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Collision of marine vehicles in Bangladesh: a study on accident characteristics

Zobair Ibn Awal

*Accident Research Institute (ARI),
Bangladesh University of Engineering and Technology (BUET),
Dhaka, Bangladesh*

M. Rafiqul Islam

*Faculty of Mechanical Engineering, Universiti Teknologi Malaysia (UTM),
Skudai, Malaysia, and*

Md Mazharul Hoque

*Accident Research Institute (ARI) and
Department of Civil Engineering,
Bangladesh University of Engineering and Technology (BUET),
Dhaka, Bangladesh*

Abstract

Purpose – This paper aims to investigate the marine vehicle accident characteristics in the inland waterways of Bangladesh, with particular emphasis on collision type accidents.

Design/methodology/approach – Accident data were collected from different sources such as the daily newspapers, reports of Department of Shipping (DOS) and Bangladesh Inland Water Transport Authority (BIWTA). The accidents are analysed according to different variables such as vehicle type, time distribution, spatial distribution, weather condition, nature of casualties, and others.

Findings – The study revealed that the leading causes of accidents were collision between ships, trawlers and country boats and loss of stability due to Nor'wester (a seasonal storm that appears from the north and western directions). Of the accidents, 80 per cent involve cargo vehicles hitting other vehicles. Collisions have increased dramatically over the last decade and the number of fatalities has increased significantly.

Research limitations/implications – Many accidents in Bangladesh often remain under-reported owing to limited exposure to the media, which is probably because the victims represent the poorer segment of society. This under-reporting appears to be a major barrier for accident analysis and prevention.

Originality/value – The paper provides an explicit idea on the characteristics of accidents, so that the problem can be easily comprehended and necessary action can be taken by different stakeholders, such as operators, law enforcement agencies, designers, users and others concerned in order to come up with a coordinated action plan to stop these severe incidents.

Keywords Marine transport, Inland waterway transport, Accidents, Collisions, Data analysis, Bangladesh

Paper type Research paper



1. Introduction

The inland shipping industry plays a very significant role in Bangladesh for carrying passengers and goods. 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 (*Bangladesh Economic Review*, 2004). The density of inland ports and terminals is high 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 40 per 100 route-km. The Government of Bangladesh, therefore, considers inland water transportation as an essential mode of transportation for building a balanced multimodal transport system to confront the upcoming development challenges. However, with the increase in population and the growing economy of the country, the waterways are getting congested as the inland waterways are not expanding significantly. Therefore, problems relating to maritime safety are emerging with new dimensions every day. Like many other countries such as Canada, USA and UK (Transportation Safety Board of Canada, 2005; NTSB, 2007; Wang *et al.*, 2005) maritime safety has become a severe issue in Bangladesh 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 situation. However, the fact 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 still 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 is one of two major causes of accidents in Bangladesh where the principal cause is being accidents due to Nor'wester or inclement weather. Unlike Nor'wester which is a natural disaster, the problem of collision type accidents initiate from manmade errors and the number of these accidents can be significantly reduced if basic safety measures are applied. This study investigates 156 collision accidents 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 characteristics of accidents so that the problems can be easily comprehended based on the analysis and necessary actions can be taken by the appropriate authorities to stop such devastations in the waterways of Bangladesh.

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 underlying problems associated with technical, social, economical and other aspects. For example, *The Report of the Task Forces* (University Press Limited, 1991) claims 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 are involved in disastrous and

fatal accidents in the waterways. Preponderance of private sector in the inland water makes the assessment of operational efficiency and safety assessment 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* (Planning Commission of Bangladesh, 1994) 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 and Dewan (2003) studied the geographical locations of passenger launch accidents and provided some description of the accident sights along with description of the waterway networks. Although the study was handicapped by the limited number of accidents it, however, concluded that most of the passenger launch accidents are of collision type. Some research findings by Khalil and Tarafder (2004) discussed the issue of design modifications for improving the extra initial stability by downward shift of centre of gravity and thereby preventing the vessels from capsizing in times of emergency. Chowdhury (2005) 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 in a general perspective which could have provided an overall picture of the maritime safety situation. For example, some statistical analysis has been published by Awal (2006) 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 per cent of total accidents). However, the conducted research had to deal with very limited amount of data available in usable format. Thereby, the actual number of accidents was much higher than the studied number of accidents. Similarly another investigation by Awal *et al.* (2006) dealt with 67 accident cases (passenger ships only) brought some interesting findings to light. It was ominous to note that 56 per cent 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 per cent). However, the results were still inconclusive because of insufficient accident data.

The deficiencies observed in the previous studies is that there have been very little work on the overall characteristics of collision type accidents and this is perhaps mostly due to deficiency in accident data. It is also observed that there are enormous scope for research and development in the field of maritime accident data collection, analysis and investigation. This study therefore, emphasises on presenting the characteristics of collision type accidents since such studies will provide the base line information for taking appropriate countermeasures and further research in order to improve maritime safety in Bangladesh.

3. Data collection and analysis

3.1 Data collection and methodology

One important aspect 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 newspaper reports that naturally emphasise human interests rather than the technical parameters. Both the departments of the Government and the newspapers as well record major fatal accidents where the loss of valuable lives and resources are being destroyed in large numbers. Many nonfatal accidents in Bangladesh yet remain underreported even these days. 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 156 collision cases are being considered in this study. A data collection form and a database have been developed using Microsoft Access, which comprises 19 different parameters. These parameters are then grouped into six major categories as shown elaborately in the database tree in Figure 1.

The accident data were 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 becomes affected by Nor'wester and encounters serious damages of valuable property and lives. The term Nor'wester is a meteorological term meaning a seasonal storm that appears from the north and western directions in the pre-monsoon season. These storms appear suddenly with extreme wind force swirling around but usually last for a very short duration. They often destroy houses, uproot trees and electric poles, abrupt communication and indeed de-stabilise and capsize boats and ships. It is observed from the analysis of 442 accident cases that 44 per cent of all the accidents take place due to adverse weather condition coupled with overloading and stability problems of the vessels. The various causes of accidents are identified in this study and have been illustrated in Figure 2.

The vessels that face these catastrophic natural calamities of the monsoon season are often not capable of withstanding the wind and wave forces of the Nor'wester which eventually leads them to capsizing. These accidents are preventable either by not exposing the vessels in the adverse weather conditions or by constructing and using such novel ships that are literally unsinkable; that is building ships with buoyant materials.

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 occurrence of 39 per cent of all the accidents. Collision between ships, boats and trawlers commence from errors that originates due to both human errors and machinery faults. It is a fact that most of the vessels in Bangladesh ply without advanced navigational equipments and mostly depend on human experience for piloting. Therefore, combating against such a problem could be a mammoth task since installing advance

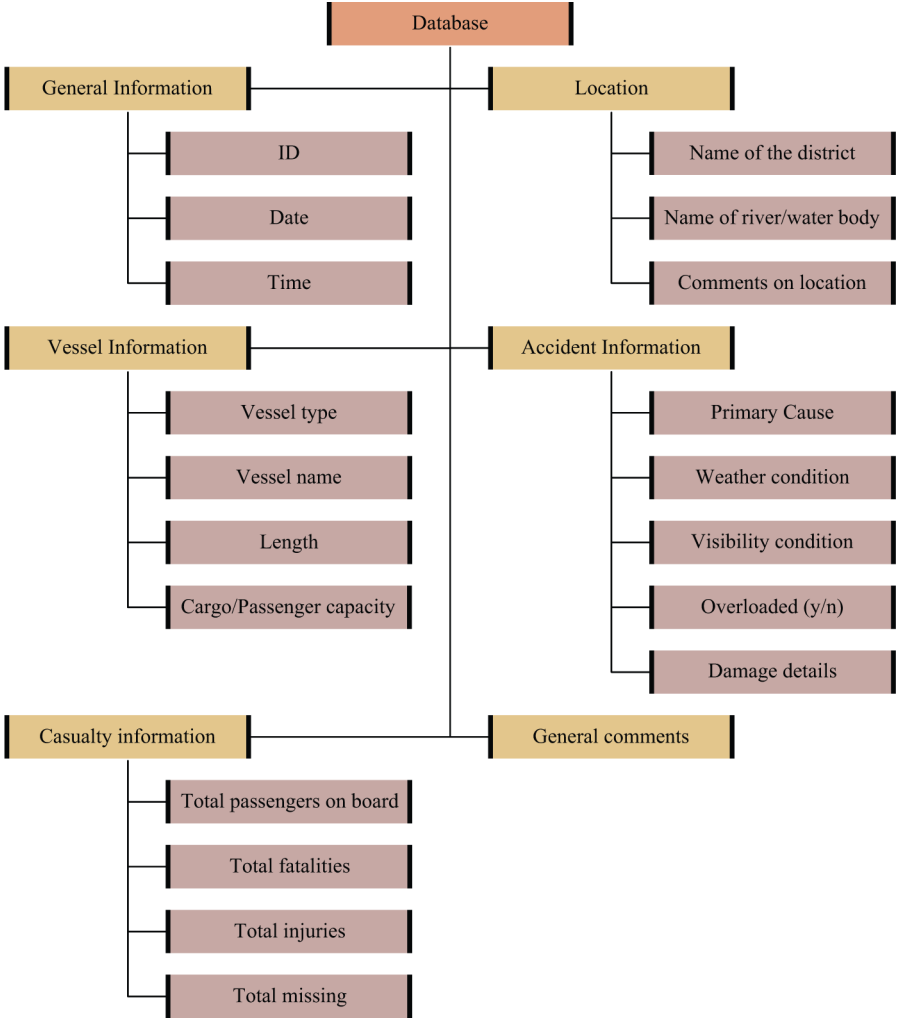


Figure 1.
The database tree

navigational equipments to a huge fleet of ships, trawlers and boats in short span of time is impractical due to the elements associated with costing, acceptability, expert manpower etc. Raising awareness among users, operators and other stakeholders and capacity building of the human resources associated with the maritime industry may not be a job that can be done overnight. Therefore, it is time that all concerned agencies come up with a coordinated action plan which indeed has the potential to bring positive changes in the maritime sector.

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

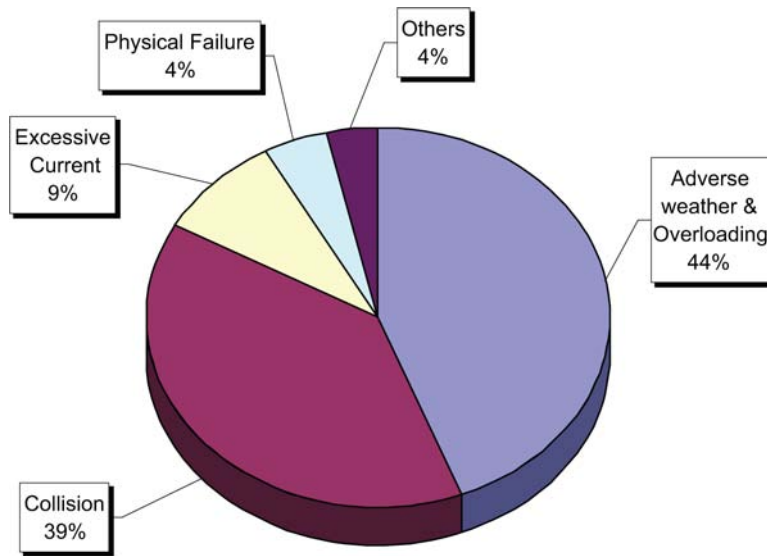


Figure 2.
Percentage of accident
types

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 per cent) as depicted in overall accident analysis of marine vehicles in Table I. The analysis also suggests that the second major share is being held by cargo vessels (cargo ships and trawlers) with a significantly high percentage of 39. It is, therefore, very distressing to observe that passenger and cargo carrying vessels are encountering more accidents than any other type of vessels which lay intolerable anxiety on the society and enormous burden on the national economy as well.

Since the 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 in Bangladesh have been identified and 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 that are have a steel hull and are 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

Table I.
Percentage of vessel
types in accidents

Major group	Vessel types	Number of vessels in accidents	Percentage	Major group percentage
Cargo ships/tractors/ boats	Cargo ships (CS)	153	29.82	39.38
	Cargo trawler (CT)	33	6.43	
	Sand-carrying cargo trawler (CTS)	11	2.14	
	Oil-tanker (OT)	3	0.58	
	Burge	1	0.19	
	Bulkhead (B)	1	0.19	
	Passenger launch (PL)	111	21.64	
	Engine boat (EB)	64	12.48	
	Country boat (CB)	48	9.36	
	Passenger trawlers (PT)	41	7.99	
	Ferry (F)	8	1.56	
	Steamer (ST)	2	0.39	
	Fishing trawler (FT)	20	3.90	
	Fishing boat (FB)	11	2.14	
Passenger launches/ tractors/boats/ferries	Paddle-steamer (PS)	2	0.39	53.41
	Tug boat (TB)	3	0.58	
	Naval craft (NAVAL)	1	0.19	
Fishing trawlers/boats				6.04
Others				1.17
Total		513	100.00	100.00

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 trips. 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 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 that 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 manoeuvred with manual rudders. Most of the country boats have the provision of being towed by the wind power using very traditional looking sails or by rowing, particularly in the inland waters of the country.

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 Figure 3. It is observed that 38 per cent of all the vehicles in collision accidents are cargo ships and 19 per cent are being passenger launches. Passenger and cargo trawlers also have a significant share in the pie (almost 20 per cent).

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. It is observed that many accident investigation reports do not collect or save such kind of information and thereby deficit in accident recordings persist noticeably. However, research findings suggest that cargo vessels are most frequently involved in hitting others in comparison to any other type of marine vessels. Figure 4 suggests that in 80 per cent of the cases cargo ships hit other marine vehicles. The rest 20 per cent of the accidents represents collision between passenger launches and country boats.

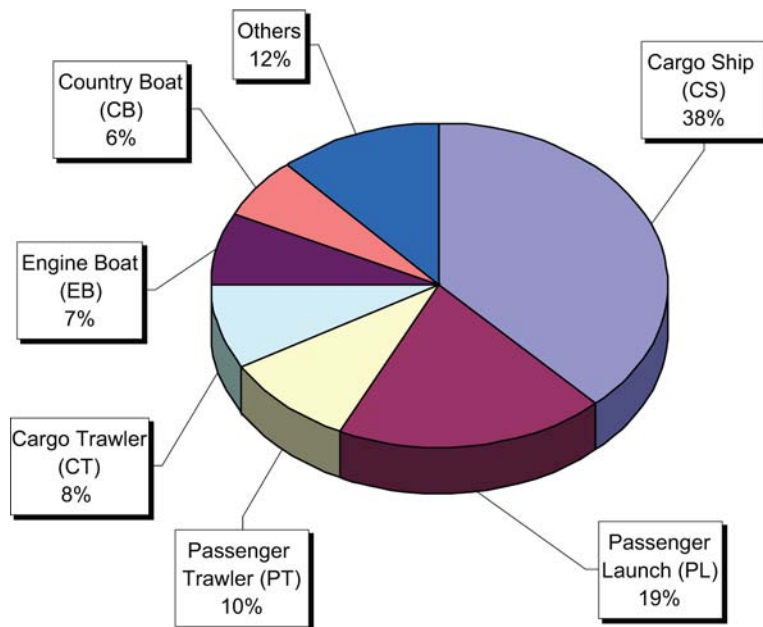
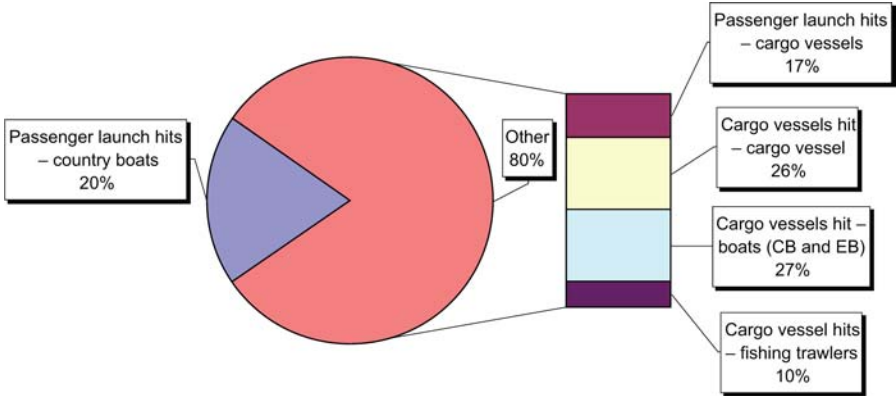


Figure 3.
Share of different vehicles
in collision accidents

Figure 4.
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 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 that are shown in Figure 5. It has been observed that in general, accidents in Bangladesh occur almost all around the year with higher tendency during the monsoon season (March to July). During this monsoon season accidents occur above the average line but more interestingly it was observed that

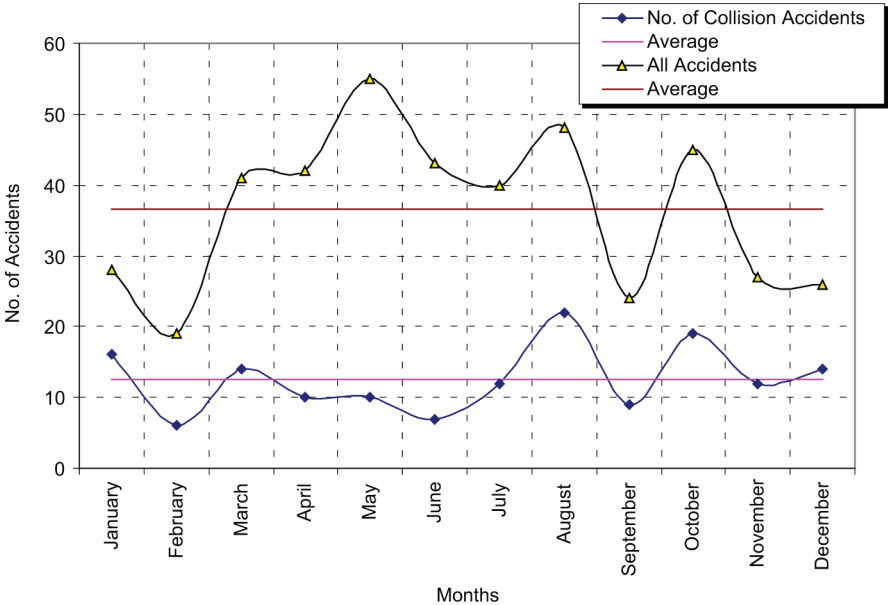


Figure 5.
Monthly distribution of
accidents

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) in comparison to the curve for all accidents (standard deviation 11.23). This variation may however be influenced by the exposure pattern of vehicles but establishing relationship between accidents and vehicle exposure is impossible due to unavailability of exposure data. Nevertheless, it may be stated that unlike other accidents collision type accidents are scattered all around the year.

Analyses on hourly distribution of accidents suggest that accidents occur all around the clock, with the exception of a very small percentage that occurs around midnight as shown in Table II. It is observed that among all the six time brackets (4 hours in each bracket) a significant number of the accidents take place during 8:00 PM to midnight. The reason is very clear because in Bangladesh most of the vessels ply without adequate navigational and lighting systems which results limited vision during the trips that they make at night. Therefore, most of the vessels plying at night are subjected 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 per cent 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.

3.2.4 Weather and visibility during accidents. The weather-visibility cross tabulation suggests that collisions occur more in good visibility conditions as much as in poor visibility conditions as shown in Table III. 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

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	100.00

Table II.
Distribution of accidents
in time bands

Weather condition	Visibility condition						Total (%)	
	<i>n</i>	Good (%)	<i>n</i>	Poor (%)	<i>n</i>	Unknown (%)		
Fair	35	97.2	39	84.8	10	13.5	84	53.9
Stormy/windy	0	0.0	0	0.0	1	1.4	1	0.6
Foggy	0	0.0	5	10.9	2	2.7	7	4.5
Unknown weather	1	2.8	2	4.3	61	82.4	64	41.0
Total	36	100.0	46	100.0	74	100.0	156	100.0

Table III.
Weather-visibility
cross-tabulation

with good visibility condition. Therefore, weather interference or limited vision due to fog or mist might not be the only causes behind these accidents. However, another important aspect of this finding is that there appears to be a noticeable deficiency in accident reporting as far as reporting of visibility and weather conditions are concerned. Around 50 per cent of these accidents have either full or partial underreporting in terms of mentioning the above parameters.

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 Figure 6. It is interpreted that the number of fatalities and injuries were same during the period from 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. 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 ten years without any sign of reducing. Consequently the numbers of fatalities are increasing significantly and thus the accidents are becoming more and more fatal.

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 IV shows the administrative division and 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

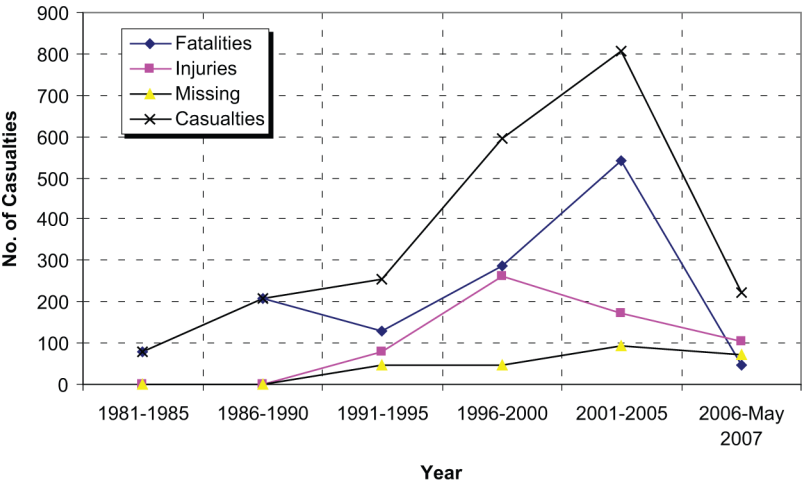


Figure 6.
Number of casualties,
fatalities, injuries and
missing since 1981

					Collision of marine vehicles
Administrative divisions	Districts	No. of accidents	Percentage (district)	Percentage (division)	
Dhaka	Dhaka	11	7.69	37.06	<div>593</div>
	Narayanganj	24	16.78		
	Munshiganj	12	8.39		
	Netrocona	6	4.20		
Barisal	Barisal	21	14.69	31.47	
	Chandpur	13	9.09		
	Bhola	7	4.90		
	Piroipur	4	2.80		
Chittagong	Chittagong	10	6.99	6.99	
	Khulna	Bagerhat	4	2.80	
Syllhet	Sunamganj	4	2.80	2.80	
Other	Other districts	27	18.88	18.88	
Total		143	100.00	100.00	

Table IV.
Administrative division
and district-wise
distribution of accidents

Table IV.
Administrative division
and district-wise
distribution of accidents

southern part of Bangladesh and possess very large river estuaries. The primary modes of transportation in these areas are exclusively watercrafts. It is therefore, very important that the safety in these particular regions remain uncompromised.

4. Conclusions and recommendations

4.1 Conclusion

The predominant types of accidents in the water ways of Bangladesh are accident due to adverse weather (Nor'westers and storms) and accident due to collision. Cargo vessels (cargo ships and cargo trawlers) and passenger vessels (passenger launches and passenger trawlers) share 75 per cent of all vehicles in collision. However, alarmingly 80 per cent 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 tendency during the business hours and during midnight. Most of the accidents and fatalities occur in Barisal, Dhaka and Chittagong administrative divisions.

As a matter of fact it was 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. In addition, the institutional commitments regarding accident investigation and scientific recording of incidents for reference and future research do not have the required impetus. Thus this underreporting appears to be a major barrier for accident analysis and prevention.

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:

- Weather forecasting system has to be improved to reduce the number of accidents and fatalities in adverse weather. In addition, enforcements may be strengthened to stop exposure of marine vessels during adverse weather conditions.
- Collision type of accidents can be reduced by avoiding foggy weather condition, ensuring adequate lighting facility, incorporating collision avoidance devices and raising awareness of the launch masters and captains. Research on the ergonomics for masters and drivers are recommended for improving their working environment so that they do not get physical and mental fatigue and/or get reluctant about their responsibility.
- Crews should be properly trained for handling emergencies and disasters. Public awareness should also be increased both by the launch owners and Government agencies. Availability of adequate amount of life saving equipments has to be ensured by the appropriate authorities.
- Study on establishing relationship between accidents and exposure is recommended. In depth analysis on fatalities and injuries relating to climate change and risky weather are also recommended.
- Promote institutional research for in depth analysis of accidents in order to come up with pragmatic solutions. Secure legitimate funding support to carry out advanced research and implement recommendations.

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