

## MARINE VEHICLE ACCIDENT CHARACTERISTICS IN BANGLADESH: STUDY ON COLLISION TYPE ACCIDENTS

Zobair Ibn Awal<sup>1</sup>, Dr. M. Rafiqul Islam<sup>2</sup> and Dr. Md. Mazharul Hoque<sup>1</sup>

<sup>1</sup> Accident Research Centre (ARC), BUET

<sup>2</sup> Faculty of Mech. Eng., Universiti Teknologi Malaysia (UTM)

### ABSTRACT

This study investigates the marine vehicle accident characteristics in the inland waterways of Bangladesh. The statistical study revealed that the leading causes of accidents were collision among ships, trawlers & country boats and loss of stability due to Nor'wester. The study also identified some other causes of accidents such as loss of stability due to rushing of passenger, overloading, grounding, etc. It was also observed that many accidents in Bangladesh often remain underreported due to less exposure to the media probably because the victims represent the poorer segment of the society. Based on this study a number of recommendations have been made for improving safety of marine vehicles in Bangladesh and for further research and investigations.

**Keywords:** Marine vessel, Inland waterways, Collision, Accident.

### 1. INTRODUCTION

The inland shipping industry plays a very significant role in carrying passengers and goods within Bangladesh. It provides naturally suitable and relatively cheaper means of transportation and is being considered as one of the most popular modes for carrying passengers and commodities particularly in the southern districts of the country. In Bangladesh the water transport network is both extensive and well-connected with the rest of the transport system. In terms of traffic intensity, the inland waterway network generates about one and half million passenger-kilometres per route-kilometre of waterway [1]. The density of inland ports and terminals is much higher with approximately three and half berthing facilities per one hundred route-kilometres. The density of passenger facilities on the inland waterways is also high at around forty per one hundred route-km. It is therefore, the Government's policy to consider inland water transportation as an essential mode of transportation for building a balanced multimodal transport system to confront the upcoming development challenges.

With the increase in population and the growing economy of the country, the waterways are getting congested despite the fact that the inland waterways are not expanding. Therefore, problems relating to maritime safety are emerging with new dimensions every day. In Bangladesh, maritime safety has become a severe issue when a number of passenger launch accidents killed several thousands of people within the past few years. In response to such emergencies, the government took some remedial measures which by some degree provided noticeable improvement to the safety scenario. However, the fact still affrights all is that accidents are still taking

place and often appear to be devastatingly fatal. The extent of damage and loss of property are tremendously expensive which severely puts substantial amount of burden on the national economy. There yet remain numerous deficiencies on maritime safety and the scope for improvements in this aspect is a contemporary demand.

This research work attempts to unveil the accident characteristics and patterns in the inland waterways of Bangladesh with particular emphasis on the collision type accidents; because collision of marine vehicles initiate from man made elements and these accidents are indeed preventable if systematic approaches are being taken. This study therefore, investigates 156 collision incidents out of 443 incidents that took place during the period of January 1981 to May 2007. The purpose of this paper is also to provide an explicit idea on the mechanism of accidents so that the problems can be easily comprehended and necessary actions can be taken by the appropriate authorities to stop such desolating incidents.

### 2. BACKGROUND STUDY

It has been observed that most studies and accident investigations highlight the marine vehicle accidents as isolated events particularly blaming the individuals directly related to maritime safety rather than delineating the problem more systematically and identifying the problems associated with respective stakeholders. For example, The Report of the Task Forces [2] avers that the fundamental problem relating to the inland shipping safety is that the private operators do not follow the rules and regulations for ship design, construction and operations. This is why their vessels lead to disastrous

and fatal accidents in the waterways. Preponderance of private sector in the inland water makes the assessment of operational efficiency difficult. Also, the private operators do not maintain regular and authentic statistics.

Similarly, some research concentrated on modification and augmentation of the rules and regulations of inland shipping studying events that appeared extremely devastating. Bangladesh Transport Sector Study [3] have classified the waterway accidents focusing on identification of broad types of waterway accidents and suggested several remedial measures commensurate with the classification of inland water transports. Huq & Dewan [4] studied the geographical locations of passenger launch accidents and provided some description of the accident sights along with description of the waterway networks. The study although handicapped by the limited number of accidents, however, concluded that most of the passenger launch accidents are of collision type. Some research findings by Khalil and Tarafder [5] discussed the issue of design modifications for improving the extra initial stability by upward shift of centre of gravity and thereby preventing the vessels from capsizing in times of emergency. Chowdhury [6] attempted to develop a GIS based accident information system for water transport accidents and recommended future research to be conducted on navigational system integrated with meteorological forecasting systems.

It was observed that due to deficiency in accident data very few studies have so far been conducted on identification of the accident characteristics from national perspective. For example, some statistical analysis has been published by Awal [7] in an attempt to identify the accident characteristics dealing with 197 accidents (passenger and cargo ships) which showed that majority of the accidents in the inland waterways of Bangladesh occur due to the effect of overloading and/or cyclone (43% of total accidents). However, the deficiency of the research was that the actual number of accidents was much higher than the studied number of accidents. Similarly another investigation by Awal, Islam & Hoque [8] dealt with sixty seven accident cases (passenger ships only) brought some interesting findings to light. It was ominous to note that fifty six percent of the passenger vessel accidents in Bangladesh end up in collision due to human error. The second largest cause was the loss of stability due to Nor'wester and overloading (21%). However, the results were still inconclusive because of insufficient accident data.

Nevertheless, it may be understood from the studies that there are indeed enormous scope of research and development in the field of accident data collection, analysis and investigation. Advances in such area will definitely help improving the safety of water transports; particularly studying the accident characteristics will provide the base line information for taking effective countermeasures and further advanced research and development.

### 3. DATA COLLECTION AND ANALYSIS

#### 3.1 Data collection and Methodology

The primary goal of this study is to compile and maintain a technical accident database working as a tool for in-depth accident analysis. Therefore, emphasis has been given on collection of accident data from various sources such as Daily Newspapers, reports of Department of Shipping (DOS) and Bangladesh Inland Water Transport Authority (BIWTA). It was observed that DOS and BIWTA store accident data essentially for legal purposes and give more emphasis on the parameters related to legal issues. Therefore, extractions of scientific data from these reports are very much cumbersome, time consuming and in most of the cases impossible. The problem even amplifies in the case of news paper reports which naturally put emphasis of the subjective matters rather than the technical parameters. Therefore, compilation of the database takes a pain staking cross matching with different sources of individual accidents in order to fill in a single accident report. However, a total of 155 collision cases are being considered in this study and a database has been developed using Microsoft Access which comprises nineteen different parameters. These parameters are then grouped into six major categories as shown elaborately in the database tree (Fig 1).

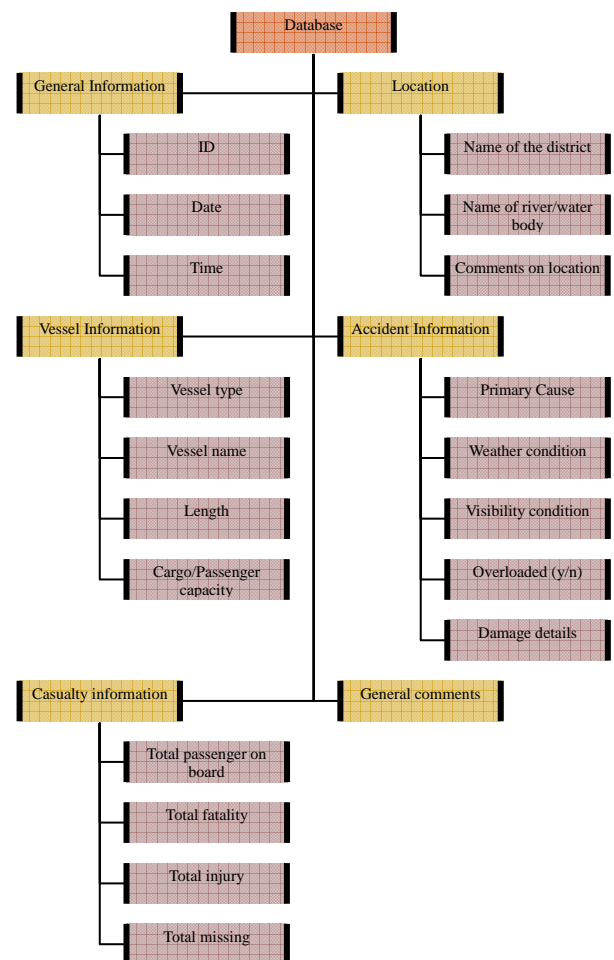


Fig 1: Database structure

The accident data was analysed using Microsoft Excel and the results have been represented in both graphical and tabular forms. Attempt has been made to keep the representation of the results as explicit and unambiguous as possible.

### 3.2 Analysis of Accidents

#### 3.2.1 Primary causes of accidents

Each year Bangladesh gets affected by Nor'wester and encounters serious damages of property and lives. The term Nor'wester is a meteorological term meaning a seasonal storm that appears from the north and western side of the map in the pre-monsoon season. These storms appear suddenly with extreme wind force but usually last for a very short duration. They often destroy houses, trees, electric poles, de-stabilise and capsize boats and ships in the rivers. It is observed from analysis of 442 accident cases that 44 percent of all the accidents take place due to adverse weather condition coupled with overloading of the vessels. The various causes of accidents as identified in this study are illustrated in Fig 2.

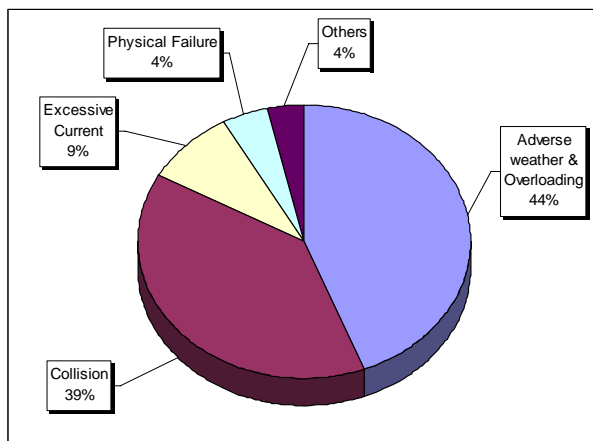


Fig 2: Percentage of accident types

Indeed, the reasons behind the accidents are very much explainable that takes place during the monsoon season. The vessels that face these catastrophic incidents are surely not capable of withstanding the wind and wave forces of the Nor'wester. These accidents are preventable either by not exposing the vessels in the adverse conditions or by constructing and using such novel ships that are literally unsinkable.

Nevertheless, the second major cause is found to be more alarming than any other causes of accidents that have been analysed. It is the collision type accident that has been observed as a serious problem for Bangladesh with a very high rate of thirty nine percent of all the accidents. Considering the severity it demands a great deal of attention to be looked into the mater.

#### 3.2.2 Vehicle involvements in accidents

Bangladesh is generally a highly populated country and the transportation network is basically expected to be congested all around the clock. The growing economy of the country is also increasing the transportation of goods and passengers not only between foreign countries but

also within the country as well. It is therefore, explainable why collision type accidents are on the higher side: the more exposed vessels in the restricted water areas the more likely collisions to happen.

It is distressing to note that most of the accidents of marine vehicles are passenger carrying launches, trawlers, boats and ferries (54 %) as depicted in overall accident analysis of marine vehicles in Fig 3. The analysis also suggests that the second major share is being held by cargo vessels (cargo ships and trawlers) with a significantly higher percentage of thirty nine. It is, therefore, very much deplorable to observe that passenger and cargo carrying vessels are encountering more accidents than any other type of vessels putting considerable anxiety on the society and enormous burden on the national economy.

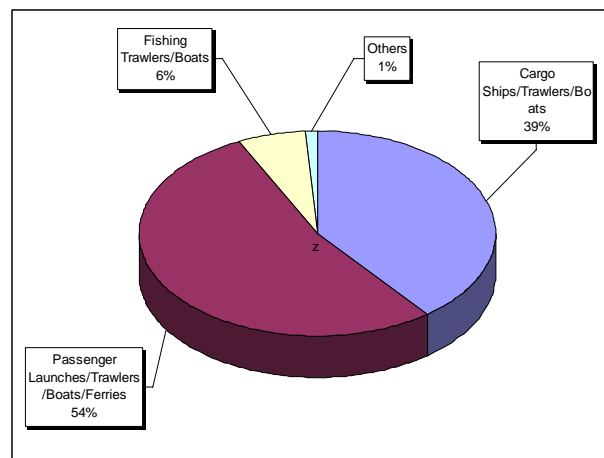


Fig 3: Percentage of vessel types

Since the principle objective of this study is to investigate the collision accidents of marine vehicles comprehensively, further analysis on vehicle types are being conducted. Seven different categories of vehicles have been taken into consideration such as: 1). Cargo Ships, 2) Passenger Launches, 3) Passenger Trawlers, 4) Cargo Trawlers, 5) Engine Boats, 6) Country Boats and 7) Others.

Cargo ships are basically larger vehicles which are made of steel hull and often designed with sub-divisional bulkheads to provide water tightness to the cargo holds. In addition, cargo ships contain cargo hatch openings on the upper deck through which the commodities are being loaded and unloaded. Also some cargo ships contain self-sufficient pumping facilities to load or unload liquid cargoes on or off the cargo holds. On the other hand, the passenger launches are generally made of steel hull with no designated cargo holds. Instead of conspicuous cargo compartments, passenger launches contain smaller private cabins to provide some luxury and privacy to the wealthy passengers. Nevertheless, in most of the passenger launches there remain large open spaces on the decks where the economy class passengers reside disorganised during a journey. It is worth mentioning that both cargo ships and passenger launches are designed with mechanical or hydraulic steering and mostly being used for medium to long distance travelling in Bangladesh.

Passenger trawlers and cargo trawlers are both similar kind of vehicles where the only difference lies on what they carry during their voyages; i.e if they carry passengers during a voyage, they are designated as passenger trawlers and if they carry cargo, they are called as cargo trawlers. Basically these vehicles are large wooden vessels with some steel plating adhered at the outer skin and also have engines mounted at the rear end. Most of them contain neither cargo holds nor passenger cabins except for a few enclosed spaces for the crews and therefore, these vehicles are used for medium to short distance travelling.

The engine boats are probably the most popular mode of transportations for medium to short distance travelling. Such boats are wooden made and propelled by agricultural multipurpose engines which are often known as shallow engines. These vehicles are relatively smaller than trawlers but noticeably larger than littler country boats. No compartments or enclosed spaces are found in this type of vessels and fundamentally these vessels have only one deck to carry passengers and their commodities and steers manually using locally made rudders.

The country boats in Bangladesh are many in numbers and varied in types with rich traditions that trace back hundreds of years in to the past. However, the common characteristic that most of the country boats possess is that all of them are non-mechanised and manually manoeuvred. Most of the country boats have the provision of being towed by the wind power using very traditional looking sails, particularly in the inland waters of the country.

As it is observed in this study that Bangladesh has a wide range of marine vehicles both in numbers and in types, but the problem related to safety is more associated with some specific types of vessels only. Investigations suggest that cargo ships and passenger launches encounter more collision than any other types of vessels. A count on the vessel types suggests the fact, as shown in Fig 4. It is observed that thirty eight percent of all the vehicles in collision accidents are cargo ships and nineteen percent are being passenger launches. Passenger and cargo trawlers also have a significant share in the pie (almost twenty percent).

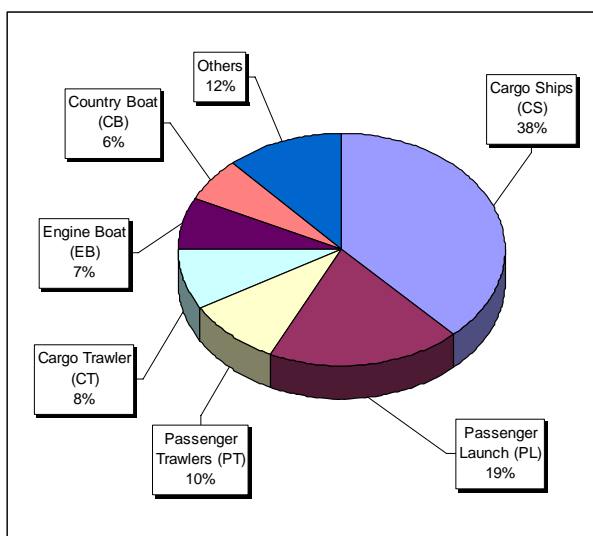


Fig 4: Share of different vehicles in collision accidents

A collision essentially takes two or more marine vehicles to occur and therefore it is absolutely important to know the distribution of involvement of vehicles in collision; particularly knowing the types of vessels hitting each other. Research findings suggest that the cargo vessels are involved by the most in comparison to any other type of marine vessels which are found to be involved in eighty percent of all the collision accidents. Fig 5 suggests that cargo ships hit most other marine vehicles in the water which is indeed a concern for all. The rest 20 percent of the accidents represents collision between passenger launches and country boats as shown in the figure.

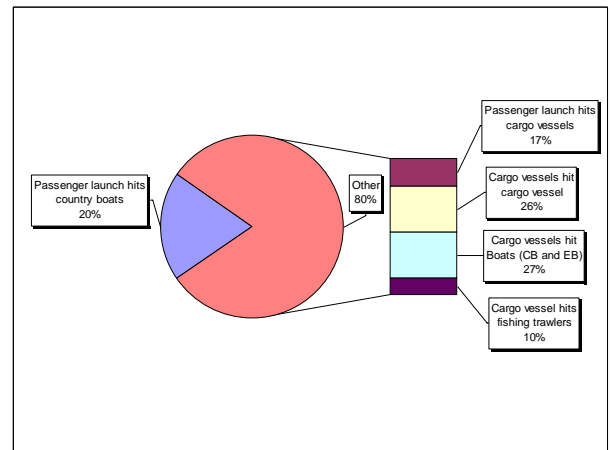


Fig 5: Percentage of collision accidents according to vessel types

Theoretically the collision type accidents are of several patterns such as head on collision, side on collision and rear end collision. An attempt has been taken to investigate these accidents but the study has been terminated due to limitation of the data. Most of the data sources do not keep records on such technical parameters such as collision angle and point of collision on the ships hull. Therefore, the exact percentages of these patterns of accidents are yet to be known.

### 3.2.3 Month and time analysis of accidents

The monthly distribution of accidents suggests some interesting findings as shown in Fig 6.

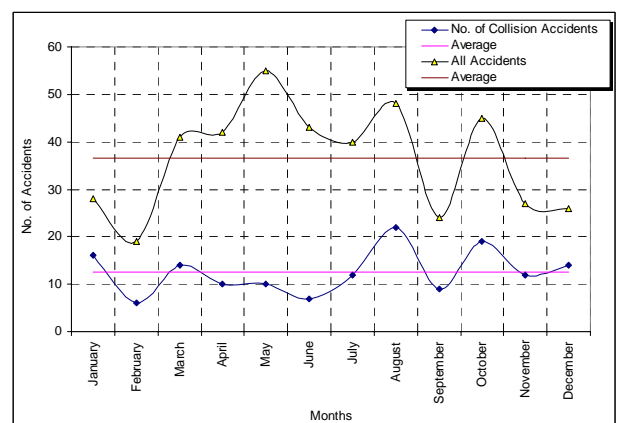


Fig 6: Monthly distribution of accidents

It has been observed in general that accidents in

Bangladesh occur almost all around the year with higher tendency during the monsoon season (March to July). During the monsoon season accidents occur above the average line but more interestingly it was observed that collision type accidents occur below the average line during the same period although the variation around the mean line is not as significant (standard deviation 4.74) as for the curve for all accidents (standard deviation 11.23). This implies that collision accidents are scattered all around the year and not dependent to particular months or weather type.

Analyses on hourly distribution of accidents suggest that accidents occur all around the clock except a very small percentage occur at the midnight hours as shown in Table 1. It is observed that among all the six time brackets (4 hours in each bracket) a lot of the accidents take place during 8:00 PM to midnight. The reason is very clear because in Bangladesh most the vessels ply without adequate navigational and lighting systems which results limited vision during the trips that they make during night time. Therefore, most of the vessels plying at night are exposed to high risks. However, it is more ominous to notice that the accidents are occurring mostly during the business hours and that is generally in the day time. If the cohorts 4:00 AM to 7:00 PM is summed up it results about 65 percent of all the collision accidents. It appears that although technical deficiencies and limited vision are significant contributors to the accidents but the elements may not be the only causes behind these catastrophes as accidents are occurring at a high rate during day time.

Table 1: Distribution of accidents in time bands

Time Bands	No. of Accidents	Percentage
00:00 - 03:59	6	6.90
04:00 - 07:59	19	21.84
08:00 - 11:59	16	18.39
12:00 - 15:59	13	14.94
16:00 - 19:59	9	10.34
20:00 - 23:59	24	27.59
Total	87	100

### 3.2.4 Weather and visibility during accidents

The weather-visibility cross tabulation suggests that collisions occur more in poor visibility conditions as much as in good visibility conditions as shown in Table 2. It is observed that only one collision has taken place during stormy weather and only seven in foggy weather. The fact that needs to be highlighted is that most of the collisions are taking place in fair weather condition which eliminates the possibility of weather interference in such accidents. However, another most important aspect of this finding is that there appears to be a noticeable deficiency in accident reporting as far as reporting visibility and weather conditions are concerned. Over fifty percent of these accidents have either full or partial underreporting in terms of mentioning the above parameters.

Table 2: Weather-visibility cross tabulation

Weather condition	Good visibility	Poor visibility	Unknown Visibility	Total
Fair	35	39	10	84
Stormy/Windy	0	0	1	1
Foggy	0	5	2	7
Unknown Weather	1	2	61	64
Total	36	46	74	156

### 3.2.5 Casualty analysis of accidents

Analysis on total casualties suggests that the trend of casualties is on the rise and shows no sign of decreasing at all as it is seen in Fig 7. It is interpreted that the number of fatalities and injuries were same during the period 1986 to 2000. However, the number of fatalities has increased significantly in comparison to the number of injuries in the recent years, particularly during 2001 to 2005. It is also notable that although the number of injuries has decreased during this period but the total number of casualties has increased due to a very steep rise in total number of fatalities. Therefore, the accidents are becoming more and more fatal in nature if compared to the accidents of the previous years. Indeed, these findings are very much shocking and require urgent attention from all concerned agencies. The curve for the number of missing people represents the number of victims whose dead bodies were not recovered. This curve although shows relatively low rate but still adds to the total number of casualties and indeed, these are also fatalities. Therefore, it may be said that collisions are increasing dramatically over the last 10 years or so without any sign of reducing. Consequently the numbers of fatalities are increasing significantly and thus the accidents are becoming more and more fatal.

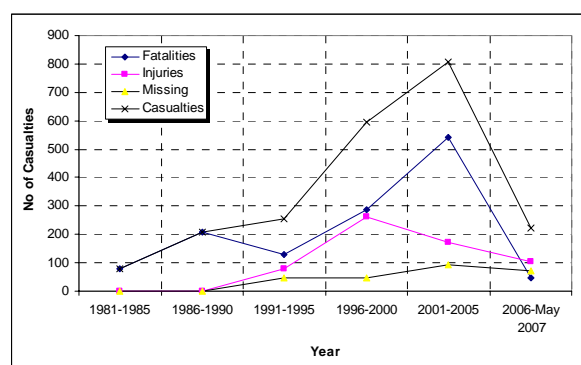


Fig 7: Number of casualties, fatalities, injuries and missing since 1981

### 3.2.6 District-wise distribution of accidents

Investigations clearly reveal that accidents occur at very specific districts of the country and at particular water areas of Bangladesh. Table 3 shows the district wise accident distribution in Bangladesh. It is observed

from the results that the water areas of Narayangangj, Barisal, Chandpur, Munshigangj, Dhaka, Chittagong and Bhola contain the most hazardous water areas of the country in terms of number of collision of marine vessels. Except for Dhaka and Narayangangj the rest of the districts are in the southern part of Bangladesh and possess very large river estuaries. The primary modes of transportation in these areas are exclusively the water crafts. It is therefore, very important that the safety in this particular region remains uncompromised.

Table 3: District wise distribution of accidents

Districts	No. of accidents	Percentage
Narayangangj	24	16.78
Barisal	21	14.69
Chandpur	13	9.09
Munshigangj	12	8.39
Dhaka	11	7.69
Chittagong	10	6.99
Bhola	7	4.90
Netrocona	6	4.20
Bagerhat	4	2.80
Piroipur	4	2.80
Sunamangaj	4	2.80
Other Districts	27	18.88
Total	143	100.00

#### 4. CONCLUSIONS AND RECOMMENDATIONS

##### 4.1 Conclusion

The predominant types of accidents in water ways of Bangladesh are accident due to adverse weather (nor'westers and storms) and accident due to collision. Cargo vehicles (cargo ships & cargo trawlers) and passenger vehicles (passenger launches & passenger trawlers) are shares seventy five percent of all vehicles in collision. However, alarmingly eighty percent of the accidents involve cargo vehicles hitting other vehicles.

Accidents due to inclement weather are more frequent in the monsoon season, although accidents due to collision are scattered all around the year with slightly more tendency towards the winter season. The total numbers of injuries are decreasing despite the fact that total numbers of casualties are increasing very steeply making accidents more and more fatal. Accidents take place almost all around the clock with slightly higher the business hours and during midnight. Most of the accidents and fatalities occur in Barisal, Dhaka and Chittagong divisions.

##### 4.2 Recommendations

Considering the importance of water transportation system in the context of Bangladesh, necessary actions should be taken immediately in order to reduce the number of tragic accidents. This will not only save peoples lives but will also relieve the nation from tremendous amount of economic losses. Recommendations for improvement of waterway safety situation on the basis of this study can be summarised as

the following:

(1) Weather forecasting system has to be improved to reduce the number of accidents and fatalities in adverse weather. In addition, enforcements may be enhanced to guard illegal plying.

(2) Collision type of accidents can be reduced by avoiding foggy weather condition, ensuring adequate lighting facility and raising awareness of the launch masters and captains. Also the working environment for masters and drivers has to be improved in terms of ergonomics so that they don't get fatigue and/or get reluctant about their responsibility.

(3) Availability of adequate amount of life saving equipments should be ensured. Crews should be trained in this regard and public awareness should also be increased both by the launch owners and Government agencies.

(4) Promote institutional research for in depth analysis of accidents in order to come up with pragmatic solutions. Secure legitimate funding support to carry out and implement research and its recommendations.

#### 5. REFERENCES

1. "Transport & Communications", *Bangladesh Economic Review*, 2004, Chapter 11, pp. 127-158.
2. "Report of the Task Forces on Bangladesh Development Strategies for the 1990's", 1991 Volume - IV, University Press Limited, Dhaka, Bangladesh.
3. "Bangladesh Transport Sector Study (BTSS)", 1994, Volume I, Planning Commission of Bangladesh, Dhaka, Bangladesh.
4. Huq, N.A. and Dewan, A.M., 2003, "Launch Disasters in Bangladesh: A Geographical Study", *Geografia*, Vol. 1 Issue 2, pp. 14-25.
5. Khalil, G.M. and Tarafder, M.S., 2004, "Ferry Disasters in The Rivers of Bangladesh: Some Remedial Measures", *The Journal of National Oceanographic And Maritime Institution*, Vol. 21, No. 2, pp. 33-53.
6. Chowdhury, A.S., 2005, "Waterway Accident Characteristics Assessment and Information System Development", Master of Engineering (Civil and Transportation) Thesis, Department of Civil Engineering, Bangladesh University of Engineering & Technology, Dhaka, Bangladesh.
7. Awal, Z.I., 2006, "A Study on Inland Water Transport Accidents in Bangladesh: Experience of A Decade (1995-2005)", *Proceedings of the International Conference on Coastal Ships & Inland Waterways*, pp. 67-72, Royal Institution of Naval architects (RINA), London, UK.
8. Awal, Z.I., Islam, M.R. and Hoque, M.M.H., 2006, "An Analysis of Passenger Vessel Accidents in the Inland Waterways of Bangladesh", *Proceedings of the Marine Technology Conference 2006*, pp. 211-219, University of Hasanuddin, Indonesia.