IDENTIFICATION OF HAZARDOUS ROAD LOCATIONS ON DHAKA-KHULNA NATIONAL HIGHWAY

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ABSTRACT

Road crashes are a major concern in the transportation sector of developing countries like Bangladesh. According to "Bangladesh Passengers Welfare Association" (BPWA) about 6,642 deaths and 21,755 injuries and more accidents occurred in 2022 in Bangladesh. This research analyzes the various accident data from the year 2018 to 2022 in route N8 (Dhaka – Mawa – Faridpur – Gopalganj – Bagerhat National Highway) in Bangladesh. This study identifies accident-prone locations, often referred to as Hazardous Road Locations (HRL) on route N8. The relevant Accident Report Forms (ARF) were collected from the Officer in Charge (OC) of the Highway Police Station (Bhatiapara Highway Police Station and Bhanga Highway Police Station). The Accident Frequency Analysis approach was used to identify accident-prone sites, which were then mapped using a Geographic Information System (GIS) on the Dhaka-Khulna National Highway. Sreenagar Filling Station Road, Bogail Bus Stop, Bhanga Gol Chottor, and 19 more locations were identified as HRL on route N8. Head-on collisions, rear-end collisions, and pedestrian hits are the most dominant types of accidents on route N8. The result from this study shows that the maximum number of accidents occurred in Daylight. The result clearly indicates that buses were the most common type of vehicle involved in accidents on Route N8.

Keywords: Hazardous Road Location, Dhaka-Khulna (N8) Highway, GIS, Accident.

1. INTRODUCTION

Road safety is a major concern in the 21st century, with a large number of people dying or suffering from severe injuries in road traffic accidents every day. A review of the figures from 2015 to 2022 - an eight-year span, shows a variety of reported data. Nirapad Sarak Chai (NISCHA-we demand safe roads), reports that in the past eight years, 32,195 road accidents have claimed the lives of 43,220 individuals, and injured 54,381 (Sadi, 2023). According to Save the Road, during this time, 130,509 road accidents have led to the deaths of 40,523 individuals, with 182,308 injured (Sadi, 2023). National highway accident analysis shows that accidents are highly clustered on a few sections, demonstrating that they can be treated site-specifically. Despite having a much lower percentage of registered vehicles, developing countries have a relatively high death rate (Hoque et al., 2001). By international standards, Bangladesh has a very serious safety problem, with 60 to 150 fatalities per 10,000 motor vehicles, compared to 25, 16, 2, and 1.4 in the US, UK, India, and Sri Lanka, respectively (Ahsan, 2012). Therefore, it is essential to implement mitigating measures that can be ensured to lower the number and severity of crashes as well as incorporate steps that can lower road accident rates (R R & S N, 2002). This thesis examines this in more detail to identify locations with high concentrations of accidents and fatalities, with the goal of prioritizing the total length of national highways that need treatment.

The Route N8 (Dhaka-Mawa-Faridpur-Gopalganj-Bagerhat), one of Bangladesh's major arterial roads, serves as a vital lifeline connecting the capital city, Dhaka, to the southwestern region of the country, including the important city of Khulna. Spanning a considerable distance, this highway plays a pivotal role in the nation's transportation infrastructure and socio-economic development. Despite being a developing nation, improving road safety in Bangladesh lags far behind global benchmarks, necessitating urgent action. The accident distribution on highways is characterized by clustering at a few locations, which are more susceptible to road traffic hazards.

This study employed a 0.1km section analysis, identifying segments with at least three fatal accidents or five total accidents within a five-year period as high-risk locations. By identifying and analysing the most dangerous hazardous locations on N8, this study aims to prioritize sections for targeted safety interventions, contributing valuable insights to improve accident prevention strategies and to ensure safety for road users not only for N8 but potentially for other national highways as well.

2. LITERATURE REVIEW

A comprehensive literature review was undertaken beforehand to conduct the accident investigation. Among nations, Bangladesh suffers a particularly high burden of road deaths. To understand this issue, one must consider three key groups of contributing factors: environment, driver behavior, and vehicle condition (Rahman et al., 2017). Official data from the Bangladesh Road Transport Authority (BRTA) reveals that 9,652 lives were tragically lost in road accidents during 2022 (Bangladesh Road Transport Authority, 2022). Inadequate road maintenance in Bangladesh, manifested through potholes, uneven surfaces, and insufficient illumination, creates hazards that compromise driver visibility and control, leading to a disproportionate number of traffic deaths. The alarming number of unroadworthy vehicles plying Bangladeshi roads, with faulty brakes, malfunctioning steering systems, and worn-out tires, significantly elevates the risk of accidents, posing a grave threat to road safety (World Health Organization, 2018). The BRTA is spearheading a multi-pronged initiative to tackle the issue of traffic-related fatalities. This includes enhancing Bangladesh's road infrastructure through construction projects, repairs, and the installation of vital safety features like traffic lights, alongside stricter traffic law enforcement by deploying additional police officers on the roads (Bangladesh Road Transport Authority, 2022). While road accidents dominated with over 7,600 incidents, Bangladesh also witnessed significant tragedies on railways (606 accidents) and waterways (262 incidents) in 2022, leading to a combined loss of over 11,000 lives and numerous injuries, as detailed in the Passenger Welfare Association's annual report (Kabir & Nurul, 2023).

The devastating impact of 2022's traffic accidents extends beyond the overall figure of 10,858 fatalities, claiming the lives of 2,804 transport workers, 666 students, 114 law enforcement officers, and individuals from various professions and political backgrounds. Motorcycles dominated the accident landscape in 2022, accounting for nearly 29% of collisions, followed by a group comprising trucks, pickups, and vans at 24%. Buses came in third with 14%, while battery-powered rickshaws and easy

bikes contributed 11%, and tractors of various brands made up 8%. CNG auto-rickshaws were involved in 6% of accidents, while cars, jeeps, and microbuses accounted for 7% (Kabir & Nurul, 2023).

3. METHODOLOGY

To accurately analyses accidents, it is important to understand the drivers, other road users, vehicles, and roadways involved, as well as how they interact with each other. The study involves the collection and analysis of accident data in order to detect HRL, followed by the creation of maps using Geographic Information System (GIS). GIS has been acknowledged as an effective data storage and management program with a superior visualization system.

3.1 Data Collection

In Bangladesh, there are several sources for collecting data on traffic accidents, such as police records, hospitals, media reporting, and so on. The Accident Report Forms (ARF), which are generally filled out by police officers, are the primary source of accident data. The concept of an Accident Report Form (ARF) was initially presented in the early 1990s in Bangladesh. There were no such statistics before to 1995 (Haque, 1989). Accident data during the period of 2018 – 2022 (five consecutive years) was analysed to identify HRL in N8 national highway. Findings are arranged according to severity of accident, categories of accident, accident time, collision type, involvement of vehicle in the accident, accident routes, proportion of pedestrians impacted, and so on.
Accidents are not randomly distributed on any road network but rather concentrate at certain spots. Accident data on the N8 was analysed at 100-meter intervals. A location is marked as a black spot or HRL when a minimum of three fatal or five total accidents occur along a 100-meter stretch of roadway over five years. The process used for identifying Blackspots or HRLs on the Dhaka-Khulna highway is split into multiple steps. The Figure 1 represents the steps:

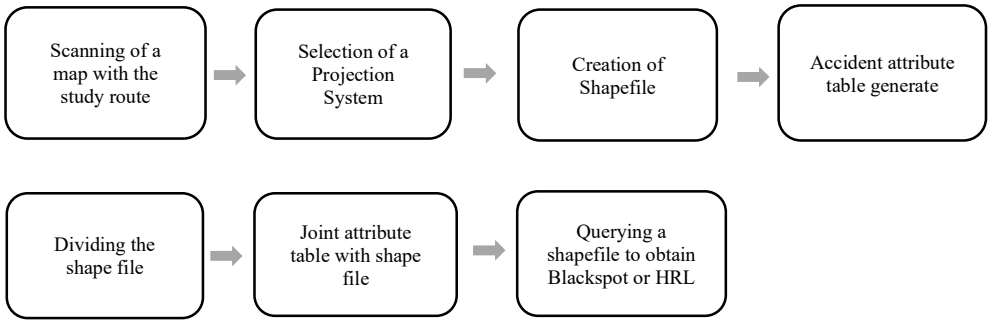

Figure 1: Steps for identification of HRL in GIS

3.2 Data Analysis

This section examines the characteristics and notable features of road crashes on N8 in Dhaka-Khulna national highway. Accident data analysis was carried out during a five-year period, from 2018 to 2022. The analysis also examines both the frequency and severity of collisions along route N8 (Dhaka – Mawa – Faridpur – Gopalganj – Bagerhat National Highway) in Bangladesh.

3.2.1 Accident occurred in route N8

Through comprehensive analysis, the study identifies and characterizes the HRL based on accident severity, collision type, environmental characteristics, and vehicle-related characteristics. A total 242 accidents were analysed on the route N8 for the period of five consecutive years (2018-2022).

Accident severity: Following figures shows that most of the accidents that took place in N8 Highway during 2018-2022 were fatal accidents. This data indicates the tremendous severity of road traffic collision scenario in Bangladesh.

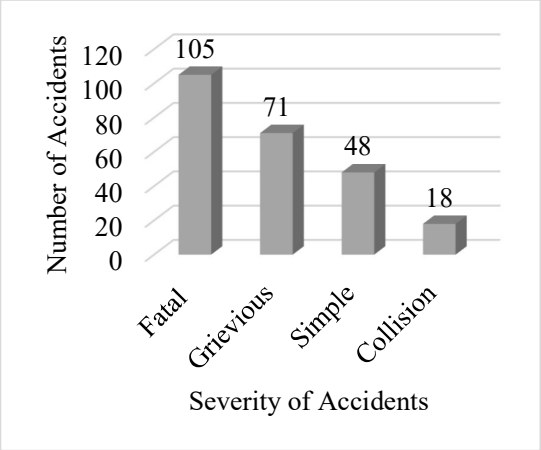

Figure 1: Accident severity on route N8 (2018-2022)

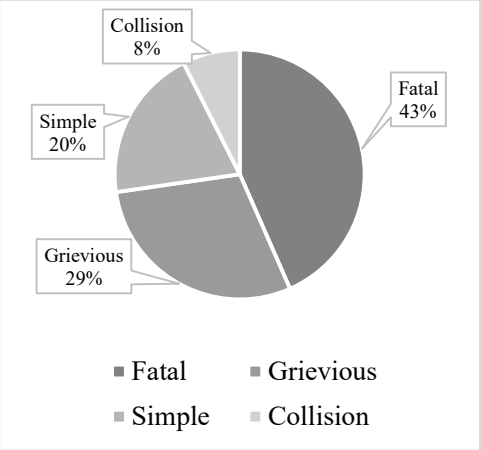

Figure 2: Percent distribution of collision severity on route N8 (2018-2022)

Collision type: Figure 5 clearly shows that head-on and hitting pedestrian type collisions is of highest frequency (27% and 25% respectively). Thus, Pedestrian is the most vulnerable road user group at N8.

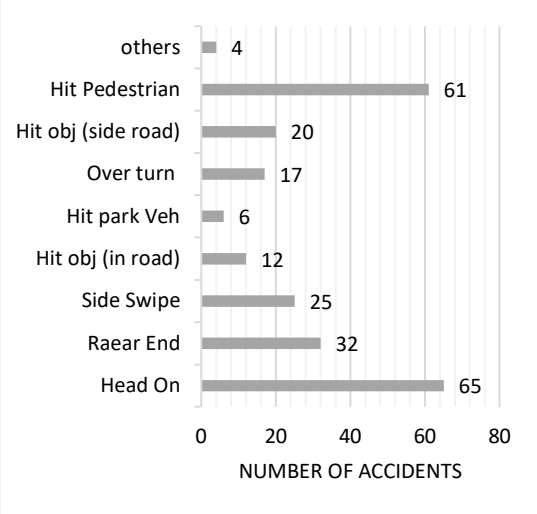

Figure 3: Distribution of accident by collision type

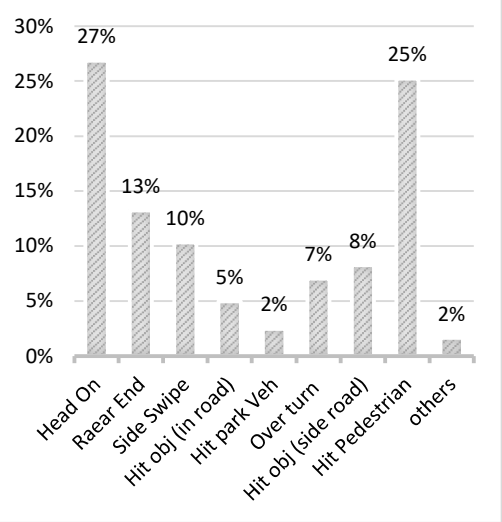

Figure 4: Percent pistribution of accidents by collision types

Environment related characteristics:

i) Month of the year: Figure 6 demonstrates that crashes were more common in March, May, Jun, July and December.

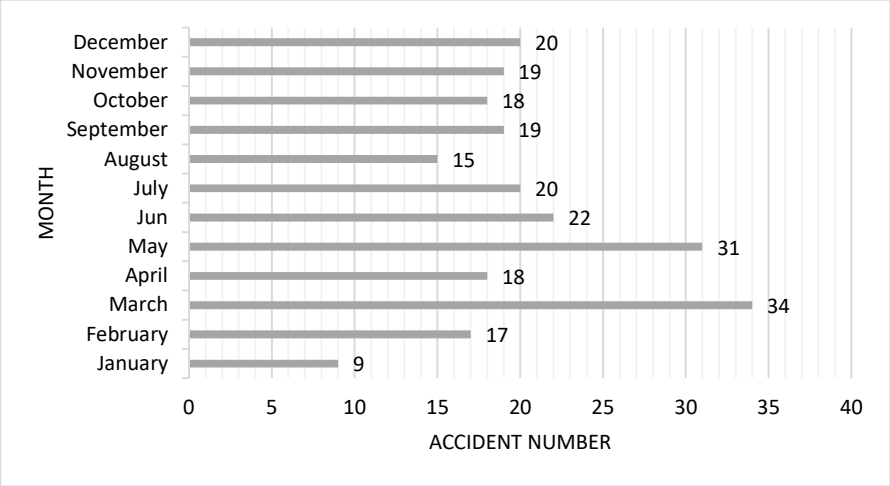

Figure 5: Accident distribution by month

ii) Time of the day and condition of light: Figure 7 sheds light on the temporal pattern of accidents on route N8. It reveals a concerning trend, with a significant spike in occurrences between 10:00 AM and 1:00 PM. It is about 16.5% of total accident. The crash incidence is likewise high between 7.00 AM -10.00 AM and 4.00 AM -7.00 AM (14.8% of total accident and 15.7% of total accident respectively).

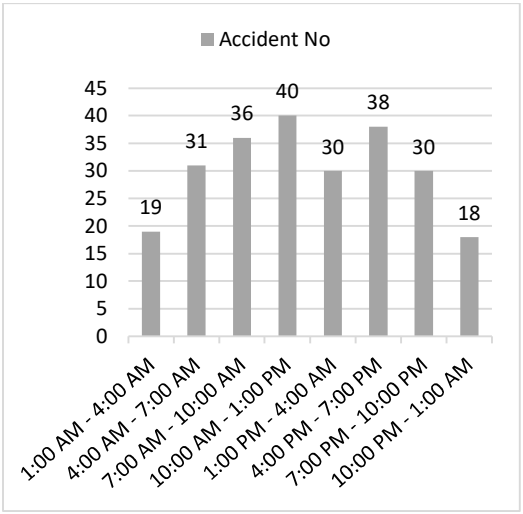

Figure 6: Accident distribution by time of the day

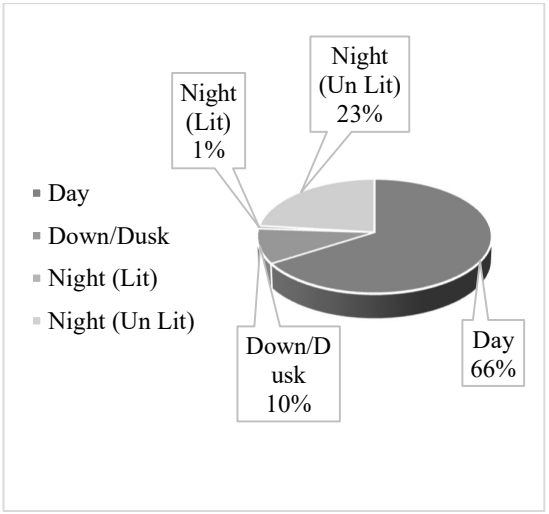

Figure 7: Accident distribution by lighting

Figure 8 demonstrates that, most of the road accident occur in day light period. The frequency of accident in dusk is 10% of total accident in route N8. At night (un lit) condition 23% of total accident occurred. From the above illustration, decisions can be made that number of accidents occurring at day-time is very high compared to other situations.

iii) Weather Condition: From the following figure (Figure 9) information of accidents regarding weather conditions, it is noticed that most of the accidents occurred in fair weather conditions. So, conclusion can be made that bad weather conditions such as rain, wind or fog did not have severe impacts on traffic collisions.

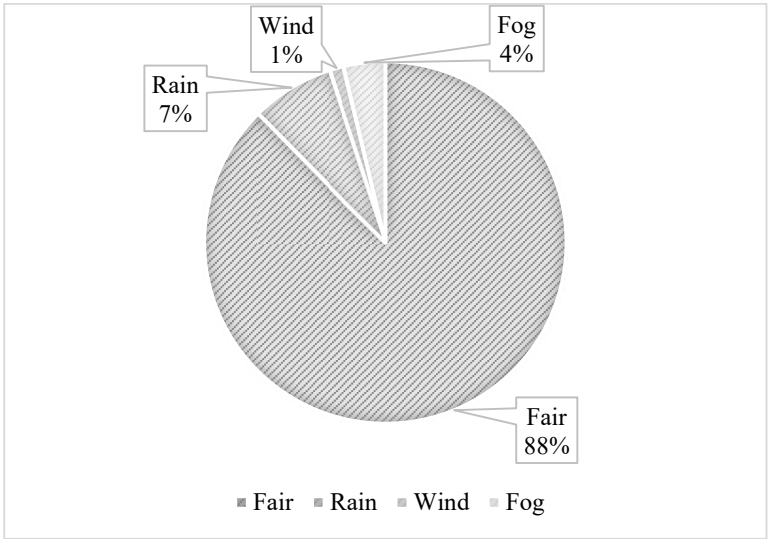

Figure 8: Accident distribution by weather condition

Vehicle related characteristics:

i) Types of vehicles involved: Figure 10 paints a concerning picture of accident involvement by different vehicle types over five years (2018-2022). Buses emerge as the clear frontrunner, with a significantly higher frequency of accidents compared to other vehicles.

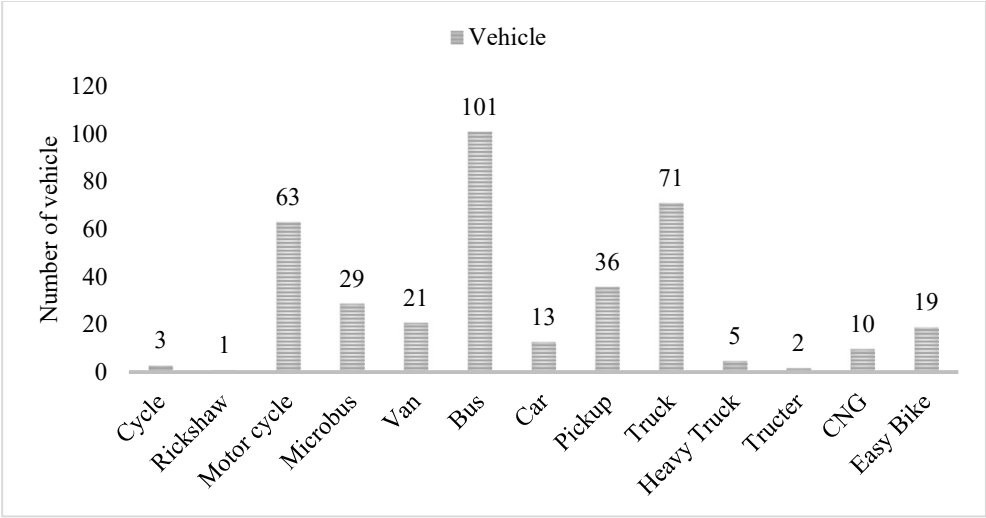

Figure 9: Type of vehicle contributing in accident

3.3 Identification of HRL

To delve deeper into accident patterns, the 183 km stretch of route N8 was meticulously segmented into 1830 sections, each spanning 100 meters. This approach allowed for a precise analysis of accident distribution throughout the entire route. On the next page the Hazardous Road Locations (HRL) of route N8 on the basis of accident data from year 2018 to 2022 is presented in Figure 11. Twenty-two HRL were identified in Dhaka- Mawa- Faridpur- Gopalganj- Bagerhat national highway for the period of five consecutive years.

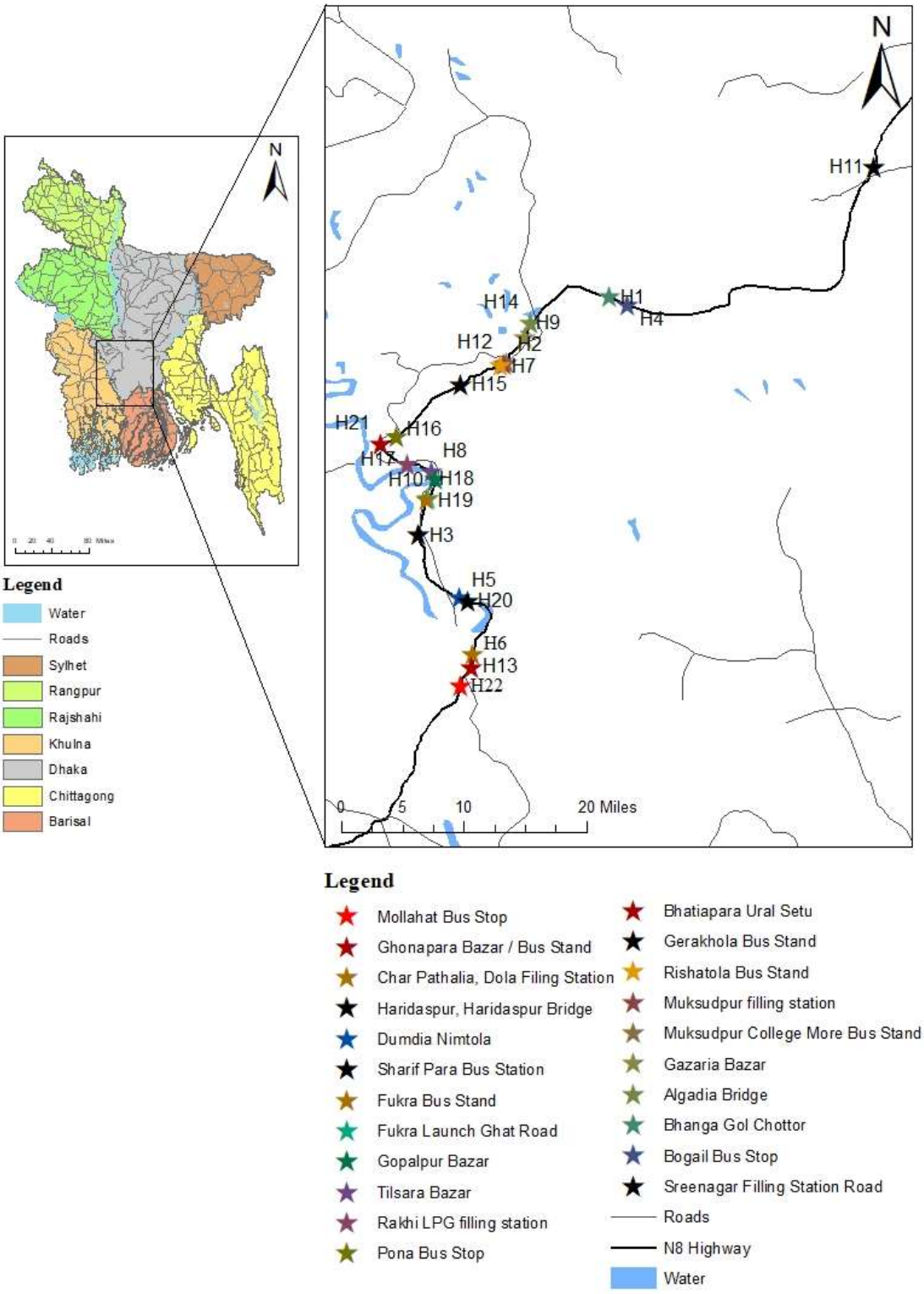

Figure 10: HRL found on N8 (Map. 1)

Table 1: HRL on Dhaka-Khulna national highway (2018-2022)

Type*	Locations	Km Post	Length (m)	Fatal Accident	Total Accident
H1	Bhanga Gol Chottor	72 to 72.6	600	14	41
H2	Muksudpur College More Bus Stand	90.1 to 90.5	400	7	11
H3	Sharif Para Bus Station	126 to 126.5	500	3	11
H4	Bogail Bus Stop	69.5 to 70.2	500	4	10
H5	Dumdia Nimtola	136 to 136.9	900	3	10
H6	Char Pathalia, Dola Filing Station	147.5 to 148	500	6	9
H7	Rishatola Bus Stand	91.1 to 91.6	500	1	8
H8	Tilsara Bazar	117.4 to 117.9	500	3	8
H9	Gazaria Bazar	86 to 86.5	500	5	7
H10	Gopalpur Bazar	118.3 to 118.8	500	1	7
H11	Sreenagar Filling Station Road	25.5 to 26	500	5	6
H12	Muksudpur filling station	90.7 to 90.9	200	1	6
H13	Ghonapara Bazar / Bus Stand	149 to 149.6	600	3	6
H14	Algadia Bridge	83.5 to 84	500	4	5
H15	Gerakhola Bus Stand	96.5 to 97	500	2	5
H16	Pona Bus Stop	107.2 to 107.6	400	3	5
H17	Rakhi LPG filling station	114 to 114.5	500	1	5
H18	Fukra Launch Ghat Road	121.1 to 121.3	200	1	5
H19	Fukra Bus Stand	121.4 to 121.6	200	1	5
H20	Haridaspur, Haridaspur Bridge	137.5 to 138.1	600	3	5
H21	Bhatiapara Ural Setu	109 to 109.7	700	3	3
H22	Mollahat Bus Stop	152.2 to 152.4	200	3	3

4. INVESTIGATION OF THE SITE

Observations in HRL along route N8 revealed concerning scenario and driver behaviours such as:

- Road blockage by para-motorized
- Unsafe pedestrian action
- Riding motorcycles without helmets
- Engaged in dangerous over-speeding and over-taking maneuvers
- Lack of designated areas for buses to stop.

Figure 11: Road blockage by Para motorized vehicle

Figure 12: Risky Access to Highway

5. FINDINGS

Over five years (2018-2022), the Dhaka-Khulna Highway has witnessed a disturbing pattern of accidents, with 242 incidents taking place, 43% of them ending in fatalities. These fatal accidents have had severe consequences, causing loss of life and impacting the country's economy. The maps prepared by GIS using five years of accident data (2018 to 2022) showed 22 hazardous road locations on route N8, which were selected based on the highest number of accidents that occurred at each location. This portion of the Dhaka-Khulna highway accounted for about 75% of all accidents. The following accident scenario has resulted from a detailed accident study on this route: about 43% of the total accidents are fatal. The month of March has a greater accident frequency followed by May, Jun, July, and December. Between 10.00 AM - 1.00 PM the frequency of crashes is highest which is about 16.5% of total accident. Head-on, Hit-pedestrians, rear-end, and side-swipe are the most common types of collision. Fair weather proves surprisingly treacherous on Route N8, accounting for a staggering 88% of the accidents recorded. Meanwhile, buses and motorcycles dominate the accident statistics on this route.

6. CONCLUSIONS

This study identifies several factors that contribute to accidents, including road conditions, weather, accident severity and vehicle condition. The study will use GIS to identify black spots, or hazardous road locations (HRLs). Delving into the intricacies of road accidents, this research sheds light on key characteristics and prevalent safety concerns. While further on-site investigations remain crucial to tailor effective remedial measures, one striking finding emerges: a significant 25% of all accidents are caused by pedestrian hits. As a result, pedestrian safety is a major concern on these roads.
To improve road safety, the following general recommendations are made:

- Relocate markets located beside highways.
- Provide designated areas for bus stops and stands.
- Properly manage para-motorized vehicles to prevent them from blocking highways.
- Provide pedestrian facilities, such as overpasses, underpasses, zebra crossings, and pedestrian signals, where needed.
- Provide dedicated lanes for non-motorized vehicles to reduce rear-end collisions.

This study has some limitations due to the data sources and methods used. It is based on police crash reports (ARF), which are limited in detail. However, this study provides valuable insights into crash

severity, which can be used to develop mitigation strategies for traffic crashes in developing countries. Additionally, road safety is a complex issue that requires collective action from governments, non-governmental organizations, industries, and people from many different disciplines.

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REFERENCES

Ahsan, D. H. (2012). Road Safety in Bangladesh: Key issues and countermeasures. *The Daily Star.*

Haque, M. M. (1989). Road accident prevention. *Journal of the Institution of Engineers*, Bangladesh, Vol. 17.

Hoque, M. M., McDonald, M., & HALL, R. D. (2001). Road Safety Improvements in Developing Countries. *National academies.*

R R, K., & S N, S. (2002). Accident Rate Prediction on Arterial Roads of Durban, South Africa. *Indian Roads Congress.*

Rahman, F., Uddin, F., Rahman, M. M., & Islam, M. A. (2017). Characterizing Hazardous Road Locations and Black Spots on Route N8 (Dhaka-Barisal National Highway) of Bangladesh. *Journal of Built Environment, Technology and Engineering*, Vol. 2.

Bangladesh Road Transport Authority. (2022). *Annual Report 2021-22.*

World Health Organization. (2018). *Global Status Report on Road Safety 2018*.

Kabir & Nurul. (2023, Jan 2). Road accidents kill 9,951 in 2022. *Newge*.

Sadi, M. (2023). Clouded figures: Understanding road accidents in Bangladesh. *Dhaka Tribune.*