

Mitigating Road Hazards: A Comprehensive Impact Assessment Of Road Accidents And Identification Of Accident-Prone Areas On NH-07 From Rishikesh To Srinagar Garhwal, Uttarakhand

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Abstract

Road accidents are a significant public health concern, posing serious threats to human life and causing substantial economic losses. This study focuses on NH-07, a crucial highway connecting Rishikesh to Srinagar Garhwal in the northern region of India, with the aim of conducting a comprehensive impact assessment of road accidents and identifying areas prone to accidents. The research employs a multidisciplinary approach, combining statistical analyses, geospatial mapping and community feedback to provide a holistic understanding of the problem. The impact assessment encompasses the analysis of accident data over a specified timeframe, considering factors such as accident severity, types of vehicles involved and contributing factors. Statistical methods and Geospatial techniques have been employed to identify accident hotspots, patterns, trends and correlations within the accident data, facilitating the development of targeted intervention strategies. Additionally, community engagement and stakeholder consultations has been conducted to gather qualitative insights into local perceptions and experiences related to road safety on NH-07. The study's findings will contribute valuable insights for policymakers, transportation authorities and local communities in formulating evidence-based strategies to enhance road safety on NH-07. The identification of accident-prone areas and the factors contributing to accidents will guide the prioritization of

resources and interventions, ultimately reducing the frequency and severity of road accidents on this critical highway.

Keywords: Road Accidents, Impact Assessment, NH-07, Accident-Prone Areas, Rishikesh to Srinagar Garhwal

1.1 Introduction

Transportation infrastructure plays a pivotal role in fostering economic development and connectivity (Siddique et al., 2015; Vishal et al., 2017). The National Highway-07 in Uttarakhand, stands as a lifeline for the region, holding exceptional significance due to its pivotal role in facilitating tourism, pilgrimage activities and driving socio-economic development. However, the region has witnessed a concerning rise in road accidents, prompting an urgent need for a comprehensive impact assessment to understand the dynamics of these incidents and identify accident-prone areas (Yateen Lokesh et al, 2018).

Road accidents have far-reaching consequences, impacting not only individuals and families but also straining healthcare systems and burdening the economy. It has significant impacts on human life, causing fatalities, injuries and property damage. It is crucial to assess the impact of road accidents and identify accident-prone areas to implement effective preventive measures. Several studies have been conducted to address this issue. Gaurav et al., 2019 proposed a solution for accident detection, severity prediction and alert system using machine learning and computer vision techniques. Sathish et al., 2016 focused on road accidents in India, particularly on NH-07, and identified major causes such as high density, non-restriction of speed, and use of mobile phones. Yakar, F. (2015) investigated the use of the Relative Frequency Method (RFM) to determine accident-prone road sections, which showed promising results in identifying such sections. Svadlenka, L. (2019) developed a fuzzy logic-based model to assess driver propensity towards accidents, considering factors such as dangerous places, road characteristics, and frequency of driving. These studies provide valuable insights into assessing the impact of road accidents and identifying accident-prone areas, which can be applied to the specific case of NH-07 from Rishikesh to Srinagar Garhwal, Uttarakhand. The current study aims to employ a multidimensional approach, incorporating statistical analyses, GIS mapping and on-site assessments to comprehensively evaluate the impact of road accidents on NH-07. By identifying

accident-prone areas and analyzing contributing factors, this study will provide evidence-based recommendations for enhancing road safety measures, traffic management strategies and emergency response mechanisms along this crucial highway.

1.2. Data and Methodology

1.2.1. Study area

National Highway 07 (NH-07), a critical lifeline traversing the northern landscapes of India, stands as a testament to the seamless integration of diverse terrains and cultures. Spanning from the bustling capital city of New Delhi to the serene Indo-China border at Mana, NH-07 connects two worlds, weaving through the heart of the majestic Garhwal Himalaya in Uttarakhand. This arterial road, often referred to as the backbone of connectivity in the region, unfolds a narrative of historical significance, economic vitality and cultural exchanges as it winds its way through prominent towns such as Roorkee, Haridwar, Rishikesh, Shivpuri, Devprayag, Srinagar, Rudraprayag, Badrinath and Hem Kund Saheb. The stretch under consideration for our study spans from the spiritual town of Rishikesh to the picturesque locale of Srinagar Garhwal, encompassing the Tehri Garhwal and Pauri Garhwal districts ([Figure 1.1](#)). It has been chosen due to the frequent accidents and recurring challenge of landslides, which poses a threat to both the infrastructure and the seamless flow of traffic along this crucial route.

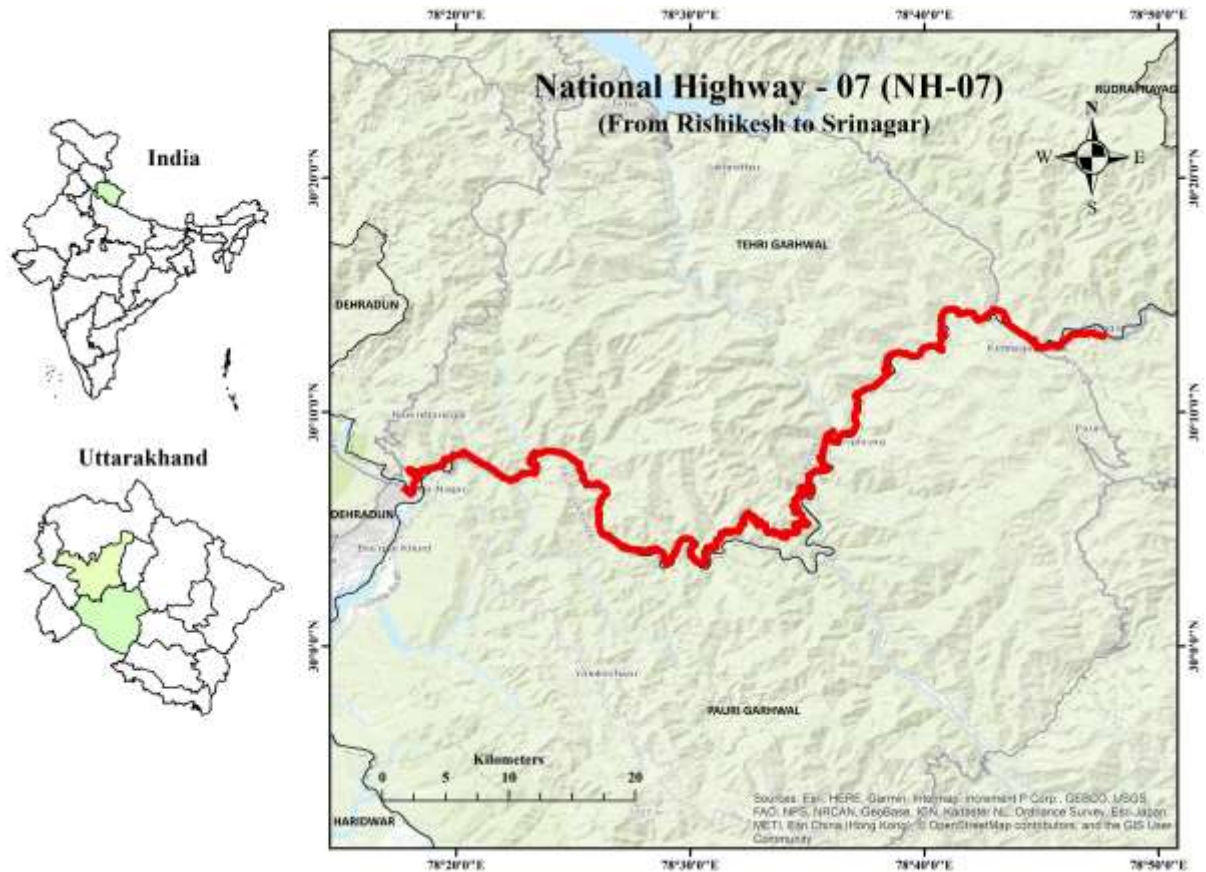


Figure 1.1. Showing location map of the study area

1.2.2. Data and methods

The data for the study of road accidents and its assessment was primarily collected from both secondary and primary sources. Secondary data, essential for providing historical context and trends, was sourced from reputable institutions and government entities. The Ministry of Road Transport and Highways (MoRTH), the State Transport Department of the Government of Uttarakhand, the Traffic Directorate of the Uttarakhand Police, and the Government of India's Ministry of Road Transport and Highways Transport Research Wings in New Delhi were among the key contributors of secondary data. This included the comprehensive Road Accidents in India 2019 data, as well as information from the Road Transport Year Book for the years 2017, 2018, 2019 and 2020. Additionally, Statista provided valuable statistics on the number of road accidents across Uttarakhand in India from 2014 to 2021, further enriching the dataset for a comprehensive analysis of road safety along NH-07 from Rishikesh to Srinagar Garhwal. Primary data sources included historical records of road accidents, encompassing details such as location, time and severity. These records were sourced from relevant government agencies, law enforcement reports and hospital

records. Geospatial information, crucial for pinpointing accident-prone areas, was derived from satellite imagery, topographic maps and Geographic Information System (GIS) databases. Traffic flow data, obtained from transportation authorities and road surveys, provided insights into vehicular density and movement patterns. Local stakeholder interviews and community feedback also contributed qualitative data, offering perspectives on road conditions and potential risk factors.

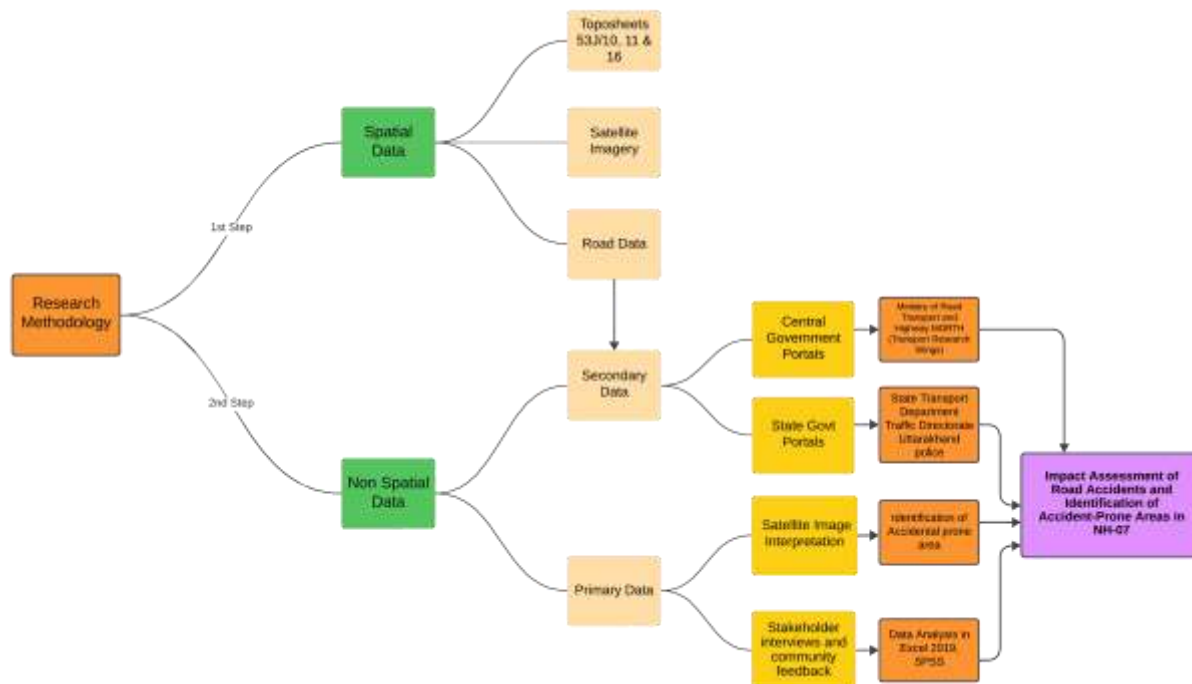


Figure 1.2. Showcases the methodological framework and data used in the study

1. Results and Discussions:

2.1 Accidents through Collision on NH-07

The analysis of accidents through collision from 2017 to 2021 reveals significant fluctuations in various collision types. Head-on collisions, a particularly severe category, demonstrated a consistent decline from 75 in 2017 to 26 in 2021, totaling 237 incidents over the five-year period. Similarly, hit-from-back accidents decreased from 55 in 2017 to 18 in 2021, with a cumulative count of 182. Hit-and-run cases also witnessed a noticeable drop from 68 in 2017 to 13 in 2021, totaling 167 (Figure 1.3). Other collision types, such as hit-from-side, vehicle overturns, runoff road, and collisions with parked vehicles, followed similar patterns of reduction. The data suggests an overall positive trend, indicating potential improvements in

road safety measures, public awareness or changes in driving behaviour.

Table 1.1. Total percentage of accidents through collision from 2017-2021

S.No	Collision type	2017	2018	2019	2020	2021	Total
1	Head on Collision	75	53	48	35	26	237
2	Hit from Back	55	48	35	26	18	182
3	Hit and run	68	39	27	20	13	167
4	Hit from Side	31	24	37	15	10	117
5	Vehicle Overturn	32	28	20	25	19	124
6	Runoff Road	20	18	15	10	6	69
7	With Parked Vehicle	15	13	14	10	15	67
8	With Animal	27	30	31	20	8	116
9	Fixed object	23	25	32	15	9	104
10	Pedestrian	25	23	20	15	1	84
11	Others	45	35	45	20	12	157

Accidents through collision 2017-2021

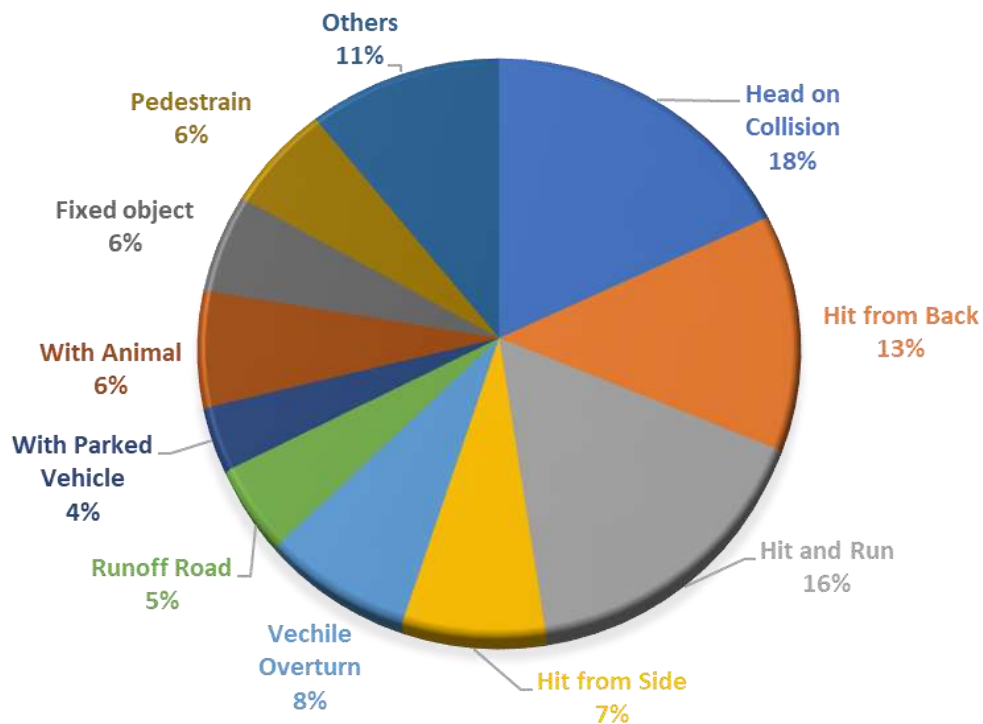


Figure 1.3. Showing Percentage accidents through collision from 2017 to 2021

2.2 Accidents by Roads Junctions

Accidents at road junctions pose a significant concern for road safety and a closer examination of the data reveals the

prevalence of various junction types in contributing to road incidents. Among the reported junction types, T-Junctions account for 20% of accidents, resulting in 11% fatalities and 19% injuries. U-Junctions, with 24% of accidents, demonstrate slightly higher severity, causing 20.34% fatalities and 24.75% injuries. Normal Turns contribute to 16% of accidents, causing 15.25% fatalities and 16.83% injuries. Staggered Junctions, at 18.4%, lead to 16.95% fatalities and 14.85% injuries. Notably, Roundabout Junctions exhibit the highest accident rate at 21.6%, accompanied by 28.81% fatalities and 24.75% injuries, underscoring the need for targeted safety measures at these specific junction types to mitigate the impact on human lives and overall road safety.

Table 1.2. Accidents by roads on junction type

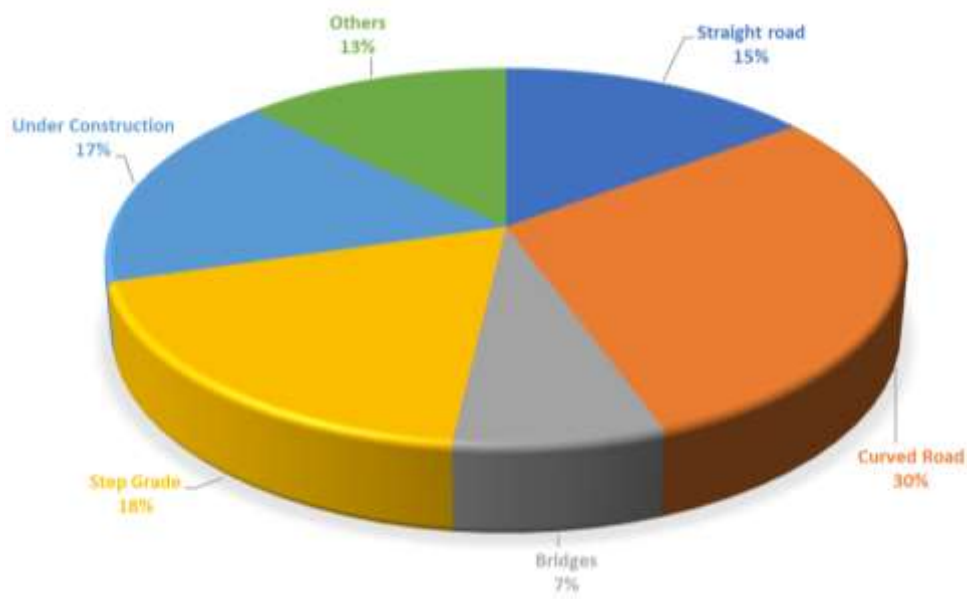
Junction type	No of Accidents	%	Person Killed	%	Person Injured	%
T-Junction	25	20	11	18.64	19	18.81
U-Junction	30	24	12	20.34	25	24.75
Normal Turn	20	16	9	15.25	17	16.83
Staggered Junction	23	18.4	10	16.95	15	14.85
Round about Junction	27	21.6	17	28.81	25	24.75

2.3 Accidents on Various Types of Paths

Accidents on various types of roads exhibit distinctive patterns, highlighting the significance of road features in influencing road safety. Analysis of accident data reveals that on straight roads, 20 accidents occurred, accounting for 14.81% of the total accidents. However, the consequences were severe, with 19.8% of persons involved succumbing to injuries and 17.36% sustaining injuries. Curved roads witnessed a higher incidence, with 40 accidents, representing 29.63% of the total. The impact was significant, leading to 24% of persons killed and 27.78% sustaining injuries. Bridges, though fewer in number with 10 accidents (7.41%), had a notable fatality rate of 12.5%. Step grades posed a substantial risk, accounting for 18.52% of accidents, resulting in 21.9% of persons killed and 16.67% injured. Under construction roads accounted for 17.04% of accidents, with 10.4% of persons killed and 11.81% injured. Other road types contributed to 12.59% of accidents, causing 11.5% fatalities and 10.42% injuries. In total, the data reflects 135 accidents, 96 fatalities, and 144 injuries, emphasizing the need for targeted safety measures based on road features to mitigate the impact of accidents.

Table 1.3. Accidents by road on various types of paths

S.No	Road feature	No of accidents	%	Person Killed	%	Person Injured	%
1	Straight road	20	14.81	19	19.8	25	17.36
2	Curved Road	40	29.63	23	24.0	40	27.78
3	Bridges	10	7.41	12	12.5	23	15.97
4	Step Grade	25	18.52	21	21.9	24	16.67
5	Under Construction	23	17.04	10	10.4	17	11.81
6	Others	17	12.59	11	11.5	15	10.42
	Total	135		96		144	

**Figure 1.4.** Showing the percentage of accidents on roads through various path

2.4 Age Profile of Victims, Fatal Accidents

The age profile of accident victims on National Highway 07 (NH-07) reveals a concerning trend over the years 2017 to 2021. The data categorizes accident victims into various age groups, shedding light on the vulnerability of different demographics. In 2017, the age group less than 18 witnessed 109 accidents, which gradually decreased to 37 in 2021. Similarly, the 18-25 age group experienced a decline from 115 accidents in 2017 to 29 in 2021. However, the age group 25-35 saw a fluctuating pattern, with a peak of 110 accidents in 2017 and a rise to 34 in 2021. The age groups 35-45 and 45-60 both showed a decline in accidents over the years, indicating some positive trends. Notably, individuals above 60 faced a notable decrease in accidents from 50 in 2017 to 14 in 2021. The data

underscores the importance of targeted interventions and policies to address road safety issues, with a particular focus on the age groups that continue to face higher risks.

Table 1.4. Age profile of accident victims on roads nh-07

Age group	2017	2018	2019	2020	2021
< 18	109	100	120	70	37
18-25	115	113	118	68	29
25-35	110	97	85	50	34
35-45	70	60	50	32	24
45-60	67	63	47	20	7
> 60	50	48	56	29	14
Age not Known	65	56	68	30	12

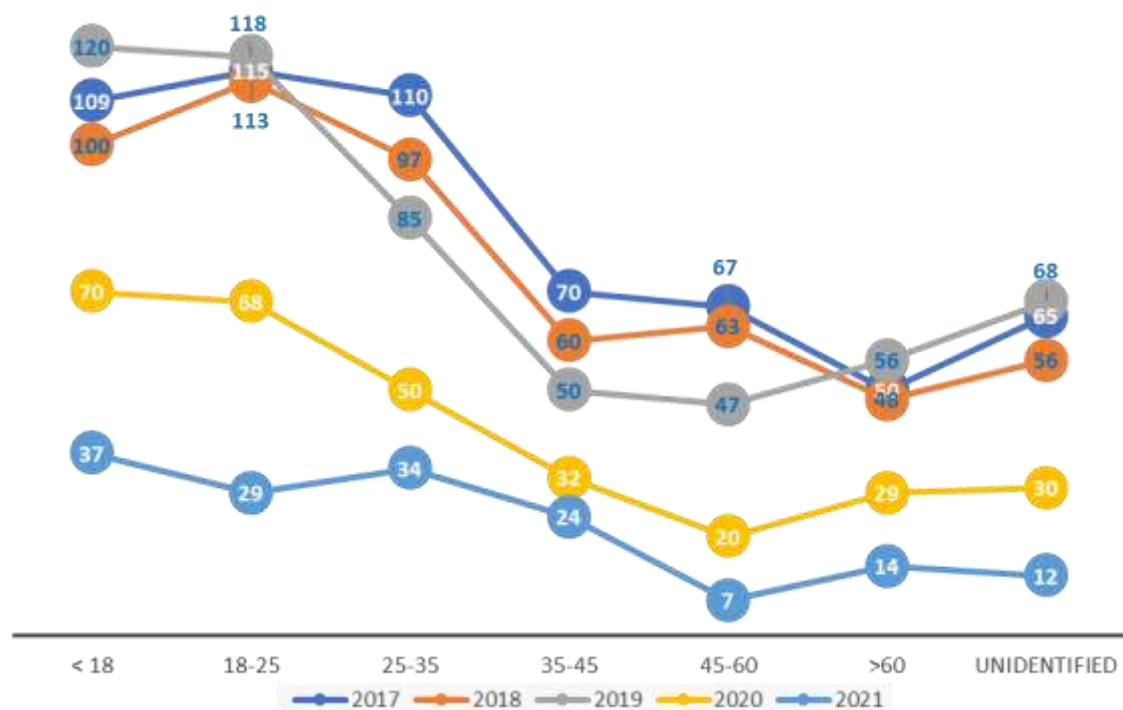


Figure 1.5. Show the age profile of accident victims on NH-07

2.5 Accidents through Weather Conditions on NH-07

Accidents on NH-07 demonstrate a significant correlation with varying weather conditions, revealing compelling statistics that highlight the impact of weather on road safety. In sunny and clear conditions, 160 accidents accounted for 36.53% of incidents, resulting in 30 fatalities (25.00%) and 62 injuries (27.80%). Rainy weather contributed to 90 accidents, representing 20.55% of the total, with 26 fatalities (21.67%) and 43 injuries (19.28%). The presence of fog or moisture was associated with 88 accidents, constituting 20.09% of incidents, leading to 29 fatalities (24.17%) and 46 injuries (20.63%). Additionally, other weather conditions contributed to 100 accidents, comprising 22.83% of the total, resulting in 35

fatalities (29.17%) and 72 injuries (32.29%). These statistics highlights the need for heightened awareness and adaptive driving behaviours in response to different weather conditions to mitigate the risk of accidents and promote road safety on NH-07.

Table 1.5. Accidents through weather condition on NH-07

Weather Condition	No. of Accidents	%	Person Killed	%	Person Injured	%
Sunny Clear	160	36.53	30	25.00	62	27.80
Rainy	90	20.55	26	21.67	43	19.28
Fog / Moist	88	20.09	29	24.17	46	20.63
Others	100	22.83	35	29.17	72	32.29

2.6 Identification of Road Accident Prone Areas

The identification of accident-prone areas along National Highway 07 (NH-07) is crucial for implementing targeted safety measures and mitigating potential risks. A comprehensive assessment has pinpointed several high-risk zones, among which Tota Ghati (30°4'31"N and 78°31'13"E), Sakhnidhar (30°5'9.5"N and 78°32'52.1"E), and Jiyalgarh stand out as particularly vulnerable areas (Figure 1.6). These locations exhibit characteristics that contribute to a heightened risk of accidents, such as challenging terrain, sharp turns, or inadequate road infrastructure. Tota Ghati, specifically the stretch between Kodyala and Sakhnidhar in Tehri district, Uttarakhand, presents a complex geological terrain with multiple rock types and slopes susceptible to failures. Geological studies conducted by Geodata India Pvt Ltd in 2014 revealed widely sheared, faulted, and fractured rocks in the Tota Ghati area, making it prone to slope failures triggered by factors like rainfall or earthquakes. This area has been identified as hazardous due to frequent accidents, often resulting in loss of lives. Uttarakhand traffic police have identified Tota Ghati as an accident-prone blackspot, emphasizing the urgent need for targeted safety interventions in this critical area.



Figure 1.6. Accident Prone Location Map of NH-07

Conclusion

The present investigation has undertaken a comprehensive examination of road hazards with a specific focus on NH-07 from Rishikesh to Srinagar Garhwal in Uttarakhand. Through a meticulous impact assessment of road accidents, the study has shed light on the multifaceted consequences of such incidents, ranging from human casualties and injuries to economic losses and infrastructure damage. The identification of accident-prone areas is a crucial step toward devising effective mitigation strategies. By pinpointing specific locations on the national highway (NH-07) where the risk of road accidents is heightened, this research provides valuable insights for policymakers, urban planners and relevant authorities.

The findings emphasize the importance of targeted interventions and investments in improving road safety infrastructure, implementing traffic management measures and enhancing public awareness programs. As the region continues to witness growth and development, addressing road hazards becomes imperative for sustainable progress and the well-being of the community. Additionally, the research highlights the significance of ongoing monitoring and periodic reassessment to adapt strategies to evolving conditions. To mitigating road hazards in the region, requiring a collaborative effort from government agencies, local communities and stakeholders. By integrating the insights gained from this impact assessment into practical interventions, we can strive

to create safer road networks, reduce accident rates, and contribute to the overall enhancement of transportation safety on NH-07 in the Uttarakhand.

References:

1. Gaurav, V., Singh, S. K., & Srivastava, A. (2019). Accident Detection Severity Prediction Identification of Accident-Prone Areas in India and Feasibility Study using Improved Image Segmentation Machine Learning and Sensors. *Machine Learning and Sensors*.
2. Sathish, Y. A., Krishnegowda, G., & Kumar, T. M. (2016). Road Safety and Accident Prevention in Third World Countries: A Case Study of NH-7 in India. *International Journal of Architectural and Environmental Engineering*, 10(2), 249-254.
3. Yakar, F. (2015). Identification of accident-prone road sections by using relative frequency method. *Promet-Traffic &Transportation*, 27(6), 539-547.
4. Svadlenka, L. (2019). The impact of road characteristics assessment on the traffic accidents occurrence. In *Sinteza 2019- International Scientific Conference on Information Technology and Data Related Research* (pp. 26-31). Singidunum University.