CHARACTERIZING HAZARDOUS ROAD LOCATIONS AND BLACK SPOTS ON ROUTE N8 (DHAKA-BARISAL NATIONAL HIGHWAY) OF BANGLADESH

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ABSTRACT

Road traffic accidents and corresponding causality are the most concerning issues in the transportation sector of a developing country like Bangladesh where road crashes are remarkably high. According to police reported road traffic accident database, every year about 2800 or more accidents occur in Bangladesh. This research analyzes the various accident data from year 2007 to 2012 using Microcomputer Accident Analysis Package (MAAP5) software in route N8 (Dhaka – Mawa – Barisal – Patuakhali National Highway) in Bangladesh. This research reveals accident prone locations which are commonly termed as black spot and Hazardous Road location (HRL) on the route N8 followed by establishing maps by Geographic Information System (GIS). Head-on, rear-end, overturning, side-swipe and hit-pedestrian are the most dominant types of accidents. Analysis shows that maximum number of accidents occurred in fair weather in route N8. The result clearly indicates that buses contribute mostly in the accidents.

Keywords: Accident, Dhaka-Barisal (N8) Highway, Black Spot, Hazardous Road Location, GIS, MAAP5.

Introduction

Road safety problem draws significant attention in a developing country like Bangladesh where road crashes are extremely high. Road traffic accidents and the corresponding deaths are the most concerning issue in the transportation sector of the world. According to WHO's global status report on road safety 2015, more than 1.25 million people die each year on the world's roads. Only 28 countries, covering 7% of the world's population, have comprehensive road safety laws on five key risk factors: drinking and driving, speeding, and failing to use motorcycle helmets, seat-belts and child restraints (WHO, 2015). It has been estimated that over 300,000 persons die and 10-15 million persons are injured every single year in road traffic accidents throughout the world. Detailed analyses of global accident statistics indicate that fatality rates per licensed vehicle in developing countries are very high in comparison with the industrialized countries. Statistics demonstrates that Bangladesh is the most dangerous country in terms of number of accident among the South Asian countries. According to police reported road traffic accident database, every year about 2800 or more accidents occur in Bangladesh. But the actual estimated road fatalities are as high as 10,000-12,000 each year (Rabbi, 2013). Other sources estimated the fatalities as high as from 12,000 to 20,000 per year. Ahsan, et al. (2012) identified that every year thousands of people are killed in road accidents in Bangladesh and 21 percent of them are children. The safety problem is very severe by international standards with some 60 to 150 fatalities per 10,000 motor vehicles in Bangladesh compared to around 25, 16, 2 and 1.4 in India, Srilanka, USA and UK respectively (Road Safety Fact, 2012). Moreover, road accidents have been shown to cost around 1% of annual gross national product (GNP) resources of developing countries, which they can ill-afford to lose. Hence it is necessary to incorporate steps which can reduce road accident rates and implement mitigating action, which can be taken to reduce the number and severity of road accident (Baguley et al, 1994; Kalga and Silanda, 2002).

The contributing factors for road accidents are typically classified into those associated with the driver, vehicle, and the environment. Contributing factors associated with the driver include error, speeding, experience, and blood-alcohol level. Factors associated with the vehicle include its type, condition and center of gravity. Environmental factors include the quality of the infrastructure, weather, and obstacles. The majority of road traffic accidents are attributed to driver factors (Evans, 1991), and this holds for many other modes such as boats (Bob-Manuel, 2002), bicycles (Cherington, 2000) and Snow mobiles (Osterom and Eriksson, 2002).

In Bangladesh there are many sources for collecting road accident data e.g. police records, hospitals, newspaper reporting etc. However the primary source of accident data is the Accident Report Forms (ARF), which is primarily filled up by police personnel. For each accident the ARF is completed by a sub-inspector of police after visiting the accident spot. The ARF is then dispatched to the respective Accident Data Units (ADU) where the information from ARF and location of the accident is

incorporated into Microcomputer Accident Analysis Package (MAAP5). The MAAP5 system is used to analyze accident database and provide the pattern of accidents in the country (Road Safety Fact, 2012). Being a developing country the road safety situation in Bangladesh is very severe compared to international standards. Some major reasons contributing to these are drivers fault, lack of infrastructure, topography, road geometry, environment and weather conditions etc. Dhaka – Mawa – Barisal – Patuakhali national highway (N8) is one of the major routes where a lot of road accident took place.
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Although developing countries have a much little share of registered vehicle, percentage of deaths is quite high there (Hoque et al., 2001). The fatality rate in road crashes is very high accounted about eighty five deaths per ten thousand registered motor vehicles per year in Bangladesh. Dhaka – Mawa – Barisal - Patuakhali national highway (N8) is a major route where huge number of accidents occurs. Although Dhaka to Mawa (or Barisal or Patuakhali) is also covered by waterways, pressure on surface transport is relatively low for this route. Recently the construction Padma Multipurpose Bridge has commenced to connect the south-western parts with the capital at Mawa-Jajira point (Padma Multipurpose Bridge, 2013). It is obvious that the Average Daily Traffic (ADT) of N8 will be much higher than before. So it is high time to analyse the accidents in this route, and establish engineering countermeasures for enhancing the safety situation of this route.

This study focuses particularly on accidents in the N8 route aiming to examine the distribution of accident based on types with particular emphasis on identification of Hazardous Road Locations (HRL) and Black Spot. Accident database shows that in 2007-2012, 398 accidents occurred in this route. Among them 311 accidents are fatal and fatality index was 1.27.

LITERATURE REVIEW

An in depth literature review was conducted before working out the investigation of accident by Microcomputer Accident Analysis Package (MAAP5) and Mapping of Black Spot using GIS on Dhaka – Mawa – Barisal – Patuakhali (N8) highway.

Traffic accident database is extremely inadequate in developing countries. Under-reporting of accidents is another limitation of accident record keeping system. For example approximately 50 percent of fatal accidents are under-reported such as Vietnam, Thailand (WHO, 2013).

Accident Database and GIS History and Application in Transportation

GIS is a computer system for capturing, storing, querying, analyzing and displaying geographic data. GIS represents a new paradigm for the organization of the information and the design of information system, the essential aspect of which is the use of concept of location as the basis of structuring of information systems. GIS permits user to display database information geographically. The most useful aspect of GIS as a management tool is its ability to associate spatial objects such as street name, route number, with related information like accident cause etc. In recent years, there has been much discussion about GIS technology and applications across a wide variety of settings. Moreover, there have been many GIS-related developments in transportation planning and engineering (FHWA, 1993; Lewis, 1990; Kim and Levine, 1996).The power of them is rooted in the fact that GIS allows inferences to be drawn about the spatial nature of the data. Examples of GIS applications in transportation include pavement management systems that work with road design, highway mapping, optimal vehicle routing, automated mapping /facilities management (AM/FM) used for infrastructure management, drainage design, traffic modeling and accident analysis, anddemographic analysis for funding justification (Antenucci *et el*. 1991). In developed countries, especially the US and Western Europe, GIS technology has been widely applied to urban traffic information management.

Meyer and Sarasua (1996) focus a common and coordinated data system that will serve all aspect of transportation management like congestion, bridge, safety, public transportation etc. Martin (1993) proves that incorporating GIS in a pavement management program improves the reporting and analysis of data through the production of maps and graphic displays. In a separate study by Johnson and Demetsky *(*1994), the capabilities of GIS in providing a framework for a management system were proven once again. Faghri and Raman (1995) developed a GIS –based traffic system for traffic accident information for Kent Country, Delaware. This system include knowledge about the crash condition such as incident site, frequency and point of road way.

Hoque (2013) asserts that vulnerable road users (VRUs) account for over 50% of road traffic casualties. He also reports that 70% of crash fatalities occur in rural areas and the key risk factors include high speed of motorized traffic, the mix of heterogeneous traffic, and the presence of a high number of vulnerable road users. Rósen et al., (2011) stated that VRUs can survive from a crash with motorized traffic more likely if the impact speed is reduced.

Another study Apparao et al. (2013) focus on identification of accident black spots for highway using GIS for some developing countries. Road traffic accidents have been recognized as one of those adverse elements which contribute to the suffocation of economic growth in the developing countries, due to the high cost related to them, hence causing social and economic concern. So Traffic safety is an important key and integral role in sustainable transportation development areas. Alam and Ahsan (2013) also focus on GIS maps for clear identifying accidents concentrating on the portion of the Dhaka – Chittagong Highway which requires proper treatment and remedial measures to decrease the higher accident rates. Shifun (2007) also did the similar work on a section of Asian highway (Dhaka-Aricha).

Accident Data Analysis Using MAAP5 and GIS

The accident analysis was done on N1 National Highway by analyzing six years accident data from the year 2004 to 2009. The accident data was collected from the MAAP5 database of Accident Research Institute (ARI) of Bangladesh University of Engineering and Technology (BUET). The (HRL) and Blackspots were identified by analyzing total and fatal accident data on the highway. Accident data was analyzed at every 100 meter interval on the road. The locations which have three or more fatal

accidents and/or five or more total accidents during the six year time period have been identified as HRL (Alam et al., 2013). Shifun (2007) has an analysis on a portion of N5 National Highway named Dhaka-Aricha highway by analyzing seven years accident data from the year 1998 to 2004. The locations which have at least three accidents during the seven year time period have been identified as HRL.

METHODOLOGY

This study involves the accident data collection, data analysis by using MAAP5 software, and site investigation followed by a questionnaire survey and finally establishes a map where black spot and HRL were identified using GIS.

Data Collection

Data collection was conducted from two sources. Data on traffic crashes were collected from Accident Research Institute (ARI), BUET which is one of the major official sources of accident data in Bangladesh. The Accident Report Forms (ARF), are primarily filled up by police personnel nearby the accident location. Later the ARF are compiled by ARI to work it with MAAP5 software. Accident data were analyzed for the period of 6 years (2007-2012) for identifying black spot or HRL. Crash data was analyzed by MAAP5 software and findings were organized by accident severity, accident categories, accident period, collision type, vehicle involvement in the accident, accident location, type of pedestrian casualties etc.

Procedure of preparing map

Subsequently map displaying HRL or Blackspot will be generated using those crash data. From this analysis we can finally conclude where improvement should be made or we can identify the black spots where accident occurs frequently. Following steps were followed for identifying the Blackspot and HRL.

- Collecting of digitize map of shape file of road network of Bangladesh and to select a projection system for the digitized map. MAAP5 based analysis gives the Kilometer post and coordinate of accident location.
- Export the accident attribute table generated in dbase format so that it can be imported to ArcMap and join attribute table to map. The coordinate value has been extracted from attribute table and placed in N8 shape file.
- Finally establish the accident Blackspots or HRL on the given road network.

The steps for Blackspot & HRL identification is shown in Figure1. On any road network, it has been seen that accidents are not randomly distributed, but are clustered at certain locations. Accident data was analyzed at 100 meter interval on the N8 route. The location is termed as black spot if a 100 meter segment of a highway the accident number is three or more in 5 year period. Similarly in a 1000m segment of a highway if accident number is four or more in 5 year period then the location is termed as hazardous road location (HRL). The procedure followed in identification of Blackspot or HRL on Dhaka-Barisal highway is divided into few steps. The steps are shown in Figure 1:

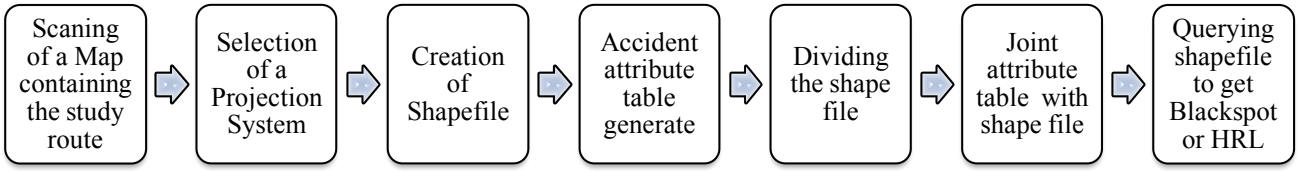

Fig. 1 Steps Followed in GIS for Blackspot & HRL identification

Data Analysis using MAAP5 Software

This section discusses the characteristics and striking features of overall road traffic accidents on national highways in Bangladesh. Accident data were analyzed for the period of 6 years from 2007-2012. The analysis involves the determination of accident and severity in the following two categories:

1. Accident of all route in Bangladesh
2. Accident of N8 route in Bangladesh (Dhaka – Mawa – Barisal - Patuakhali National Highway)

The analysis of crashes involves the determination of accident and severity depending on several features. Accident of all routes in Bangladesh is shown in Table 1.

Accident Severity: Table 2 shows that accident in different routes of national highways in Bangladesh. Percentage of accident was 19%, 16%, 8%, 8%, 24%, 5%, 7%, 9% and 4% in route number N1 to N9 respectively. It can be observed that 80% of all accidents are fatal and 15% are grievous type. Fatality index appears highest (1.59) in route N4.

Table 1: Distribution of accidents by route

Name of Route	Length (km)	Accident number	Accident per km
Dhaka - Chittagong - Cox's Bazar - Teknaf (N1)	455	830	1.82
Dhaka- Sylhet –Jaflong (N2)	286	684	2.31
Dhaka - Tongi-Mymensingh (N3)	112	347	3.09
Joydebpur -Tangail - Madhupur – Jamalpur (N4)	146	361	2.47

Dhaka -Nabinagar -Manikganj - Bogra - Panchagarh (N5)	507	1036	2.04
Kashinathpur - Pabna- Rajshahi (N6)	150	205	1.37
Daulatdia Ferryghat – Goalchamot- Khulna – Digraj (N7)	252	302	1.2
Dhaka – Mawa- Barisal -Patuakhali(N8)	191	398	2.08
Jamuna Approach Road (N9)	43.1	154	3.57

Table 2: Distribution of accidents by severity

	Accident					Casualty					
Route no.	Fatal	Grievous	Simple	Collision	Total	Fatal	Grievous injury	Simple injury	Total	% of total fatality	Fatality index
1	670	108	25	27	830	1242	269	46	1557	19.78	1.50
2	547	108	17	12	684	1025	239	31	1295	16.45	1.50
3	296	39	7	5	347	495	92	11	598	7.60	1.43
4	297	44	11	9	361	575	100	22	697	8.86	1.59
5	803	167	41	25	1036	1386	348	73	1807	22.96	1.34
6	170	25	7	3	205	264	63	9	336	4.27	1.29
7	227	61	8	6	302	437	119	18	574	7.29	1.45
8	311	69	12	6	398	507	154	34	695	8.83	1.27
9	115	26	5	8	154	222	76	14	312	3.96	1.44
Total	3436	647	133	101	4317	6153	1460	258	7871	100	1.43

Road Class: Figure 2 demonstrates accidents in different routes depending on road class. Result shows that 46% of total accident occurred in national highway which was the maximum. 18% of the total accident took place in city road, and 14% was in regional road.

Collision Type: Figure 3 shows that 42% of total accidents was vehicles hit pedestrians type, while head on collisions was about 23% of total accidents. Rear end collisions were 13% of the total accidents.

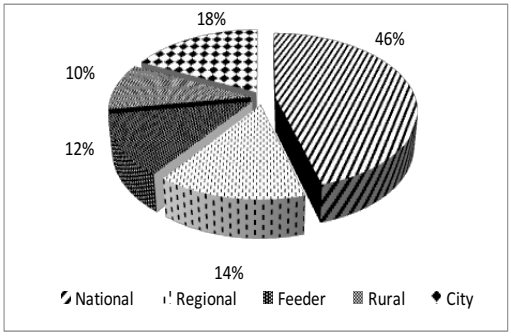

Fig. 2 Distribution of accidents by collision type

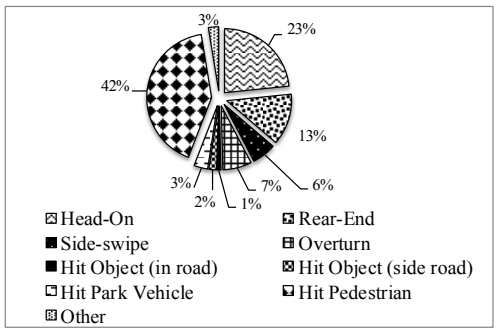

Fig. 3 Accident in different road class

Pedestrians Accident: Figure 4 shows a comparison between total number of accidents and pedestrian accidents in different routes of Bangladesh. Figure 4 demonstrates clearly that in N3, N6, N7, N8 and N9 the difference between the total number of accident and the total pedestrian accident in the routes are comparatively less, which means that pedestrian accident frequencies are higher. Figure 5 shows that 89% of pedestrian accident was fatal and 10% was grievous injury.

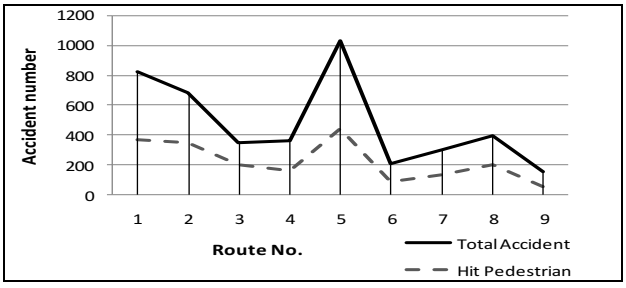

Fig. 4 Accidental number of hit pedestrian and total accident

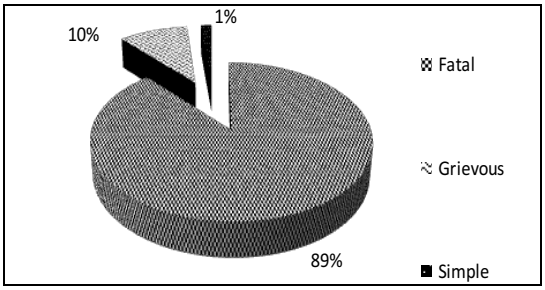

Fig. 5 Distribution of accidents by pedestrians severity

Accident in route N8 in Bangladesh

The analysis involves the determination of accident and severity features according to environmental characteristics, road related characteristics, vehicle, driver, pedestrian related characteristics and other contributing characteristics.

Environmental characteristics

i) Year: Table 3 illustrates yearly distribution of accident and corresponding causality. In 2007 casualties per accident rate was 1.45 and in 2010 the rate was the maximum (2.12). In 2012 casualties per accident was 1.70. Although accident frequency is decreasing but casualties per accident are rising.

Table 3: Distribution of accidents and casualties by year

Year	Accidents number	Casualties number	Casualty/accident
2007	100	145	1.45
2008	110	178	1.62
2009	64	132	2.06
2010	41	87	2.12
2011	40	80	2
2012	43	73	1. 70
Total	398	695	1.75

ii) Month of year: Figure 6 shows that accidents were higher during the month of December, March, April, May, and January.
iii) Time of Day and Lighting Condition: Figure 7 illustrates hourly distribution of accident in route N8. It is clear that accidents are more frequent between 9.00am-12.00pm. It is about 23% of total accident. In between 12.00pm -3.00pm the accident frequency is also high.

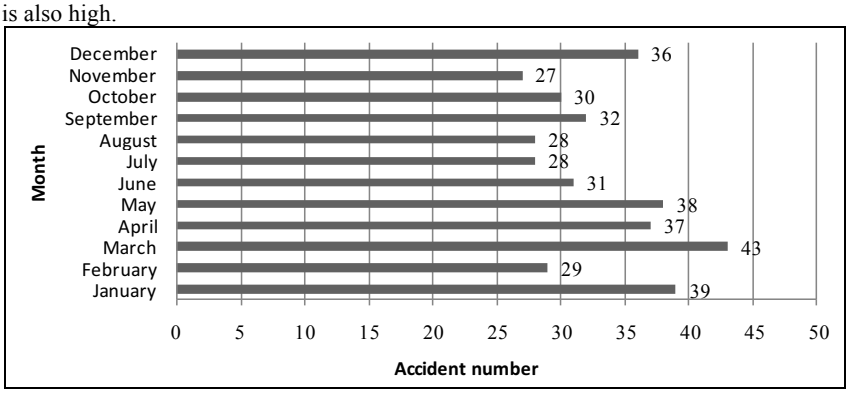

Fig. 6 Accident distribution by month

Figure 8 makes clear that, most of the road accident and corresponding casualties occur in day period. The frequency of accident in dusk is 12% of total accident in route N8. At night when it is dark 11% of total accident took place. It should be noted that at night traffic volume in route N8 is comparatively low.

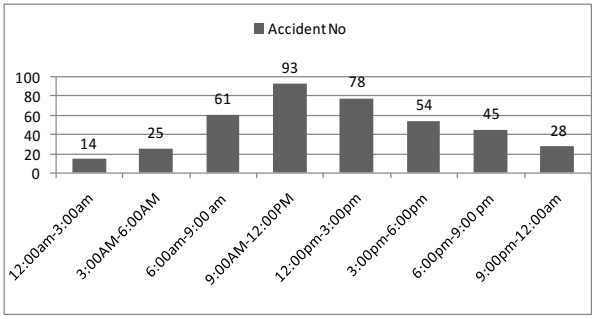

Fig.7 Accident distribution by lighting

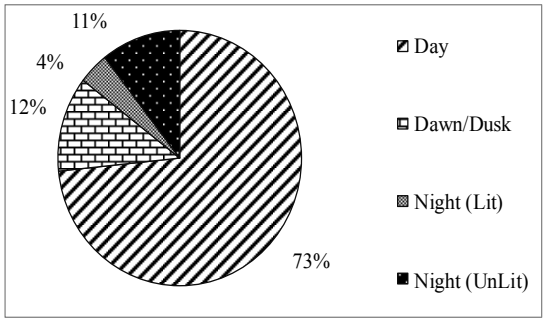

Fig. 8 Accident distribution by time of the day

iv) Weather conditions: Table 4 shows the relationship of weather and vehicular contribution with accident rate. Analysis shows that maximum number (94%) of accidents occurred in fair weather in route N8. Bi-vehicular accident frequency represents the accident between two vehicles occurring in a particular weather. Bi-vehicular accident frequency is 57.15% in rainy weather. It is determined by the percentage of accidents occurring in contribution to two vehicle divided by the total number of accidents in that particular weather.

Table 4: Distribution of accidents by weather

Weather	Accident Number		
	No. of vehicles contribution in accident	Total	Bi-vehicular accident frequency

	1	2	3		
Fair	242	132	1	375	35.2%
Rain	6	8	0	14	57.15%
Wind	0	1	0	1	100%
Fog	5	3	0	8	37.5%
Total	253	144	1	398	

Road related characteristics

i) Type of junctions: Figure 9 shows the distribution of accident in different types of junction. 82% of total accidents occur in non-junction in route N8. In other types of junction and T junction the percentage of accidents are 9% and 5% respectively. Figure 10 shows that, the distribution of fatal accident in different types of junction. 84% of total accidents occurred in non-junction referring to straight portion of road in route N8. In round junction and T junction the accident frequency is 7% and 4% respectively.

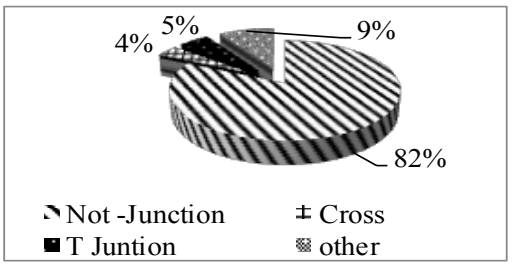

Fig. 9 Total accident distribution by different junction

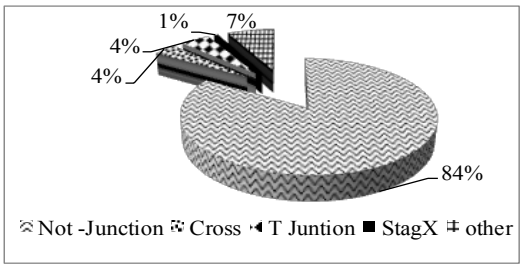

Fig. 10 Fatal accident distribution by different junction

ii) Road Divider: Result depicts that maximum accident (95%) occurs in the locations where no divider is present.
iii) Road geometry: Table 5 demonstrates the distribution of accident based on different road geometry. Most accident occurred in straight road in route N8.

Table 5: Distribution of accidents by road geometry

Road geometry	Accidents No
Straight	361
Curve	27
Slope	8
Curve & Slope	0
Crest	2
Total	398

Vehicle Related Characteristics

i) Vehicle damage: Figure 11 shows the distribution of accidents based on vehicle damage. It is demonstrated that 20% of the vehicles are suspected for both front damage and multiple damage. 50% of the vehicles had no damage. They are presumed to be responsible for pedestrian causality.

ii) Vehicle type: Figure 12 indicates contribution of different types of vehicles in accident. The result clearly reveals that buses contribute mostly in the accidents. Heavy trucks and motor cycles also contribute a lot to the accidents.

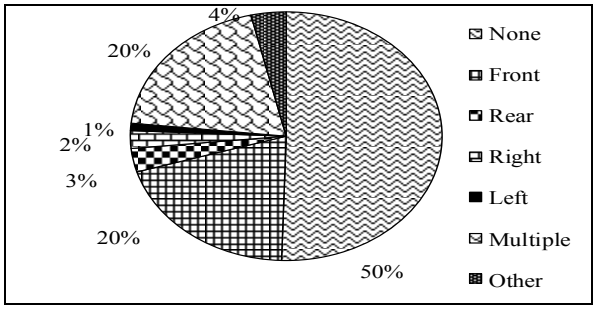

Fig. 11 Distribution of accidents based on vehicle damage

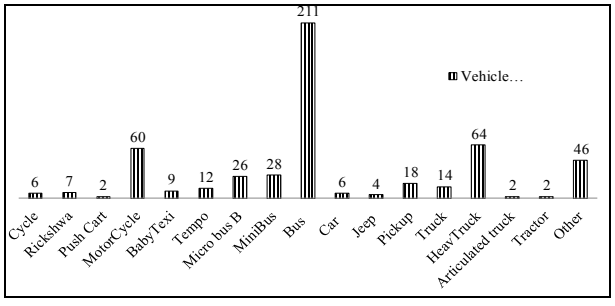

Fig. 12 Types of vehicles contributing in accident

Pedestrian related characteristics

i) Pedestrian Location and Action: Figure 13 shows the distribution of accident based on pedestrian position. When pedestrians walk/stay in road side then maximum (39%) accident occurs. 31% accident took place while pedestrians were on the road. Figure 14 shows the distribution of accident depending on pedestrian action. Fatal accidents as well as total accident frequencies are much while the pedestrian were walking on the edge or on the side of the road or along the shoulder.

ii)

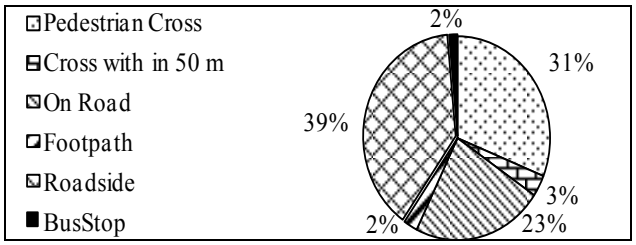

Fig. 13 Distribution of accident based on pedestrian position

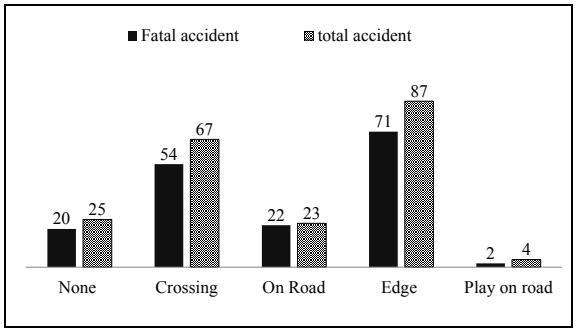

Fig. 14 Distribution of accident depending on pedestrian action

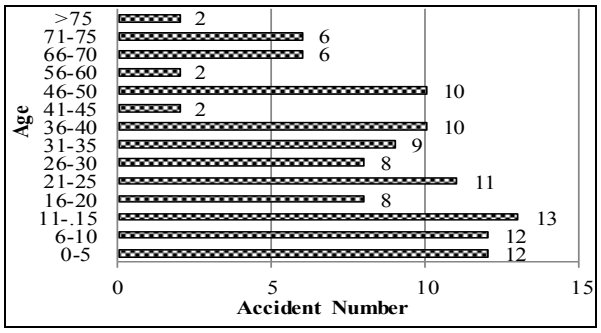

Fig. 15 Distribution of accident based on pedestrian's age

ii) Pedestrian age: Figure 15 shows the distribution of accidents based on pedestrians' age. It is found that accident frequency is most for youth group age ranging from 11-15years. Accident number is also high for 46-50, 36-40, 21-25, 6-10 and 0-5 years' old groups. Result shows that 82% casualties occurred for male pedestrians.

Contributing factors for accidents

Figure 18 clearly illustrates that pedestrian, road fault and over speed are the most important casual factors behind accident.

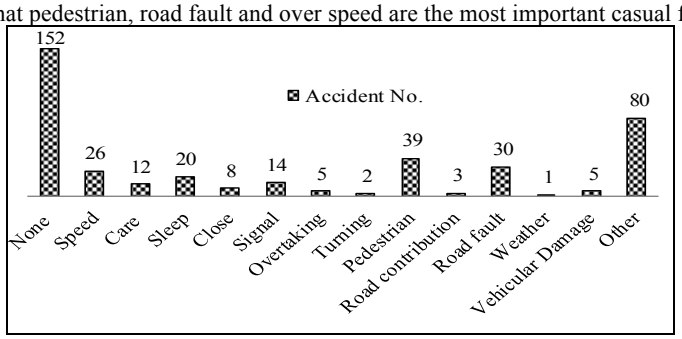

Fig. 16 Contributing factors for accidents

i) Drunk driving: It is evident from figure 17 that most of the drivers were not suspected for drinking alcohol.

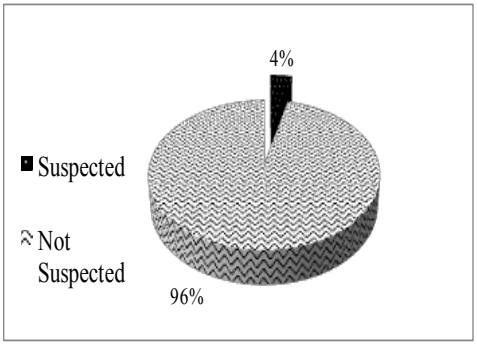

Fig. 17 Suspicion drunk driving

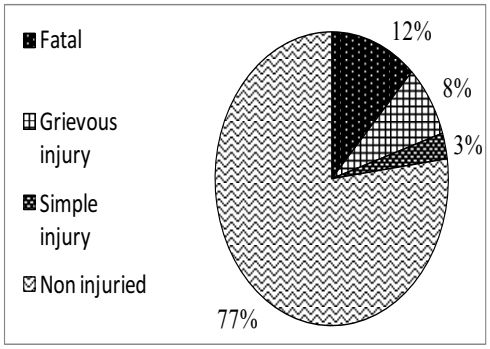

Fig. 18 Distribution of accident based on driver's injury

ii) Driver injury: Figure 18 demonstrates that percentage of driver's injuries is comparatively low while 12% are fatal accidents.

Black-spot or HRL Identification

The study investigated a total 191 km length of route N8. The highway under study encompasses varied geometrical and environmental conditions. For accident analysis purpose, the highway was divided into 1910 divisions where each section covered 100m length. The HRL and Blackspots of route N8 is presented in Figure 19. Seven HRL and seven black spots were identified in Dhaka – Mawa – Barisal - Patuakhali National Highway.

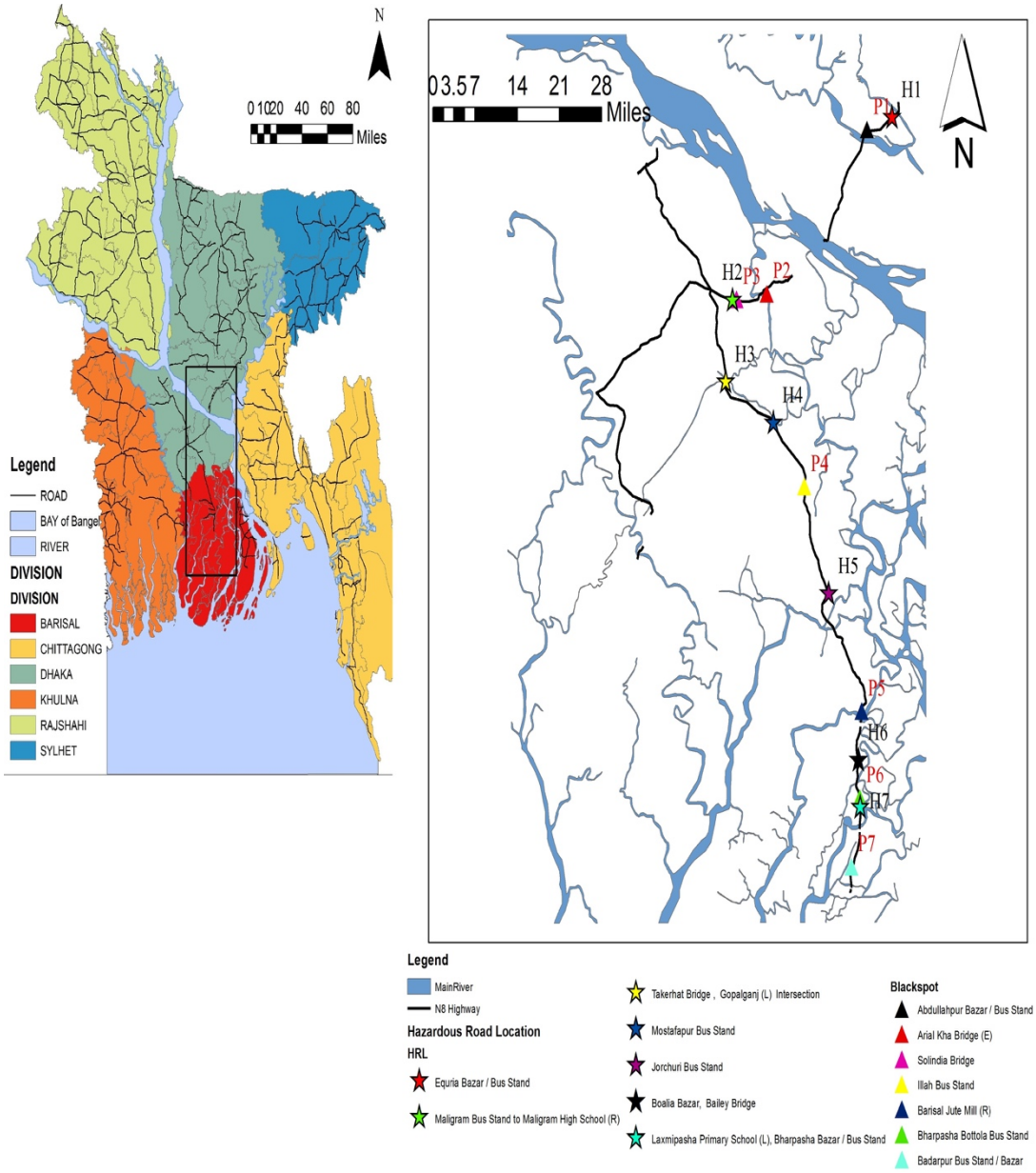

Fig. 19 Blackspot and HRL on N8 highway (Map.1)

Table 6: Blackspot or HRL on Dhaka-Barisal highway (2007-2011)

Type*	km Post	Length (m)	Location	Total accident
H1	7 to 7.5	500	Equria Bazar / Bus Stand	5
P1	13.9 to 14	100	Abdullahpur Bazar / Bus Stand	4
P2	50.8 to 50.9	100	Arial Kha Bridge (E)	3
P3	57.6 to 57.7	100	Solindia Bridge	3
H2	59 to 59.7	700	Maligram Bus Stand, Maligram High School (R)	12
H3	184.5 to 185.3	800	Takerhat Bridge, Gopalganj (L) Intersection	5
H4	199.6 to 19.8	200	Mostafapur Bus Stand	6
P4	214.9 to 215	100	Illah Bus Stand	4
H5	236.8 to 237	200	Jorchuri Bus Stand	4
P5	266.2 to 267.3	100	Barisal Jute Mill (R)	3
H6	271.1 to 272.1	1000	Boalia Bazar, Bailey Bridge	4
P6	278.5 to 278.6	100	Bharpasha Bottola Bus Stand	3
H7	280.1 to 280.4	300	Laxmipasha Primary School (L), Bharpasha bazar /Bus stand	4
P7	289.6 to 289.7	100	Badarpur Bus Stand / Bazar	4

* P= Black spot and H=Hazardous Road Location

SITE INVESTIGATION

Road conditions were investigated in black spots or HRL on N8 highway route. Following observations were obtained:

- Narrow road
- Narrow and risky bridge
- No shoulder No road marking
- Broken road surface
- Road blockage by para-motorized
- Shoulder damage due to rutting of soft soil
- Unsafe pedestrians action
- No-warning helmet during motorcycle driving
- Over-speeding and Over-taking tendency
- Have not proper space for bus stop/stand

Fig. 23 Narrow Bridge

Fig. 24 Risky Bridge

Fig. 25 Shoulder Damage

Fig. 26 Shoulder Damage due to Rutting of Soft Soil

Fig. 27 Soil Displacement from edge

Fig. 28 Road blockage by Para motorized vehicle

FINDINGS

From this study it is found that a total of 398 accidents have occurred on Dhaka – Barisal Highway during the six year duration from 2007-2012 and 311 accidents among the total are fatal. So, it is clearly visible that about 78% of the accidents are fatal which have caused severe casualty and loss to life as well as the economy of our country. The GIS maps prepared from six years accident data (2007 to 2012) have shown that 7 black spots and 7 hazardous road locations are situated on route N8. About 9% of the total accidents occurred in this portion of Dhaka-Barisal highway. Most important feature in this route is pedestrian causality which account for 51% of total accident. So it has been clearly identified that accidents are concentrated on this portion of the Dhaka –Barisal Highway. This portion requires proper treatment and remedial measures to decrease the higher accident rates. Dhaka-Barisal Highway has been selected from all the 14 hazardous locations on the basis of the highest number of accidents. Details accident analysis on this route on various parameters has given the following accident scenario: about 80% of the total accidents are fatal and per accident fatalities is 1.27. Accident and corresponding causality is 1.75. In 2007 casualty/accident rate was 1.45 and in 2010 the rate was maximum (2.12). In 2012 the casualty/accident was 1.70. Accident frequency is higher in the month of March, April, May, December and January. The accident frequency is highest between 9.00am-12.00pm. It covers 23% of total accident. Head-on, rear-end, overturning, side-swipe and hit-pedestrian are the most dominant types of accident. Accident and casualty statistics of 6 years (2007-2012) shows that, these five types account for 90% of total accidents in route N8. Analysis shows that maximum (94%) accident occurs in fair weather in route N8. But analysis of bi- vehicular accident shows highest accident frequency (57.15%) in rainy weather. Road fault and over speed is the most important casual factors behind accident. Bus and motor cycle are most accident prone modes of transport. 50% vehicles have found that no damage was occurred during accident. They are supposed to be responsible for pedestrian causality. Pedestrian casualties occur half of accidents. When pedestrians walk/stay in road side then maximum accident occurs. Most of the driver was not suspected for drinking alcohol. The driver injuries percentage is comparatively low.

CONCLUSION

This study suggests the factors contributing to accidents are road environment, weather, geometry, driver's characteristics and vehicular factors. This study will finally use GIS for identifying Black spot or HRL. This paper underlined salient features of road accident characteristics and delineated typical safety issues .Further site investigation is required to design appropriate remedial measures. The most evident point of this route is that about half of total accident results pedestrian causalities. Therefore pedestrian safety is a major concern for those routes.

Some more general recommendations are as follows:

- Narrow road and bridge is the main reason of accident in few Blackspot or HRL in N8.
- Markets located beside highways should be replaced to other place.
- Space should be provided for bus stop/ stand.
- Para-motorized vehicles block the highway space. So a proper management of these vehicles should be ensured.
- Adequate enforcement should be provided to ensure that the drivers follow the traffic rules strictly.
- Some facilities for pedestrians such as overpass, underpass, zebra crossing, pedestrian signal etc should be provided where required.
- Exclusive lanes for non-motorized vehicles should be provided which may reduce rare end collision.

There are some limitations in this study owing to the data sources and approach used for the analysis. The present study is based on the police crash report from ARI. The detailed information about the crash is limited due to the simplicity of crash report form. However, this study provides several comprehensions into the crash injury severity for considering mitigation strategies of traffic crashes in developing countries. Additionally road safety is a collective concernvfor decision-making by government as well as non-governmental organizations, industry and people from many different disciplines.

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