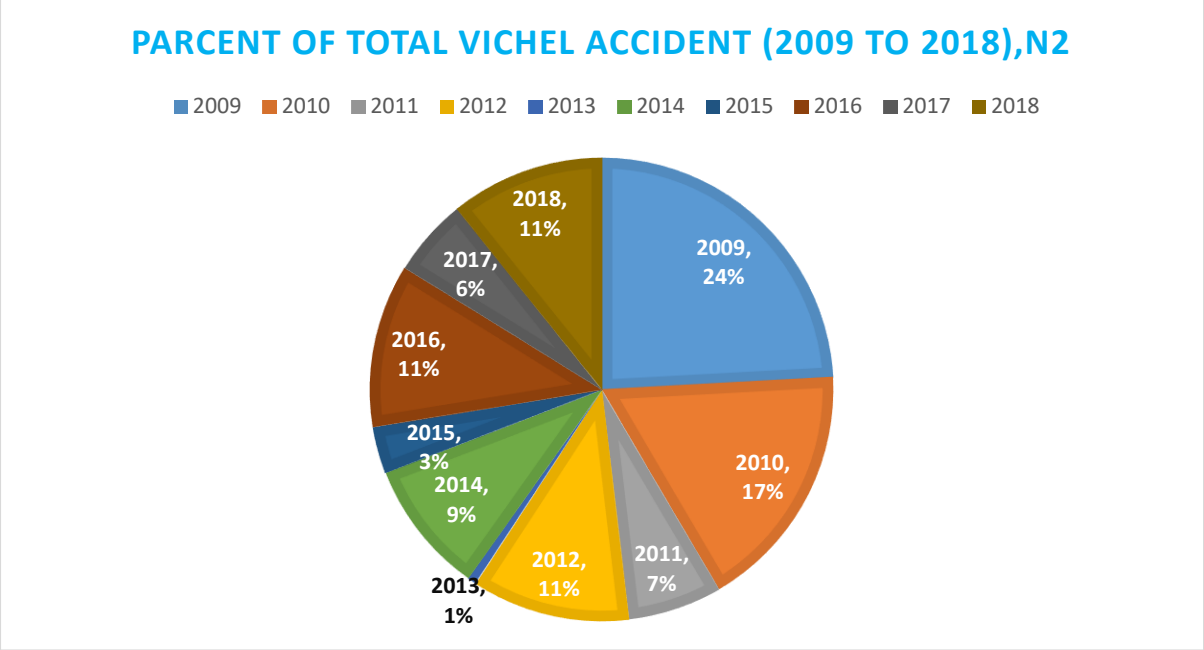


Figure 4.2.4: Total Yearly Accidents of N2 (2009 to 2018)

Here we see in figure 4.2.4 that,

• The year 2013 witnessed the fewest number of accidents, while the year 2009 experienced the highest number of accidents over the time frame of 2009 until 2018.

The chart depicting vehicle accidents on N2 is derived from Table 4.2, referred to as the Vehicle Accident Chart. This analysis illustrates the frequency of single, double, triple, and multiple vehicle accidents that occurred on the N2 highway between the years 2009 and 2018.

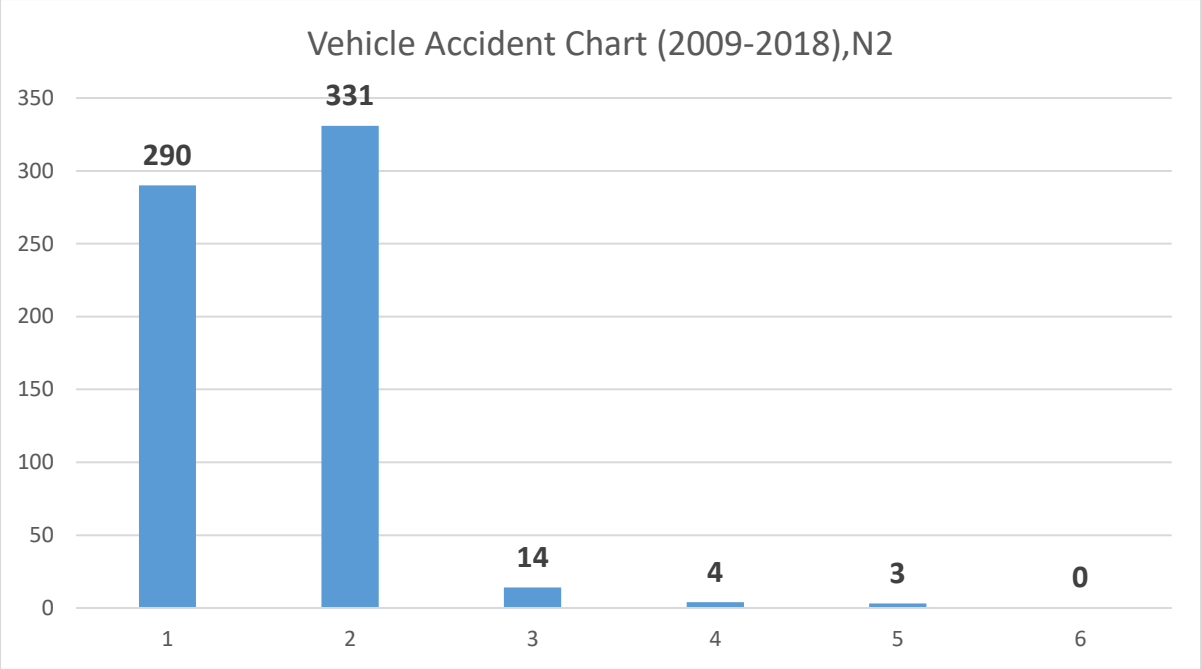


Figure 4.2.5: Vehicle Accident Charts of N2

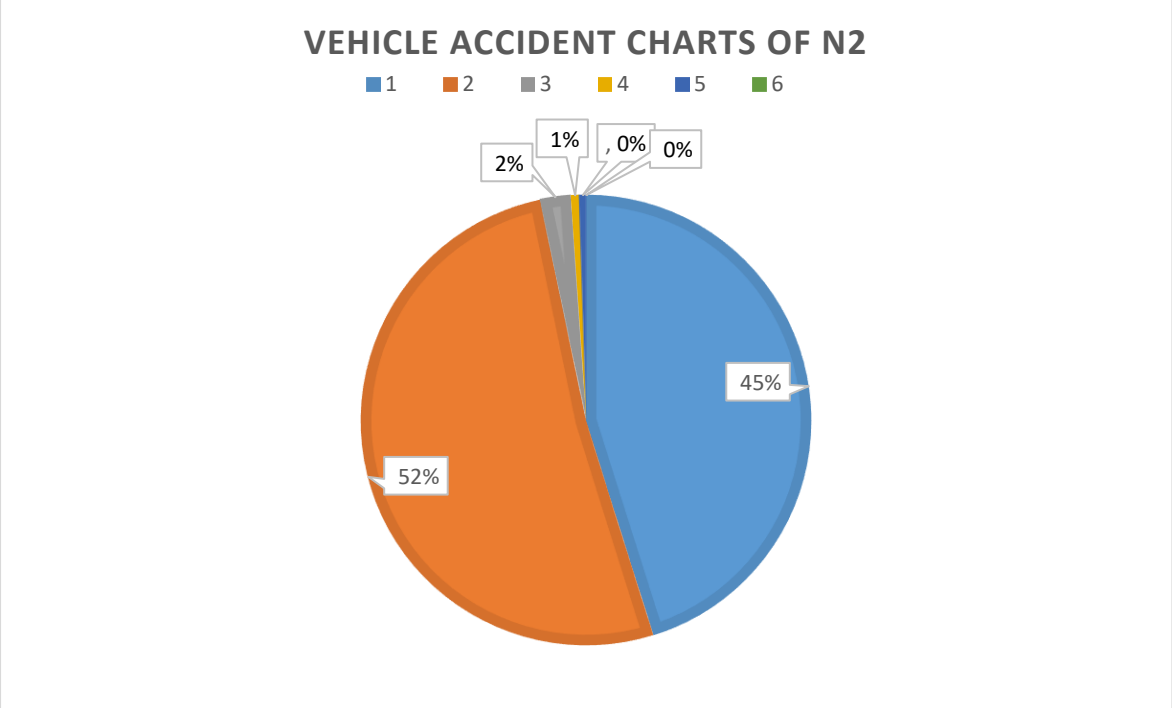


Figure 4.2.6: Vehicle Accident Charts of N2

In figures 4.2.4 and 4.2.5, it is evident that the majority of accidents on the Dhaka-Sylhet highway N2 are classified as single car crashes and dual vehicle accidents, similar to those observed on highway N1.

In our investigation, it was found that 45% of the accidents observed were classified as single vehicle accidents, while 52% were categorized as double vehicle accidents. It is worth noting that a relatively small proportion of accidents involving three or more vehicles occurred on N2 over the ten-year period under study.

4.3 Accident Severity of N1 (2009 to 2018)

Now we have added Accident Severity Tables of N1.

ACCIDENT TABLE

CONDITIONS SET **EDT-2018**

YEAR **2009-2018**

ROUTE NUMBER **N1**

Accident Severity

YEAR	Fatal	Griev	Simple	Colln	Total
2009	103	15	2	4	124
2010	92	8	4	4	106
2011	34	3	0	1	38
2012	59	10	2	4	75
2013	99	9	3	1	112
2014	104	11	2	3	120
2015	119	10	4	1	134
2016	188	12	5	3	208
2017	216	12	3	2	233
2018	230	15	4	3	252
Total	**1244**	**105**	**29**	**26**	**1402**

Table 4.3: Accident severity of N1

Note: Fatal = Fatal Accident; Griev = Grievous Accident; Simple = Simple Accident, Colln = Collision Only Accident/ Property Damage Only (PDO).

These represents the Injury level and the damage of vehicles in any Accident.

From table 4.4.1 we have added our analysis and bring an accident severity chart. Here we use pie chart on figure 4.4.2

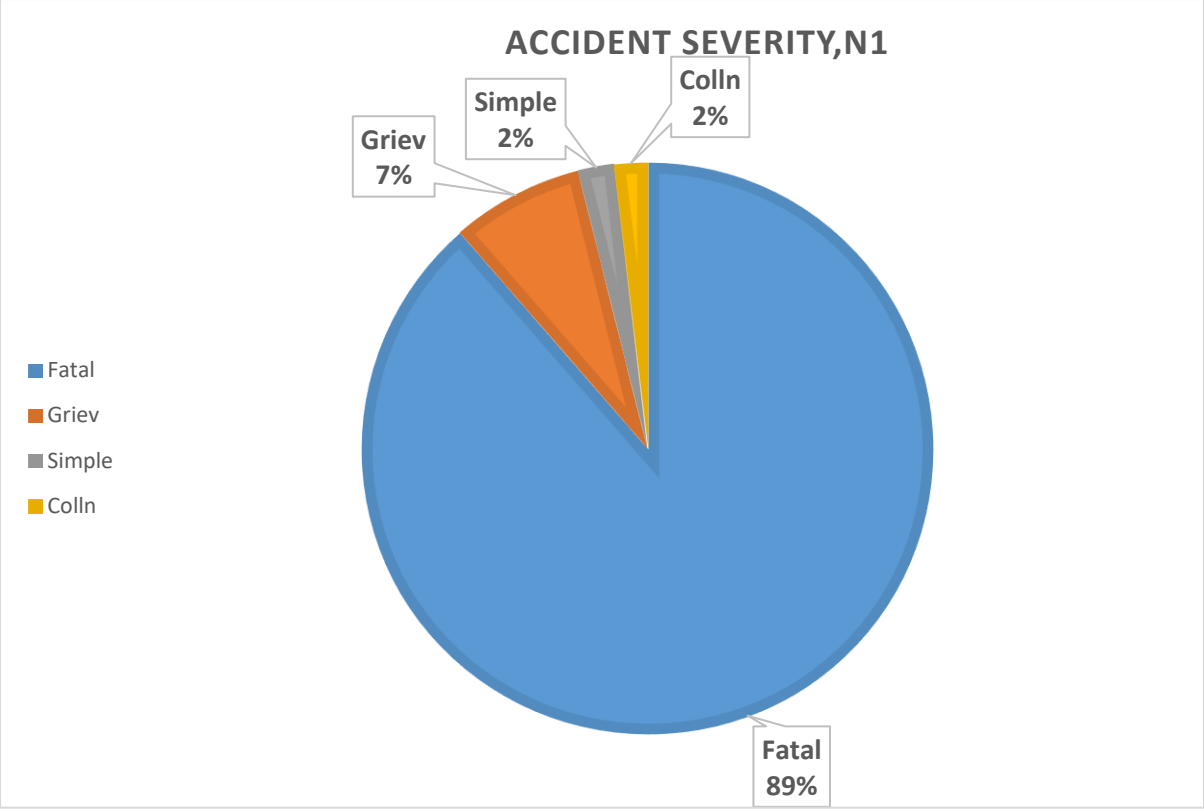


Figure 4.4.1: Accident Severity of N1 2009 to 2018

In Figure 4.4.1, it is observed that the Dhaka-Chittagong highway N1 exhibits a significant occurrence of fatal accidents, as indicated by the accident severity chart.

In the aforementioned route, it was observed that approximately 87% of accidents were classified as fatal, 9% as severe, 2% as simple, and 2% as collision accidents, spanning the time period from 2009 to 2018.

According to the data presented in Table 4.3, it is evident that there was a substantial increase in the occurrence of fatal accidents in the years 2009, 2014, and 2018.

In the subsequent section of our study, we will endeavor to ascertain the underlying causes behind the significant increase in fatal accidents over these particular years. Furthermore, we will provide potential solutions to address this pressing issue in the findings and recommendation segment.

4.4 Accident Severity of N2 (2009 to 2018):

The accident severity table relating to Dhaka-Sylhet Highway N2 has been included in this document.

ACCIDENT TABLE

CONDITIONS SET

EDT-2018

YEAR **2009-2018**

ROUTE NUMBER **N2**

Accident Severity

YEAR	Fatal	Griev	Simple	Colln	Total
2009	122	24	6	6	158
2010	89	14	5	1	109
2011	35	6	0	0	41
2012	55	10	0	2	67
2013	2	0	0	0	2
2014	55	6	0	0	61
2015	15	3	1	0	19
2016	48	5	4	3	60
2017	49	10	2	2	63
2018	62	13	6	1	82
Total	**532**	**91**	**24**	**15**	**662**

Table 4.4: Accident severity of N2

Note: Fatal = Fatal Accident; Griev = Grievous Accident; Simple = Simple Accident, Colln = Collision only Accident/ Property Damage Only (PDO).

These variables describe the severity of injuries and the extent of car damage in any given accident.

Based on the data shown in Table 4.4, we have conducted an analysis and generated a graphic depicting accident severity. In this context, a pie chart is shown in Figure 4.4.1.

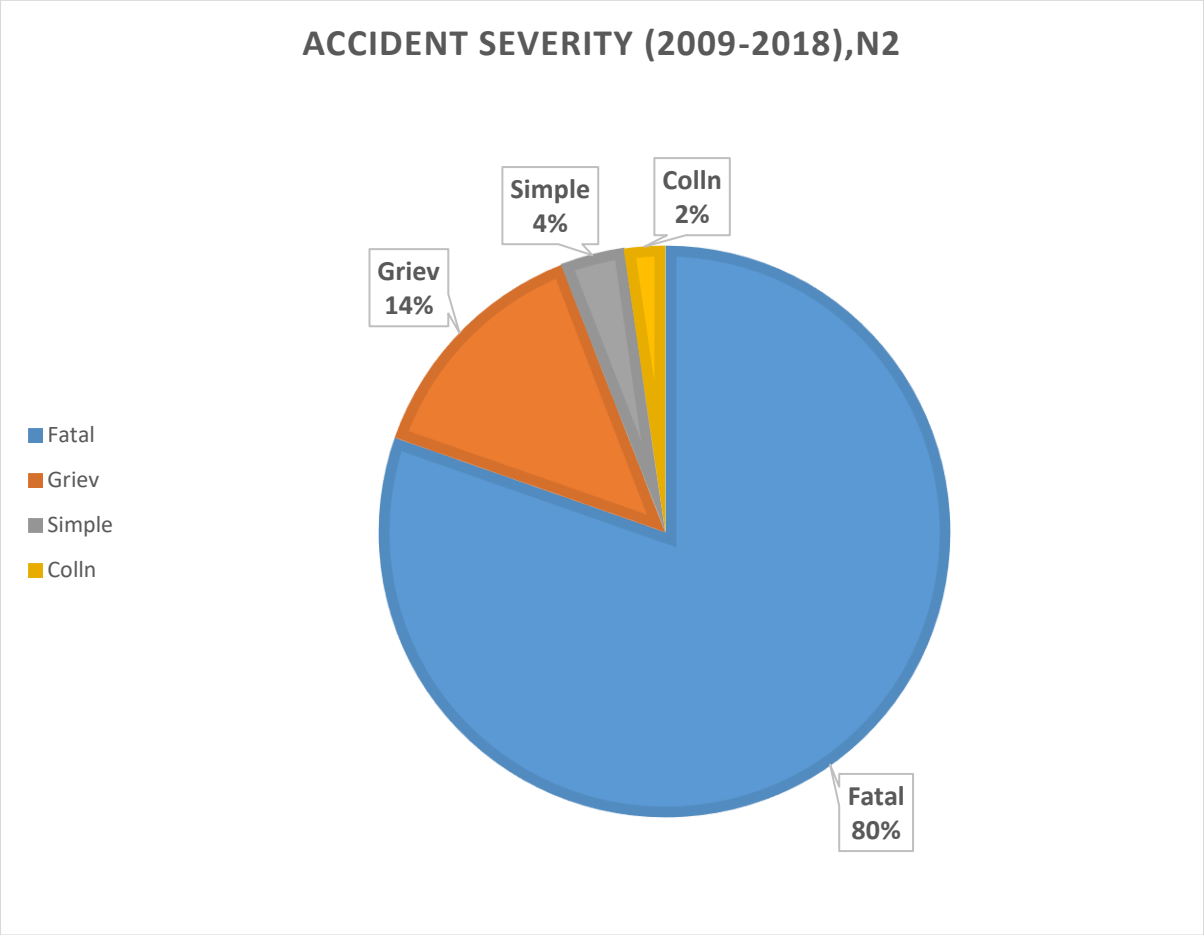


Figure 4.4.2: Accident Severity of N2 2009 to 2018

In Figure 4.4.2, it is observed that the Dhaka-Sylhet highway N2 has a significant frequency of fatal accidents in the Accident Severity Chart, similar to N1.

Between the years 2008 and 2018, an analysis of this particular route revealed that around 80% of the incidents were classified as fatal, 14% as horrific, 4% as simple, and 2% as collision accidents.

According to the data presented in Table 4.4, it is evident that there was a significant increase in the amount of fatal accidents during the years 2009 and 2010.

Only a small number of accidents occurred on the Dhaka-Sylhet Highway in 2013.

In the subsequent section of our study, we will endeavor to ascertain the underlying causes behind the significant increase in fatal accidents over these particular years. Furthermore, we will provide potential solutions to address this issue in the findings and recommendation section.

Chapter 5
CONCLUSION

5.1 Introduction

This chapter presents the primary findings of our investigation and offers corresponding recommendations derived from these findings. In order to enhance the comprehensiveness of our study, it is imperative to incorporate key findings in a sequential manner. Furthermore, it is equally important to include recommendations alongside these findings. In addition to the aforementioned constraints, our study has also incorporated the corresponding conclusions.

5.2 Key Findings

We have conducted an analysis on the accident data collected from National Highway N1 as well as N2 for the period of 2009 to 2018, employing several methodologies. Presented below are the important findings that have been incorporated into this document.

- The year 2011 recorded the most minimal number of accidents in N1. During that period, the project for expanding the road was underway. Drivers were limited to operating cars at reduced speeds. Reducing speed has the potential to mitigate the number of casualties.
- The majority of accidents on both highways consist of single-vehicle and double-vehicle incidents.
- Approximately 57% of vehicular incidents involve a single vehicle, whereas nearly 42% of accidents involve two vehicles.
- The implementation of road dividers, often known as medians, has the potential to mitigate road accidents.
- Approximately 80% of these incidents result in fatalities, while 15% are categorized as severe and 2% as minor. Additionally, 2% of the incidents involve collisions occurring on both Highways. A significant quantity of fatal accidents has detrimental impacts on the national gross domestic product (GDP).
- The majority of accidents transpired on both highways in the absence of traffic control measures. In terms of vulnerability, it is important to focus on specific areas of traffic control, namely the center line, pedestrian crossings, and areas where traffic is regulated by police.
- The majority of accidents in both highways occurred in non-junction areas. Cross intersections exhibit a higher frequency of accidents in comparison to other types of junctions.
- In both instances pertaining to Highways, it has been observed that pedestrians are the most susceptible individuals in the context of road accidents.
- Head-on and rear-end collisions exert a substantial influence on the occurrence of traffic accidents.
- The majority of accidents occurred under fair weather conditions. The occurrence of rain and fog resulted in numerous accidents.
- There exists a distinction between the overall amount of incidents and the subset of accidents that result in casualties. Over the course of several years, there has been an observed increase in the occurrence of accidents, while simultaneously witnessing a drop in the number of fatalities resulting from these incidents.
- The majority of car accidents in both Highways were found to have happened in the absence of any discernible vehicle problems. Numerous accidents transpire as a result of various malfunctions, including braking, light, and other system failures.

- ❖ Approximately 59% of the overall accidents occurring on N1 and approximately 63% of the total accidents on N2 have been seen to result in no fatalities.
- ❖ In N1, specifically on both the first and second days of the every month, and in N2, specifically on the 15th as well as 10th days of the the month, a higher number of accidents occur compared to other dates. During these specified dates, the roadways experience a significant influx of traffic.

In summary, the primary factors contributing to road accidents across both lanes include an increased number of vehicles, inadequate road conditions, higher speeds, a greater likelihood of disregarding traffic regulations, insufficient education, inadequate traffic control measures, a higher prevalence of unfit vehicles, an increased number of hazardous areas on highways, and a scarcity of traffic lights.

5.3 Recommendations

Strategies for Mitigating Road Traffic Accidents in Bangladesh:

• A. Measures for Enhancing Street and Road Environments:

1. The implementation of a systematic increase in the arrangement of street dividers.
2. Enhancement of Shoulder Functionality.
3. Standard Mathematical Framework.
4. Enhancements to Streetlamps, Traffic Signs, Signals, and Markings. The acceleration of the board and the potential hazards associated with roadside conditions pose challenges to the management of executive transportation.

• B. Enhancing Measures for Vehicle and Traffic Operations:

1. Enhancing the public transportation infrastructure.
2. The Implementation of Seatbelt and Helmet Usage.
3. Regulate the operation of non-standard cars on public roads.
4. The Enforcement of Traffic Laws

• C. Measures to Promote Exploration, Training, and Awareness:

1. Supporting studies on traffic safety.
2. Strengthen the structure for recording and analyzing accident data.
3. Reiterate the academic and professional limits.
4. Information and education about road security.

Street and Street Climate Improvement

little effort Transient Intermittent Estimates include enhancing the shoulder, eliminating visual obstructions, controlling access, reducing street side danger and getting off the board, enhancing transport narrows, increasing traveler asylum and road illumination, and surface..

To lessen Road accidents:

Better signage, no tiny type, entire word use, use of covers and smalls, genuine contrast along with visibility, bolts pointing in meaningful directions

less words per mile per minute, fewer phrases per sign that can be understood in one reading at a fourth-grade reading level in the time available at the legal pace,

Better roadways, for example, with no intersections or stop signs at the bottom of a descending blind curve (constantly first discovered in the pouring rain in the dark),

Fewer alternatives per mile, fewer options for vehicles to choose from every second, for instance, too many covered entrances, exits, and signs in a series of crossing sites that are uncomfortably close to one another,

There is no approaching traffic and all roadways are one-way; substantial renovations are needed. When it comes to new roadways,

There are no exits nor tunnels on the left; the left lane is for swift passing rather than easing down to leave or enter and starting late to make up lost time in congestion. For these reasons, slower automobiles might dangerously mix in with faster ones.

No equal halting, which causes traffic congestion for longer periods of time as inexperienced drivers struggle to follow the rules of vector science,

Level 1 traffic vehicles only; no sharing of the road with pedestrians or self-propelled vehicles like cycles,

Two-way traffic adjustments, truck and cruiser pathways,

In the initial stages of automobile usage, there were no established protocols for determining the right of way at intersections, resulting in frequent collisions between the two primary vehicles in Ohio. In fact, all vehicles in the state were involved in collisions. However, even with the implementation of comprehensive right of way regulations, accidents continue to occur.

There is a need for the replacement of older vehicles lacking essential safety features, such as full-window decoration airbags, ABS ESP halting automated processes with electronic stability programs, and back-up cameras, with newer and safer vehicles. This can be achieved through financial incentives to encourage the exchange of older vehicles for newer ones that are equipped with advanced safety technologies. Additionally, it is proposed to increase registration fees for aging vehicles that do not meet modern safety standards. Furthermore, the government could implement a buyback program for hazardous vehicles, followed by their destruction.

The implementation of tire-pneumatic pressure siphons at street entrances, funded by charges levied on roads, cars, and fuel, is proposed as a means to provide optimal and consistent vehicle control. These measures are deemed essential and fundamental in nature.

Adaptive speed restrictions, which are increasingly correlated with weather conditions and traffic volume, occasionally allow for greater speed limits.
The automatic payment of prepaid expenses is facilitated by the use of OCR (optical character recognition) technology, which enables the recognition of our vehicle's license plate. This system aims to prevent delays and lane changes on highways that may occur when searching for coins & paper currency.

Various publications have evaluated the annual fatality count to range from 12,000 to 20,000. As a result, the problem of wellness is of significant concern according to international standards, as seen by the very high number of deaths per 10,000 motor vehicles in Bangladesh, ranging from around 60 to 150. In

comparison, the countries of India, Sri Lanka, the United States of America, and the UK report far lower figures of 25, 16, 2, and 1.4 fatalities respectively. The ownership of motor cars in Bangladesh has exhibited a constant growth pattern, with the current rate estimated to be about 2 to 10 automobiles per 1,000 individuals. However, despite significant advancements in the number of motor vehicles, the demand for transportation in the country continues to be primarily fulfilled by non-motorized modes, such as walking and carts. Furthermore, the level of motorization in the country remains considerably lower compared to other nations. For instance, India, Sri Lanka, the UK, and the USA have approximately 12, 25, 426, and 765 motor vehicles per 1,000 individuals respectively. The aforementioned advancements, in conjunction with other associated urban hazards, have resulted in significant concerns over road traffic safety.

Integrated Safety Management

Based on the aforementioned description, it is evident that collisions and injuries are a matter of public concern, and the responsibility for implementing prevention strategies lies with various government sectors, including urban and regional planning, road development and upkeep, transportation management, medical care, educational professional training, information dissemination, and enforcement, among others. Private entities, such as road user clubs and insurance firms, have the potential to actively participate and provide significant expertise or resources. However, it is important to have a management style that is comprehensive and encompasses several sectors, ensuring their integration.

- The assessment of safety issues and causes contributing to accidents should be conducted using a multidisciplinary approach, including all potential strategies for mitigating accidents (including various forms of interventions).
- The determination of priority objectives for actions must be a collaborative process involving representatives from all sectors accountable for taking action.
- The selection of the primary courses for action should be a collaborative effort, taking into consideration the problems that need to be addressed. Additionally, a budget should be assigned or specified to facilitate the thorough planning and execution of the steps by the relevant stakeholders.
- A proposed course of action involves the establishment of a coordinating entity tasked with ensuring the timely implementation of mutually supportive measuring strategies.
- The utilization of program evaluation should serve as the foundation for establishing best practices in preventative measures.

Road and Road Environment Improvement

The implementation of Low-Cost Short-term Intermittent Measures encompasses several strategies such as enhancing the shoulder, eliminating visual obstructions, implementing access control, addressing roadside hazards, managing parking, and upgrading the bus's bay, traveler shelter, lighting on streets, and road surface.

Enhancements in several aspects of transportation infrastructure can contribute to the overall improvement of traffic management and pedestrian safety. These improvements may include the upgrading of traffic signs, the implementation of effective drainage systems, the enhancement of curves on roadways, the optimization of intersections, the development of pedestrian amenities such as sidewalks and crosswalks, the implementation of pedestrianization strategies, and the implementation of speed management measures, among others.
Long-term policy and capital-intensive measures encompass a range of strategies such as planning and guidelines, land use control, risk management by means of transport and land-use regulations, functional order, audit or evaluation, control of access, highway monitoring, bridge and bridge strategy, expansion of divided highways, establishment of service or frontage roads, grade separation interchange facilities, grade-separated pedestrian facilities, and provision of additional space at junctions, among others.

5.4 Limitations of our work

The evaluation was mostly influenced by asset limits. Efficiently managing a large repository of data for the purpose of data mining necessitates the utilization of high-performance computers equipped with robust technical configurations. It was determined that the personal computer designated for the purpose of conducting information retrieval duties for this exposition was unable to effectively handle the substantial volume of data. Thus, it became imperative to reduce the magnitude of the accident database. It is commonplace that if it were feasible to utilize the complete database, the conclusions may have proved more precise.

In order to provide a seamless and efficient conversion and recording process of the complete database, a tool was required to transfer the data to MS Excel. At that juncture, it would have seemed plausible to incorporate the additional signs in our analysis that have been overlooked due to inconsistency among the sector leaders.

5.5 Possibilities of our work

- Future study on N1 and N2 warrants more investigation.
- The enhancement of the N1 and N2 highway infrastructure.
- By utilizing our thesis, it becomes feasible to determine the areas in both N1 and N2 that require the most significant improvements.
- The recommendation section provided can be implemented throughout all highways in Bangladesh.
- The implementation of a thesis strategy can be employed in future research endeavors focused on the highways and roads of Bangladesh, providing students with a framework for investigating this topic.
- This thesis has the potential to provide valuable assistance to the transportation authorities of Bangladesh in several ways.

5.6 Conclusions

Road accidents have the potential to result in irreversible damage and inflict harm onto individuals irrespective of the timing. Occasionally, it exerts a significant impact on a substantial number of individuals. The impact of a vehicle collision is distressing. Individuals experience the permanent loss of their loved ones. As a consequence of accidents, individuals who sustain injuries can impose a significant financial and emotional burden on their families, as their afflictions are not confined to physical pain alone.

Our research endeavors aim to make a valuable contribution towards enhancing the infrastructure of N1, N2, and other major motorways in Bangladesh.

It is imperative for individuals from diverse backgrounds to together address the issue at hand. Lastly, it is imperative for the government to initiate a comprehensive program aimed at addressing this issue and implementing stringent measures to maintain law and order in order to mitigate the occurrence of road accidents.

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- Characteristics of accidents of selected arterials of metropolitan Dhaka Raufuzzaman, Md.

APPENDIX

It is observed that before year 2004 the total accident frequency on this national highway is comparatively little with respect to the recent years. The number of accident in four full calendar years (2000 to 2003) is 226 but in last three years (2004 to 2006) it becomes 508, which means that it is increased 2.3 times more. Accident fatality is also considerably maximum with respect to total accidents which are about 68% than follows by grievous 19%, simple 9% and collision type of accidents are 4% observed in figure 4.2.

Table 4.1: Accident Severity on Dhaka-Chittagong National Highway

Year	Fatal	Grievous	Simple	Collision	Total
2000	35	11	10	1	57
2001	14	11	2	3	30
2002	60	23	12	4	99
2003	26	4	7	3	40
2004	127	38	18	8	191
2005	119	28	10	8	165
2006	124	22	5	1	152
Total	505	137	64	28	734

Source: Accident Research Institute (ARI), 2007, BUET, Dhaka-1000

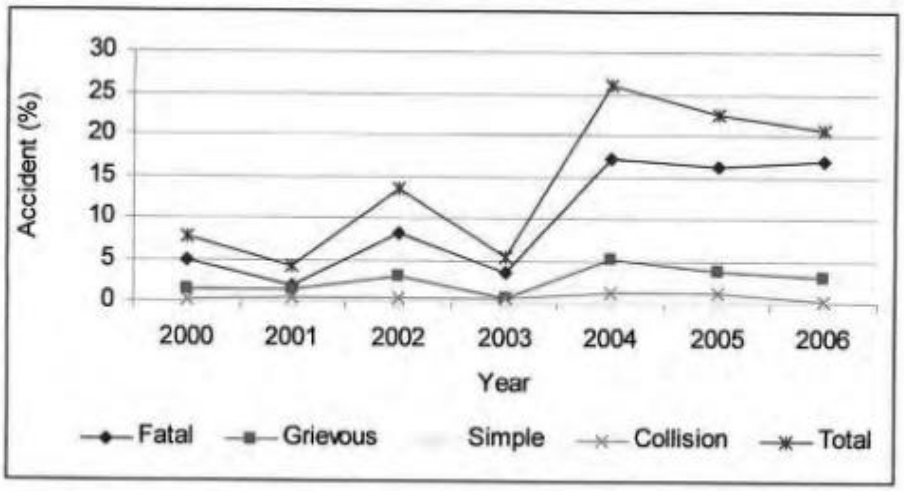


Figure 4.1: Yearly Accident Severity on Dhaka-Chittagong Highway.

It is also observed in figure 4.1 that, during last seven years, fatal accidents arc dominated allover other types of accidents. Fatal accident in year 2000 is 35 but after seven years it is increased 124 which are about 3.6 times more. Grievous types of accident as second dominating accident types which has also a significance effect on this highway and also increased after year 2004 with respect the past years. Simple and collision types of accident occurred in this highway relatively identical during the study period.

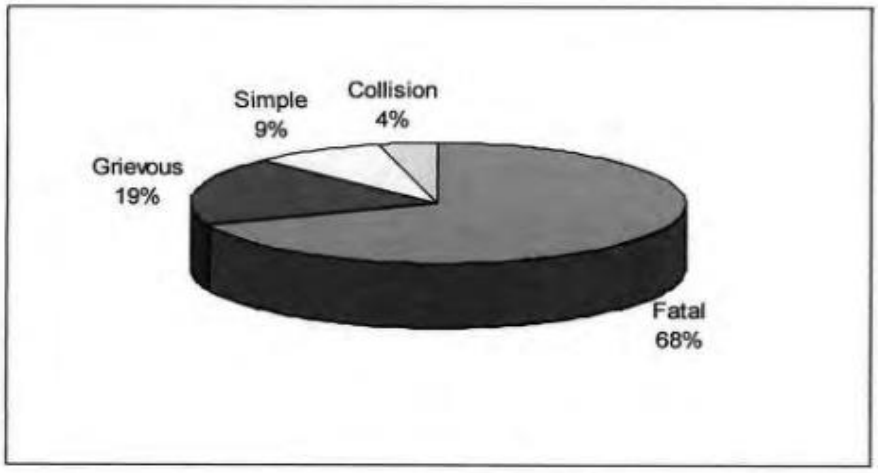


Figure 4.2: Accident Severity on Dhaka-Chittagong Highway

Table 4.2: Accident Involved Vehicle Class on Dhaka-Chittagong Highway

User Class	2000	2001	2002	2003	2004	2005	2006	Total
Large Bus	30	10	31	17	88	61	60	297
Small Bus	7	4	21	9	24	42	14	111
Truck	39	22	65	22	104	75	74	401
Car	10	4	8	6	36	24	24	112
Others	1	0	8	5	31	26	21	92
Total	87	40	133	59	283	218	193	1013

Source: Accident Research Institute (ARI), 2007, BUET, Dhaka-1000

Table 4.3: Accident Based on Period Dhaka-Chittagong Highway

Time	2000	2001	2002	2003	2004	2005	2006	Total
12.00A.M-1.59 A.M	1	3	6	0	9	21	13	53
2.00A.M-3.59 A.M	1	4	6	1	14	9	8	43
4.00A.M-5.59 A.M	3	6	4	5	13	18	18	67
6.00A.M-7.59 A.M	2	3	10	2	20	21	18	76
8.00A.M-9.59 A.M	7	2	14	6	17	14	13	73
10.00A.M-11.59 A.M	6	1	17	2	22	22	17	87
12.00P.M-13.59 P.M	7	2	11	5	25	12	19	81
14.00P.M-15.59 P.M	11	2	8	4	11	11	13	60
16.00P.M-17.59 P.M	7	3	13	6	18	7	13	67
18.00P.M-19.59 P.M	5	0	2	3	17	11	6	44
20.00P.M-21.59 P.M	7	2	4	6	13	12	4	48
22.00P.M-23.59 P.M	0	2	4	0	10	7	5	28
Total (24 hours)	57	30	99	40	189	165	147	727

Source: Accident Research Institute (ARI), 2007, BUET, Dhaka-1000

This analysis exposed that maximum vehicles involvement in accident is considerably high after year 2004. In year 2004, vehicles involved due to accident on this national highway are about 28% of total accident involved vehicles during study seven years.

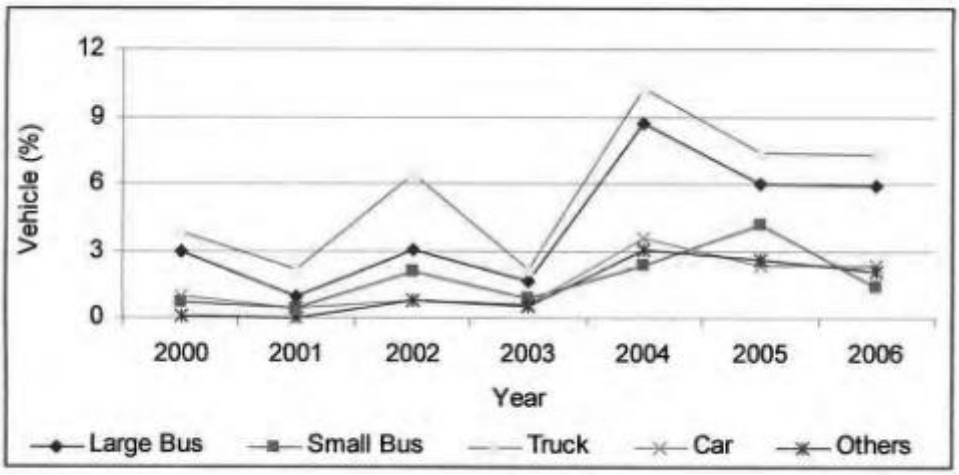
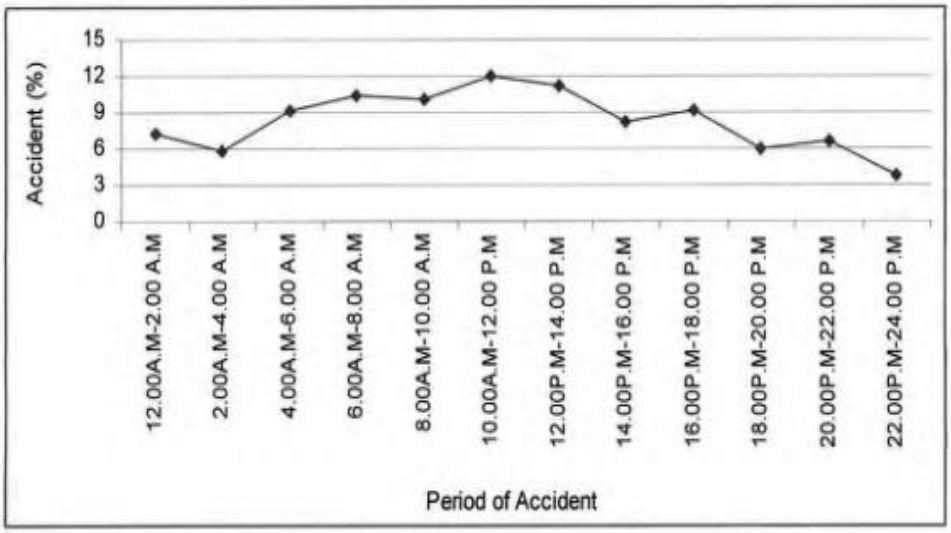


Figure 4.3: Yearly Accident Involved Vehicle on Dhaka-Chittagong Highway.



From the analysis of accident involved road vehicles in figure 4.4, it is observed that the maximum accident responsible vehicle class is truck on this selected highway which is about 40% of total accident involved damaged vehicle during this study period and followed by large bus, small bus and car which is 29%, II % and II % respectively.

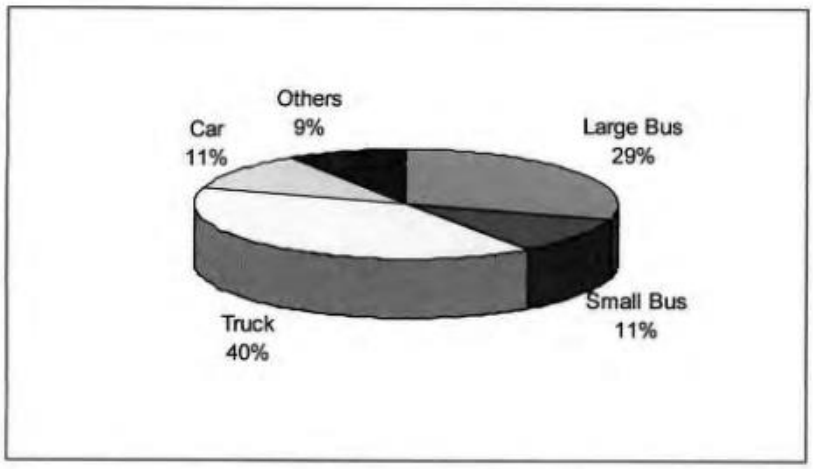


Figure 4.4: Accident Involved Vehicle on Dhaka-Chittagong Highway

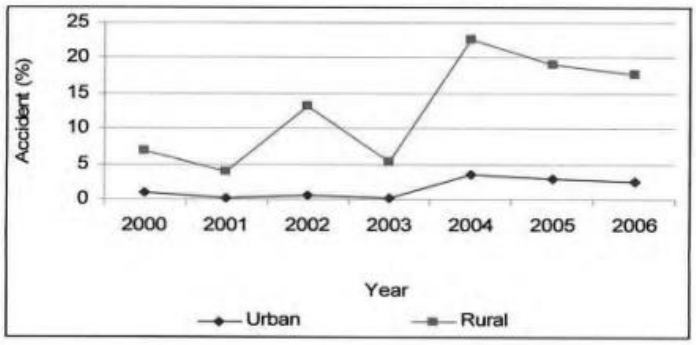


Figure 4.7: Yearly Accident Distribution Area on Dhaka-Chittagong Highway

From figure 4.7, it is observed that accident distribution in rural area is always elevated scale through out study period over urban area. After year 2003, accident frequencies on both urban and rural area are increased considerably and these are very higher scale for rural areas which are about 60% of total accidents.

Table 4.5: Accident Severity on Dhaka-Sylhet National Highway

Year	Fatal	Grievous	Simple	Collision	Total
2000	78	22	7	3	110
2001	62	20	7	0	89
2002	44	16	4	0	64
2003	24	15	1	0	40
2004	46	8	0	1	55
2005	35	4	2	0	41
2006	65	19	1	2	87
Total	354	104	22	6	486

Source: Accident Research Institute (ARI), 2007, BUET, Dhaka-1000

It is observed from figure 4.9 that in before year 2003 the total accident frequency on this national highway is comparatively high with respect to the recent years. The number of accident in four calendar years (2000 to 2003) is 303 but in last three years (2004 to 2006) it becomes 183, which is decreased 0.6 times. Accident fatality is also considerably maximum with respect to total accidents which are about 73% than follows by grievous 21%, simple 5% and collision type of total accidents.

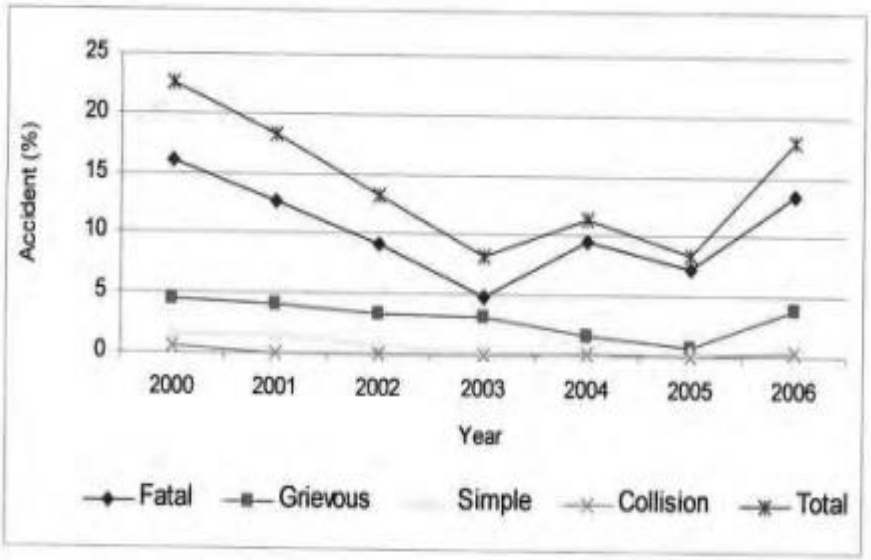


Figure 4.9: Yearly Accident Severity on Dhaka-Sylhet Highway.

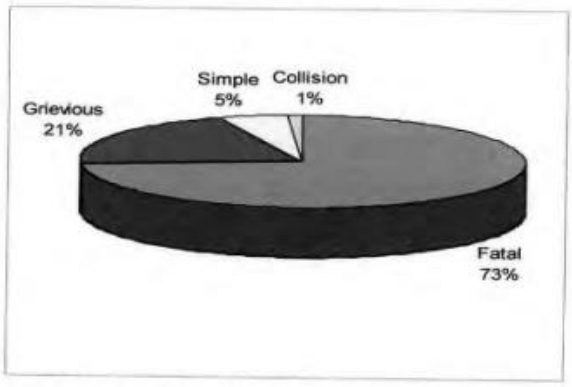


Figure 4.10: Accident Severity on Dhaka-Sylhet Highway

From the analysis of graphical distribution for accidents severity types on Dhaka-Sylhet national highway in figure 4.10, it is observed that fatal accidents 73% are dominated all over the study period than other types of accident. In past the accident severities are too much high on this national highway and it is gradually decreased up to year 2003, but after this year it is observed that severity of accident is again start to increase and it is too more than last study year. Comparatively grievous accidents are second dominating accident severity on this national highway. It is comparatively low with respect to fatal accident type. Simple and collision type of accident have less effect on this highway.

Table 4.6: Accident Vehicle Class on Dhaka-Sylhet National Highway

User Class	2000	2001	2002	2003	2004	2005	2006	Total
L. Bus	46	31	29	15	22	15	43	201
S. Bus	26	18	15	13	15	7	10	104
Truck	40	35	29	12	20	11	30	177
Car	9	6	6	3	3	3	12	42
Others	21	26	12	14	20	12	8	113
Total	142	116	91	57	80	48	103	637

Source: Accident Research Institute (ARI), 2007, BUET, Dhaka-1000

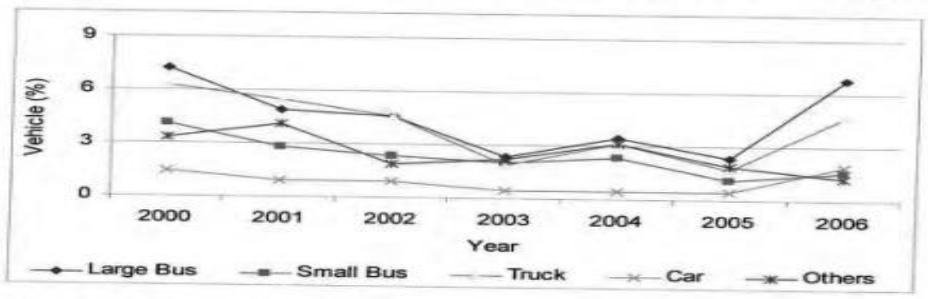


Figure 4.11: Yearly Accident Involved Vehicle on Dhaka-Sylhet Highway

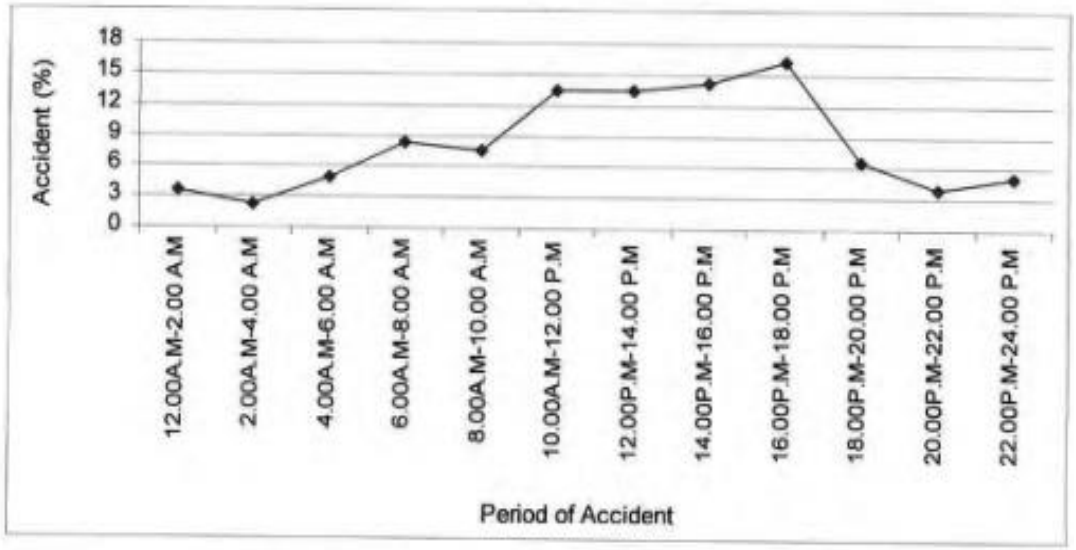
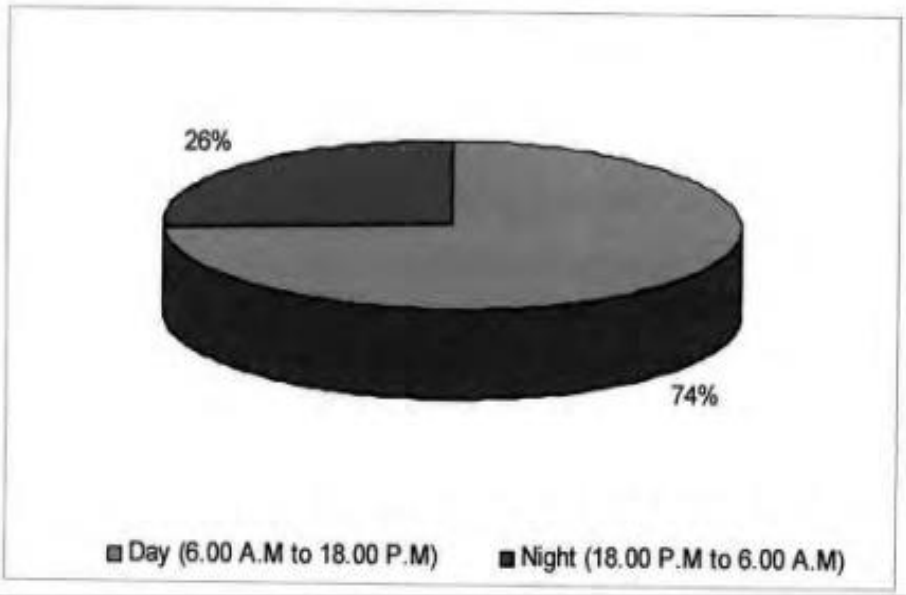


Figure 4.13: Accident Period on Dhaka-Sylhet Highway.

From the analysis of accident distribution in figure 4.13, it is observed that on Dhaka-Sylhet national highway during the study period, maximum accidents are dominated in between 10.00 A.M to 18.00 P.M which is about 58%. Generally more accidents are occurred in time 16.00P.M to 18.00 P.M which is about 16% of total accident occurred on this national highway. Considerably low accident frequency is observed in other periods on this study highway. The accident frequency are started to increase after 4.00 AM and again start to drop after period 18.00 P.M. The safer period on this national highway is in between 2.00 A.M to 4.00 A.M based on the data analysis.



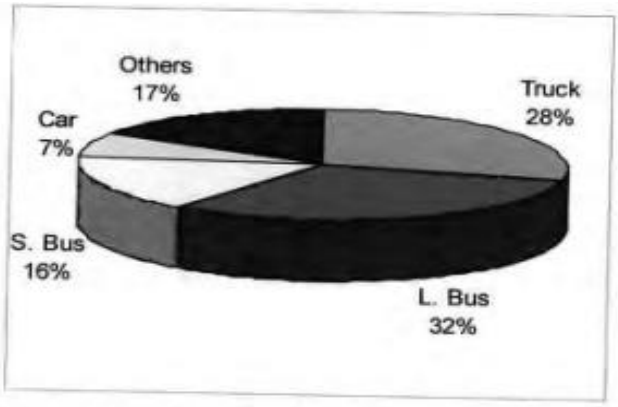


Figure 4.12: Accident Involved Vehicle on Dhaka-Sylhet Highway

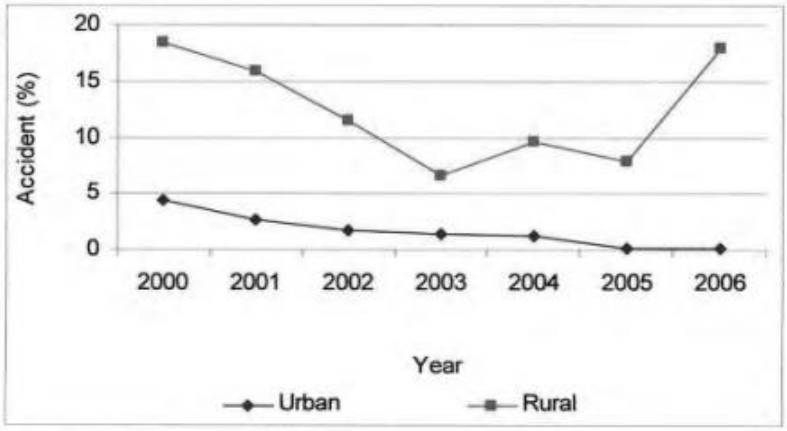


Figure 4.15: Yearly Accident Distribution Area on Dhaka-Sylhet Highway

From figure 4.15, it is observed that accident rate in rural area is always higher scale through out study period over urban area. Before year 2003, accident frequency on both urban and rural areas is considerably more. But in recent year though accident frequency is minimum in urban areas, it is very higher scale of total accidents in rural areas on this national highway. The minimum accidents are occurred in year 2003 is about 8% and maximum accidents are occurred in year 2000 which was around 23% of total accident on this national highway. Accident frequency is also more for last study year is about 18%.

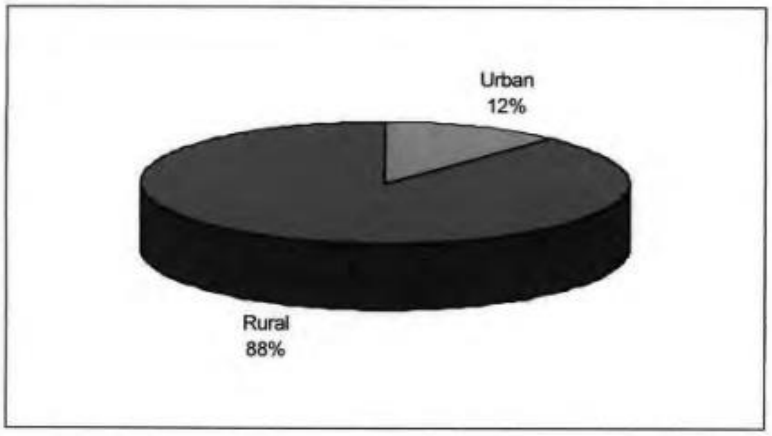


Figure 4.16: Accident Area on Dhaka-Sylhet National Highway.