# CAUSES OF ROAD TRAFFIC ACCIDENT ALONG NAUBISE-NARAYANGHAT ROAD AXIS AND CHALLENGES TO RESPOND

**A Thesis**

**Submitted to APF Command and Staff College**

**Faculty of Humanities and Social Sciences**

**Tribhuvan University**

**In Partial Fulfillment of the Requirements**

**For Master's Degree in**

**Security, Development and Peace Studies**


**Submitted by**

**GANESH BAHADUR SHAH**

**Ninth Batch (2080-082)**

**Roll No: 123740079**

**TU Regd. No: 6-1-55-75-97**

**APF Command and Staff College**

**Sanogaucharan, Kathmandu, Nepal**


**April 2025**

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# DECLARATION

I, GANESH BAHADUR SHAH, declare that this thesis entitled **"CAUSES OF ROAD TRAFFIC ACCIDENT ALONG NAUBISE-NARAYANGHAT ROAD AXIS AND CHALLENGES TO RESPOND"** submitted to the Armed Police Force Command and Staff Collage, Sanogaucharan, is my own original work unless otherwise indicated or acknowledged in the thesis. The thesis does not contain material which has been accepted or submitted for any other degree at the University or other institution. All sources and information have been specially acknowledged by reference to the author of institution(s).

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# LETTER OF RECOMMENDATION

This thesis entitled "**CAUSES OF ROAD TRAFFIC ACCIDENT ALONG NAUBISE-NARAYANGHAT ROAD AXIS AND CHALLENGES TO RESPOND"** has been prepared by GANESH BAHADUR SHAH under my supervision. I hereby recommend it in partial fulfillment of the requirement of Master's Degree in Security, Development and Peace Studies, Tribhuvan University. I, hereby recommend this thesis for the final evaluation and approval.

……

Prof. Dr. Dand Pani Adhikari

Thesis Supervisor

Date: 02 April 2025

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# LETTER OF APPROVAL

This thesis, titled "**CAUSES OF ROAD TRAFFIC ACCIDENT ALONG NAUBISE-NARAYANGHAT ROAD AXIS AND CHALLENGES TO RESPOND**," submitted by GANESH BAHADUR SHAH to the APF Command and Staff College, Faculty of Humanities and Social Sciences, Tribhuvan University, in partial fulfillment of the requirements for a Master's Degree in Security, Development, and Peace Studies, has been approved by the undersigned members of the Evaluation Committee.

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# ABSTRACT

The Naubise-Narayanghat, a vital transportation road to Kathmandu Valley, faces RTAs frequently due to driver's behaviour, fragile geography, poor infrastructure and extreme weather condition. This study examines the primary causes of RTAs and the challenges faced while responding and the measure to make effective rescue operation. The study has adopted qualitative exploratory-descriptive approach through surveys, KIs, interview, FGD and field observation methods. The data has been descriptively and thematically analyzed to uncover factors involved. Accidents and casualties' rates are found to be fluctuating over the period of five consecutive fiscal years from 077/78 to 081/82. Motorbikes dominate the accident involvement with 40% followed by truck/tanker with 18% and car/jeep with 16 %. Driver's behavior, and poor road conditions are key contributors to road accidents. Drivers's error remains responsible for 61% accidents while poor road conditions accounts 21%. The finding consistent with Combination Theory highlighting multiple interdependent factors contribute the road accident. Among driver's behaviour, excessive speed found to be responsible for 68% of accident. The study also highlights the challenges in emergency response, including the lack of resources, insufficient trained personnel, lack of information, extrication difficulties, hilly terrain and complex Trishuli River, weather condition, and lack of road safety law. Multidisciplinary approach includes enhancing traffic law enforcement, improving road infrastructure, implementing modern technologies, conducting road safety awareness programs to reduce traffic road accidents. Findings emphasize that advanced resource management, centralized information system, a comprehensive road safety law, sufficient trained manpower are indispensable to improve post-accident response. By addressing both the causes and response challenges, this study contributes to the ongoing discourse on road safety and disaster management in Nepal, with broader implications for other high-risk road networks in low-income countries.

*Keyword:* Accident, driver's behaviour, response challenges, road safety, strategies

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| | |
|---|---|
| ADR | Agreement Concerning the International Carriage of Dangerous Goods by Road |
| ADAS | Advanced Driver Assistance Systems |
| APF | Armed Police Force |
| AH | Asian Highway |
| AIDS | Acquired Immunodeficiency Syndrome |
| Bn | Battalion |
| DMTS | Disaster Management Training School |
| DRRMA | Disaster Risk Reduction Management Act |
| DWIDP | Department of Water Induced Disaster Prevention |
| Dr | Doctor |
| EST | Electronic Stability Control |
| Et al | Et alia |
| FGD | Focus Group Discussion |
| GPS | Global Positioning System |
| HA | Health Assistant |
| HICs | High-Income Countries |
| HIV | Human Immunodeficiency Virus |
| iRAP | International Road Assessment Programme |
| ITF | International Transport Forum |
| ITS | Intelligent Transport System |
| KIs | Key Informant |
| LICs | Low Income Countries |

| | |
|---|---|
| MD | Doctors in Medicine |
| MVTMA | Motor Vehicle and Transport Act |
| NA | Napali Army |
| NDTM | Nepal's Department of Transport Management |
| NHTSA | National Highway Traffic Safety Administration |
| NRSAP | National Road Safety Action Plan |
| NRSCS | National Road Safety Council |
| NSEE | National Statistics and Evaluation |
| OECD | Organization for Economic Co-operation and Development |
| PM | Post Meridiam |
| PSTD | Post-Traumatic Stress Disorder |
| RAIMS | Road Information Management System |
| RTAs | Road Traffic Accidents |
| RTIs | Road Traffic Injuries |
| SUVs | Sport Utility Vehicle |
| TRL | Transport Research Laboratory |
| UNDRR | United Nations Office for Disaster Risk Reduction |
| UK | United Kingdom |
| VMS | Variant Message Systems |
| WHO | World Health Organization |

# CHAPTER I

# INTRODUCTION

## 1.1. Introduction

This study is about road traffic accident along Naubise-Narayanghat road axis, which is in the Bagmati Province, central Nepal. It is a vital transportation lifeline linking Kathmandu Valley to the Terai region. Spanning a total length of 118.4 kilometers, the road comprises two segments: the Naubise to Mugling section (82.4 kilometers) as part of the Prithvi Highway and the Mugling to Narayanghat section (36 kilometers) falling under the Madan Ashrit Highway (Giri et al., 2023). Naubise-Narayanghat Road, designated as part of the Asian Highway Network (AH-42), is one of the most significant trade and transit routes in Nepal (Department of Road, Ministry of Physical Infrastructure and Transport, 2025). Unlike other routes that link Kathmandu Valley with the Terai, eastern and western Nepal, this road has served as a key transportation route for daily goods, materials, and fuel as well as other economic activities.

Most section of the road follows the course of Trishuli River, passing through the geologically fragile mountainous terrain. It encompasses key settlements: Naubise, Dharke, Gajuri, Malekhu, Benighat, Kurintar, Mugling, Dasdhunga, and Narayanghat. With high average daily traffic is more than 10000 vehicles, the road is congested, especially by two wheelers, cars, microbus, freight trucks and buses (Simaltal Bus Accident Task Force, 2024). However, besides its importance, the Naubise-Narayanghat Road is also suffered by harsh problems of landslides, road condition, and accidents caused by heavy monsoon rains and lack of maintenance (K. C. Devkota et al., 2013). Since this road is crucial in the chain of transportation networks in Nepal, especially for capital city Kathmandu, safety, efficiency, and reliability become prime importance for national connectivity and economic development.

Accident is referred as unintended event resulting in injury, damage, or loss. It is an unintended and unexpected events that disrupt normal functioning and often lead to adverse outcomes (Perrow, 2011). An unintended and unexpected event that results in harm or damage, often arising from a combination of human, technical, and organizational factors (Hollnagel, 2016). Thus, an accident is an unintended event that leads to harm or damage, often arising from complex interactions within systems or environments.

According to United Nations Office for Disaster Risk Reduction “a road traffic accident is any accident involving at least one road vehicle in motion resulting in at least one person injured or killed” (OECD, 2019 as cited in UNDRR, 2025). Road Traffic Accidents (RTAs) are defined as accident occurring on roads involving at least one moving vehicle and another object, which could be another vehicle, a pedestrian, or a stationary object (Manandhar, 2022b). A traffic accident is defined as an accident involving at least one vehicle on a road open to public traffic in which at least one person is injured or killed (NSEE, 2025; as cited in UNDRR, 2025). The consequences of RTAs can range from injuries to fatalities, property damage, and disruptions to traffic flow.

A traffic accident is defined as a collision involving one or more vehicles. It can also involve other “moving objects,” such as a pedestrian or cyclist. Traffic accidents also frequently involve fixed objects, such as trees, walls, or parked vehicles (Morelli Law Firm, 2025). Traffic accidents occur when two or more vehicles crash with each other, causing injuries to drivers, passengers, pedestrians, animals, property, etc. (Borsos et al., 2015; Vlkovský et al., 2017; Mohammed et al., 2019; Evans, 1996 as cited in Bucsuházy et al., 2020). Road accidents can be the result of the driving system malfunctions involving vehicle, road infrastructure, road user and their interactions.

Road Traffic accidents have been found to be classified into different types by researchers, each caused by specific reasons. Being able to know them is helpful for preventive measures. Head-on collision, side-swipe collision, rollover, single vehicle accident, and multiple vehicle accident are most common road traffic accidents which have been described in detail in subsequent section.

Rear-end collisions, a common occurrence on roadways, happen when a vehicle strikes the back of another, often due to distracted driving, speeding, aggressive driving, or tailgating, and can result in whiplash injuries (Yazdi, 2024). Head-on collisions, where two vehicles collide front-to-front, are particularly dangerous, frequently caused by drivers entering oncoming traffic due to distractions, fatigue, or impairment, with higher speeds dramatically increasing the risk of severe injuries or fatalities (Goguen, 2023). Side-impact collisions, or T-bone accidents, involve vehicles colliding side-to-side, ranging from minor to significant damage. Rollover accidents, especially prevalent in top-heavy vehicles, occur when a vehicle flips, often caused by sharp turns, sudden swerving, or poor road conditions, and are categorized as tripped

or untripped, posing a high risk of occupant ejection or crushing. According to National Highway Traffic Safety Administration (NHTSA) of US, single-vehicle accidents involve a vehicle colliding with a fixed object, pedestrian, animal, or leaving the road, frequently caused by driver distractions, speeding, impairment, fatigue, or adverse weather, leading to significant damage and injuries. Multi-vehicle accidents, involving three or more vehicles, including chain reaction collisions and multi-car pileups (Khom, 2025), particularly in adverse weather, can cause substantial property damage and numerous injuries.

Motorization has eased lives of many individuals and societies, but the benefits have come with a price (Gopalakrishnan, 2012). RTAs are one of the major public health concerns worldwide, and Nepal is no exception. According to the World Health Organization (WHO), an estimated 1.19 million lives are lost every year due to road traffic injuries, and many more people sustain non-fatal injuries that result in long-term disabilities (WHO, 2023). According to the WHO 2020 report, Nepal ranks 72$^{nd}$ in terms of road safety (Task force on Simaltal accident, 2081). Data from the Nepal Police for the fiscal year 2080/81 indicates that, on average, there are 97 road accidents daily, resulting in 88 injuries and 7 fatalities.

The death rates per licensed vehicle are higher in developing countries compared to industrialized countries (WHO, 2011 as cited in (Geremew, 2024). RTAs are a leading cause of morbidity and mortality in South-East Asia, including Nepal (Mishra et al., 2010). Roads in Nepal are considered among the most hazardous globally, with the likelihood of vehicle accidents being over 100 times greater than in Japan and 10 times higher than in India (Adhikari, 2016). From April 2022 to April 2023, there were 2,320 deaths and 28,856 injuries due to road traffic accidents, primarily attributed to reckless driving, poor road engineering, and inadequate emergency response making Nepal's highways deathtraps (Karki, 2023). Over the past five years, Nepal has tragically lost over 12,542 lives and suffered over 29,729 serious injuries due to road accidents. Insufficient compliance with safety regulations, negligence in road construction and engineering, reckless driving, and inadequate vehicle maintenance (Khatri, 2024) has been collectively contributing to an alarming rise in accidents.

Different causses are found to be contributing to road traffic accident globally. The most common risk factors associated with RTA are over speed, driving under influence of alcohol, not using safety measures such as seat belts, helmets, and child restraints, poorly constructed roads, increased number of vehicles that are poorly maintained, unplanned urbanization and

industrialization, motorization, overpopulation and fragile traffic rules (Pradhan et al., 2023). Road traffic accidents result from a combination of reckless driving, over-speeding, alcohol consumption, mechanical failures, overtaking, pedestrian negligence, and poor road conditions in Kathmandu Valley Reckless driving remains on the top of the ranking (Gautam & Joshi, 2024). Whereas poor vehicle maintenance has been identified as main cause of road accidents followed by negligence and over-speeding in Kathmandu (Manandhar & Timilsina, 2023). Analyzing the causes of RTAs along the Naubise-Narayanghat corridor reveals several factors have been significant role.

Generally, challenge is taken as something that needs great mental or physical efforts in order to be done successfully and therefore tests a person's ability. Mostly, literatures have been found defining challenge in three ways. Challenges are often characterized as difficult, novel, or complex in nature (Csikszentmihalyi, 1990; Latham and Locke, 1991; Amabile et al., 1994; Tedeschi and Calhoun, 2004; Kashdan and Silvia, 2009; Dweck and Yeager, 2019; Bjork and Bjork, 2020 as cited in Horikoshi, 2023). They are frequently seen as situations requiring skills or resources (Lazarus and Folkman, 1984; Csikszentmihalyi, 2003; Tedeschi and Calhoun, 2004; Dodge et al., 2012; as cited in Horikoshi, 2023), which may be tested or enhanced by surpassing personal limits.

Challenges can also be reinterpreted and transformed into opportunities for action, learning, growth, or skill development (Lazarus and Folkman, 1984; Amabile et al., 1994; Clough and Strycharczyk, 2012; Nakamura and Csikszentmihalyi, 2014; as cited in Horikoshi, 2023), often linked to adaptation in various studies ( Lazarus and Folkman, 1984; Tedeschi and Calhoun, 2004; as cited in Horikoshi, 2023). Here, challenges to respond road traffic accidents refer to a situation creating hindrance or difficulties for effective response.

RTAs occurring in hilly areas are difficult to respond due to the topography and inaccessibility. Emergency services are often delayed by difficult landscapes, which increases the chance of fatalities and injuries. Narrow roads with sharp curves complicate navigation for rescue vehicles. Adverse weather conditions like heavy rain, fog, or snow can slow down response times and the effectiveness of rescue operations. Such conditions increase the rate of accidents and make emergency responses more difficult (Flesch law firm, 2024). This is compounded by infrastructure issues.

Roads in most hilly areas are underdeveloped with poor signage and a lack of safety barriers,

increasing the risk of accidents. Most of the emergency services are not well equipped and trained to handle accidents effectively. In most cases, the lack of quick response teams leads to chaotic situations where untrained bystanders try to rescue, causing more harm to the victims. The "golden hour" following a traumatic injury is frequently lost as a result of delays, which increases the rates of death and illness (Joshi et al., 2014). In addition, the thin distribution of medical facilities in hilly regions undermines proper accident response. Victims are usually transported for long distances to hospitals for appropriate care, which may be harmful to their survival and recovery.

Difficult terrains, poor infrastructure, and a general lack of medical resources indicate the dire need for focused interventions to enhance emergency response in such areas. Improvement in road infrastructure, training of quick response teams, and better access to medical care (Yari et al., 2024) are the ways of reducing road traffic accidents in hilly areas.

Responding to RTAs in this region poses significant challenges. The rugged topography may have made it extremely difficult for emergency services to access accident sites promptly, often resulting in delayed medical assistance. Furthermore, the inadequacy of well-equipped trauma centers along the route exacerbates the problem, leaving victims without timely and adequate care (Sathian et al., 2018)). This lack of proper facilities and delayed response significantly increases the risk of fatalities and severe injuries, highlighting the urgent need for improved infrastructure and emergency preparedness in the area.

A multi-dimensional approach is found to be effective to address the problem of road traffic accidents. These includes strict enforcement of traffic laws, improvement in road infrastructure, and better emergency medical services (Sathian et al., 2018). Public awareness on safe driving practices could also go a long way in reducing accidents.

### 1.2. Statement of the problem

RTAs are a global public health concern, with significant social, economic, and health impacts. The World Health Organization (WHO, 2018) highlights that RTAs are a leading cause of death and disability, particularly in low- and middle-income countries, where inadequate infrastructure, poor enforcement of traffic laws, and rapid motorization exacerbate the problem. Scholarly debates on the causes of RTAs often focus on human factors (e.g., speeding, drunk driving, and fatigue), road infrastructure deficiencies (e.g., poor design, lack of signage, and

inadequate maintenance), and vehicle-related issues such as mechanical failures and overloading) (Haddon, 1980; WHO, 2018).

The Naubise-Narayanghat road axis is one of the major arteries of the highway network in Nepal, acting as an important link between the capital city, Kathmandu, and the southern plains. Truck, bus, tipper, microbus, car, tractor, dozer, motorbike etc. are mostly widely used as a modes of transportation (Giri et al., 2023) in this road. It is considered as having high accident rates, remains a hazardous journey due to its dusty and uneven diversions, rugged terrain, sharp turns, and overwhelming traffic congestion. For many, travelling along this route become a nerve-wracking situation due to high collision risks and unpredictable road conditions (Khatiwada, 2024). Without urgent improvements in road safety and infrastructure, this hazardous trend will continue to claim lives, demanding immediate attention and responsible action.

This road has been observed as one of the most prone areas of road traffic accidents in Nepal, where many causes may have contributed to the high accident rates. The challenges to response these accidents may have been further compounded safety risk. A multi-dimensional approach including improvement of infrastructure, law enforcement, and education of the public may have significance role to reduce the causes and improve the response to RTAs in this road axis.

The Naubise-Narayanghat road section, a critical highway in Nepal, exemplifies these challenges. This road has been experiencing frequent high accident rates due to its poor road condition, sharp curves, and heavy traffic flow as well as weather condition. Studies specific to Nepal, such as those by Manandhar (2022), highlights that driver negligence, poor road conditions, and overloading of vehicles are primary contributors to accidents on this route. The lack of adequate emergency response systems, including insufficient comprehensive law for command control, coordination, insufficient training and manpower, delayed ambulance services and insufficient trauma care facilities along the highway, poses significant challenges in mitigating the consequences of accidents. Despite its strategic importance as a lifeline for trade and transportation, the Naubise-Narayanghat road section remains prone to RTAs, underscoring the urgent need for targeted interventions. This study seeks to examine the specific causes of RTAs along this road section and evaluate the challenges in responding to these accidents, contributing to the broader approach to enhance road safety in Nepal and similar contexts.

### 1.3. Research questions

The study has focused to answer the following research questions.

a. What is the current trend of road traffic accidents along the Naubise-Narayanghat road section?
b. What are the primary causes of road traffic accidents in this road section?
c. What challenges do rescuers face to respond road traffic accidents, and how can rescue practices be made more effective?

### 1.4. Objective of the study

To reduce the accidents by addressing the existing causes and to improve the response practices by addressing challenges, the study has set the objectives as follows:

a. To identify the current pattern/trend of the road traffic accidents in relation to accident types, involvement of vehicle, rate of accident, etc. along the Naubise-Narayanghat road axis**.**
b. To analyze the existing causes of road traffic accident including driver's behaviour, road condition, weather, law enforcement experiencing along this road section.
c. To evaluate the response mechanism practiced by emergency response teams especially APF, Nepal and challenges faced by them and strategies to enhance the response.

### 1.5. Significance of the study

The Naubise-Narayanghat road is vital to Nepal for connecting Kathmandu with the southern plains and India. However, it has been experiencing accidents frequently posing threat to both safety and property at large and impacts the nation's economy altogether (Atreya et al., 2021). This study has investigated causes and challenges to response in road safety, suggesting effective prevention and response strategies to improve safety on a key transport corridor in Nepal.

It also raises awareness of the socio-economic impact of road accidents through the illustration of their human and financial costs. According to Nepal's Department of Transport Management (NDTM), RTAs cause numerous deaths and injuries annually, especially along this route. The results have identified important factors such as driver behavior, road conditions, vehicle

maintenance, and environmental influences that will give an overall view of the hazards (Awale, 2024). The findings of this research bring attention of the policymakers, transport authorities, and other stakeholders concerned with infrastructure upgrade, enforcement, and public awareness to improve road safety. The challenges in responding to accidents along this route are equally concerning as the road passes through hilly and geologically unstable terrain, making timely rescue operations difficult. The research can contribute for effective response identifying the challenges faced by responders and by providing insightful suggestion as well.

### 1.6. Limitation of the study

This research, while aimed at providing valuable insights into traffic accidents on the Naubise-Narayanghat road and the response challenges faced by APF, Nepal, is subject to several limitations:

a. Findings are limited to the Naubise-Narayanghat road and cannot be generalized to other roads in Nepal due to unique geographical, infrastructural, and traffic patterns.
b. Secondary data from traffic police records, government reports, and literature may contain inaccuracies, underreporting, or inconsistencies.
c. Interviews and surveys with drivers, traffic police, passengers, local authorities, and emergency responders are susceptible to response bias.
d. The dynamic nature of traffic conditions, influenced by seasonal variations and ongoing road improvements, restricts the ability to draw definitive conclusions.
e. The study is limited to challenge faced by APF, Nepal while responding to accidents.
f. The study does not explore the economic and psychological limitations resulting from traffic accidents along this road.

# CHAPTER II

# REVIEW OF LITERATURE

This chapter includes the review of literature. It has assessed existing research on a road traffic accident under different themes. It has included theories on road traffic accident, causes of accident, and challenges to respond.

## 2.1. Theoretical perspective on road traffic accident

The theoretical underpinnings of RTA research provide crucial frameworks for understanding causation and prevention. Mishra & Niraula (2024) correctly pointed to the prominence of theories like the Domino Theory, Human Factors Theory, and System Theory. Heinrich's (1941, as cited in Chee, 2017) Domino Theory, with its linear sequence of events, while simplistic, highlighted the chain reaction nature of accidents. However, it can be criticized for its linearity, failing to capture the complexity of interacting factors.

Peterson (1978; as cited in Saxena, 2017) rightly countered this by emphasizing the unpredictable combination of multiple factors, a more realistic depiction. Haddon's (1980) Combination Theory, with its focus on human, vehicle, infrastructure, and environmental elements, offered a more holistic approach, which is vital in complex scenarios like Nepal's. Reason's (1990) Human Factors Theory, supported by Giri et al. (2023), emphasized the critical role of human error, suggesting that interventions must focus on improving human decision-making and behavior. Firenze's System Model Theory, as discussed by Larsson et al. (2010), shifts the focus from individual blame to systemic failures, arguing that addressing systemic issues is crucial for sustainable road safety. This analytical approach is vital, as it moves beyond simplistic cause-and-effect models to a more nuanced understanding of RTAs.

When examining the causes of RTAs along the challenging Naubise-Narayanghat road axis and the response challenges faced, adopting both the Human Factors Theory and the Combination Theory offers a particularly robust and contextually relevant approach. As Mishra & Niraula (2024) rightfully point out, various theories exist to explain RTAs, but not all are equally suitable for this specific research context. The Domino Theory with its linear sequence of events, simplifies the complex reality of RTAs. While it highlighted the chain reaction nature of accidents, it failed to account for the multiple, often simultaneous factors contributing to

them, a critical oversight in a dynamic and complex environment like the Naubise-Narayanghat road. Similarly, the System Model Theory while valuable in highlighting systemic failures, may not adequately address the immediate, on-the-ground challenges of accident response in a region with specific geographical and infrastructural limitations.

In contrast, the Human Factors as supported by Giri et al. (2023), directly addresses the critical role of human error in RTAs. This is particularly relevant along the Naubise-Narayanghat road, where driver behavior, influenced by factors like fatigue, stress, and inadequate training, significantly contributes to accidents. As Atreya et al. (2021) found in their analysis of Nepalese RTA data, driver negligence and excessive speed are primary contributing factors. Given the challenging terrain and often congested traffic along this route, understanding and mitigating human error is paramount. Moreover, the Combination Theory provided a comprehensive framework for analyzing the interplay of human, vehicle, infrastructure, and environmental factors. This holistic approach is essential for the Naubise-Narayanghat road, where accidents often result from a complex interaction of factors, including poor road conditions, inadequate vehicle maintenance, and challenging weather patterns. The iRAP Nepal Strategic Road Network Assessment Report 2022, for instance, highlighted the significant infrastructure risks along this route. By combining these two theories in this study the researcher had a more nuanced understanding of both the immediate human factors contributing to accidents and the broader systemic and environmental factors that exacerbate them, thereby providing a more comprehensive and actionable analysis.

## 2.2. Causes of accident

Understanding the root causes of RTAs is crucial for developing effective prevention and response strategies. Research has consistently identified a complex interplay of factors contributing to these incidents, ranging from human error to infrastructural deficiencies. The following literature review explores these causes, drawing from diverse studies to provide a comprehensive overview of the key elements influencing RTAs.

### 2.2.1 Human factors and driver behaviour

The literature consistently and overwhelmingly points to human factors, particularly driver behavior, as the primary cause of RTAs. Berhanu (2000)'s assertion that 80-90% of accidents were due to driver errors, while seemingly high, is supported by various studies. Vorko-Jović

et al. (2006)'s focused on excessive speed, poor visibility, and male driver behavior in urban settings highlights the need for targeted interventions in high-density areas. Bener et al. (2017)'s emphasized on fatigue, aggressive driving, and mobile phone use among younger drivers underscores the impact of modern distractions on road safety. Bucsuházy et al. (2020)'s analyzed of specific human behaviors, including cognitive decline and gender-specific tendencies, highlights the need for fit interventions for different demographic groups. Atreya et al. (2021)'s findings in Nepal, showing driver negligence and speed as primary factors, emphasized the universality of human error. This consistent focus on human factors suggests that behavioral interventions, such as driver education, stricter enforcement, and public awareness campaigns, are essential for reducing RTAs.

### 2.2.2 Infrastructure and environment

While human factors dominate, the complexity of RTA causation necessitates a broader perspective. Ojha (2021)'s emphasis on human, road, and vehicle factors in Nepal underscored the need for a multi-pronged approach. Kuikel et al. (2022)'s focus on Nepal's dangerous roads due to geography and human factors highlighted the need for infrastructure improvements. Manandhar (2022)'s analysis of poor infrastructure, weak enforcement, and socio-economic factors in Nepal revealed the systemic nature of the problem. The iRAP report (2022)'s assessment of Nepal's high-risk roads provided concrete evidence of infrastructure deficiencies. Guo et al. (2003) and Caliendo et al. (2007)'s focus on environmental factors like speeding and road design underscores the need for engineering solutions. Ashraf et al. (2019)'s analysis of traffic volume, weather, and road conditions highlighted the complexity of environmental influences. These studies collectively suggest that a holistic approach, integrating infrastructure improvements, stricter enforcement, and environmental considerations, is essential for sustainable road safety.

## 2.3. Impacts and demographic patterns of RTAs: Beyond immediate injuries

The impact of RTAs extends far beyond immediate physical injuries, with enduring psychological and social consequences. Mayou and Bryant (2002)'s finding of persistent mental health issues and chronic pain highlighted the need for long-term support for RTA victims. Kakkar et al. (2014)'s emphasis on psychiatric symptoms and chronic pain stressed the psychological impact of RTAs. Pradhan et al. (2023) and Huang et al. (2016)'s demographic studies, focusing on young males, highlighted the need for targeted interventions for high-risk

groups. Gautam & Joshi (2024)'s analysis of motorcycle accidents and young drivers in Kathmandu Valley provided valuable insights into specific accident patterns. Geremew (2024)'s findings on pedestrian vulnerability and male predominance highlighted the need for targeted safety measures. These studies collectively suggest that a comprehensive approach, addressing both immediate and long-term impacts and focusing on high-risk demographics, is crucial for effective RTA prevention and management.

### 2.4. Challenges of RTA response and the importance of timely intervention

Responding to RTAs presents unique challenges, particularly in geologically complex environments. Devkota et al. (2008) and K.C. et al. (2013)'s analyses of landslides and geological factors highlighted the need for robust disaster management systems. Gopalakrishnan (2012)'s emphasis on the "Golden Hour" focused the importance of immediate medical care. Mamo et al. (2023)'s findings on delays in admission and head injuries highlight the need for improved pre-hospital care. Sathian et al. (2018)'s critique of Nepal's inadequate health system underlined the need for investment in trauma care and emergency response. Hsiao et al. (2013)'s data on on-scene deaths and head injuries reinforced the need for rapid response and effective trauma management. These studies collectively suggest that improving emergency response systems, training healthcare professionals, and investing in infrastructure are essential for mitigating the impact of RTAs.

### 2.5. Legal Frameworks, strategic interventions, and global collaboration: A Path Forward

Legal frameworks and strategic interventions are crucial for enhancing road safety. The Constitution of Nepal (2015) outlines that healthcare services should be equally available to all individuals (Article 31) and that the transportation sector must be safe, well-managed, and accessible to people with disabilities (Article 51). Various domestic acts, such as the Motor Vehicle and Transport Management Act (MVTMA) 1993, provides the legal basis for road safety measures. It regulates vehicle licensing, inspections, traffic, accident response, insurance, and penalties. MVTMA aims to ensure safety through licensing requirements, vehicle standards, and prohibitions against reckless driving and alcohol use. The Act grants enforcement powers to police and transport inspectors, including on-the-spot fines and severe penalties for fatal accidents. However, its effectiveness is limited by enforcement issues, low fines, and weak monitoring. The National Road Safety Action Plan (NRSAP) 2021-2030,

aiming to halve road fatalities, aligns with global targets like the SDGs and the Stockholm Declaration.

Goniewicz et al. (2016) stressed for a multi-faceted approach highlighting the need for collaboration across sectors. Forjuoh (2003)'s emphasis on customized strategies for Low-Income Countries favored the need for context-specific solutions. Rehman et al. (2023)'s emphasized on public awareness highlights the importance of community engagement. WHO (2011)'s advocacy for the Safe System Approach focused the need for a holistic, human-centered approach. Daniels (2011) assessed on vehicle safety, infrastructure, and user behavior highlighting the interconnectedness of these factors. Sayer (1994)'s accident reduction and prevention strategies provide a framework for proactive intervention. These studies collectively suggested that a comprehensive, collaborative, and context-sensitive approach, integrating legal frameworks, strategic interventions, and global best practices, is essential for achieving sustainable road safety.

This literature review has featured the multi-faceted nature of road traffic accidents, highlighting the critical interplay of human factors, infrastructural deficiencies, environmental conditions, and systemic challenges. By adopting a combined theoretical approach and examining diverse studies, this analysis reveals that effective RTA prevention and response necessitate a holistic strategy. This strategy must integrate robust legal frameworks, context-specific interventions, public awareness campaigns, and improvements in emergency response systems. Ultimately, a collaborative, multi-sectoral approach, guided by both theoretical insights and empirical evidence, is essential to mitigate the devastating impact of RTAs and achieve sustainable road safety.

### 2.6. Research gap

Numerous studies have been conducted to examine various dimensions of RTAs in Nepal, uncovering patterns, victim profiles, and key contributing factors. Manandhar (2022a) discussed the impact of bad road conditions, drunk driving, and weather on road traffic accidents in Kathmandu Valley. The results showed strong correlations between bad road conditions, drunk driving, and weather conditions with automobile accidents, but gender affects drunk driving but not the others. The study revealed the need for better road maintenance and enforcement against drunk driving to reduce accidents. Studies like Sharma et al. (2022) and Adhikari et al. (2021) stressed human factors, including reckless driving, speeding, and traffic

rule violations, as major causes of RTAs. And policy research has shown that existing road safety regulations are either weakly enforced or outdated, reducing their impact on accident prevention in Nepal.

However, recent, location-specific studies on the Naubise-Narayanghat road section, a high-risk highway, remain unstudied. The current accident trends in this area are poorly understood, making it challenging to determine how accidents are occurring. While prior research has identified general causes of RTAs in Nepal and beyond, there is limited empirical analysis of the specific factors—such as road design, vehicle conditions, and driver behavior—contributing to accidents on this segment. Additionally, this road section has specific geographic features with complex river system and intense weather condition as well. Although emergency medical services and traffic management strategies have been broadly discussed, their effectiveness challenges to respond the accidents in this TRAs prone section of road remains unexplored. Bridging these gaps is essential for setting targeted interventions to enhance road safety and emergency response along the Naubise-Narayanghat road section.

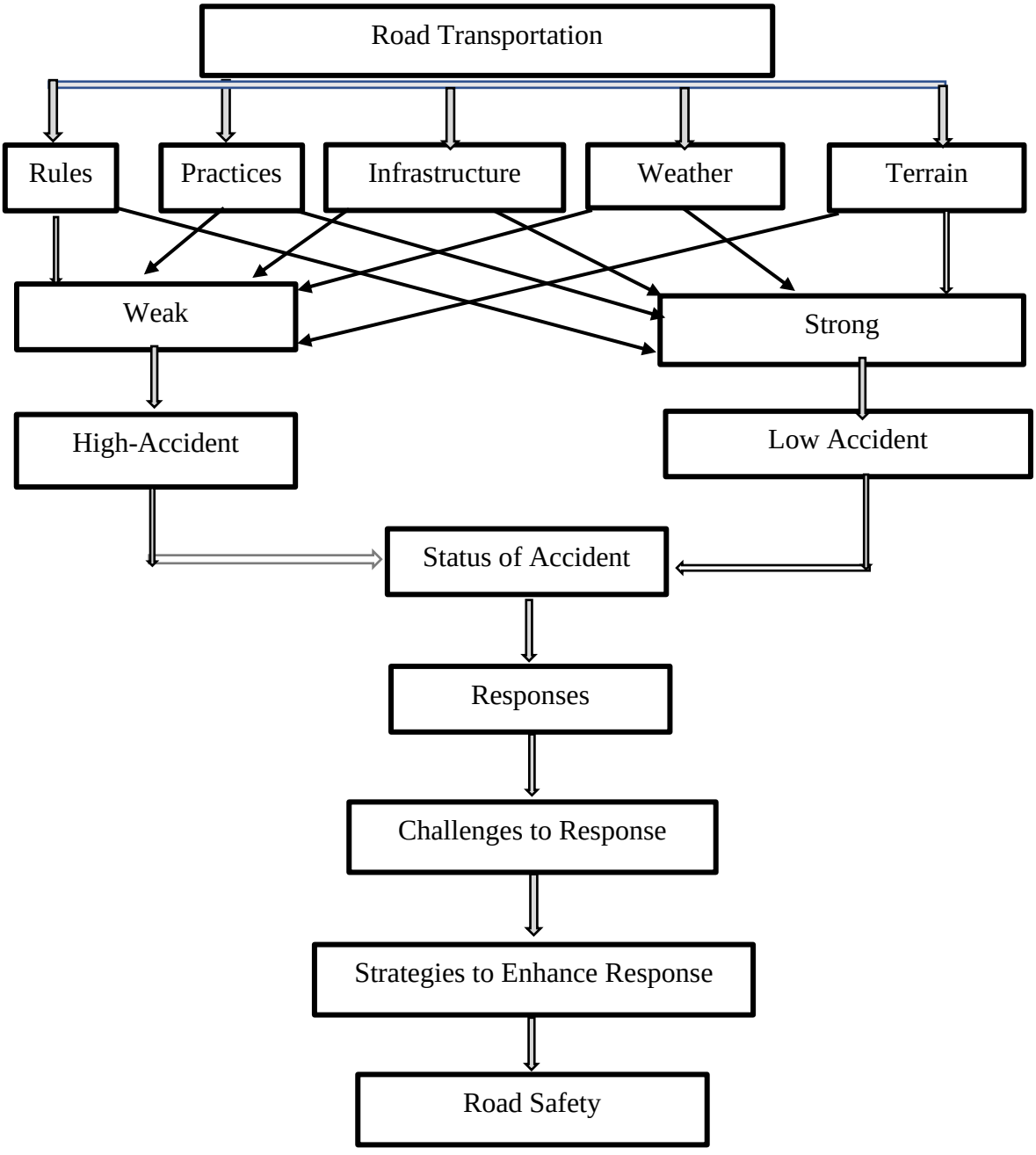
## 2.7. Conceptual framework

A conceptual framework illustrates the expected relationships among variables within a study. It provides a structured approach to understanding how different concepts interact, guiding the research process by outlining the connections between the independent and dependent variables. Creswell and Creswell (2018) define a conceptual framework as a tool that helps us understand or anticipate how things happen in the real world. De Hass et al. (2020) has further refined this concept by emphasizing the importance of establishing theoretical connections. This means explaining not only how variables are related but also why these relationships exist based on existing theories and knowledge. The research on road traffic accident Naubise-Narayanghat road section is based on the conceptual framework displayed as in Figure 2.1.

To have an in-depth insight in this problem the Combination Theory (Pembuain et al., 2019) has been followed. With this approach several interdepending factors-geographical, infrastructural, human error, weather, vehicle conditions etc. have been analyzed to find the causes of road traffic accidents. Human factors that greatly contribute to the rate of accidents include overspending, reckless overtaking, and driver fatigue (Chand et al., 2021). This factor is compounded by weak enforcement of traffic regulations and lack of awareness among both drivers and pedestrians about road safety measures.

**Figure: 2.1**

*Conceptual Framework of the Study*




*Source*: Adapted and Modified from Hughes et al. (2016)

The framework (Fig. 2.1) illustrates the primary causative factors: weak enforcement of traffic rules, unsafe driving practices, inadequate infrastructure, adverse weather condition and difficult terrain. These elements do not singly contribute but rather interact to exacerbate the risk of RTAs. Weak enforcement directly enables unsafe driving practices, as drivers perceive

a low risk of consequences for violations. Simultaneously, poor infrastructure, such as sharp bends and inadequate signage, amplifies the dangers posed by these unsafe practices. This initial stage sets the stage for a high-risk environment where accidents are likely to occur. The chronological flow is evident: weak rules precede and influence unsafe practices, while infrastructure acts as a constant, either mitigating or exacerbating the risks.

In contrast to this, if the laws are strictly enforced, it helps to dramatically reduce the numbers of RTAs. In developed countries the rate of accident is very low in comparison to developing countries, the strict law enforcement is one of the prime causes of this result. Likewise, the better infrastructure condition, welled engineered road, continuous road safety assessment, maintenance of road, ensure road safety. The adverse weather and difficult terrain further deteriorate the situation. In mountainous and hilly region, they are also key contributor of RTAs. In recent year, Naubise-Narayanghat road experienced two fatal road accident due to these factors. So, the strict law enforcement of law, better road condition, friendly weather, accessible terrain contribute to reduce RTAs ensuring road safety. The confluence of weak rules, unsafe practices, and poor infrastructure directly results in a high incidence of accidents along the Naubise-Narayanghat road and vice versa. The failure to address the foundational factors leads to a predictable outcome. The high accident rates are not merely statistical anomalies but a direct consequence of systemic issues. So, the various factors play the contributing to determine the status of RTAs.

When accidents occur, the effectiveness of the response is critical. However, challenges such as lack of resources, insufficient trained manpower, lack of centralized information dissemination system, the insufficient laws for command-and-control mechanism and coordination and insufficient trauma care facilities make response more difficult. To ensure road safety certain interventions are indispensable. Strategic interventions such as strengthening law enforcement, upgrading road infrastructure, promoting public awareness and education, trained adequate manpower, advanced equipment, and enhancing emergency response systems help to address the root causes identified in the initial stage. Strengthening law enforcement aims to mitigate unsafe driving practices by enforcing traffic rules. Upgrading infrastructure directly addresses the poor road conditions that contribute to accidents and hinder emergency response. Public awareness and education seek to change driver behavior and improve preparedness. Enhancing emergency response systems aims to improve post-accident management by ensuring timely and effective interventions.

The study ultimately culminates in the road safety objective, which envisions a safer Naubise-Narayanghat road axis. This objective is not merely aspirational but a direct result of implementing the proposed interventions. By addressing the foundational factors and improving response mechanisms, the research aims to create a sustainable reduction in accident rates and enhance overall road safety. The study highlights the importance of a holistic and coordinated approach, where interventions are not isolated but part of a comprehensive strategy to improve road safety.

# CHAPTER III

# RESEARCH METHODOLOGY

Recher has followed a systematic methodology to conduct the search. This study had adopted a constructivist philosophical worldview. This approach prioritizes understanding the social phenomena as constructed through the lived experiences, interactions, and perceptions of those involved (Creswell et al., 2018). Rather than seeking an objective reality, the study focuses on the subjective understandings of road traffic accidents as shaped by the specific context. By engaging with stakeholders—road users, residents, local authorities, emergency responders, and medical care providers—through qualitative methods, the research acknowledges that the causes of accidents and the challenges in responding are not singular but rather emerge from a complex interplay of social, cultural, and infrastructural factors unique to this road axis. This approach allows for the exploration of how these stakeholders actively construct their understanding of road safety, revealing the multi-causal nature of accidents and the difficulties encountered in response efforts within the particular social reality of the Naubise-Narayanghat road axis.

## 3.1 Research design

This research has adopted a qualitative exploratory design to understand the complex causes of road accidents on the Naubise-Narayanghat Road and the challenges rescuers face. This had opted to explore in-depth experiences and perceptions of participants to uncover the underlying issues (Hunter, 2019). As an exploratory nature of the research, non-probability sampling has been chosen. Convenience had followed to select the accessible participants, while purposive sampling was employed (Etikan et al., 2016) to approach rescuers (APF, deep divers, traffic police, medical person) to know the real challenges faced by them while responding road traffic accident.

Multi-methods have ability to significantly improve the accuracy and enhance. They are reliable and have unique characteristics (Vivek, R., Nanthagopan, 2021). Survey, Key Informants (KIs), Focus Group Discussions (FGDs) (Appendix A, B), and participatory observation had been used. Through these methods diverse data, from quantitative experiences to expert insights and observational context had gathered to have a comprehensive understanding of causes of the road traffic accident and challenges faced by rescuers during

rescue operation.

Data analysis had been conducted through both descriptive and thematic approaches. To find Patterns and trends of data collected by survey had been analyzed by using descriptive analysis tool. Thematic analysis, following Braun and Clarke (2006), had analyzed qualitative data from interviews, FGDs, and observations to identify recurring themes related to accident causes and rescue challenges.

### 3.2 Study area

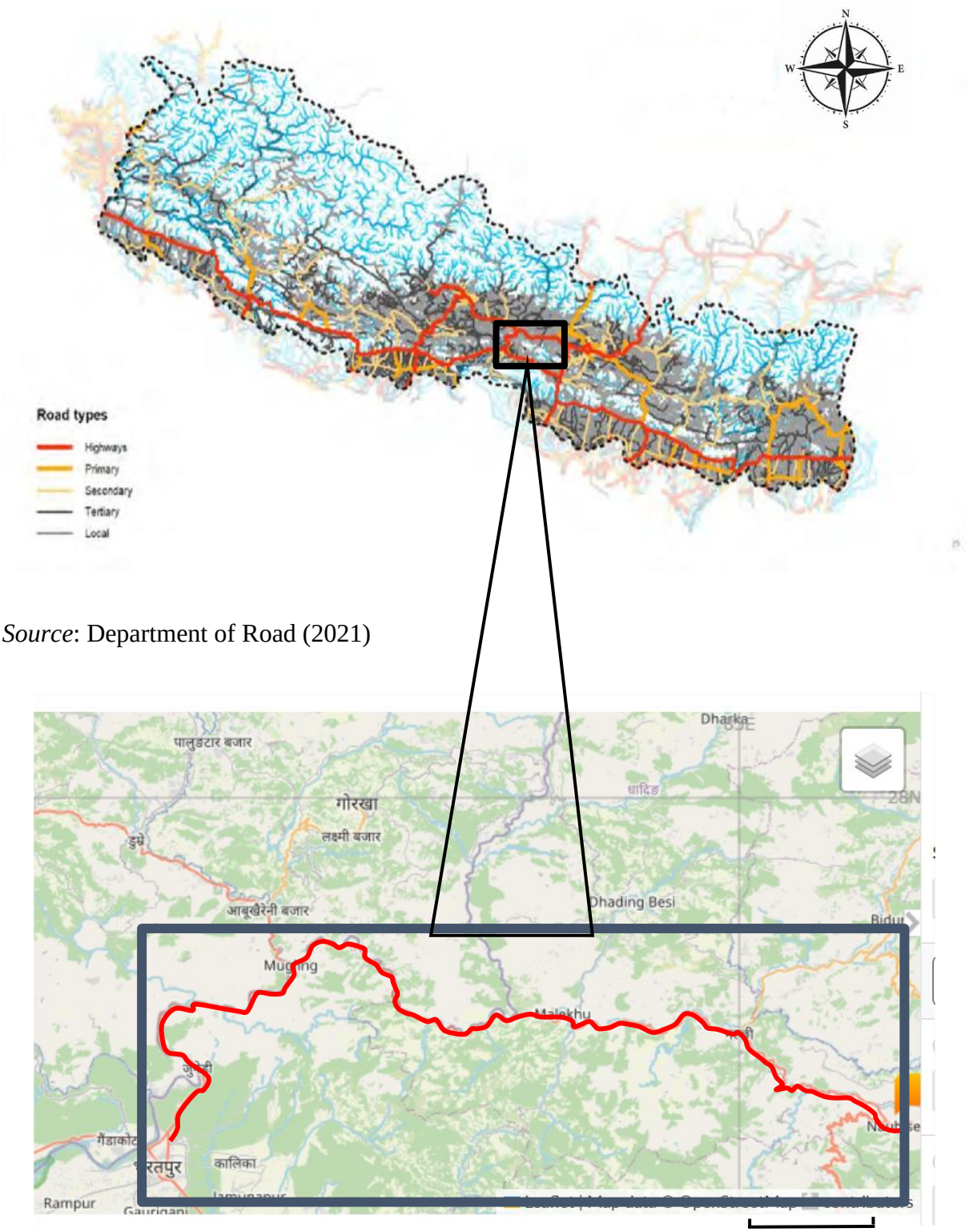
The study area was geographically limited to the Naubise-Narayanghat Road section, spanning the coordinates N 27° 41' 48.7176″, E 84° 25' 15.5892″ to N 27° 42' 59.2956″, E 85° 8' 58.6284″ (Figure 3.2). The field study was conducted from January 3, 2025, to January 14, 2025. The study had employed non-probability sampling consisting of convenient and purposive techniques. The population of the study area consists of driver, rescuer, local authorities, traffic police, medical person, local people, committee of vehicle entrepreneur, road office, vehicle management office. The study has followed a stratified convenient sampling technique to ensure inclusiveness across the diverse population. Due to the practical constraints of surveying a large sample of population, convenient sampling was the primary method for gathering data. Available population along the highway especially the drivers and rescuers were approached to collect data for survey questionnaire on their experiences, observations, and perceived causes of accidents, ensuring a broad range of perspectives are captured.

Complementing the convenient sampling, purposive sampling was utilized to gain in-depth insights from local authorities and rescuers. Given their specialized knowledge and direct involvement in accident response, these participants were selected based on their expertise. In-depth interviews and focus group discussions had been conducted to explore the challenges they face, the contributing factors they observe, and potential solutions. The deep-diver, local authorities, traffic police were seclected to have in-depth data about their experience and perception.

This targeted approach will provide valuable qualitative data, supplementing the broader survey results and offering a deeper understanding of the complex issues surrounding road traffic accidents along the Naubise-Narayanghat Road Axis. Data collection methods such as surveys, interviews, focus group discussions, and field observations used.

**Figure 3.1**

*Location Map of the Study Area*




*Source*: Department of Road (2021)

*Source*: Google Earth Map (2025)

### 3.3 Nature and sources of data

The data used in this study was in qualitative in nature. And the data sources include both primary and secondary sources. Structured data follows a fixed format, while unstructured data does not. Primary data was gathered through firsthand, whereas secondary data had been obtained from the traffic police database and other existing sources. The validity of the research has been shaped by the methods used for data collection and analysis (Bryman & Bell, 2015), ensuring a clear understanding of data nature and sources, which in turn guided the processes of data collection, analysis, and interpretation. To fulfill the objectives of this research, the nature of data has been selected both qualitative and quantitative. Primary data were collected from the field whereas the secondary data from the traffic data base, reports, and journals.

#### 3.3.1. Primary data

Primary data were collected through Survey, KIs, individual interviews and FGD as well as from observation. For survey questionnaire, 74 respondents were selected consisting of various population such as drivers, passenger, emergency responders and local authority. Special consideration was given to ensure the representation within specific population. Drivers of different vehicle were selected ensuring proper representation. The primary data collection method is displayed in Table 3.1, which illustrates that multi-methods have been followed to collect the primary data.

**Table 3.1**

*Method of Primary Data Collection*

| S.N. | Method | Number of Participants | Size |
|---|---|---|---|
| 1 | Survey | 74 | 1 |
| 2 | Interview | 10 | 10 |
| 3 | KI | 2 | 2 |
| 4 | FGD | 10 | 1 |
| 5 | Field observation | | |

*Source:* Generated by Researcher (2025)

Likewise, to conduct interview population of different representations visited to ensure diverse perspectives from informants (Appendix A-D), The representation of the population has been tried to be addressed ensuring paranormality. The. KIs was conducted with experts such as traffic police, emergency medical personnel, and government officials. Additionally, in-depth interview of emergency responders was taken provided qualitative insights.

Similarly, one FGD was conducted with deep divers from APF, DMTS. The FGD was held within the primase of APF, Nepal DMTS, Kurintar where10 members of APF personnel were present (refer Appendix B). Additionally, empirical observation had been done to understand the various dynamics of road traffic prevalent along Naubise-Narayanghat road.

### 3.3.2. Secondary data

Secondary data for this study includes traffic accident records from traffic police database, government reports, research articles, and news archives related to the Naubise-Narayanghat road. To enhance the reliability and comprehensiveness of the analysis, key institutions such as the Provincial Traffic Police Office in Ramnagar, Chitawan, District Police Office, Dhading, and the District Police Office in Chitwan, along with other relevant local units (refer to Appendix A) were visited. These sources provided crucial contextual information, allowing for a deeper understanding of accident patterns, contributing factors, and policy implications. By triangulating secondary data with primary findings, the research ensures a well-rounded analysis of accident trends and response challenges.

## 3.4 Techniques and Tools of data collection

The survey through Kobo Toolbox was conducted with a mix of structured and semi structured questions (e.g., Likert scale, multiple-choice). In his original paper, Likert (1932) highlighted that an individual possesses an infinite number of definable attitudes, which can be grouped into "clusters" of responses. He also discussed the assumptions underlying his "survey of opinions," which formed the basis for his results and psychological interpretations (Likert, 1932; Komorita & Graham, 1965, as cited in Joshi & Pal, 2015).

A semi-structured format was followed for KIs and Interview and FGD allowing flexibility to explore specific areas of expertise. KIs and Interviews were conducted with traffic police, medical personnel, local authorities, and other stakeholders, aiming to gather personal

experiences, challenges faced during accidents, and suggestions for improvement. With expecting emergence of unexpected themes and insights, conversational format was allowed to these participants.

### 3.5 Data analysis

This study employed a descriptive and thematic analytical approach. Data collected through Survey and police data base were presented in graphical and tabular formats, and subsequently analyzed descriptively to interpret data. Similarly, data collected through KIs, interviews, and FGDs, were thematically analyzed. As suggested by Braun & Clarke (2006), triangulation was done to validate the data.

### 3.6 Ethical considerations

Ethical consideration has been taken into consideration while collecting data. Consent from institutions and persons were taken verbally prior to data collection. Established ethical standards as suggested by Resnik (2020) were followed.

Participants have been informed about the purpose of the study, the voluntary nature of their participation, and their right to withdraw at any time. They had been assured that their identity would be protected if needed. Likewise, personal identifier would be removed, and pseudonyms would be used where necessary.

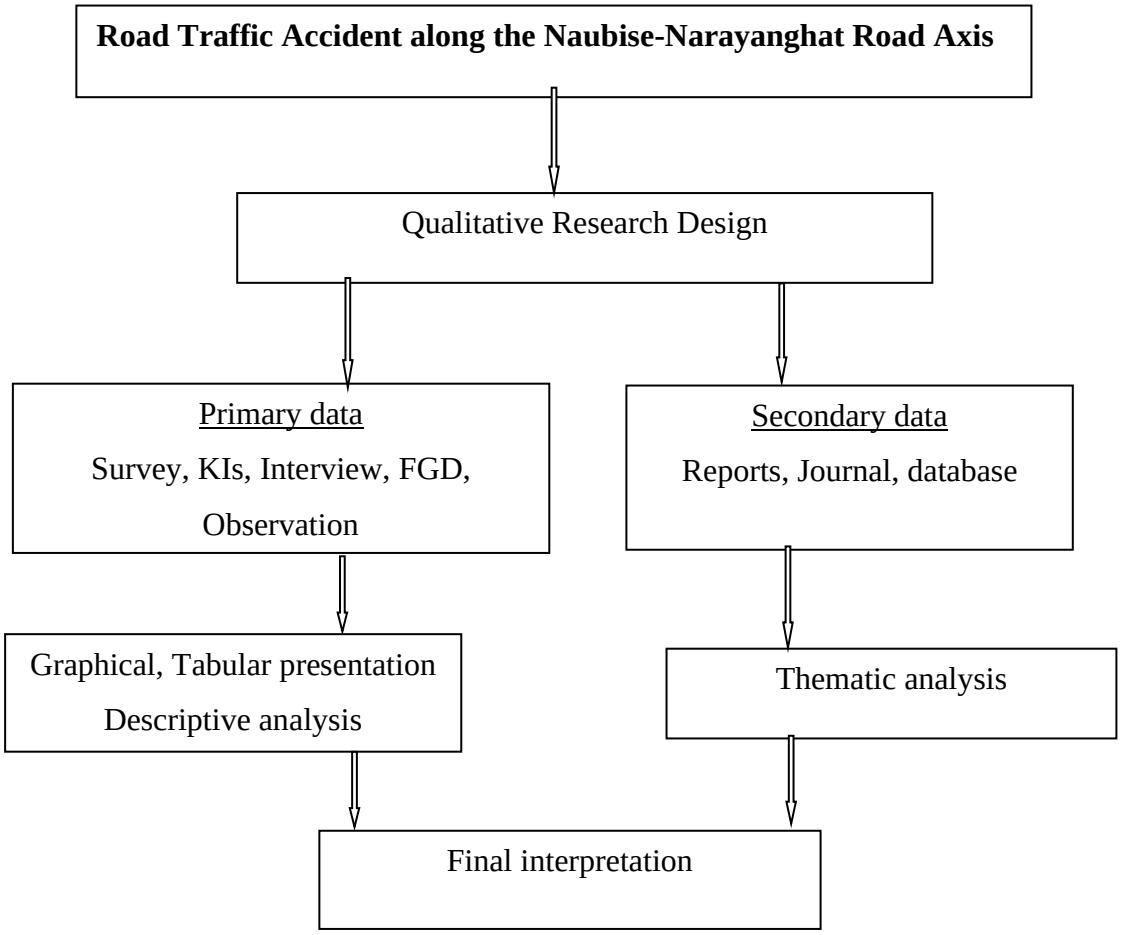
Besides this, proper citations have been done to avoid plagiarism. All digital data has been stored securely on password-protected devices, with no access to others. Interviews have been conducted in a respectful and culturally sensitive manner. Efforts were made to create a comfortable environment for participants to share their experiences openly.

### 3.7 Summary

The general outline of the research design has been illustrated in Figure 3.2. Three questions have been framed to address the requirement of the study. Being qualitative research design, it has embodied qualitative with structured and semi-structured form. Convenient sampling technique has been used in the field survey while theoretical sampling for KIs, Interview and FGD have been adopted for in-depth analysis of the accidents. descriptive and thematic analysis have been done to explain and interpret the data.

**Figure 3.2**

*Research Design of the Study*




*Source*: Generated by the Researcher (2025)

To attain more reliable findings, descriptive and thematic data analysis were followed. This study is framed within Constructivist perspective consisting qualitative aspects of accident issues.

# CHAPTER IV

# FINDING AND DISCUSSION

The analysis of the causes of road traffic accidents are presented in this chapter based on three research questions. This section is divided into two parts. The first part is dedicated to present findings concentrating on research questions. The first research question has included descriptive statistical analysis of existing trend in road traffic accidents. It has also comprised of the perception of drivers, passengers, emergency responders, and other stakeholders and data from the traffic police database. The second research question has examined the causes of road traffic accident synthesizing both primary and secondary data. Likewise, third research question has concentrated on how to improve the performance of emergency responders while responding to road traffic accidents.

Second part consists of discussion with analyzing and evaluating the finding with literature. Though the study is largely grounded in statistical evidence from quantitative survey data to demonstrate reality on the ground, qualitative narratives serve as important supplements to add context.

## 4.1. Finding

This study has explored factors contributing to road traffic accidents along the Naubise-Narayanghat road axis. Data collected through field survey and traffic database have been presented in statistical, graphical and narrative form and analyzed in descriptive and thematic ways. The results section is organized around three major aspects related to the trend, causes and challenges to respond of road traffic accidents, based on perceptions from drivers, emergency responders, passengers, local authorities, traffic police, transport offices, and road offices and data collected from traffic police office. The subsequent part under this section has provided details concentrating on thematic explanation of three different subject.

### 4.1.1. Current trend in road traffic accident along the Naubise-Narayanghat road axis

Studies have found that rising fatalities and injuries are linked to speeding, reckless driving, and inadequate road conditions in Nepal involving different types of vehicles. So, understanding current trends in RTAs along Naubise-Narayanghat road is vital for improving

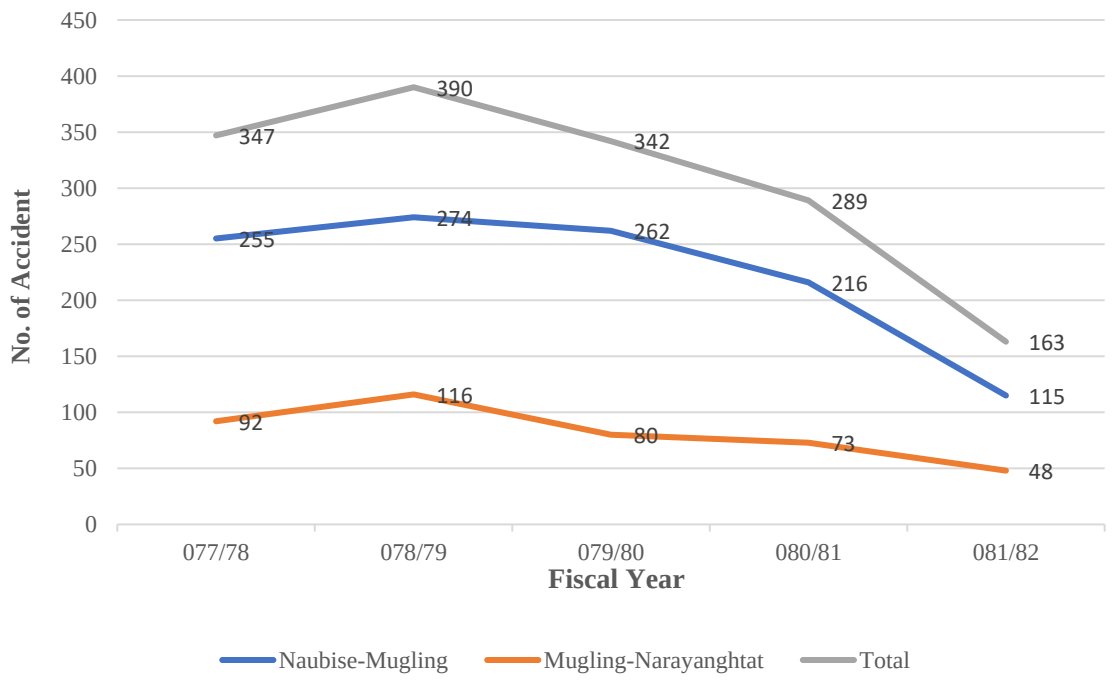
road safety and reducing fatalities. Analyzing accident trends helps identify causes, evaluate safety measures, and design targeted interventions. By providing insights on accident, stakeholders can implement evidence-based policies to enhance road safety and emergency responses.

### a. Status of road traffic accident along Naubise-Narayanghat road

RTAs remain a major global public health challenge, causing loss of life, injuries, and economic strain. However, the rate of accident occurring in developed and developed counties is significantly different. Nepal is no exception, -facing severe impacts that disrupt lives and deplete resources. Analyzing current accident trend- number of accidents, vehicle, victims, time - is crucial for policymakers to develop effective strategies. Such insights can help mitigate the human and economic toll of RTAs in the country. The Naubise-Narayanghat road section has been experiencing significant loss of life and extensive property damage because of frequent road traffic accidents. Figures 4.1 to 4.10 give insight to make effective strategies to reduce their occurrence and mitigating their impact.

**Figure 4.1**

*Trend of Road Traffic Accident Along Naubise-Narayanghat Road Axis*




*Source*: Bagmati Province Traffic Police Office, Ramnagar, Chitwan (2081)

As illustrated in (Fig. 4.1), the total number of road accidents along Naubise–Narayanghat road sections reached its highest point during the fiscal year 078/79 (390 accidents) before showing a consistent decline in subsequent years, culminating in 163 accidents in 081/82. Throughout this period, the Naubise–Mugling stretch consistently recorded a larger share of incidents compared to the Mugling–Narayanghat segment, although both sections show a downward trend over time. This indicates the improvement of road safety is gradually taking pace addressing the existing causes contributing to higher accidents rates along this road section.

These findings highlight targeted interventions—such as better road maintenance, stricter traffic law enforcement, and improved driver education—may have contributed to reducing accidents on these critical routes. Moreover, studies have indicated that multi-sectoral approaches, which include infrastructure upgrades and community-based awareness (including driving) campaigns, are important to sustaining lower accident rates.

Table 4.1 illustrates the trend of road accident in term of casualties such as fatal, serious, and minor injuries over the fiscal years 076/77 to 080/81along the Naubise-Mugling road section.

**Table 4.1**

*Road Traffic Casualties Along Naubise-Mugling Section from Fiscal Year 076/77-081/82*

| Fiscal Year | Total Accident | Minor Injury | Serious Injury | Fatal |
|---|---|---|---|---|
| 076/77 | 125 | 49 | 205 | 53 |
| 077/78 | 255 | 184 | 322 | 46 |
| 078/79 | 274 | 183 | 463 | 63 |
| 079/80 | 262 | 80 | 447 | 39 |
| 080/81 | 216 | 90 | 434 | 43 |
| 081/82 | 115 | 62 | 226 | 12 |
| **Total** | **1247** | **648** | **2097** | **256** |

*Source*: Bagmati Province Traffic Police Office, Ramnagar, Chitwan (2081)

According to Traffic office, minor injury is an injury that is not life-threatening may require basic first aid at home or attention from a healthcare provider, such as in cases of cuts, scrapes,

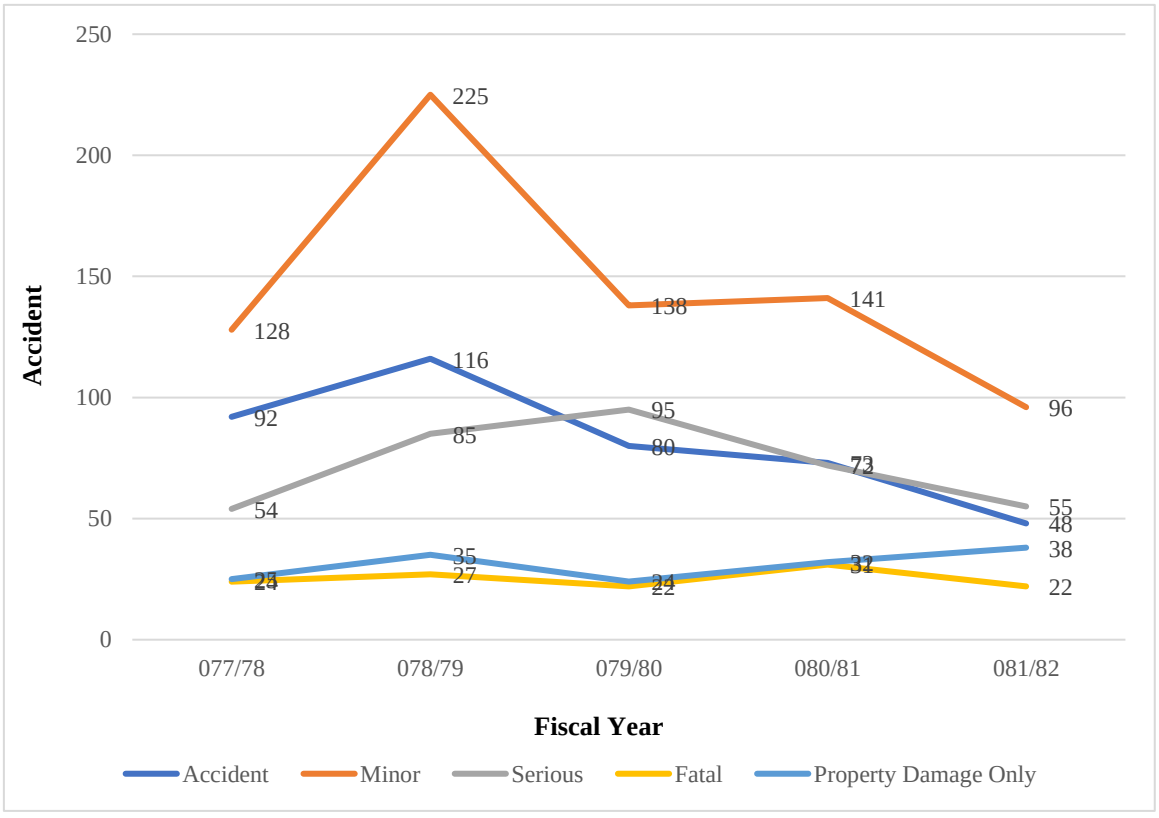
burns, and bites. Likewise, serious injury was categorized as severe physical trauma, requiring immediate hospitalization, results from external forces causing injuries like amputations or vision loss, often due to falls, burns, or violence.

As shown in (Fig. 4.1) Fatal injuries remain relatively stable across the years with minor fluctuations. Serious injuries show a slight rise until 078/79, followed by a significant decline in 079/80, with a slight increase in 080/81. Minor injuries had reached a peak in 078/79 before showing a gradual decline in subsequent years. The data presentation highlights that while light injuries were the most frequent, serious injuries saw the most notable change during this period.

Figure 4.2 presents accident data over multiple years along Mugling-Narayanghat road section, categorized into different severity levels: minor, serious, fatal, property damage only, and total accidents. The trends highlight fluctuations in accident severity over time, revealing key insights into the frequency and impact of road incidents.

**Figure 4.2**

*Road Traffic Casualties Along Mugling-Narayanghat Section from Fiscal Year 077/78-081/82*



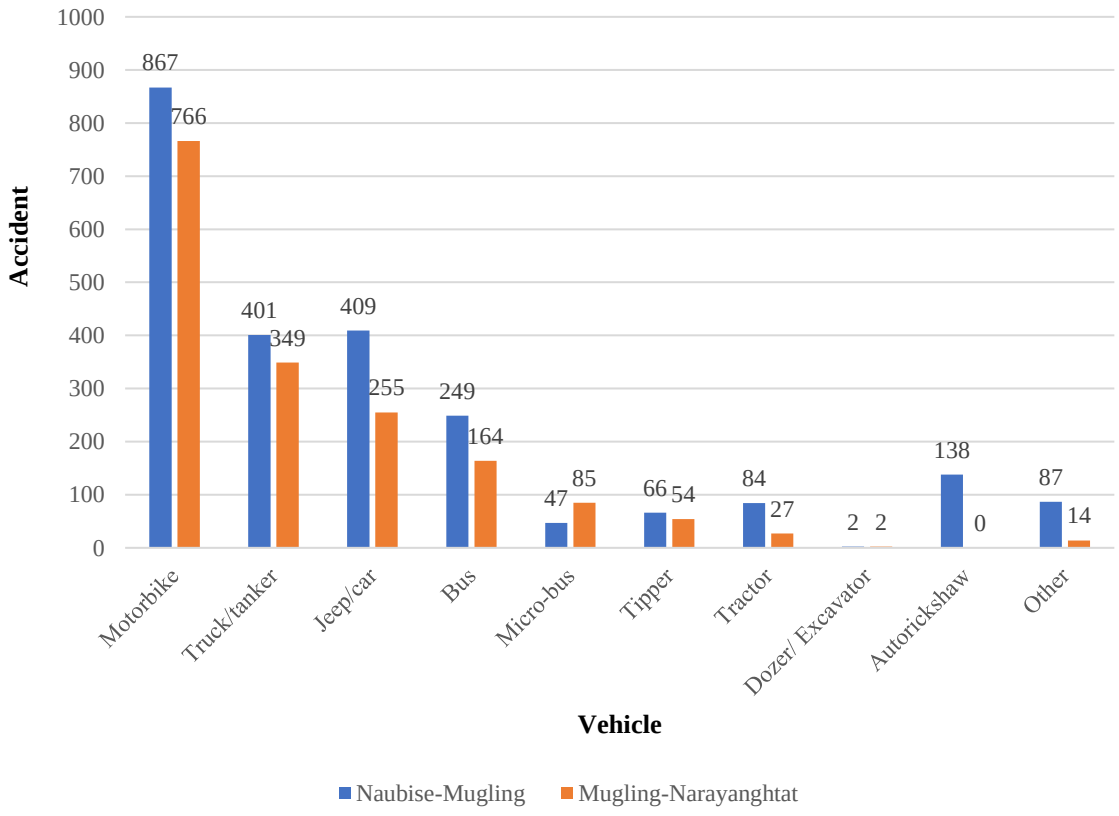

*Source*: Bagmati Province Traffic Police Office, Ramnagar, Chitwan (2081)

The graphic presentation of data (Fig. 4.2) shows that hike in numbers of all kinds of victims in the fiscal year 077/78 and 078/79. This surge might have been due to higher traffic, deteriorating road conditions, or inadequate safety measures. The overall trend indicates a decline in minor, total, and serious accidents over the years, suggesting improvements in safety measures. However, fatal incidents showed fluctuations before eventually decreasing, reflecting continued risks despite general progress. Meanwhile, property damage-only cases increased, highlighting ongoing concerns about material losses even as severe injuries became less frequent.

Figures 4.3 illustrates the comparison study of vehicles involved in the road traffic accident. It includes the vehicles operating along both sections of road.

**Figure 4.3**

*Comparison of Vehicles Involved in Accident Between Naubise-Mugling and Mugling Narayanghat Road Section*



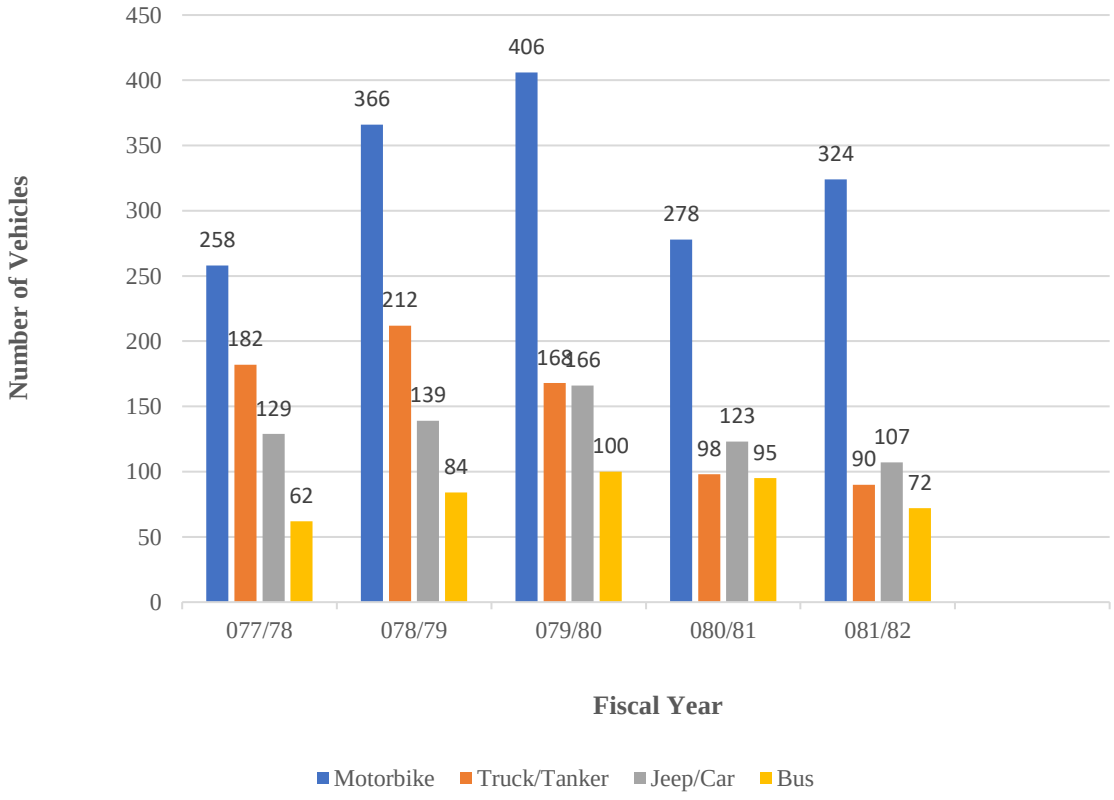

*Source*: Bagmati Province Traffic Police Office, Ramnagar, Chitwan (2081)

Motorbikes have the highest accidents on both routes (867 and 766, respectively), indicating vulnerability to road conditions or reckless driving as displayed in Fig.4.3. Trucks/tankers and jeeps/cars also report significant accidents, pointing to issues like congestion or driver's behaviour. Buses and micro-buses have moderate accident counts, higher on Naubise-Mugling, likely due to greater traffic. Heavy vehicles (e.g., dozers, tractors) have fewer accidents, suggesting different operating conditions.

Figure 4.4 describes vehicles primarily involved in road traffic accident along this road. Motorbikes, trucks, jeeps/cars, and buses are the primary vehicles involved in road traffic accidents. Over the years motorbikes consistently held the highest position in terms of accident involvement, followed closely by trucks or tankers in the first three consecutive years in both section of road. However, in the most recent year, jeeps and cars have slightly surpassed trucks and tankers in their contribution to accidents.

**Figure 4.4**

*Vehicles Mostly Involved in the Accident in Naubise-Narayanghat Road Axis*



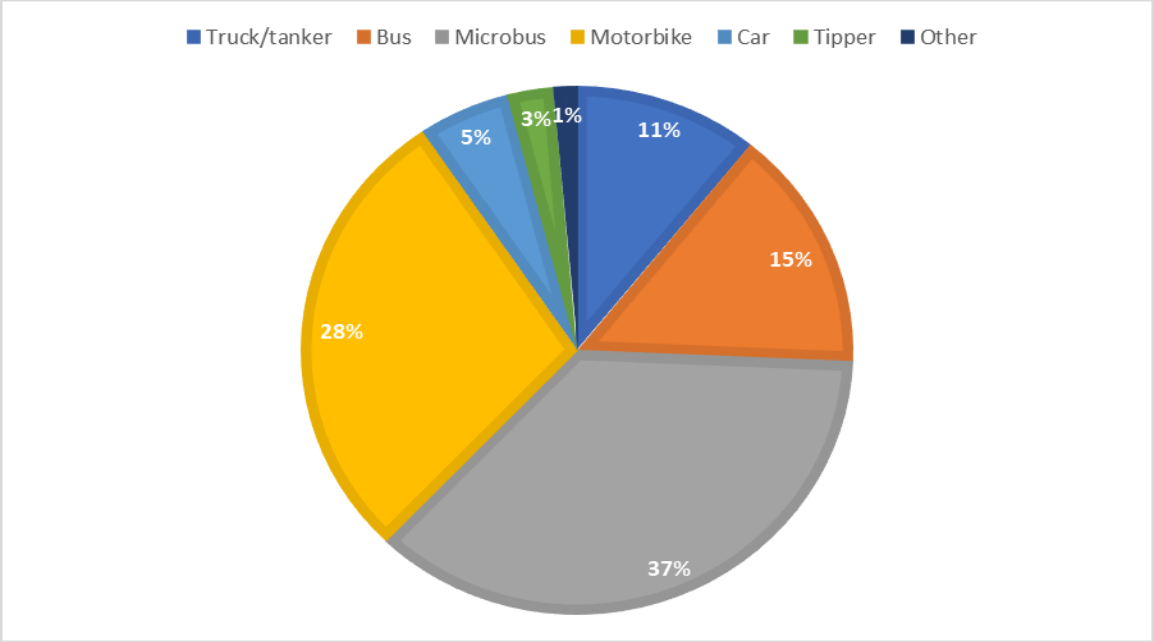

*Source*: Bagmati Province Traffic Police Office, Ramnagar, Chitwan (2081)

Collectively, these four types of vehicles account for approximately 90% of all traffic accidents (Fig. 4.4). This significant percentage underscores the critical need for policies aimed at reducing road accidents to focus primarily on these vehicle categories. By targeting motorbikes, trucks, jeeps/cars, and buses, authorities can develop more effective strategies to enhance road safety and minimize the occurrence of accidents.

Perception of the Field Survey respondents on "how often different vehicles have been involved in road accidents" is shown in Figure 4.8. Microbus lead the most, making 37% of these incidents and is followed by motorbikes with 28% of the accidents. Bus comes next, accounting for 15%. Car and Truck/tankers are part of 5% and 3% of accidents, respectively. Tipper and other vehicles each contribute 1% and 3%.

**Figure 4.5**

*Perception of Respondents about Vehicles Involved in Accident Along Mugling-Narayanghat Road Section*




*Source*: Field Survey (2025)

The data reveals a fascinating insight: microbuses are perceived to dominate accident involvement, yet the actual figures tell a different story. Motorbikes take the lead as the top contributor to road traffic accidents, followed by other vehicles. Buses also rank among the

four major contributors, though their involvement is notably lower compared to trucks.

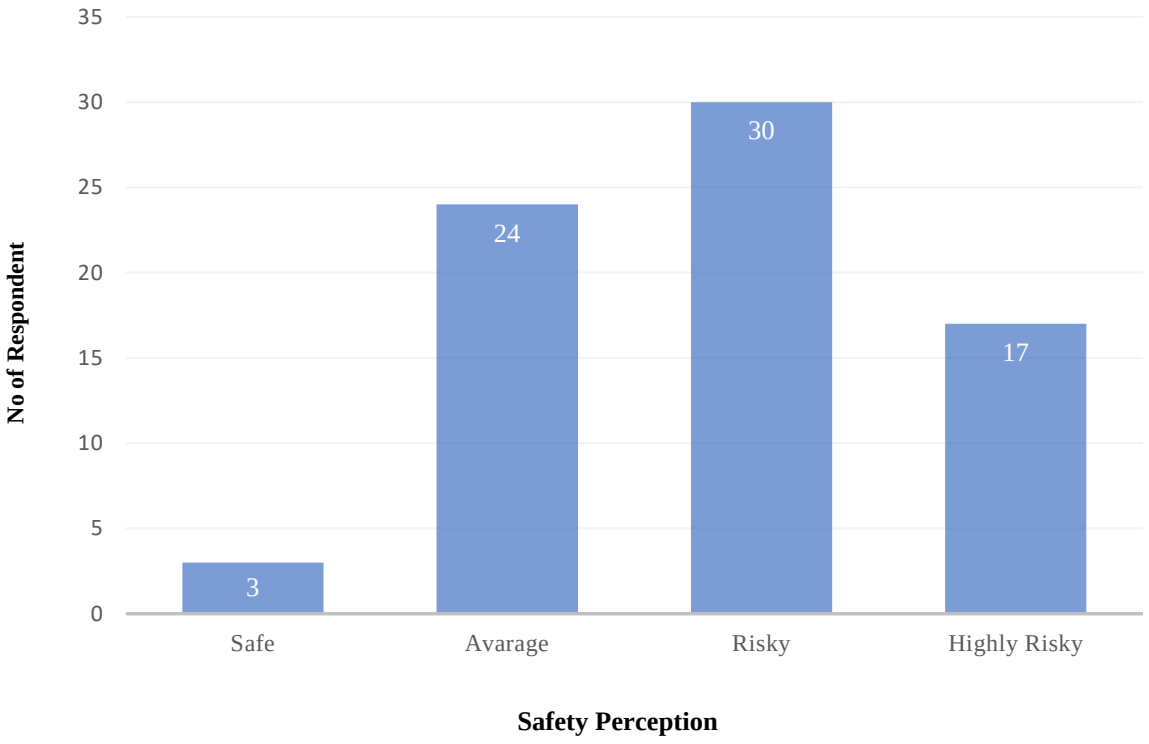
Interestingly, while respondents' perceptions about the exact ranking of vehicles don't fully align with the data, their intuition about the primary vehicles involved in accidents is remarkably close to reality. This near alignment suggests that public awareness of the key players in road accidents is fairly accurate, even if the specifics differ slightly.

### b. Road safety perception of respondents

As illustrated in Figure 4.6, the prevailing sentiment among the public compels the necessity for targeted policy adjustments—such as improved road infrastructure, enhanced traffic law enforcement, and comprehensive public education campaigns—to foster a safer driving environment. Such feedback-driven policymaking is supported by studies emphasizing that responsive governance, which actively incorporates citizen perceptions, leads to more effective and sustainable road safety outcomes (Elvik, 2019; Peden et al., 2004).

**Figure 4.6**

*Safety Perception Respondents about Naubise-Narayanghat Road Axis*




*Source*: Field Survey (2025)

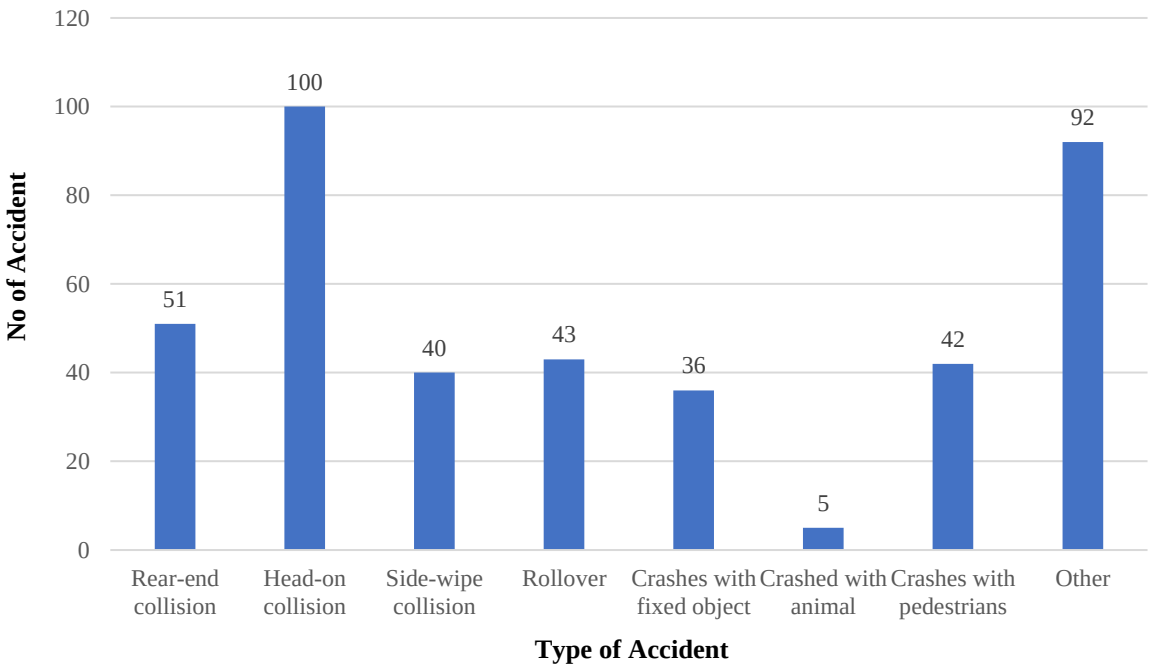
Most respondents perceive the routes as unsafe (Fig. 4.6). Out of the total, 30 (40.54%) respondents perceive the routes as risky, while 24 (32.43%) respondents perceive the road as average. Interestingly, 17 (22.97%) perceive the routes as highly risky, meaning that a substantial number of routes have highly risky. Only a negligible percentage, 3 (4.054%) perceived road as safe, indicating that the general travel condition is unsafe. This clearly shows that focused interventions on Naubise-Narayanghat road axis are required to improve safety to change the perception of users.

### c. Types of accident

Naubise-Narayanghat road section has been experiencing various type of road traffic accidents. These include collisions, rollovers, crashed with pedestrian and other types of accident as well. Driver's behaviour consisting with excessive speed, negligence, driving under influence of alcohol etc. have been found most frequent ones contributing to different type of accidents. Figures 4.7 and 4.8 provide a comparative understanding of types of accidents along this road section.

**Figure 4.7**

*Types of Accidents Occurring Along the Mugling-Narayanghat Road Section*

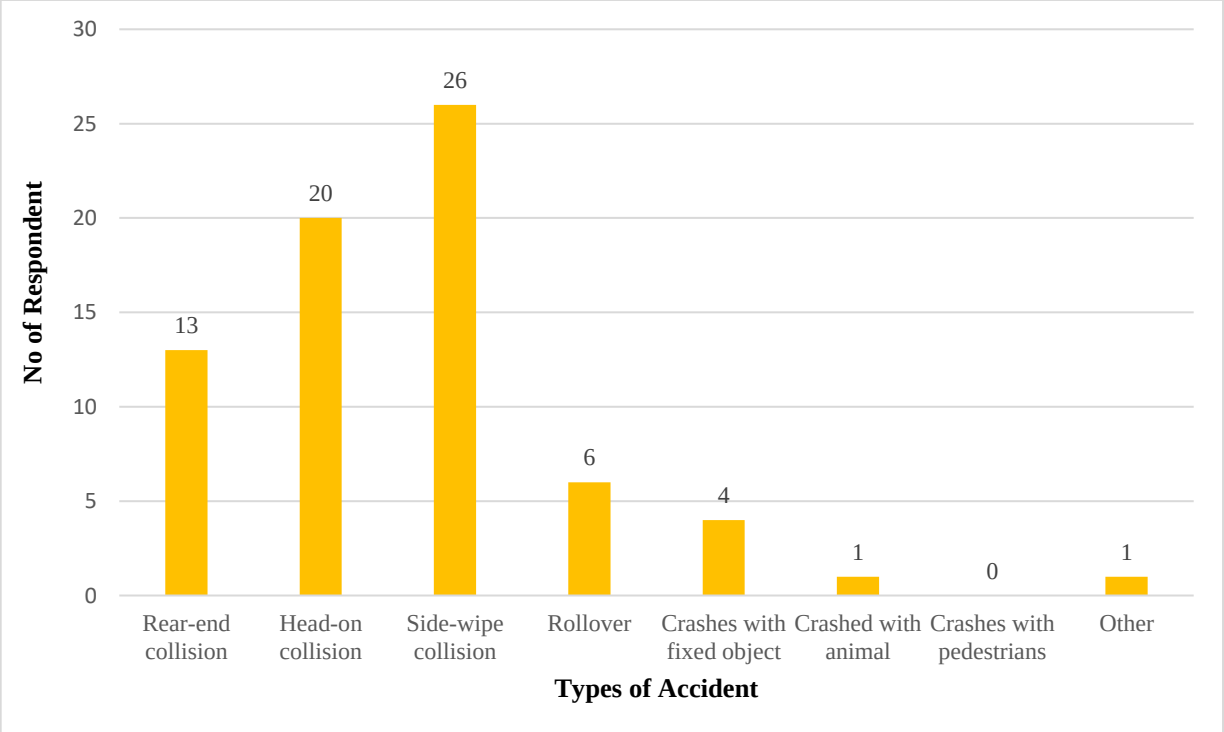



*Source*: Bagmati Province Traffic Police Office, Ramnagar, Chitwan (2081)

As illustrated (Fig. 4.7), head-on collisions leading the involvement in accidents as the most frequent type of accident along the Naubise–Narayanghat road axis, with 100 recorded cases, followed closely by the "Other" category (92). Rear-end collisions accounted for 51 incidents, while side-swipe collisions and rollovers accounted 40 and 43 cases, respectively. Crashes with pedestrians (42) and collisions with fixed objects (36) also rose significant concerns, whereas crashes with animals (5) were relatively less significant. The data highlights the significant involvement of most of the vehicle in accidents.

**Figure 4.8**

*Perception of Respondents on Types of Accidents Occurred Along Naubise-Narayanghat Road Axis*




*Source*: Field survey (2025)

It is revealed that most of the respondents with 26 in no. think rear-end collisions are the most frequent (Fig. 4.8). Likewise. 6 and 4 no. of respondent acknowledge that head-on collisions and side-wipe collisions are the frequent ones. Rollovers and crashes with fixed objects are taken as relatively rare occurrence by respondent with 1 and 0, respectively. Causes of Accident. Interestingly, public perception does not fully align with the data, though it is relatively close. This discrepancy suggests a need for greater awareness in the respondents.

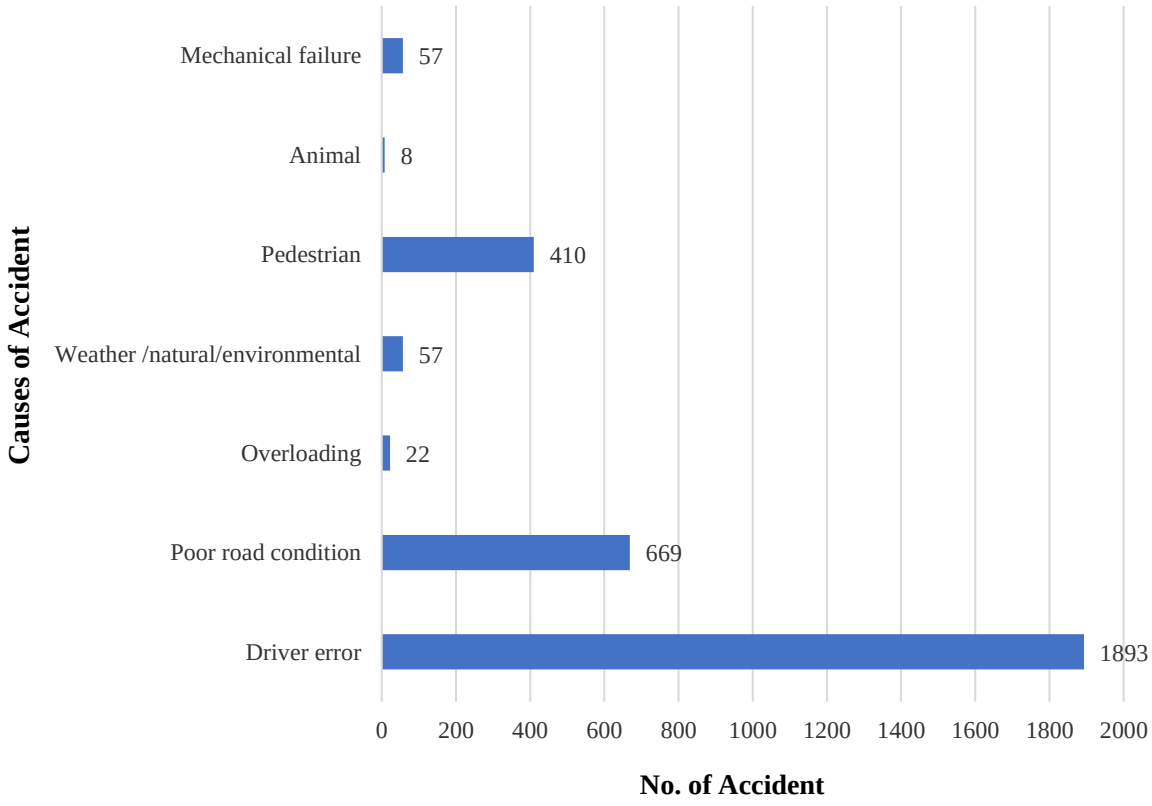
### 4.1.2. Causes of accident

Accidents can happen due to many reasons, and understanding their causes is important to prevent them. Some common causes include human error, such as distracted driving or fatigue, environmental factors like poor weather or road conditions, and mechanical failures in vehicles (Smith, 2020). Unsafe behaviors of driver, such as speeding or not following safety rules, also contribute to accidents (Johnson & Lee, 2019). Additionally, lack of proper training or awareness can lead to mistakes that result in accidents (Brown et al., 2021).

This section focuses on investigating the causes of accidents along the Naubise-Narayanghat road to address the second research objective. To analyze the primary factors contributing to accidents on this route, data from the traffic database for the last five consecutive fiscal years has been utilized. The findings are graphically presented in Figures 4.9 to 4.10.

**Figure 4.9**

*Causes of Accident along the Naubise-Narayanghat Road Axis*

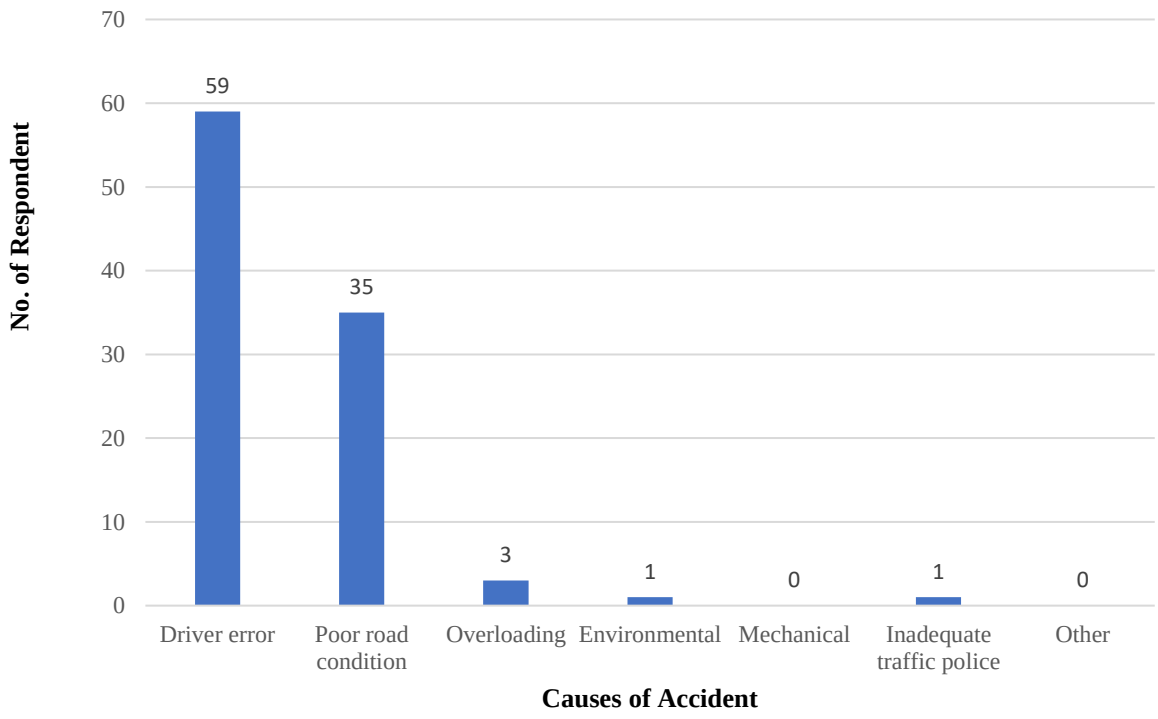



*Source*: Bagmati Province Traffic Police Office, Ramnagar, Chitwan (2081)

It is displayed that among various causes of accidents "Driver's behaviour" is predominant factor, accounting for 1893 incidents during fiscal year 076/77 to 081/82 along the Naubise-Narayanghat road axis (Fig. 4.9). Road conditions rank second with 669 accidents, highlighting infrastructure-related challenges. Pedestrians contribute to 410 accidents, while mechanical failures account for 57. Likewise, weather-related causes lead to 57 accidents, and overload contributes to 22 incidents. The data highlights the critical need for improving driver awareness, road conditions, and vehicle maintenance to reduce accidents effectively.

**Figure 4.10**

*Causes of Accident According to Field Survey*




*Source*: Field survey (2025)

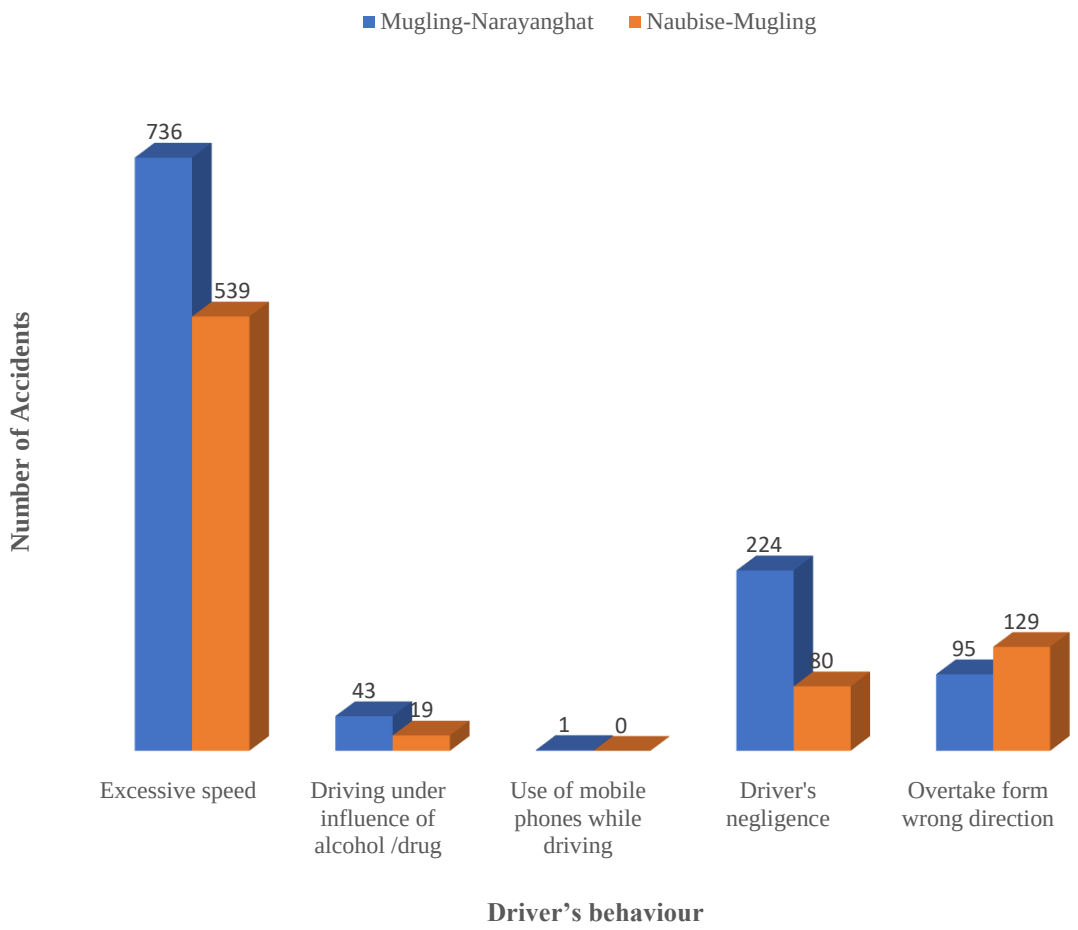
Field survey findings (Fig. 4.10) align closely with the data obtained from the traffic police database, reinforcing the conclusion that driver's behaviour is the primary cause of road traffic accidents along the Naubise-Narayanghat road axis. Out of the 74 respondents surveyed, a significant majority of 59 individuals believe driver error as the main factor contributing to accidents. This is followed by poor road conditions, which was cited by 35 respondents as a contributing factor. Other potential causes were deemed relatively insignificant by the

respondents, as they received minimal attention in the survey responses. This pattern is consistent with the traffic police records, which also highlight driver's behaviour as the leading cause of accidents on this segment of road. The detailed breakdown of these findings, including a comparative analysis of the survey results and the traffic police data, is visually displayed in Figure 4.9 and 4.10, providing a clear and comprehensive overview of the contributing factors to road accidents in this road section.

Figure 4.11 presents a comparative study of the number of accidents caused by different types of driver's behaviour along the Naubise-Mugling and Mugling-Narayanghat road sections.

**Figure 4.11**

*Accidents along Naubise-Narayanghat Road due to Driver's behaviour*




*Source*: Bagmati Province Traffic Police Office, Ramnagar, Chitwan (2081)

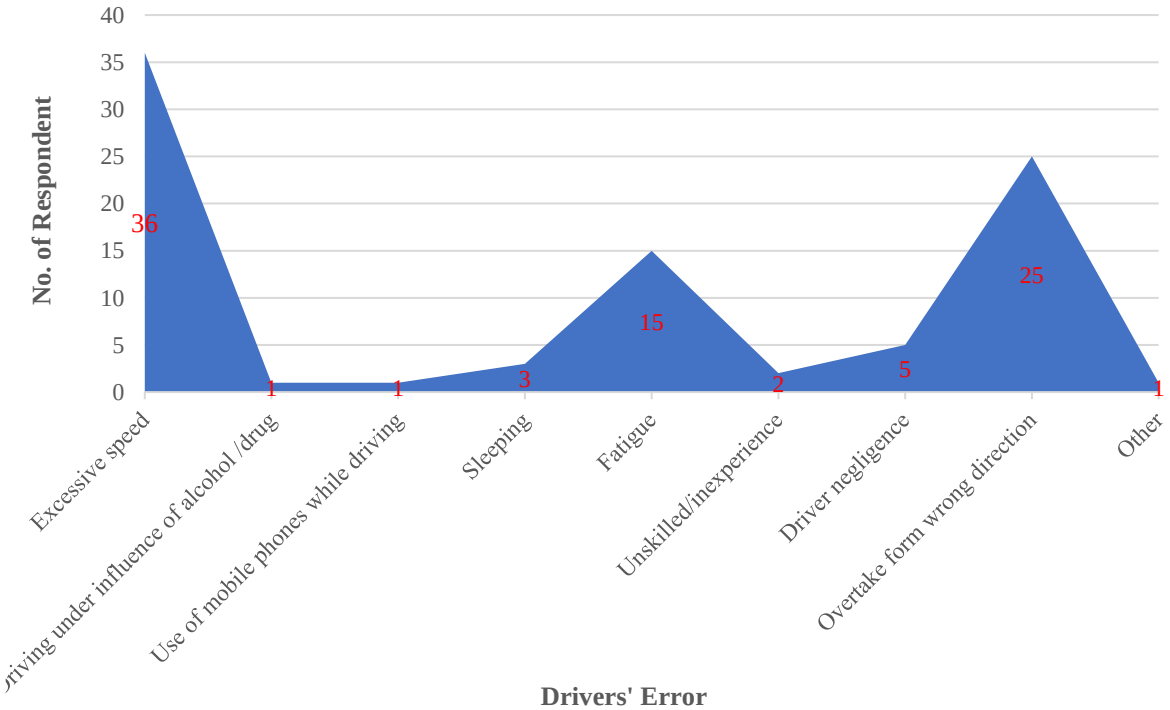
Excessive speed is the leading cause of accidents, accounting for 736 incidents in the Mugling-

Narayanghat section and 539 in the Naubise-Mugling section (Fig. 4.11). Driver negligence ranks second in the Mugling-Narayanghat section, contributing to 224 accidents, while overtaking from the wrong direction holds the second position in the Naubise-Mugling section, with 129 accidents. However, use of mobile during driving is last on ranking in both road sections causing insignificant number of road accident.

Figure 4.12, based on traffic police data, highlights that excessive speed is the primary cause of accidents, followed by negligence and overtaking from the wrong direction while other driver's behaviors contribute less significantly to road accidents. Similarly, the field survey data aligns with the traffic police data, identifying excessive speed as the leading cause.

**Figure 4.12**

*Accidents along Naubise-Narayanghat Road due to Driver's behaviour According to Field Survey*




*Source*: Field survey (2025)

However, the second most frequent behavior, overtaking from the wrong direction shows discrepancies with traffic police database. This variation indicates the importance of considering multiple data sources to gain a comprehensive understanding of accident causation.

These findings (Figs. 4.11 & 4.12) demonstrate the critical role of driver's behavior to road safety and the heterogeneous effect of various driving faults on these road sections, with the primary cause of traffic accidents being speeding.

Likewise, all the 10 interviewees sated "driver's behaviour is a primary cause of road traffic accidents. Specially, drivers of small vehicles frequently violate lane discipline and exceed speed limits. Additionally, poor road conditions along the Naubise-Narayanghat route further increase accident risks" (Interviews, 2025-01-09).

The narrative indicates that the driver's behaviour has dominant role in contributing to road traffic accident which has been fueled by poor road conditions. The perceptions of interviewees found to be fully aligned with data from traffic police database. Hence, the findings triangulated have the same argument with drivers' error remains the leading cause of road traffic accidents.

The finding reveals that primary cause of road traffic accident along the Naubise-Narayanghat road axis driver's behaviour. This is closely connected to traffic law enforcement. It indicates the weak law enforcement by traffic police and Inspector from transport management office. To know the real cause behind it, the perception of different traffic police was taken and transportation management office was visited. One of Interview stated:

> "The VTM Act 1993's current penalties provisions are insufficient to effectively discourage violations. Since the maximum fine is only Rs 1500, many drivers disregard traffic laws, which frequently results in incidents of reckless behavior, speeding, and drunk driving. Furthermore, we lack the manpower necessary to properly monitor and enforce traffic laws. Our ability to control violations is further weakened by the absence of sophisticated technology, such as CCTV surveillance and radar guns. A speed card system along this road would make it easier to monitor and control the speed which can significantly decrease the accident rate, but sadly, such measures are not yet in place."
>
> (Interview, 2025-01-09*)*

The statement from the traffic police officer reveals serious weaknesses in traffic law enforcement. Because of the MVTM Act 1993's low penalty ceiling, which does not provide a strong deterrent for traffic infractions-reckless driving, speeding, and drunk driving-continue to occur. The issue is further exacerbated by the fact that maintaining efficient traffic monitoring is challenging due to a lack of personnel, the absence of sophisticated technology,

like CCTV and radar guns. This restricts the ability of law enforcement to enforce the law and makes it simpler for offenders to evade punishment. By guaranteeing more stringent monitoring and more severe penalties for violations, a speed card system and higher fines could contribute to increase road safety.

To address these issues traffic police is currently involving in awareness programs such as class to students, community, new driver, entrepreneurs and contractor of vehicle, general people, internal workshop, traffic day, driver/passenger friendship class, brochure, leaflet. Pamphlet. Because of the result of such programs and other initiations, the rate of traffic accident in slowly decreasing along Naubise-Narayanghat road axis.

However, drivers and the public frequently think that traffic personnel are corrupt and don't strictly enforce the law. Road traffic accidents are thought to be caused in part by their apparent resistance to enforce regulations. Traffic police, however, refute this allegation, claiming that they carry out their responsibilities in a responsible manner.

### 4.1.3. Mechanism for road traffic accident response in Nepal

Efficiently handling rescue operations following traffic accident-related disasters necessitates a comprehensive and well-organized strategy. This strategy incorporates sufficient law, advanced technological solutions, and the collaborative efforts of multiple emergency response agencies. Local administration, (Nepali army-based on situation), Nepal Police, APF, Nepal, first emergency responder, road office etc. involve in post-crash rescue operation in Nepal. The institutional framework for managing RTAs involves the enactment of various laws, regulations, and agencies dedicated to this purpose.

Though the framework lacks proper procedure of road traffic accident response, Nepal's emergency response system for road traffic accidents necessitates multiple stakeholders' involvement by fulfilling their own role. Emergency numbers such as 100 (Nepal Police) and 102 (Ambulance Services) are in operation for immediate assistance. The local administration often plays leading role by coordinating the response activities of accident. It supports rescue operation making available necessary resources to the scene. Road office manages to open the obstructed road by opening it with arranging heavy equipment in fixed interval especially in rainy season. Traffic Police respond the accident to manage traffic congestion, investigates incidents, documents evidence, and assists in victim rescue and

transportation to hospitals. While Nepal Police involves in both rescue and investigation functions. Medical care is a key component, with government hospitals mandated to provide immediate treatment to accident victims. APF, Nepal has been playing vital role in rescue operation of road traffic accident. It has been actively participating in response of accidents with the provision of DRRMA ACT 2074 and APF, Nepal Act 2058. Nepali Army is mobilized only in exceptional circumstances. Under-water rescue has been mostly carried out by APF, Nepal performing lead role.

Besides, insurance is mandatory for all motor vehicles, ensuring coverage for medical expenses and compensation for accident victims. The government sets specific compensation amounts for injury and death cases, with families of deceased victims receiving financial support through insurance claims. However, continuous dispute has been observed between victim and Bus owner and transport entrepreneurs committee regarding additional compensation.

However, despite these practices, challenges such as delayed medical assistance, weak coordination between agencies, and limited resource and poor infrastructure design and maintenance hinder effective emergency response.

### 4.1.4. Challenges to respond the road traffic accident

Emergency responders are facing various challenges throughout the world. Obviously, Nepal is not exception rather rescuers in Nepal have been facing more challenges due to various reasons such difficult terrain, adverse weather, lack of resources (trained manpower, equipment, technology etc.), lack of adequate trauma centers along the highway, traffic congestion, and poor roads condition. These challenges further added to the problems of a timely response. Based on the present study the challenges faced by emergency responders especially by APF, Nepal has been mentioned as follows:

#### a. Assessment of the situation

When APF personnel arrive at road crash accident site, their initial and most important task is to scan the entire situation rapidly and thoroughly to understand what has occurred, they can make a plan to continue on need basis. To have an effective and efficient operation, they must have enough information about the vehicle's passengers, the time of accident etc. Upon emphasizing the importance of assessment of situation Commandant of APF, Nepal DMTC, Kurintar stated:

> "Accident scene assessments are extremely challenging due to adequate information about the accident site vehicle, passenger and time. The vehicle submerged into the river becomes more challenging due to the current and turbid nature water of Trishuli River. Inaccessibility in limited area of river makes the recue task more challenging. The whereabout of vehicle and passengers are difficult to identified. Look the example of Simaltal bus accident, there are so many cases where vehicles still are not located even after years of accident."
>
> (I-3, Interview, January 08, 2025)

Responding to road traffic accident along Naubise-Narayanghat road axis is becoming more challenging to APF personnel due to lack of adequate information of victims, time, location, environment condition. Accurately assessing victim conditions and potential hazards is made more difficult by the chaotic combination of heavy vehicle traffic and bystanders. The sheer volume of debris and the unstable terrain frequently make it difficult to conduct the quick and precise assessment that is essential for a successful rescue, so APF must put safety first while aiming for prompt action. To address this challenge, the need of proper mechanism which make available the information in case of immediate need.

**b. Lack of resources**

Emergency responders responding road traffic accidents has been facing lack of resources everywhere. The FGD conducting with deep divers revealed that they are facing scarce of resources while responding traffic accidents.

The commandant of APF, Nepal Disaster Management Training School (DMTS), Kurintar, added:

> "The rescuers are using old rescue equipment, which are less effective. APF, Nepal has been engaging in both difficult terrain and underwater rescue. APF personnel are performing their duties by putting their life at risk. There is a dire need of modern equipment (Appendix E) to effectively respond road traffic accident along the Naubise-Narayanghat road section. He further stated that mentioning the list of necessary equipment for rescue."
>
> (I-3, Interview, January 08, 2025)

This statement shows a significant gap in emergency response capabilities along the Naubise-Narayanghat road axis. The compulsion to use old rescue equipment significantly hampers the effectiveness of rescue operations, particularly in the challenging terrain and water submerged accidents faced by the APF, Nepal. This reveals an indispensable modern equipment for effective and efficient rescue operation.

Likewise, the officiating commander of Disaster Security Base, Adamghat also reiterated that they lack basic rescue equipment while involving in rescue efforts. During KI, The CDO of Chitawan added, “Emergency responders are not able to rescue up to their optimum capacity due to scarce of rescue equipment. APF, Nepal has lacked rescue equipment. Nepal Police does not have basic rescue equipment. The heavy equipment to open road during the rainy season is not enough to respond time” (Paudel, 2024).

APF, Nepal No 3 Brigade Commander, KI, fully agreed the lack of resources and pointed out:

> “The current capacity of the APF, Nepal has been limited due to lack of modern equipment to conduct rescue operations effectively and efficiently, particularly in challenging environments like the Trishuli River. To address this, an 80 HP boat is urgently required to ensure efficient and timely rescue operations in the river. Furthermore, the deployment of APF personnel along the critical road axis between Adamghat and Naubise is inadequate to respond promptly to emergencies. To improve response times and overall effectiveness, the upgradation of current dependent company into battalion and establishment of an additional security base is in need. The lack of adequately trained manpower also significantly has been affecting the respond, as the current disaster management trained manpower under the brigade is quite low that is 167.”
>
> (I-3, Interview, January 10, 2025)

To triangulate the perception expressed by different key persons and interviewees, the researcher also had an interview with the commander of APF No 17 Battalion (Bn). During the visit, he mentioned,

> “The battalion has been facing several challenges in responding to road traffic accidents, significantly impacting its efficiency. Key issues include a shortage of vehicles, ambulances, and medical personnel, which hinder timely and effective

> responses. Additionally, despite having a team of ten deep divers, the battalion lacks essential rescue equipment, further limiting its operational capabilities. Compounding these difficulties is its extensive Area of Responsibility (AOR), which spans over 50 km up to Mauwa Khola, making timely interventions even more challenging."
>
> (I-6, Interview, January 09, 2025)

By analyzing the statement of KIs and interviewees, it is found that the ability of APF, Nepal to respond effectively to road traffic accidents has been hindered by significant resource shortages limiting its operational capability. By addressing these issues through better resource arrangement and strategic planning, the units working at field level can significantly improve its response efficiency, ultimately saving more lives and reducing the impact of such incidents.

To understand the statues of medical preparedness and capacity, medical officer of the only trauma center located in Kurintar along the Naubise-Narayanghat road was accessed who explained,

> "The four-level trauma center is currently facing a significant staffing shortage, as it does not meet the required manpower provisions. Ideally, the center should have one Doctor of Medicine (MD) consultant, two medical officers, five nurses, and paramedics as needed. However, it currently operates with only one medical officer. The trauma center is not also linked with road access. Its area of responsibility covers huge section of road which is beyond its recent capacity. To address this gap and ensure effective emergency response, the center has collaborated with eleven private hospitals to manage and respond to accident cases promptly and effectively."
>
> (I-9, Interview, January 08, 2025)

The four-level trauma center is facing a severe staffing shortage, operating with only one medical officer instead of the required medical personnel, which affects its ability to provide adequate trauma care. Additionally, the center lacks proper road access, delaying emergency response times, and its coverage area exceeds its current capacity. To address these challenges, the center has partnered with eleven private hospitals to distribute accident cases and enhance emergency response. While this collaboration helps mitigate immediate issues, long-term solutions such as recruiting more staff and improving infrastructure are crucial for sustainable

trauma care management.

Though the Trauma Center was found to be well equipped, it lacked adequate manpower. It hindered its effectiveness while responding road traffic accident. However, to have an effective post-crash response the Centre had collaborated with private hospitals to respond accidents promptly. The innovative idea adopted by the Centre was appreciable. The details of staffing status and hospitals have been displayed in Tables 4.3 and 4.4, respectively.

**Table 4.2**

*Provision of Staff and Current Strength*

| SN | Staff | No of staff according to provision | No of staff currently working |
|---|---|---|---|
| 1 | MD | 1 | - |
| 2 | Medical officer | 2 | 1 |
| 3 | Nurse | 5 | - |
| 4 | Paramedics | As per need | 4 |
| 5 | Health Assistant (HA) | - | 1 |
| 6 | Radiologist Assistant | - | 1 |
| 7 | Lab Assistant | - | 3 |

*Source*: Trauma Center Kurintar, (2025)

The staffing situation at the four-level trauma center reveals a critical gap between the required and available workforce, severely affecting its operational capacity. Ideally, the center should have one MD consultant, two medical officers, five nurses, and paramedics as needed. However, the current workforce falls significantly short of these provisions. Notably, there is no MD consultant or nurse, leaving only one medical officer to manage cases. While four paramedics are available, their adequacy in handling emergency cases remains uncertain. Additionally, the center employs one Health Assistant, one Radiologist Assistant, and three Lab Assistants, roles that were not originally specified in the staffing provisions. This imbalance indicates a misalignment between the designated staffing structure and actual

workforce availability, which could compromise the effectiveness of trauma care.

The attempt of collaboration made of Trauma Center has been shown in Table 4.3. This was a unique method employed by the Center to have an effective and efficient rescue effort. Collaboration of Trauma Center, Kurintar with different private hospitals located in different places along the Naubise-Narayanghat road axis, has been presented (Tab. 4.3). This has really supported to respond the accident in timely manner.

**Tabel 4.3**

*Collaboration of Trauma Center with Private Hospital*

| SN | Name of Hospital | Address | Coordinator | Ambulance | Phone Number |
|---|---|---|---|---|---|
| 1 | Gajuri Private Hospital | Gajuri Gp pa-1 | Dr Arbind Yadav | 2 | 9844511112 |
| 2 | Gajuri Government Hospital | Gajuri Gp pa-1 | Dr Sudip Pandey | 1 | 9843703751 |
| 3 | Malekhu Rajmarga Hospital | Malekhu | Roshan Khatiwada | 1 | 9844098160 |
| 4 | Malekhu Teaching Hospital | Malekhu | Nirajan Kandel | - | 9840811968 |
| 5 | Ichhakamana Gaupalika Hospital | Kurintar-4 | Dr Renu Silwal | 1 | 9865997837 |
| 6 | Manakamana Polyclinic | Kurintar-4 | Basudev Silwal | - | 9855061118 |
| 7 | Fisling Polyclinic | fisling -3 | Binod Shrestha | - | 9851277357 |
| 8 | Saibaba Community hospital | Naubise 1 Dharke | | - | |
| 9 | Highway Community Hospital Pvt. Ltd Addamghat | Gajuri Ga pa-6 | Hari Bahadur Ale | 2 | 9865488477 |
| 10 | Mugling Highway Hospital | Ichhakamana -5 | Ram Bdr Lama | - | 9845697650 |
| 11 | Janta Care Hospital Pvt. Ltd | Ichhakamana -5 | Rajan tirpathi | - | 9855082075 |

*Source*: Trauma Center Kurintar (2025)

### c. The geographical condition and nature of Trishuli river

The road traverses a geologically unstable area, flanked by steep hills on one side and the Trishuli River on the other. The strong currents of the river, turbid water with extremely poor visibility, pose significant challenges to rescue efforts, rendering even advanced modern equipment less effective. Additionally, environmental and weather condition make respond activities more challenging. The Simaltal bus accident, triggered by a landslide, has yet to see a successful rescue operation despite numerous efforts by both national and international rescue teams. The location of the vehicle and the status of some victims still remain unknown. Figure 4.12 shows the continuous involvement of rescuers searching for Simaltal bus accident victims in Trishuli river. This figure describes how difficult it is to conduct rescue operation during monsoon season.

**Figure 4.12**

*Rescuers Searching for Simaltal Victims*

*Source*: Sky News (16 July 2024)

On 18th July 2024 (2081/03/28 BS.) at around 03:00 hrs, the passenger bus labeled with 'Ganapati Delux' with registration no. Bagmati Province 03-001-Kha-2495 which was traveling from Kathmandu toward Gaur, Khajalla, Rautahat, and another passenger bus labeled

"Angel Deluxe," with registration no. Bagmati Province 03-006-Kha-1516 which was enroute from Birgunj to Kathmandu, were swept away by floodwaters at Simaltal along Mugling-Narayanghat highway and fell together into the Trishuli River. Among 62 passengers including the crew members of both bus, three passengers narrowly managed to survive. APF personnel took the leading role in search and rescue operation. Rescuers from neighboring country India also attended the site to provide in search and rescue operation. The rescue efforts were continued for many days but it was turned into vain. The turbid water because of continuous flood in Trishuli, high current, the rescuers were not able to produce result despite their rigorous efforts.

Even after a decade of accident, the whereabouts of the then Home Minister Madhav Prasad Ghimire and his vehicle remain unknown. Additionally, items such as the bullet, excavator, and dozer that fell into the Trishuli River have not been recovered, the commandant of APF, Nepal DMTS, Kurintar reminded. Twenty-one vehicles, including a gas-tanker that fell into the Trishuli River, have also not been recovered until now (Simaltal Bus Accident Taskforce Report, 2081). As a result, the full nature and characteristics of the Trishuli River have yet to be thoroughly studied or understood.

The FGD with deep diver teams of DMTS revealed:

> "The high current of Trishuli river, whorl and turbid water with zero visibility under water make difficult to locate victims of the accidents. They lacked the high-capacity boat (80 hp) to sustain the current and modern equipment to carry out the rescue operation. The equipment manufactured targeting low current and stationary water rescue are not effective in such kind of rescue operation. It is highly risky to rescuers to carry out rescue operation in monsoon season."
>
> (FGD, 08 January 2025)

The challenging conditions of the Trishuli River, characterized by its high current and poor visibility, significantly obstructs effective rescue operations, hindering locating victim's position. The inadequacy of current rescue equipment does not match challenging geomorphological environment of Trishuli River. The experience accumulated by rescuers revealed that the critical need for specialized, modern equipment are indispensable to the unique and hazardous characteristics of the river to ensure timely and safe rescues. Ultimately,

the lack of appropriate resources directly compromises the effectiveness of emergency response and the safety of rescue personnel.

**d. Lack of information**

One of the most immediate challenges is the delay in emergency response. If the exact location of the accident is unclear or inaccurately reported, emergency services may struggle to locate the scene quickly. This delay can be critical, especially in life-threatening situations. Additionally, without details about the severity of the accident—such as the number of vehicles involved, the extent of injuries, or potential hazards like fires or chemical spills—responders may not dispatch the appropriate resources, leading to either inadequate or excessive deployment.

The commandant of APF, Nepal DMTS, Kurintar, highlighted that "timely information about road traffic accidents is crucial to effective rescue effort, however, it often reaches them too late, primarily through the police, which significantly delays rescue operations". This issue has also been acknowledged by the APF, Nepal No. 3 Brigade commander, who confirmed the ongoing challenge faced by APF, Nepal while responding rescue operation is lack of information having in time. Analyzing the statement of both the officers, APF, the deficiency in information should be addressed for effective rescue efforts.

**e. Weather and environmental condition**

The road corridor has often been severely impacted by extreme summer rainfall. This intense rainfall triggered numerous landslides and slope failures along the road and surrounding areas, a situation further exacerbated during monsoon, which blocked traffic for weeks (Department of Water Induced Disaster Prevention, DWIDP 2009). The situation has been further deteriorated by climate change causing intense rainfall during short interval of time.

Unmanaged human interventions (e.g., road track opening at mountain slope), combined with heavy rainfall and shifts in precipitation patterns to increase in intense rainfall events, have intensified debris flow, often eroding roads along its path. The accidents at Simaltal and Jhyaple Kola occurred along this road were direct consequences of human activities, tragically claiming numerous innocent lives. Therefore, the environment has a dual impact—on one hand, it destroys infrastructure such as roads, bridges, and safety barriers, while on the other, it

significantly hinders rescue operations.

On September 27 and 28, a continuous heavy rainfall caused landslides in Jhyaple Khola, burying two microbuses and one bus, resulting in 35 fatalities. All the vehicles involve in the accident were en route to Kathmandu, consisting of a bus with registration number Na.4 Kha 2270 coming from Gorkha, microbus with registration number Ba.2 Kha 1345 coming from Chitwan, and winger with registration number Lu.1 Ja 4577**.** The local administration was alleged guilty for the accident that not taking adequate action to stop vehicles before the lineside prone area.

**Figure 4.13**

*Rescue Effort in Jhyaple Khola*


*Source:* República, (29 September 2024)

The fragile geological condition susceptible to landslide has been always putting life on risk while travelling through this road. So environmental and weather condition also play significant role to happen road traffic accident along this road axis. Every year people have been losing their life due to these external factors.

### f. Challenges in extrication

The specific characteristic of Naubise-Narayanghat road axis amplifies the technical difficulties of victim extrication for APF Nepal members. The twisting, frequently steep landscape enhances the risk of vehicles being left in unstable positions, demanding specialized stabilization methods outside of normal procedures. The application of hydraulic rescue equipment, essential for slicing through contemporary high-strength steel automobile frames, is made more difficult by the isolated areas and possibility of restricted power supply. Moreover, the requirement of the exact and correct utilization of equipment in small spaces that are usually unstable demands an extremely high level of technical expertise. This requirement is even more because of the high possibility of equipment failure that can occur in such a hostile and difficult environment. To stop any movement of the vehicles that might put the victims or rescuers in danger, stabilization equipment must be used. it is essential to continuously check for the presence of flammable materials or structural instability. To protect themselves from a variety of dangers, emergency response teams frequently don personal protective equipment, such as helmets, high-visibility clothes and specialized gloves.

Besides, to make entrance into the vehicle demand special equipment both in underwater and steep cases. During FGD it is revealed that “the APF personnel lacks special equipment-Hydraulic Cutters, Power Saws, Spreaders, Hydraulic Rams, Stabilization Equipmentto etc.-to carry out their responsibilities effectively. Moreover, it came to know that the need of advanced training for this type of rescue is needed” (FGD, 2025-01-08). These immense technical challenges are further intensified by the regular and high volume of heavy vehicle traffic that regularly flows on this raid, which further contributes to the complexity inherent in effectively directing the scene and providing safety to everyone involved. APF responders need to rapidly evaluate the condition of the vehicle, stabilize it from further movement, and utilize proper extrication methods, all while managing the inherent dangers of the terrain and the urgency of the emergency. The constant risk of landslides, particularly in monsoon season, adds another level of hazard, demanding eternal vigilance and flexibility.

The need for rapid and efficient extrication is paramount, but the challenging environment, lack of equipment, inadequate training etc. make response more difficult. To make their deployment more effective, the advanced training should be begun in specific areas. Nepal has to identify and address challenges to increase its efficiency and effectiveness.

### g. Increased risk to victims and responders

The absence of critical information increases risks for both victims and responders. Unidentified hazards, such as fuel leaks, downed power lines, or dangerous goods, can endanger everyone at the scene. Additionally, without knowledge of the number and condition of victims, medical teams cannot prioritize care effectively, potentially leading to preventable fatalities or complications. Responders may also face greater risks if they are unprepared for the specific challenges of the accident.

### h. Legal complications

The existing MVTM Act 1993 (2049 BS.) does not properly address the need of proper mechanism of road rescue. It slightly talks about the responsibility of traffic police and driver. How the road rescue should be conducted and which agencies involvement is necessary, the Act remains salient. Rescuers from different agencies- Nepali Army (NA), APF, Nepa- mobilize under DRRM Act 2017. The absence of a suitable mechanism and legal provisions makes it extremely difficult for Nepal to carry out efficient rescue operations during traffic accidents.

Since multiple agencies function without a single command structure, unclear policies lead to disorganized and delayed interventions. This ad-hoc practice further complicates the need of resources during rescue operation. Due to inefficiencies caused by this legal void, accident victims are more likely to face worse situation and receive delayed medical attention. It's also interesting that the office primarily responsible for executing the VMTM Act does not have any responsibilities in rescue efforts.

### i. Risks And Safety Measures

Rescue is highly risky job. Rescuers must put their life to rescue others. Upon approaching the incident scene, rescuers must be cognizant of potential risks. They must bear in mind the flow of traffic near the accident scene, potential hazards from damaged vehicles, such as leaking fuel or broken glass, and the risk of vehicle movement during the rescue. Evetime, they are exposed to potential risk of injured even loss of life.

APF, personnel have been frequently experiencing this situation. During the FGD, one of the

deep divers stated:

> "Rescue operations along the Naubise-Narayanghat road axis are extremely challenging due to the difficult terrain, risky river nature and unpredictable conditions. As a rescuer, I often face risks like landslides, vehicle instability, and strong river currents when retrieving accident victims. The lack of proper equipment and delayed medical support make our work even more dangerous. Every operation demands quick decision-making and teamwork to avoid putting ourselves in harm's way while trying to save others. Without better safety measures and coordination, the risks to both victims and rescuers remain alarmingly high."
>
> (FGD, 08 January 2025)

The text stresses the critical need for better safety protocols and coordination by highlighting the extreme difficulties and risks that rescuers encounter on the Naubise-Narayanghat road as a result of difficult terrain, complex nature of river, insufficient supplies, and erratic conditions.

To mitigate these risks, the use of advanced equipment, trained manpower is must to ensure the safety environment of rescue. Furthermore, continuous monitoring for the presence of flammable substances or structural instability and use of personal protective equipment is vital to get shield against various hazards.

### j. Training

When it comes to road accident rescues, APF, Nepal has been essential part for rescue operation. APF personnel have been trained for rescue operation by in one single course. APF, Nepal lacks separate advanced rescue operation training on different field. It has been undermining its performance during responding road traffic accident. One of the interviewees stated:

> "I am frequently involving in rescue operation of victim for road traffic accident. We have been trained for every type of rescue operations. We have basic knowledge but we lack special skill, knowledge for specific field. To make our work more effective simulation training in realistic environment is necessary. Our effectiveness and safety would greatly increase if we had access to current rescue equipment and ongoing training programs".

(Interview, 08 January 2025)

Despite having experience, the respondent admits to lacking in advanced knowledge and abilities, highlighting the necessity of realistic simulation training to fulfill this gap. There is no separate training for extrication of vehicle and victims. No simulation has been found to be conducted to prepare for this kind of rescue operation. The safety and efficacy of rescue operations are greatly impacted by this shortcoming of training in addition to a lack of contemporary equipment. The need for continual training emphasizes the dynamic nature of rescue techniques and the necessity of adapting to changing vehicle structure and accident scenarios. Road crash rescue teams deal with difficulties that call for specialized training and a high degree of readiness. Effective response depends on current knowledge and realistic training exercises.

**k. Manpower**

Though APF, Nepal has been continuously involving in every type o rescue operation as lead agency, it has been facing shortage of manpower along this road axis. There is only one DM Security Base with few manpower at Adamghat, Dhading. Besides, APF, Nepal DMTS has been performing operational role in case of need. The presence of Bn level of unit is indispensable to ensure security and respond effectively during rescue operations. The commander of No. 3 Bde stated:

> "Look, currently, we only have 167 DM trained personnel under this brigade, which is insufficient in term of critical nature of our responsibilities. We are tasked with securing the most strategic supply route to Kathmandu, yet our limited manpower restricts our ability to provide both security and effective rescue operations.one the one hand the protection of supply of route is most challenging by existing manpower on the other hand the road is susceptibility to different type of disaster. Ideally, we need at least a battalion-level unit to ensure basic security and respond swiftly to emergencies. During the continuous two-day rainfall in September this year, our resources were stretched thin, and we had to request additional support from Valley Brigade (No. 9) to manage the situation. Without adequate personnel and resources, our ability to handle large-scale disasters and road accidents remains severely compromised."

(I-1, Interview, 10 January 2025)

The limited manpower APF, Nepal along this road has restricted their ability to response. The dependence on outside assistance, as demonstrated by the September rainstorm, demonstrates the inadequacy of manpower highlighting urgency of battalion-level presence along this road. The upgradation of dependent Company Dhading seems must for effective and efficient work.

### 4.1.5. Strategy for effective response

To increase the effectiveness of response of rescuers to road traffic accident, multi-sectoral approached is indispensable. Challenges linked to various sectors should be addressed. The ability of APF, Nepal can be significantly enhanced by emphasizing focused training, better equipment, and enhanced interagency coordination, formulating proper Mechanism.

**a. Specialized Training and Simulation:**

Regularly conducting realistic simulation exercises that replicate the difficult conditions of Nepal's roads is necessary. APF personnel need advanced training in vehicle extrication techniques, especially for modern high-strength steel vehicles, and stabilization procedures for accidents occurring on steep slopes and uneven terrain. Training should also cover advanced medical triage and first aid, with an emphasis on managing trauma in resource-constrained environments. This includes simulating accidents in a variety of weather and terrain condition. The WHO claims that pre-hospital care training dramatically lowers the death rates from traffic accidents.

**b. Advanced equipment adaptation**

Role of equipment in effective response is vital. Without proper equipment the ability of rescuers cannot be fully utilized. Moreover, the environment of Naubise-Narayanghat road axis is challenging. It needs advanced equipment to conduct rescue operation effectively and efficiently. However, APF personnel has been using old equipment for long time, which been limiting their ability. To increase APF personnel efficiency, the availability of Hydraulic Cutters, Power Saws, Spreaders, Hydraulic Rams, Stabilization Equipment, 80 HP boat, ROVs or Underwater Drones, Diving chamber etc. are must. Besides, personnel protective equipment is significant as well. In order to stay in touch in remote locations, portable and reliable communication devices are essential It is also necessary to invest in sophisticated lighting and scene management equipment. So, the difficult terrain and complex river system need more advanced equipment to make effective rescue operations.

### c. Legal provision

To improve efficiency and reduce deficiencies, the mechanism for a successful road rescue response creates a cohesive and coordinated system. Developed countries have found to be practiced governing their rescue operation under proper mechanism. However, road rescue operations in Nepal, are currently conducted ad-hoc basis by involvement of several agencies under various legal provisions, which causes fragmentation and inefficiencies. The functions of local authorities, emergency medical services, traffic police, and disaster response teams are governed by several laws, but no single law unifies their coordination. A thorough road safety law that incorporates all facets of road rescue, such as emergency response procedures, interagency coordination, command structure, funding sources, and accountability measures, is required to address this gap. This provision would guarantee the efficient conduct of rescue missions, lower the number of fatalities, and enhance road safety management in general.

### d. Improved information sharing mechanism

To guarantee a timely and effective rescue response, a unified network system for road traffic accident information is necessary. Faster coordination, quicker response times, and better emergency medical assistance would be made possible by combining ambulance services into a single network. Additionally, combining passenger and vehicle information into a single system would make it easier to retrieve critical data quickly in the event of an accident, enabling responders to offer assistance in a timely manner. Both drivers and emergency responders can make better decisions if they have access to real-time information about accident conditions. Road safety could be enhanced and secondary accidents could be avoided by giving drivers timely accident and road condition alerts, as was the case in Jhyaple Khola. An organized, technologically advanced rescue response system would improve productivity, lessen operational flaws, and foster a more unified approach to traffic safety.

### e. Manpower

APF, Nepal's scarce deployment along the strategically crucial Naubise-Narayanghat route, reveals its operational limitation. To maintain strong security and carry out efficient rescue operations along this route solely dependent on understaffed DM Security Base located at Adamghat, Dhading though APF, Nepal DMTS has been playing significant role in rescue operation in need basis. A much larger and permanently deployed unit is required to fulfill the dual mandate of protecting this vital supply line and responding to frequent disasters, such as

traffic accidents and natural disasters. The lack of a permanent operational unit makes the area vulnerable and makes it more difficult to respond to emergencies in a timely and thorough manner. In addition to impeding rescue operations, this manpower shortage jeopardizes the safety of a main strategic route to Kathmandu, highlighting the urgent need for reinforcement.

### f. Improvement of Trauma Center

There is only one trauma center in Kurintar now, and it is understaffed and difficult to reach. Given the vast area it serves, the center finds it difficult to provide quality emergency care with just one medical officer running the facility. Timely medical intervention for accident victims is further hampered by the trauma center's difficult road accessibility. Modernizing the facility with improved infrastructure, cutting-edge medical technology, and a fully functional ambulance system is crucial to improve medical care. In order to provide effective and efficient trauma care, it is also essential to increase the number of medical professionals, such as physicians, paramedics, and support staff. In areas that are prone to accidents, strengthening this trauma center would greatly enhance emergency response and save more lives.

### g. Stabilization of the terrain along the road

Naubise-Narayanghat road segment is extremely susceptible to geohazards like flooding, erosion, and landslides, especially during the monsoon season. The region's steep terrain, delicate geology, and haphazard road construction methods all increase these risks. Improved drainage systems, rockfall mitigation strategies, and slope stabilization techniques such as bioengineering can mitigate these issues and drastically lower the risk of disasters. It has been revealed by one of interviewee from road office during the researcher visit to the office that they are giving priority to this technique to stabilize the terrain, which was observed during field visit as well.

Besides, the need of efficient governance and policy coordination, technical solutions between three levels of government are equally important to mitigate the risk of potential landslide risk. In order to avoid haphazard road construction, which frequently makes vulnerabilities further worse, the federal, provincial, and local governments must work together to align policies, resources, and construction standards. The Simaltal bus accident was the result of haphazard construction of road on the steep mountain. The necessity of a coordinated approach to infrastructure development in disaster-prone areas is vital to decrease the environmental hazard along this road axis. The Naubise-Narayanghat road segment can be made more sustainable

over the long run by the adaptation of both geoengineering solutions with effective governance and community involvement in infrastructure development.

A comprehensive approach is required to improve road rescue effectiveness for APF, Nepal along the difficult Naubise-Narayanghat road axis. Significant gaps in manpower, training, equipment, legal frameworks, information sharing, and trauma care must be addressed. Capacity enhancement of APF, Nepal can result sound response.

## 4.2. Discussion

This section validates the research findings by aligning them with existing literature, providing a comprehensive understanding of road traffic accidents along the Naubise-Narayanghat road axis. The findings of this study, which focus on current trend, causes and challenges of RTAs along the Naubise-Narayanghat road axis in Nepal, align closely with existing literature on road safety and accident causation. The discussion below validates each key finding with relevant literature, highlighting the consistency and significance of the results.

### 4.2.1 Road traffic trends in Naubise-Narayanghat road section

The finding reveals that the number of traffic accidents along the Naubise-Narayanghat road axis fluctuates, peaking in fiscal year 078/79 and then declining. There was a steady rise in accidents along the Naubise-Narayanghat road axis until fiscal year 078/79, when 392 accidents occurred whereas a decrease in traffic accidents was noted after peak hours. This result offers an interesting contrast to the pattern noted by Gautam & Joshi (2024); Saxena (2017) and Geremew (2024). Geremew argued that developing countries like those in sub-Saharan Africa, such as the Kilimanjaro Region in Tanzania, have seen an increase in accidents. Likewise, the study by Gautam and Joshi in Kathmandu showed a slow rise in accident rates over a ten-year period. As mentioned in the report of Ministry of Road Transport & Highways Transport Research Wing cited in Saxena (2017) aggregate no. of road accidents increased by 2.5 % from 4,89,400 of 2014 to 5,01,423 of 2015 in India.

Several factors, including improved road conditions and more strict enforcement of traffic laws, may be responsible for this departure from the Naubise-Narayanghat road axis. It is concluded that a unique trend on the Naubise-Narayanghat road, contrasting with observed accident increases in other developing regions and Kathmandu.

The Naubise-Narayanghat road segment is facing varying accident rates. Finding indicates a slight decrease in casualties, including fatalities, serious injuries, and minor injuries, since fiscal year 078/79 establishing contrast relation with Gautam & Joshi's (2024)'s findings which show a gradual increase in road traffic accident casualties. The observed decline in official statistics may have been led by a number of recent interventions, including improved road infrastructure and increased traffic law enforcement (test of alcohol and drug, fine for traffic violations, inspection of vehicle condition) and awareness programs such as class to students, community, new driver, entrepreneurs and contractor of vehicle, general people, internal workshop, traffic day, driver/passenger friendship class, brochure, leaflet. Pamphlet and refreshment center, traffic awareness parking etc.

The most common vehicles involved in collisions along the Naubise-Narayanghat road were found to be motorbikes, trucks, jeeps/cars, and buses. 1633 motorbikes were found to be involved in accident along this route over five consecutive fiscal year from 077/78 to 081/82. Likewise, Truck/tanker were accounting 750 involved in accident over this period with second in rank, while car/jeep with 664, bus with 413, autorickshaw with 138, microbus with 132, Tipper with 120, tractor with 111, dozer with 4 and other category was accounted with 101casees were found to be involved. This finding is consistent with the literatures.

This finding is partially consistent with the literatures. According to Gautam & Joshi (2024) motorbikes and heavy vehicles are frequently involved in accidents because of their inherent vulnerabilities and operational difficulties. The literature (Gautam & Joshi, 2024) revealed that over the last 10 years in Kathmandu Valley, motorcycles/scooters and cars/vans/jeeps were the most frequently involved in road accidents. Motorcycle/scooters stands on the top accounting 54675 no. of accidents during this period followed by cars/van/jeep. However, the car/van/jeep category stands in second position in this study which is contrast to the finding of the study. Likewise, Khadka et al. (2024) indicated that motorcycles/scooters, constituting 77.27 per cent (13,127) of registered vehicles, dominated with 932 RTAs during the study in Karnali Province aligning with the finding. However, another the study by Ashraf et al. (2019) in Korea during 2000 to 2012 shows that 68% of total accidents are by passenger cars only contrasting with the finding the motorbike covers the most portion of the accident along Naubise-Narayanghat road axis.

Motorbikes high-rate involvement in accidents on the Naubise-Narayanghat road might be prevalence of young, inexperienced, aggressive driving, excessive speed of riders. This calls

for targeted safety campaigns and more stringent enforcement of traffic laws, including those pertaining to helmet use and speed limits. Similarly, the high rate of auto, truck, and van accidents points to the necessity of better road infrastructure, awareness campaigns, and driver education in order to address road conditions and driver behavior. Stricter commercial vehicle regulations, rigorous driver training, and improved maintenance mechanical test are essential for trucks and tankers. Improvement of road safety along this axis requires focused interventions that are specific to each type of vehicle, such as motorcycle safety campaigns and better laws and driver education for private and commercial vehicles.

Rolison et al. (2018) also discuss how inexperienced drivers and risky behaviors, particularly among young drivers, contribute to accidents, which is in line with the study's findings. Targeted interventions, such as stricter licensing requirements for motorbike and truck drivers, as well as improved vehicle safety standards, could help reduce the involvement of these vehicles in accidents.

The majority of respondents perceived the Naubise-Narayanghat road as unsafe, with many citing highly risky and poor road conditions. Singh (2017) and Sathian et al. (2018) discuss how public perception of road safety can influence driving behavior and the effectiveness of road safety policies. The study's findings that most respondents perceive the road as unsafe align with these studies, indicating a need for targeted interventions to improve public confidence in road safety. Goniewicz et al. (2016) emphasize the importance of public awareness campaigns in improving road safety, which is consistent with the study's findings that public perception plays a crucial role in shaping road safety policies. Public awareness campaigns and community engagement initiatives could help change public perceptions of road safety, leading to more cautious driving behaviors and greater support.

The study reveals that a significant majority of respondents perceive the Naubise-Narayanghat road axis as unsafe, with 40.54% considering it "risky" and 22.97% labeling it "highly risky." Only 4.05% of respondents viewed the road as "safe." This perception aligns with the literatures-iRAP (2022), Manandhar & Timilsina (2023), and Ojha (2021). Speeding, improper overtaking, bad weather, and poor road conditions have contributed to determine the perception of respondents as risky road.

Accident risks are further increased by frequent landslides, sharp curves, and inadequate safety barriers, especially for heavy vehicles and motorcycles. In order to address these safety issues

and guarantee safer travel along this vital transit route, better road infrastructure, increased law enforcement, and focused driver education programs are needed.

The most common accident types—head-on collisions, rear-end crashes, rollovers, and single-vehicle accidents—are primarily caused by excessive speed, lane violations, and adverse weather conditions (Guo et al., 2003; Mackie, 2023; NHTSA, 2025). Rollover accidents are frequent among overloaded trucks, while rear-end crashes are often linked to distracted driving and aggressive behavior. Addressing these safety challenges requires stricter law enforcement, infrastructure upgrades, and enhanced driver education programs to reduce accident risks and ensure safer travel along this critical transportation route.

### 4.2.2 Causes of road traffic accident

The study identified driver's behaviour as the leading cause of RTAs along the Naubise-Narayanghat road axis, followed by poor road condition, error by pedestrians, mechanical failure, weather/environmental condition and animal. 61% of the accidents were caused by the driver' error, 21% by poor road conditions, 13% by pedestrians, and 2% by weather/environmental and mechanical factors each.

Among the driver's behaviour, excessive speed, negligence, and overtaking from the wrong direction being the most common behaviors contributing to accidents. Exceeding speed remains as a dominant contributor with 68% to road traffic accident along Naubise-Narayanghat road axis. Likewise, Driver' negligence with 16%, overtake from wrong direction with 12%, driving under influence of alcohol with 3% were found during the study. The finding is found to be consistent with previous research. Berhanu (2000) and Bucsuházy et al. (2020) both emphasize that driver behavior, particularly human error, is a significant contributor to RTAs, accounting for 80-90% of accidents. Likewise, Guo et al. (2003) and Rolison et al. (2018) also highlight speeding and distraction as major factors in road accidents.

According to Khadka et al. (2024), excessive speed is a major contributing factor with 57.83% of accidents, raising alarmingly concern. Likewise, Vorko-Jović et al. (2006) attribute accidents directly to excessive speed. While highlighting reckless driving as the main factor, Gautam & Joshi (2024) also recognize that overseeding is a significant contributing factor, accounting for 12% of accidents. This is further supported by Manandhar & Timilsina (2023), who point out that accidents occur when "driving vehicles at speeds exceeding defined limits."

In addition, Giri et al. (2023) revealed operating on tight schedules, tend to overspeed and overtake recklessly, contributing to frequent collisions.

The emphasis on speed is complemented by the important factor of driver negligence. According to Gautam & Joshi (2024), nearly 81% of accidents are caused by reckless driving, making it the main contributor. This is supported by Kuikel et al. (2022), who claim that "driver negligence" is the main contributing factor, followed by excessive speed and alcohol use. Additionally, according to Manandhar & Timilsina (2023), accidents are caused by a failure to exercise appropriate care, which includes doing unsafe things or not taking necessary actions.

In addition to these main reasons, general safety driving infractions also play a big role in accident rates. According to Ashraf et al. (2019), breaking safety driving regulations is the cause of 56% of collisions, underscoring the larger issue of unsafe driving practices. Although mentioned in the original finding, the specific problem of overtaking from the wrong direction was not specifically addressed in the literature that was supplied. The consistent of finding on driver's behaviour across multiple studies necessitate the targeted interventions, such as driver education programs, stricter enforcement of traffic laws, and public awareness campaigns to reduce risky driving behaviors.

Another significant reason for RTAs, which account for 21% of all RTAs along the Naubise-Narayanghat road axis, is inadequate infrastructure. The result is found to be consistent with previous research. According to iRAP (2022), there is a higher chance of accidents due to narrow roads, improper lane markings, and insufficient safety barriers. Similarly, K.C. et al. (2013) emphasized that the road is extremely dangerous, especially for heavy vehicles, due to the steep and winding terrain and frequent landslides. Furthermore, Huang et al. (2016) noted that inadequate street lighting and signage were important factors influencing nighttime driving safety. Roads affected by Manandhar & Timilsina (2023) also support this fact, stating that weather conditions like rain can deteriorate road surfaces and decrease grip. Furthermore, Atubi (2009) and Segeni (2009) discussed how poor road infrastructure, including sharp curves, potholes, and inadequate signage, contributes to accidents, especially in low- and middle-income countries.

The consistent finding of inadequate infrastructure contributing to 21% of accidents on the Naubise-Narayanghat road, corroborated by numerous studies, underscores the critical role of road design and maintenance in traffic safety. The convergence of findings across global and

regional studies reinforces the need for targeted infrastructure improvements to mitigate accidents, particularly in regions with complex road conditions and limited resources.

The weather and environmental condition also plays contributing role for rising traffic accident along Naubise-Narayanghat road axis. This finding closely aligned with Khadka et al. (2024), Pandit (2024) and Bener et al. (2017). Khadka et al. (2024) revealed that weather and environmental factor contributes to 2-68% accidents while Pandit, (2024) indicated environmental factors such as heavy rainfall, fog, and landslides increase the likelihood of accidents, particularly in the monsoon season. Reduced visibility and slippery roads make vehicle control more difficult, often leading to multi-vehicle collisions and rollovers.

Similarly, Bener et al. (2017) identified the hilly terrain, combined with high-speed driving, increases the risk of vehicles losing control, especially on sharp curves and slippery roads. Empirical studies have shown that speed-related crashes result in higher fatality rates, as the force of impact is significantly greater. Addressing geographical and environmental challenges requires better engineering for road construction, specialized rescue equipment, training for responders, and improved infrastructure of trauma center could ensure road safety and effective even during adverse weather condition.

Mechanical failure significantly contributes to road traffic accidents on the Naubise-Narayanghat road axis is strongly supported by existing literature. Khadka et al. (2024) quantify this impact, stating that mechanical defects account for 21.35% of accidents, a consistent figure throughout their study period. This aligns with the observations of Sharma & Koirala (2021), who highlight specific mechanical issues like faulty braking systems, worn-out tires, and engine failures as common precursors to accidents on road.

Several studies attribute this problem to the prevalence of poorly maintained heavy vehicles. Ojha (2021) emphasizes the disproportionate involvement of trucks and buses in serious accidents due to their size, weight, and frequent mechanical failures, particularly brake failures on steep slopes caused by overloading. This is further corroborated by Gautam & Joshi (2024), who explicitly identify engine malfunction and mechanical failure as significant accident causes. Manandhar & Timilsina (2023) detail the range of vehicle condition issues, including cracked windshields, faulty brakes, worn-out brake pads, and bald tires, that contribute to accidents.

The root of this problem is further explored by the Department of Transport Management (2023), which reveals that many old and poorly maintained trucks and buses operate on the route without regular inspections. The absence of strict enforcement of vehicle fitness regulations exacerbates this issue, creating a scenario where mechanical failures pose a constant threat to road safety. This indicates serous lapse in law enforcement system. To address this issue the regular vehicle condition checkup is must.

The validation of research findings through established theories and empirical studies stresses the multi-faceted nature of road traffic accidents along the Naubise-Narayanghat road axis. The alignment of finding with global and national research strengthens the argument that driver's behavior, poor infrastructure, and inefficient emergency response mechanisms are key contributing factors.

### 4.2.3 Challenges to respond to accident

The study reveals that numerous challenges have been faced by emergency rescuers while responding road traffic accident along Naubise-Narayanghat road axis. Assessment of situation is found to be often hindered by limited access to accident sites and inadequate information about victims and vehicles which is aligned by Gopalakrishnan (2012) emphasizing delayed assessment during the "golden hour" significantly increases mortality rates. Similarly, Goniewicz et al. (2016) found that a lack of real-time information delays medical interventions, leading to higher fatality rates in traffic accidents.

Similarly lack of resources, manpower and training are contributing to exacerbate the challenges to respond. Mamo et al. (2023) pointed that shortage of ambulances, medical supplies, and advanced rescue equipment limit the capacity to respond of responders. This fact is supported by OECD (2019). It stressed that resource constraints in developing nations exacerbate accident fatality rates.

Nepal's emergency response system suffers from a shortage of skilled rescue personnel. Sathian et al. (2018) and Rolison et al. (2018 emphasized the need for enhanced training, skill development for effective rescue operation**.** Additionally, Mamo et al. (2023) reported that understaffing leads to delayed interventions, while Goniewicz et al. (2016) emphasized that strengthening human resources in emergency services is critical for reducing accident-related fatalities.

The hilly terrain and proximity to the Trishuli River pose significant risks for rescue operations. Devkota et al. (2008) highlighted that steep hills, narrow roads, and landslide-prone areas make accident sites difficult to reach, delaying emergency response. K.C. et al. (2013) further emphasized that river proximity increases the complexity of rescues, particularly when vehicles plunge into water or are swept away by strong currents. It is also deteriorated by adverse weather conditions, including heavy rainfall, fog, and landslides, significantly impact rescue efforts. Pandey & Lama (2020) found that monsoon-related hazards increase accident risks and obstruct rescue operations. Likewise, Ashraf et al. (2019) noted that poor weather conditions in mountainous regions reduce visibility and road traction, further delaying emergency response times.

Besides emergency responders along Naubise-Narayanghat road often face dangers such as falling debris, landslides, and high current water of Trishuli River, making rescues hazardous. Pawłowski et al. (2019) found that high-risk accident zones increase injury risks for both victims and rescuers, while Goniewicz et al. (2016) stressed the importance of proper risk assessments to ensure responder safety.

The lack of proper road safety law, the issue of coordination between agencies, command control, management of resources are unaddressed, making rescue operation less effective and efficient along this route. Singh (2017) noted that complicated legal frameworks and bureaucratic inefficiencies slow down accident investigations and rescue operations. Likewise, Saxena (2017) observed that unclear legal guidelines on responder responsibilities can hinder rapid intervention.

### 4.2.4 Strategies to enhance responses to road accidents

Having insights into the challenges faced by rescuers especially APF, Nepal, multisectoral strategies are in need to effectively conduct rescue operation along this road. Addressing challenges related to training, resources, legal frameworks, information sharing, manpower, trauma care, and terrain stabilization**.** Emergency response effectiveness is closely linked to inter-agency coordination, proper legal mechanisms, and modern rescue infrastructure **(**Goniewicz et al., 2016). Strengthening APF, Nepal's response capacity through focused training, advanced equipment, and improved coordination would significantly enhance rescue operations along this accident-prone highway.

Regular simulation exercises replicating Nepal's challenging road conditions are crucial for APF personnel. Training should emphasize vehicle extrication techniques, advanced medical triage, and accident management on steep and unstable terrains (WHO, 2021). Research by Gopalakrishnan (2012**)** suggests that pre-hospital care training significantly lowers road accident mortality rates**,** reinforcing the need for scenario-based drills in diverse weather and terrain conditions.

Effective rescue operations depend on modern and specialized equipment. However, APF personnel currently rely on outdated tools, limiting their efficiency. Equipping teams with hydraulic cutters, power saws, stabilization tools, underwater drones (ROVs), and advanced communication devices would improve rescue response in high-risk zones (Goniewicz et al., 2016). Studies in OECD (2019) indicate that investing in advanced technology improves the speed and success of rescue operations in accident-prone regions.

The need of a comprehensive legal framework enduring unified command system to ensure effective deployment, coordination and investigation can significantly improve effectiveness of rescue responses. This fact is aligned with Cvetković (2024). It mentions that in Serbia, traffic Accident Investigation Center has been effectively to handle road traffic accident responses and investigation by establishing regulating framework. Likewise, Singh, 2017) and Saxena (2017) support this finding as well. Singh (2017) mentions that developed countries have successfully reduced accidents rate by establishing centralized mechanisms for road accident response. Furthermore, Saxena (2017) highlights how a cohesive legal framework enhances rescue coordination, ensuring efficient deployment of emergency services. The gap that rescuers experiencing today can be addressed by adopting a road safety law.

A centralized accident information system can improve response times by integrating ambulance services, vehicle data, and real-time accident alerts (Goniewicz et al., 2016). A study by Rehman et al. (2023) found that faster information sharing leads to better emergency coordination and reduced fatalities. Implementing an integrated digital platform for road safety would ensure timely intervention, accident prevention, and real-time driver alerts, reducing secondary accidents along hazardous sections like Jhyaple Khola. The role of centralized system in rescue operation is vital ones.

The APF's current deployment along the Naubise-Narayanghat route is insufficient to handle frequent accidents and disasters. A single DM Security Base in Adamghat, Dhading, is

inadequate for managing both security operations and emergency rescues. Studies by Mamo et al. (2023) show that understaffing in disaster-prone regions leads to delayed interventions and increased fatalities. Establishing a permanently stationed rescue unit would enhance emergency preparedness and security along this strategic corridor.

A major bottleneck in road traffic accident response is the limited access to trauma care facilities. The only trauma center at Kurintar is understaffed and poorly equipped, significantly delaying critical medical interventions (Sathian et al., 2018). Research by Gopalakrishnan (2012) highlights that expanding trauma centers and equipping them with modern medical technology drastically improves survival rates. Nepal must modernize trauma care infrastructure, deploy mobile medical teams, and improve ambulance services to enhance post-accident care.

The Naubise-Narayanghat road is highly vulnerable to landslides, floods, and erosion, especially during the monsoon season. The finding is supported by the literatures K.C. et al. (2013), OECD (2019), Simaltal Bus Accident Taskforce Report (2024) and Brabb (1984). K.C. et al. (2013) highlights improving drainage systems, implementing bioengineering techniques, and stabilizing slopes can reduce accident risks. While study by OECD (2019) on infrastructure emphasizes the importance of coordinated governance between federal, provincial, and local bodies to ensure sustainable road development. Likewise, Simaltal Bus Accident Taskforce Report, (2024) shows the dangers of haphazard road construction, reinforcing the need for integrated planning and environmental risk mitigation. Landslides, road collapses, and vehicle skidding hinder effective accident response. Identifying landslide-prone areas is crucial for mitigating risks and economic losses. Additionally, Brabb (1984) indicates landslide susceptibility assessment helps to evaluates landslide likelihood based on terrain which support to hazard mitigation.

A comprehensive and multi-sectoral approach is essential to improve APF, Nepal's ability to respond effectively to road accidents along the Naubise-Narayanghat highway. Strengthening training programs, upgrading rescue equipment, implementing unified legal frameworks, improving trauma care, and stabilizing road infrastructure would enhance emergency preparedness and reduce fatalities. Addressing these challenges requires collaboration between government agencies, law enforcement, healthcare providers, and local communities to build a sustainable, well-coordinated rescue system.

### 4.2.5 Strategy to improve road safety

The finding reveals that most of the accidents occurred due to drivers' error, poor road condition, weather and environmental causes and mechanical failure. The prevalence of accident due to drivers' error and mechanical failure indicate a serious gaps practice of law enforcement by concerned agencies. Whereas poor road condition and environmental are link to development polices, practices and technologies. So, to enhance road safety the deficiencies in practice must be addressed.

The cause of soft enforcement of traffic law and widespread allegation of involvement in irregularities of traffic police need further research. However, the system of accountability and supervision by authority can support to fix these issues. The maintain the mechanical condition the continuous check is necessary. The existing law authorizes power to inspector from transport management office. They have rarely found executing their duty leading to not to be maintained vehicle health condition. Authorized officer needs to be held accountable for maintaining vehicle condition.

The low provision of penalties needs to be increased as noticed by traffic police during field survey. According to them current provision only authorizes to penal up to Rs.1500 only which is not enough to maintain traffic discipline. Most of the violator prefer to pay penalties rather to not to violate traffic law. The Government needs to revisit traffic regulations so that roads can be made safer to use and travel for all.

The implementation of road safety strategies like restricting mobile phone use while driving, deploying speed cameras, and utilizing Variable Message Systems (VMS) can significantly decrease traffic accidents. Laberge-Nadeau et al. (1992) argues that by gradually introducing and enforcing these strategies, authorities can effectively mitigate key risk factors, leading to safer roads for all users. The VMS undoubtedly reduces accidents, most profoundly when used for accidents and fog warning messages. Besides the use of sensors which can work in altered situation has been found to be used in vehicle as Advanced Driver Assistance Systems (ADAS). The use of Electronic Stability Control (ESC) in UK, Germany, USA, Sweden have significantly contributed to reduce the accidents.

The adoption of modern technologies such CCTV, establishing centralized information system to update about road and weather condition can significantly improve road safety. Besides, the use of radar gun to monitor the speed is vital to maintain speed of vehicles as it the primary cause of accidents. The establishment of central network of ambulance can ease the timely response to road accident.

Ojha (2021) states that including dedicated lanes to separate different types of vehicles and pedestrians can positively effect on the severity of vehicle related accidents. Making roads and shoulders wider can help reduce how often accidents happen. Also, reducing the number of overloaded trucks can lead to fewer crashes. The study further mentions road safety measures should be built into the road design process by making safety audits mandatory and ensuring that their recommendations are put into practice. Road safety impact assessments and controls should also be integrated into all land development projects. It is also supported by Saxena (2017) emphasizing on mandatory road safety assessment. So, road safety should be guaranteed while making plan of constructing road and continuous road safety assessment must be conducted to ensure the safety condition of road.

The continuation of road safety awareness programs such as class to students, clubs, community, general people, drivers, can help to understand the about road safety. The inclusion of road safety in the curriculum at different levels to educate student can be corner stone for road safety departure. So, to address the root cause of road traffic accident the multisectoral approach is needed to ensure road safety along Naubise-Narayanghat road axis.

# CHAPTER V

# SUMMARY AND CONCLUSION

## 5.1. Summary

The Naubise-Narayanghat road axis (118.4 km) is located in Bagmati Province serves as vital transportation route to Kathmandu city. Following the Trishuli River through fragile mountainous terrain, the road experiences more than 10,000 vehicles flow (Subedi, 2018) daily. However, environmental issues such as landslides, intense rainfall, poor road conditions, driver's behavior, poor mechanical condition often threaten road safety of this road. (Pandit, 2024).

RTA is an unintended and unexpected event involving at least one moving vehicle, often leading to injuries, fatalities, or property damage (Perrow, 2011; Hollnagel, 2016). In RTAs at least one moving object is involved (Manandhar, 2022b; NSEE, 2025). They disrupt traffic flow and can result from vehicle malfunctions, infrastructure issues, or driver's behaviour (Borsos et al., 2015; Bucsuházy et al., 2020). RTAs occur in various forms, including head-on collisions, rear-end crashes, rollovers, and multi-vehicle pileup.

Nepal faces severe road safety issues, ranking 72$^{nd}$ globally, with 97 daily crashes causing 88 injuries and 7 fatalities on average (WHO, 2023; Nepal Police, 2080/81). The Naubise-Narayanghat road axis, a key transport route, remains highly accident-prone due to rugged terrain, sharp curves, traffic congestion, and lack of infrastructure maintenance (Khatiwada, 2024). Without urgent safety measures, better road engineering, and stricter enforcement, this hazardous trend will persist, posing a continued risk to public safety.

Responding to RTA in hilly regions presents significant difficulties due to rugged terrain, poor infrastructure, and limited emergency services (Flesch Law Firm, 2024). Narrow roads, sharp curves, and adverse weather conditions delay rescue efforts, increasing fatality risks, especially when trauma centers are scarce (Joshi et al., 2014; Sathian et al., 2018). The lack of trained emergency responders and quick medical access further worsens survival outcomes. Addressing these issues requires better road infrastructure, enhanced emergency response systems, and public awareness initiatives to reduce RTAs and improve rescue efficiency (Yari et al., 2024).

The Naubise-Narayanghat road experiences high accident rates due to poor road conditions, sharp curves, heavy traffic, and adverse weather (Manandhar, 2022). Driver negligence, vehicle overloading, and inadequate emergency response systems further exacerbate accident risks. Despite being a key trade and transport route, the road remains highly accident-prone, highlighting the urgent need for safety interventions.

This study examines the causes of RTAs and response challenges and strategies to improve road safety measures in Nepal. It has set three objectives: to understand the current trend of road traffic accident along this road, to analyze the underlying causes of accidents along this road and to propose the ways to enhance the response to these accidents.

This research employed a constructivist approach through qualitative research design to understand road traffic accidents along the Naubise-Narayanghat road axis by exploring the lived experiences and perceptions of stakeholders. Primary data was collected through surveys, KIs, FGDs, and field observations. The study area focused within the Naubise-Narayanghat road, and data collection spanned from January 3 to 14, 2025. Data sources included primary data gathered from stakeholders and secondary data from sources like traffic police records. Data analysis involved descriptive and thematic analysis, with triangulation for validation, while ensuring ethical considerations throughout the research process.

The findings of the study reveal accidents and casualty have fluctuated over the years along Naubise-Narayanghat road axis, reaching on peak in fiscal year 078/79 during the period of fiscal year 077/78 to 081/82. After the fiscal year 078/79 the rate of accident and causalities have been observed in declining order. Motorbikes, trucks, jeeps/cars, and buses are found to be the primary involved in road traffic accidents. Over the years motorbikes consistently held the highest position with 1632 accidents during the fiscal period 077/78 to 081/82. It reached on highest level with 402 cases of involvement accidents. It is followed closely by trucks or tankers in the first three consecutive years in both sections of the road. Involvement of bus and microbus in the accident have also significance presence as well. In the most recent year, jeeps and cars have slightly surpassed trucks and tankers in their contribution to accidents alarming that their contribution in accident will be more in coming days as the trend of adopting private vehicle as mode of transportation is increasing.

Among various causes of accidents, it is observed that the "driver’s behaviour" is predominant factor, accounting for 1893 accidents during fiscal year 076/77 to 081/82 along the Naubise-

Narayanghat road axis (Fig. 5.2). Poor road condition follows it with 669 accidents, highlighting infrastructure-related challenges. Pedestrians contribute to 410 accidents. Driver's behaviour consists excessive speed, negligence, driving under influence of alcohol, using mobile phone during driving, overtaking from wrong direction etc. while other have notable contribution to road traffic accidents, excessive speed has vital role to cause accident along this road,

Nepal's road traffic accident response involves a multi-agency approach, including local administration, Nepal Police, APF, Nepal, and medical services, guided by various legal regulations and supported by emergency numbers like 100 and 102 for police and ambulance respectively. While various agencies have defined roles by different laws, the system faces challenges such as delayed assistance, poor inter-agency coordination, limited resources, and inadequate infrastructure, hindering its effectiveness.

The study points that emergency responders, particularly APF, Nepal, has been facing numerous challenges while dealing with road traffic accidents along Naubise-Narayanghat road axis. These include difficulties in accurately assessing accident situations due to lack of timely information, scarcity of essential resources like modern rescue equipment, and the complexities posed by the challenging geographical conditions and the dangerous nature of the Trishuli River. Delays in response are often caused by inadequate information about accident locations and severity. Weather and environmental conditions, such as landslides triggered by heavy rainfall, further exacerbate the problem, damaging infrastructure and hindering rescue efforts. Extrication of victims is technically difficult due to the terrain and the nature of vehicle damage, and the lack of specialized equipment and training increases risks for both victims and responders. Legal complications arising from the absence of a proper road rescue mechanism and manpower shortages also contribute to ineffective and delayed responses.

The study proposes multisectoral approach to improve the effectiveness of road traffic accident response. It consists of providing specialized training and realistic simulation exercises for responders, ensuring access to advanced rescue equipment, and establishing a comprehensive legal framework to govern rescue operations. Implementing an improved information-sharing mechanism is essential for timely and effective responses, and addressing manpower shortages within APF, Nepal is also necessary.

The study highlights that to reduce road accidents, both human and systemic factors is essential

to be addressed. As driver error and mechanical failure are found to be significant contributors, stronger law enforcement, strict vehicle maintenance checks, and increased penalties for violations are crucial. Simultaneously, enhancing road safety requires development policies that prioritize improved road conditions and environmental considerations. Modern technologies like speed cameras, variable message systems, and advanced driver-assistance systems should be implemented, alongside better road design incorporating safety audits. Additionally, continuous road safety awareness programs and the integration of road safety education into school curriculum are significant for encouraging a culture of road safety.

## 5.2. Conclusion

Road traffic trends along the Naubise-Narayanghat road axis reveals a fluctuating pattern. It indicates the influence of localized factors, such as road conditions and enforcement play vital role to determine accident and casualty frequency. The persistent involvement of motorbikes, trucks, cars and buses in accidents indicate their vulnerabilities to accidents. This observation aligns with the principles of situational crime prevention theory. This theory emphasizes that accidents, like crimes, are often influenced by specific environmental and situational factors. In this case, road design, traffic management, and targeted interventions aimed at high-risk vehicles can alter the situation to reduce accident opportunities.

Driver's behaviour contributes as a primary cause of accidents, followed by poor road conditions, while pedestrian errors, mechanical failure, and weather/environmental factors play less contributing role. Driver errors, including speeding, negligence, and improper overtaking are significant contributors. The Human Factor Theory considers a significant proportion of accidents are attributable to human error, while Combination Theory argues that not only human factor, but other factors also contribute to occur accidents. The alignment of finding - human factor is a key contributor of the road traffic accident- with a Human Factor Theory and other factors such poor road condition, weather condition, mechanical failure consistent with the Combination Theory. It is needed to emphasize on reducing human-related accidents: proper driver education, vehicle and roadway engineering those accounts for human capabilities, and consistent implementation of traffic regulations. The study further reveals how hazardous roadways and weather conditions create a dangerous interplay with driver actions, demonstrating that environmental factors significantly shape driving behaviors and outcome.

Lack of resources, the complexities of the geographical terrain, delays in information, adverse

weather conditions, and difficulties extrication pose significant challenges to Emergency responders especially APF, Nepal along the Naubise-Narayanghat road. Additionally, the absence of a proper road safety law, coordination between agencies, and risks to both victims and responders further compound these challenges. It highlights need of a holistic approach to address the complexities of accident response. besides

# APPENDICES

**Appendix A**

Refer to page no 18, para-3

## PARTICIPANTS AND RESPONDENTS INVOLVED IN THE STUDY

| Participants in survey questionnaires | | | |
|---|---|---|---|
| Age group | Male | Female | Total |
| Under 18 | | | - |
| 18-30 | 15 | 2 | 17 |
| 31-45 | 36 | 4 | 40 |
| 46-60 | 17 | - | 17 |
| Above 60 | - | - | - |
| Total | | | 74 |
| | | | |
| Participants in interviews | | | |
| Male | | Female | Total |
| 16 | | 1 | 17 |
| | | | |
| Participants in KI | | | |
| Male | | Female | Total |
| 2 | | 0 | 2 |
| Participants in FGD | | | |
| Male | | Female | Total |
| 10 | | - | 10 |

**Appendix B**

Refers to page 18, para-3

# DETAILS OF INTERVIEWEES

| SN | Office | Code |
|---|---|---|
| 1 | APF, Nepal No 3 Bde Commander | I-1 |
| 2 | Chief District Officer, Chitawan | I-2 |
| 3 | Commandant, APF, Nepal DMTS, Kurintar | I-3 |
| 4 | Bagmati Province Traffic Office, Ramnagar, Chitwan | I-4 |
| 5 | Bn Commander APF, Nepal No 17 Bn, Bhandara, Chitawan | I-6 |
| 6 | In-charge, Area Police Office, Gajuri | I-7 |
| 7 | In-charge, District Traffic Police Office, Chitwan | I-8 |
| 8 | In-charge, District Traffic Police Office, Gajuri, Dhading | I-9 |
| 9 | In-charge, Trauma Center, Kurintar | I-10 |
| 10 | C.D.E. Road Division Office, Bharatpur | I-11 |
| 11 | Chief, Transport Management Office, Bahartput, Chitwan | I-12 |
| 12 | Driver | I-13 |
| 13 | Driver, Bus | I-14 |
| 14 | Driver, Truck | I-15 |
| 15 | Driver, Microbus | I-16 |
| 16 | Bus Operator Committee. Bharatpur | I-17 |

| | | |
|---|---|---|
| 17 | Driver | I-18 |

**Appendix C**

**Refer to page 18**

Refers to page 18, para-3

# DETAILS OF KEY INFORMANTS (KIs)

| SN | Rank | Name | Office | Code |
|---|---|---|---|---|
| 1 | ASI | Rabin Thapamagar | Traffic Police Post, Mugling | K-1 |
| 2 | AHC | Dilli Bhattrai | Deep Diver | K-2 |

**Appendix D**

Refer to page 18

# SURVEY QUESTIONS

1. Name
2. Contact no
3. Gender

    a. Male
    b. Female
    c. LGBTQI

4. Age

    a. Under 18
    b. 18–30
    c. 31–45
    d. 46–60
    e. 60 and above

5. Adress

    a. Koshi province
    b. Madesh province
    c. Bagmati province
    d. Gandaki province
    e. Lumbini province
    f. Karnali province
    g. Sudurpaschim province

6. What is your education?
    a. Primary
    b. Secondary
    c. Higher secondary

d. Graduate
e. postgraduate

7. What is your primary occupation?
    a. Emergency responder
    b. Driver
    c. People's representatives
    d. Journalist
    e. Civil service
    f. Bus-operator committee
    g. Businessman
    h. Student
    i. Agriculture
    j. Other (specify

8. Which vehicle have you been driving?

    a. Truck
    b. Bus
    c. Microbus
    d. Car
    e. Motorbike
    f. Tipper
    g. Tractor
    h. Excavator/ dozer
    i. Bullet
    j. Other

9. In your opinion, how do you categorize this route in term of safety?
    a. Highly safe
    b. Safe
    c. Average
    d. Risky
    e. Highly risky

10. In your opinion, which type of accident is mostly occurred?
    a. Rear-end collision
    b. Head-on collision
    c. Side-wipe collision
    d. Rollover
    e. Crashes with fixed objects
    f. Crashed with animal
    g. Crashes with pedestrians
    h. Collision due to crossing of turning
    i. Other

11. At what time do you think the accident mostly occurred?
    a. Morning (6AM-12 PM)
    b. Afternoon (12 PM-6PM)
    c. Evening (6 PM-12 AM)
    d. Night (12 AM-6 AM)

12. What do you think in which months does the accident mostly take place?
    a. Baishakh
    b. Jestha
    c. Ashadh
    d. Srawan
    e. Bhadra
    f. Asoj
    g. Kartik
    h. Mangsir
    i. Paush
    j. Magh
    k. Falgun
    l. Chaitra

13. In your opinion, what type of vehicle is mostly involved in the accident?
    a. Truck

b. Bus
c. Microbus
d. Car
e. Motorbike
f. Tipper
g. Tractor
h. Excavator/ dozer
i. Bullet
j. Other

14. In your opinion, which is the most common cause of traffic accidents along this road?
    a. Poor road conditions
    b. Driver error
    c. Overloading
    d. Environmental/weather
    e. Mechanical
    f. Inadequate traffic police
    g. Lack of modern surveillance and monitoring system
    h. Lack of implementation of traffic law
    i. Pedestrian/ Animal
    j. Other (please specify)

15. In your opinion, which is the most common driver error responsible for road accident?
    a. Excessive speed
    b. Driving under influence of alcohol
    c. Use of mobile phone while driving
    d. Sleeping
    e. Fatigue
    f. Unskilled /inexperience
    g. Driver negligence
    h. Disregard for traffic discipline
    i. Overtake form wrong from direction
    j. Lack of traffic rule awareness

16. What do you think the most possible cause of infrastructure contributing to road accident?

    a. Inadequate maintenance
    b. Inadequate signage and marking
    c. Narrow road
    d. Sharp bend
    e. Inadequate lighting

17. Report and data have shown that the most accident taken in this route are due to driver error, do you agree?
    a. Yes
    b. No

18. In your opinion how the driver error can be prevented to reduce road traffic accidents?

    a. Strict enforcement of law
    b. Increasing in penalty years
    c. Educating driver by training
    d. Annulling the license in case of repeated violation of traffic law
    e. Implementation of modern surveillance and monitoring system
    f. Other

19. In your opinion, who is more responsible to occur environmental accident?
    a. Driver
    b. Passenger
    c. Law enforcement agencies
    d. Road department
    e. Lack of coordination among three level government
    f. Other

20. In your opinion, how the accident taken place due to environmental cause can be avoidable?
    a. Issuing warning information
    b. Co-ordinated action among law enforcement agencies

c. Enforcement of restriction on movement
d. Surveillance on probable disaster-prone area
e. Self-awareness by driver and passenger
f. Other

21. What do you think APF, Nepal has been responding accident scene timely?
    a. Very timely
    b. Timely
    c. Average
    d. Untimely
    e. Very untimely

22. What do you think, APF, Nepal has been conducting its role satisfactorily while responding traffic accident?
    a. Strongly satisfy
    b. Satisfy
    c. Average
    d. Dissatisfy
    e. Strongly dissatisfy

23. How do you evaluate the role of APF, Nepal in response to road traffic accident?
    a. Very effective
    b. Effective
    c. Neutral
    d. Ineffective
    e. Very ineffective

24. In your opinion, how road traffic accident can be reduced to improve road safety in future?
    a. Driver education programs
    b. Strict enforcement of traffic law
    c. Speed limit enforcement
    d. Operation of modern surveillance and monitoring system
    e. Better road maintenance
    f. Increase traffic police

g. Improved signage and lighting
h. Other (please specify

25. Do think the improvement in existing traffic law to ensure road safety?

a. Yes
b. No

**Appendix E**

**Refer to page 18**

# INTERVIEW AND KEY INFORMANT INTERVIEW (KI) QUESTIONS

**For Traffic Police, APF, Nepal and Local Authorities, Driver, Medical Personnel:**

1. Id No./Rank/Name

   ……

2. What is the current trend of Road Traffic Accident (RTA) along the Naubise-Narayanghat road axis?

   ……

3. Accident data and survey questionnaires show that driver error is the primary cause of accidents. Do you agree?"?

   ……

4. Motorbikes are the most frequently involved in accidents, followed by trucks. What measures can be taken to reduce this type of accident?

   ……

5. Among driver errors, speeding is the most frequent cause of accidents. How can such types of accidents be mitigated?"

   ……

6. What are challenges faced Emergency Responders while responding to RTA?

   ……

7. How can emergency responders effectively respond to road traffic accidents?

……

8. "Do you see any lapses or weaknesses in the existing traffic laws? Would you recommend any amendments to increase their effectiveness?"

……

**Appendix F**

Refers to page number 41

LIST OF RESCUE EQUIPMENT

| SN | Equipment |
|---|---|
| 1. | Scuba diving pressure gauge |
| 2. | Remotely Operated Vehicles (ROVs) or Underwater Drones |
| 3. | Side Scan Sonar |
| 4. | Multi-beam Sonar |
| 5. | Handheld Underwater and Waterproof Metal Detectors and Magnetometers |
| 6. | Under Water Video Camera with Sensor |
| 7. | Out Board motor with raft 80 HP |
| 8. | Combi tools for road traffic accident (hydraulic) |
| 9. | Under Water Lighting & Accessories |
| 10. | Diving chamber |
| 11. | Scuba diving dive computer |
| 12. | Scuba diving back inflation diving system (BCD bag) |
| 13. | NRS life jacket |
| 14. | Touise dig three diving rope |
| 15. | Hand pump (Carlson- 35) |
| 16. | Best kayak for diving |
| 17. | GMS Mercury communication unit ocean reef diving |
| 18. | Wind Blower (electric chargeable) |
| 19. | Scuba diving wet suit |
| 20. | Fire suit |
| 21. | Fire rope |
| 22. | Scuba diving steel tank |
| 23. | Waterproof search camera |
| 24. | O ring for rope rescue |
| 25. | Marking buoy |

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