

## **ACCIDENT ASSESSMENT AND PATTERN EVALUATION OF ROAD TRAFFIC CRASHES AT JOYDEBPUR, GAZIPUR**

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### **ABSTRACT**

Road traffic accidents (RTAs) remain a major threat to public safety in Bangladesh, especially in rapidly urbanizing areas like Joydebpur, Gazipur. Although national reports indicate rising accident trends, localized studies are still limited. This study aims to analyze six years (2019-2024) of accident data collected from Joydebpur Sadar Thana, focusing on identifying patterns, major causes, and proposing safety interventions. Official police records were used in the study and considered variables such as accident year, vehicle type, driver age, and location (ward number). Data were analyzed using trend assessments and spatial comparisons. The findings reveal that 2023 recorded the highest number of accidents, accounting for approximately 37% of the total. Trucks were involved in the majority of cases, with most responsible drivers falling within the 18-30 year age range. The maximum number of incidents was fatal, and overall 59% occurred during daytime hours. Wards 22 and 23 were identified as the most accident-prone zones. Reckless driving, particularly along the Dhaka-Mymensingh highway, was found to be the leading cause. This case study emphasizes the need for strict enforcement of traffic laws, awareness programs for young drivers, and the installation of speed control measures in high-risk areas. The insights from this localized analysis can support policymakers in reducing road accidents and improving urban safety in Joydebpur and similar regions.

**Keywords:** *Road Traffic Accident, Joydebpur Sadar Thana, Fatality rate, Spatial comparison, Highway Accident.*

## **1. INTRODUCTION:**

Road traffic accidents (RTAs) represent one of the pressing global public-health challenges of the modern era. Each year, approximately 1.35 million people die, and tens of millions suffer injuries due to RTAs worldwide (World Health Organization, 2023). The impact is particularly severe in low and middle-income countries (LMICs), where road safety systems and infrastructure have not kept pace with rapid urbanization and motorization (Munasinghe, 2023; Shahid et al., 2015). The rising volume of vehicles and the increasing travel demand in urban areas are making congestion and accident risks worse around the world (Vithanage, K., & Wijayarathne, 2021). In many Asian countries, especially in South and Southeast Asia, roads are highly unsafe because different types of vehicles, such as trucks, buses, motorcycles, rickshaws, and pedestrians, all share the same space. The lack of lane discipline, insufficient driver training, and weak enforcement also play an important role in the region's high fatality rates (Galvez-Perez et al., 2024). Studies from Malaysia and Sri Lanka further show that accident hotspots are mainly found at intersections, highways, and industrial corridors where mixed traffic meets without proper safety controls (Munasinghe, 2023; Shahid et al., 2015).

In Bangladesh, road safety has become a serious crisis that heavily impacts people in the economically active age groups. Research shows that problems in road infrastructure, such as undivided roads and the absence of pedestrian facilities, along with unsafe behaviors like overspeeding, wrong-side driving, and driver fatigue, often increase crash severity (Kamruzzaman et al., 2014; Jabbar et al., 1970). Hospital-based studies and field surveys consistently report that heavy vehicles such as trucks and buses are involved in many severe accidents, and young drivers as well as pedestrians are commonly among the victims (Ahmad et al., 2018; Jabbar et al., 1970). Recent national-level research also points out mismatches in official reporting and emphasizes the importance of combining police data with spatial and temporal analysis methods to identify accident hotspots more accurately and support better policy decisions (Rahman et al., 2023; Das et al., 2024).

Although several national and regional studies exist, there is still a lack of detailed research on peri-urban industrial areas. Gazipur district, situated along the Dhaka-Mymensingh Highway, functions as a major industrial and commuter hub where mixed traffic and frequent accidents are common. In Joydebpur Sadar Thana, heavy movement of trucks, buses, motorcycles, auto rickshaws, and large numbers of pedestrians, combined with continuous through-traffic from Dhaka, creates many conflict points. Poor speed control and limited enforcement further increase the likelihood of serious crashes. However, peer-reviewed studies specifically focused on Joydebpur are still very few, which limits safety planning at the ward and corridor levels (Khatun et al., 2024). To fill this gap, the present study examines six years of police-reported crash data from 2019 to 2024 in Joydebpur Sadar Thana. The analysis covers temporal trends, characteristics of vehicles and drivers involved, and spatial hotspot identification using GIS. Expected outcomes include ward-level hotspot maps, yearly trend patterns and profiles of high-risk vehicle types and driver groups. These results are intended to support targeted speed management, awareness programs for young drivers, and stronger enforcement in high-risk corridors. By connecting broader research with local-level evidence, the study offers practical guidance to reduce crashes in Joydebpur and other similar peri-urban regions.

Objective of the study:

1. To analyze temporal, vehicle wise, and driver wise crash characteristics and identify high risk groups in Joydebpur Sadar Thana.
2. To detect spatial crash hotspots using GIS and prepare ward level risk maps for targeted safety countermeasures.

## 2. METHODOLOGY

### 2.1 Study Area

The study has been carried out in Joydebpur Thana, Gazipur, located in the central district of Dhaka Division, Bangladesh, which is well known for having a large population and high traffic density. Joydebpur Thana consists of 13 wards, with the town center reference point at Latitude 23°9'39" N and 90°43'08" E. The Dhaka-Mymensingh Highway passes through some wards, contributing significantly to accident-prone areas, while the remaining wards consist of arterial and collector roads connecting to the highway. The geographic location is shown in Figure 1.

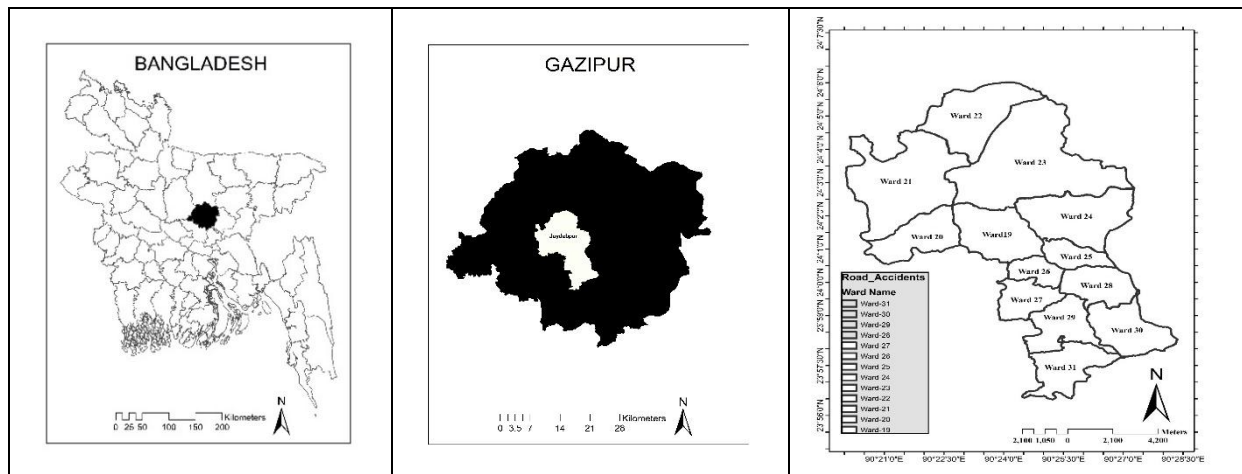


Figure 1: Study area of Joydebpur Sadar Thana

### 2.2 Data Collection

Accident records were obtained from Joydebpur Sadar Thana police files for 2019-2024. Extracted field included location (ward number), date and time, driver's age, vehicle type, reported cause, and outcome (fatal, injury, or property damage).

### 2.3 Data Analysis.

Microsoft Excel 2016 was used to analyse data for each ward, including cases involving fatalities and injuries. It also shows the age distribution of drivers, vehicle types, seasonal variation, and the hourly variation of accidents across all wards. ArcGIS (Version 10.8) was employed to obtain geographic coordinates (latitude and longitude), prepare spatial maps, and visualize accident frequency distributions.

## 3. RESULT AND DISCUSSION

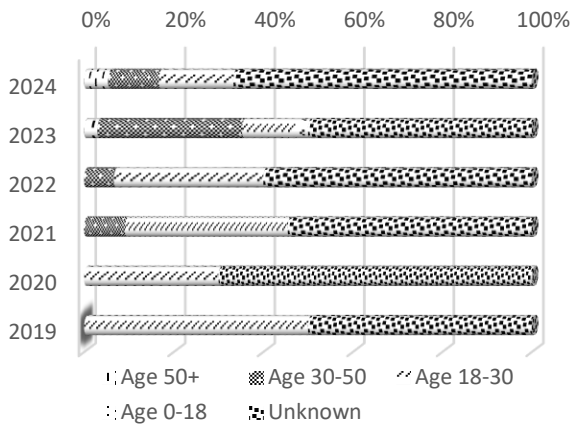
### 3.1 Traffic Accident Patterns Across Vehicle, Age, And Temporal Factors

Joydebpur, Gazipur, located near the major urban centre of Dhaka, experiences heavy traffic, which makes road accidents a significant public safety concern. For this study, 94 accident records from 2019 to 2024 were collected from official police reports and are summarized in Table 1.

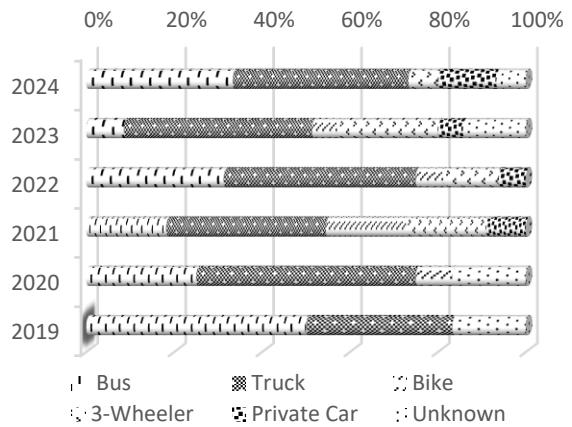
Table 1: Percentage distribution of road accidents by category (2019-2024)

| Category           | Group       | Year    |         |         |         |         |         |
|--------------------|-------------|---------|---------|---------|---------|---------|---------|
|                    |             | 2019(%) | 2020(%) | 2021(%) | 2022(%) | 2023(%) | 2024(%) |
| Age Group          | Age 50+     | 0.00    | 0.00    | 0.00    | 0.00    | 2.94    | 5.56    |
|                    | Age 30-50   | 0.00    | 0.00    | 9.09    | 6.67    | 32.35   | 11.11   |
|                    | Age 18-30   | 50.00   | 30.00   | 36.36   | 33.33   | 11.76   | 16.67   |
|                    | Age 0-18    | 0.00    | 0.00    | 0.00    | 0.00    | 2.94    | 0.00    |
|                    | Unknown     | 50.00   | 70.00   | 54.55   | 60.00   | 50.00   | 66.67   |
| Vehicle            | Bus         | 50.00   | 25.00   | 18.18   | 31.25   | 8.57    | 33.33   |
|                    | Truck       | 33.33   | 50.00   | 36.36   | 43.75   | 42.86   | 40.00   |
|                    | Bike        | 0.00    | 8.33    | 18.18   | 6.25    | 5.71    | 0.00    |
|                    | 3-Wheeler   | 0.00    | 0.00    | 18.18   | 12.50   | 22.86   | 6.67    |
|                    | Private car | 0.00    | 0.00    | 9.09    | 6.25    | 5.71    | 13.33   |
|                    | Unknown     | 16.67   | 16.67   | 0.00    | 0.00    | 14.29   | 6.67    |
| Daytime            | Day         | 50.00   | 70.00   | 72.73   | 53.33   | 67.65   | 38.89   |
|                    | Night       | 50.00   | 30.00   | 27.27   | 46.67   | 32.35   | 61.11   |
| Day Classification | Weekend     | 16.67   | 20.00   | 9.09    | 6.67    | 8.82    | 16.67   |
|                    | Weekdays    | 83.33   | 80.00   | 90.91   | 93.33   | 91.18   | 83.33   |
| Season             | Summer      | 33.33   | 10.00   | 9.09    | 33.33   | 26.47   | 50.00   |
|                    | Monsoon     | 50.00   | 20.00   | 63.64   | 33.33   | 50.00   | 11.11   |
|                    | Winter      | 16.67   | 70.00   | 27.27   | 33.33   | 23.53   | 38.89   |

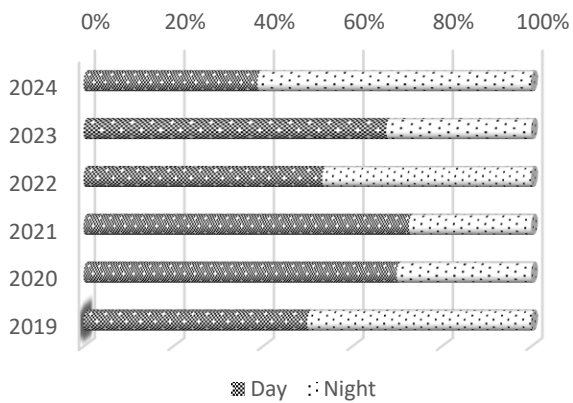
The analysis of road accident data from 2019 to 2024, as shown in Table 1, highlights some noticeable patterns related to driver age, vehicle type, time of occurrence, and season. Among the different age groups, drivers aged 18-30 years were involved in the highest number of accidents throughout most of the period, varying from about 30% in 2020 to 16.67% in 2024. This pattern is likely attributable to limited driving experience, higher risk-taking propensity, and lower hazard perception among younger drivers, factors well established in traffic safety literature. Drivers from 30 to 50 also show substantial potential involvement, peaking around 32% in 2023, while drivers over 50 years are minimally involved due to reduced mobility and more cautious driving behavior. When it comes to vehicles, trucks are involved in most of the accidents. They were about a third in 2019, went up to around 43% in 2023, and then dropped a bit in 2024. This trend aligns with the dominance of freight traffic along the Dhaka-Mymensingh highway, which carries a high volume of industrial and long-distance vehicles. The number of bus accidents shows considerable variation; for instance, nearly half of the bus-related crashes occurred in 2019, then less than 10% of them did so in 2023, but more than all the buses went ahead and did it again anyway by 2024. Some cars and a few three-wheelers turn up, but most of the time, less than 15%, and nothing much. Temporal analysis indicates that daytime accidents predominated in earlier years, peaking at 73% in 2021. A marked shift occurred in later years, with nighttime accidents exceeding 60% by 2024. This increase is consistent with reduced visibility, driver fatigue, higher off-peak speeds, and inadequacies in roadway lighting. Seasonal variation shows that the summer and monsoon months are worse, with perhaps half the crashes occurring during summer 2024. Adverse weather conditions during these periods, such as slippery pavements and increased pedestrian activity, are associated with this trend. Winter months recorded fewer accidents because drivers often maintain speed due to foggy conditions and the overall low volume of traffic. Overall, young drivers' involvement, heavy vehicles' dominance, increasing nighttime travel, and seasonal hazards are key contributors to road accidents in Joydebpur. These findings underscore the need for targeted safety interventions, including heavy-vehicle regulation, enhanced nighttime traffic management, and season-specific mitigation strategies.



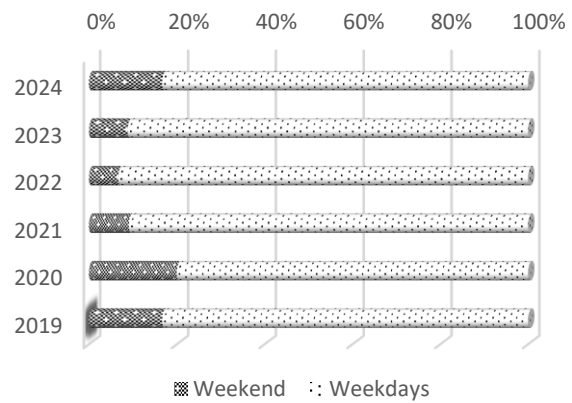
a): % of road accidents by age group



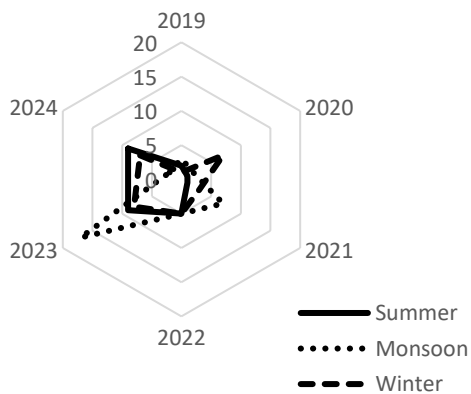
b): % of road accidents by vehicle



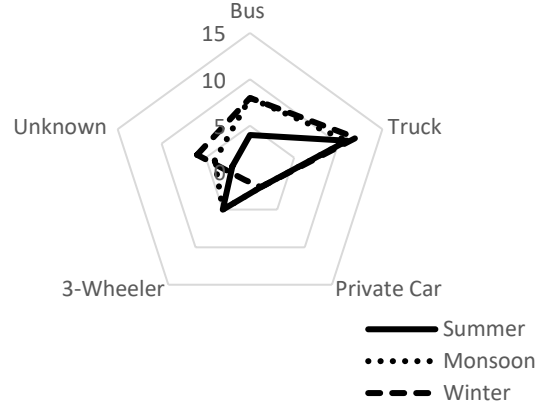
c): % of road accidents by weekdays & weekend



d): % of road accidents by daytime



e): Seasonal variation of road accidents across years



f): Seasonal variation of road accidents by vehicle

Figure 3 shows the percentage of accidents from 2019 to 2024. The accident rate is gradually increasing over the year. Peaking at about 37% in 2023, before a small decrease in 2024. An increase in the number of accidents that there are more vehicles on the road because of industrial expansion and rapid urban development in this area. The partial drop in 2024 is due to the improvement of infrastructure, road repairs, etc.

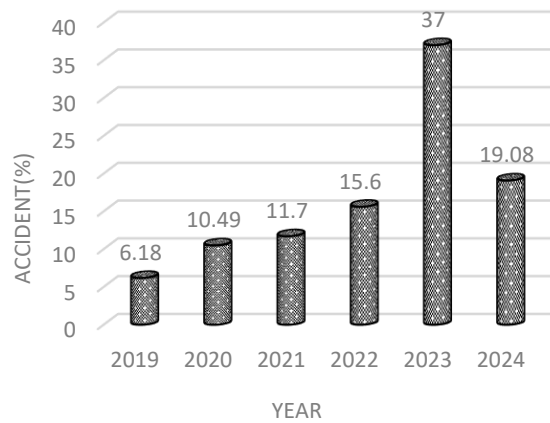


Figure 3: Yearly distribution of road accidents (2019–2024)

### 3.2 Location Map Of The Most Hazardous Road

Figure 4 shows that the location of the most hazardous road is between these wards. Dhaka-Mymensingh road is the most accident-prone road with comparison to other local roads. More crashes occur on this highway because of over-speeding, lane-changing behaviour, the absence of a service road, and inadequate signage. Which is located along wards 19, 22, and 23, which means these are high-risk areas. Therefore, from the accident plot, these corridors need special attention. Traffic control, keeping speed checks, and driver alert, etc. types of measures that will help to reduce the number of crashes in this corridor.

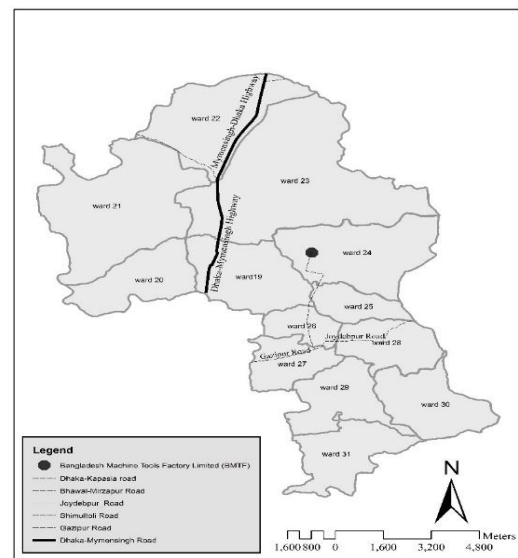
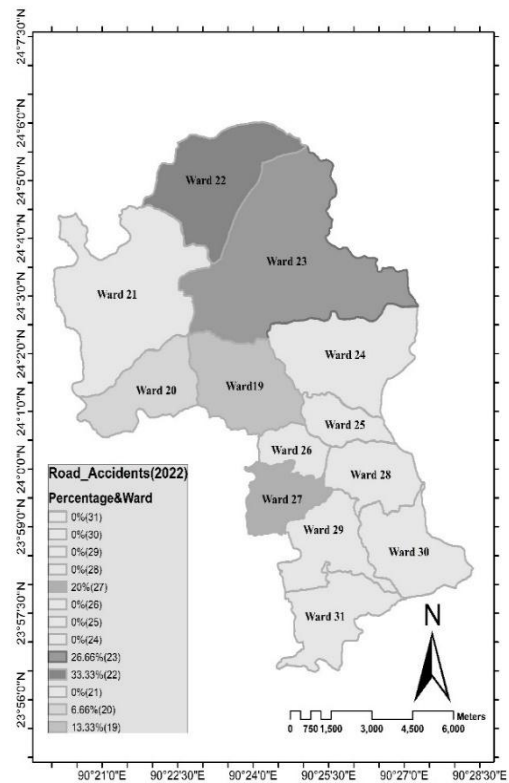
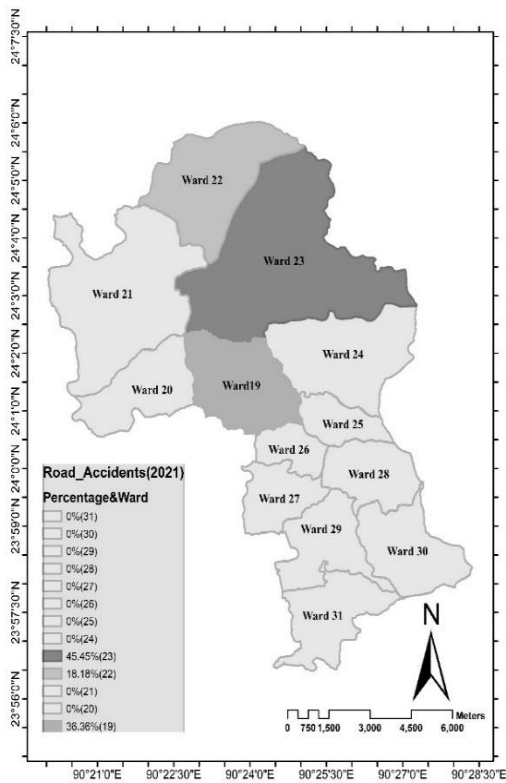
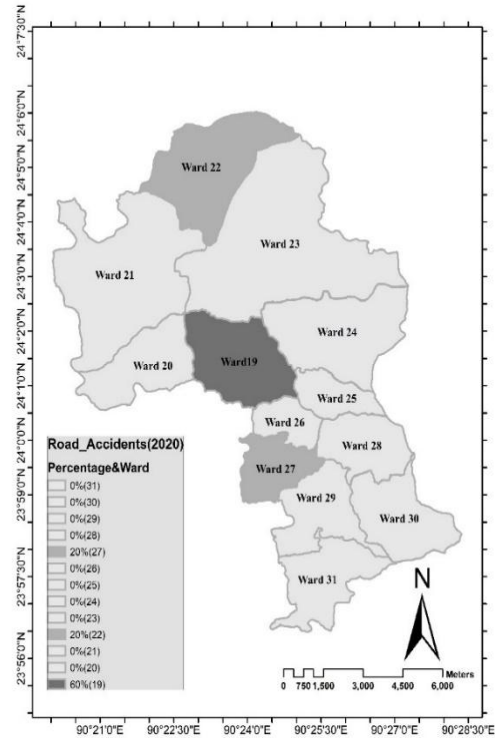
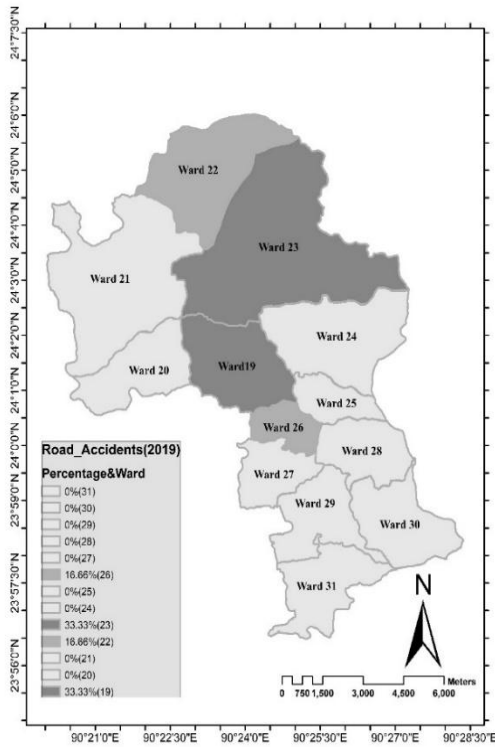


Figure 4: Location map of the most hazardous road

### 3.3 Location map of the most hazardous ward

The distribution of accidents in Joydebpur from 2019 to 2024 was analysed using GIS mapping. We can see from Figure 5 each map for each year. Most years, it shows that Ward 22 is the worst spot, with the most accidents, especially in 2023, and then it declines a little in 2024. Ward 22, located along the Dhaka-Mymensingh highway, consistently had the highest number of accidents due to high traffic volume, heavy vehicles, high-speed travel, and frequent intersections. Wards 19 and 23 also have frequent accidents due to a similar reason. Ward 27, situated on the Gazipur-Joydebpur road, showed a gradual increase in accidents due to growing traffic and limited traffic control measures. Wards 21, 25, and 30 have no accidents at all, reflecting lower traffic exposure. Overall, the GIS-based visualization highlights Ward 22 as the most accident-prone area, followed by wards 19, 23, and 27, emphasizing the need for targeted safety interventions in these high-risk zones.



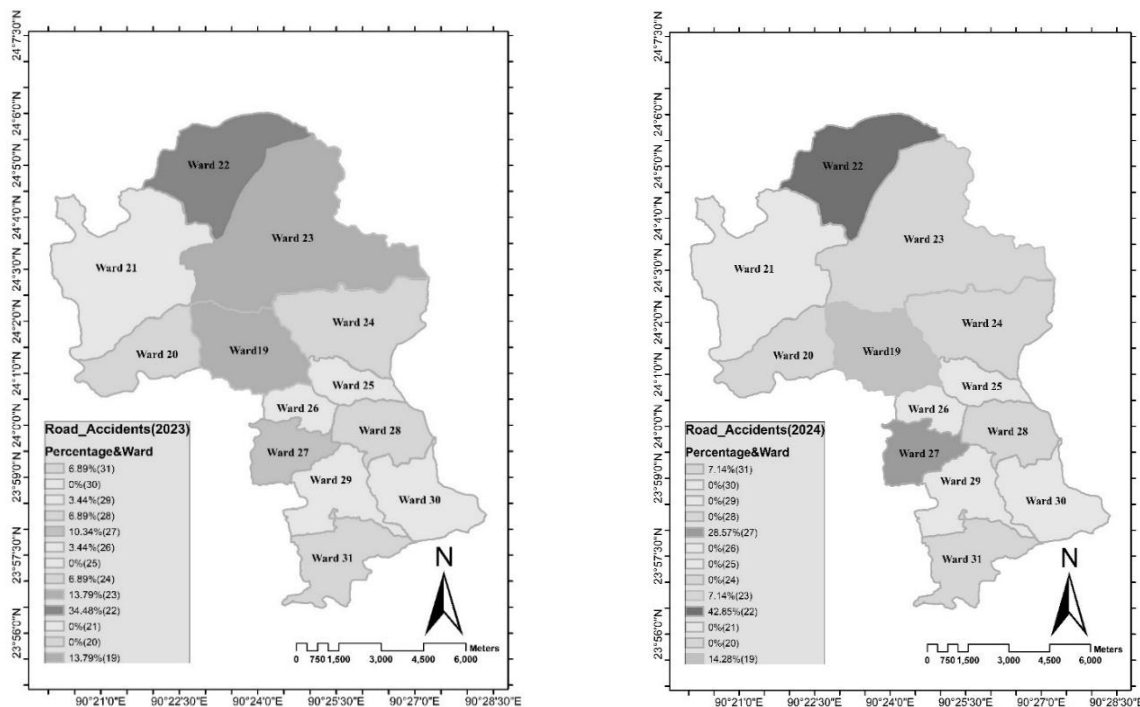


Figure 5: Location map of the most hazardous ward (2019-2024)

## 5. CONCLUSION

The study looks at six years of road accident data (2019-2024) from Joydebpur Sadar Thana and shows some patterns of accidents. According to data, most accidents happened in 2023, about 37%. The age group between 18-30 is more engaged, and trucks cause a big part of these accidents. Many accidents also happen during public holidays because many people travel at that time. Daytime had more accidents because of more vehicle movements, as well as pedestrians on the road. This study reveals that in summer and monsoon seasons, there is higher number of accidents than in winter. In terms of location, wards 22 and 23 face more accidents than others. The Dhaka-Mymensingh highway experiences frequent accidents as this road is always busy. Finally, the results suggest that controlling traffic rules, alerting younger drivers, and better roads with proper speed control could help reduce these problems.

## DECLARATION OF USE OF AI:

The authors declare that artificial intelligence (AI) tools were used solely for grammar checking, spelling correction, and minor language refinement during the preparation of this manuscript. No AI tools were used to generate scientific content, perform data analysis, develop methodologies, or interpret results. All research design, experimental work, data interpretation, and conclusions were fully conducted and verified by the authors.

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