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The International Journal of Small Craft Technology **(*IJSCT*)** provides a forum for the reporting and discussion on technical and scientific issues associated with research and development of recreational and commercial small craft. The *IJSCT* is published as Part B of the Transactions of The Royal Institution of Naval Architects. Contributions in the form of scientific and technical papers and notes on the following aspects of small craft technology are invited:

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CONTENTS

PAPERS

Development of a New Generation of Inland Waterways Maintenance Craft for the British Waterways Narrow Beam Canal system 1
I H G Parry

Practical Aspects of Canting Keel Design, Construction and Analysis 13
L Tier, M Owen and T Sadler

Wind Tunnel Tests of an America's Cup Keel – A Test Case for CFD Validation 23
S Werner, L Larsson and B Regnström

TECHNICAL NOTES

A Study on Inland Water Transport Accidents in Bangladesh: Experience of a Decade (1995 – 2005) 35
Z I Awal

DISCUSSION

An Experimental Study of the Hydrodynamics of a Yacht with a Canting Keel and Forward Rudder 41
(Vol 149 Part B1 2007)

International Journal of Small Craft Technology

TECHNICAL NOTE

A STUDY ON INLAND WATER TRANSPORT ACCIDENTS IN BANGLADESH: EXPERIENCE OF A DECADE (1995-2005)

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SUMMARY

Inland Water Transport (IWT) plays a very significant role in the transportation system of Bangladesh. Its low expenses and high accessibility, as compared with other alternatives, amplifies a great demand for carrying goods and passengers within the country. Although water transportation sector in Bangladesh possess geographical advantage but there are deficiencies in the safety aspect. This study has been aimed at collecting and analysing data of water transport accidents that occurred in the inland waterways of Bangladesh during 1995 to 2005. A total of 197 cases were considered for the study which primarily included accidents of passenger and cargo vessels. It has been observed that the number of accidents increased significantly over the years and most predominant causes of accidents were found to be overloading, cyclone and collision. Several recommendations have been put forward with a vision to develop a safer and sustainable water transport system for the country.

NOMENCLATURE

IWT = Inland Water Transport
BIWTA = Bangladesh Inland Water Transport Authority
ERZ = Economic Resource Zone
DOS = Department of Shipping

1. INTRODUCTION

Bangladesh lies at the apex of the Bay of Bengal and has rivers that come down from the surrounding countries and flow through it. Nearly the whole area of the country consists of low and plain lands. According to Banglapedia [1] about 7% surface of the country is covered by a dense 24,000-km long network of inland waterways. Three major river systems and their confluence form the world's largest delta here. Bangladesh has about 9,000 sq km of territorial waters with a 720-km long coast line and 20,000 sq km of Economic Resources Zone (ERZ) in the sea. About two-thirds of the land is vulnerable to flooding. Most areas remain under water for two to five months a year. As a result, costs of development and maintenance of roads and railways are high. On the other hand, inland water transport has always been a natural and relatively cheap means of transport in Bangladesh. In certain areas, it is the only mode of transport. Including the country's unclassified routes, the total length of its waterway (700 rivers) is about 13,000 km. Of this, 8,433 km is navigable by larger vessels in the rainy season (5,968 km of which is classified for navigation) while in the dry season about 4,800 km is navigable (classified 3,865 km). Figure 1 illustrates the river network of Bangladesh.

The IWT system in Bangladesh is both extensive and well-connected with the rest of the transport system. In terms of traffic intensity, the inland waterway network generates about 1.57 million passenger-kilometres per route-kilometre of waterway [2]. The density of inland ports and terminals is much higher on the inland waterways with approximately 3.7 berthing facilities per 100 route-kilometres. The density of passenger facilities on the inland waterways is also high at around 40 per 100 route-km.

Figure 1: Waterway Network of Bangladesh

With the increase in population in the country the waterways are getting very congested. Consequently, the number of accidents in the water ways are also uprising and causing serious socio-economic problems. Some recent investigations show that over seven thousand people have died, injured and been reported missing due to these accidents in the past few years. This caused a great concern in both local as well as international community and has become a national issue.

2. BACKGROUND STUDY

2.1 WATER TRANSPORT SAFETY RELATED STUDIES

A number of studies related to water transportation system of Bangladesh have been carried out in the past few years. According to the Report of the Task Forces on Bangladesh Development Strategies for the 1990's [3] the inland water transportation system in Bangladesh is the oldest mode of transport that carries nearly one third of the country's total passenger and freight. The report revealed that the private operators own more than 90 percent of the water transports plying in the country. Unlike to public sector, the operators do not follow the rules and regulations. This is why their vessels lead to disastrous and fatal accidents in the water ways of the country. Preponderance of private sector in inland water also makes the assessment of operational efficiency difficult. Also, the private operators do not maintain regular and authentic statistics. A similar study by Islam [4] on passenger safety concluded that the problem of passenger vessel safety is not purely a technical one but rather socio-economic in nature.

An investigation of accidents, damages and cargo losses in inland shipping has been made by Zahanyar and Haque [5] who examined the causes of waterway accidents and made recommendations for the prevention of accidents. Bangladesh Transport Sector Study [6] have classified the waterway accidents focusing on identification of broad types of waterway accidents and suggested several remedial measures commensurate with the classification. BIWTA [7] having constraints of waterway accident investigation system highlighted the safety and stability parameters of the passenger vessels plying within the inland waterways of Bangladesh. In this study technical characteristics of various types of vessels like year of built, different dimensions, passenger capacity, number of engine, engine type of each registered passenger vessel were analysed by the consultant of BIWTA named Maritime Centre. Detailed discussion and evaluation of the data are yet to be accomplished.

In a recent study, Chowdhury [8] developed a GIS based accident information system for water transport accidents and studied the characteristics of the incidents. The study was, however, limited to the analysis of the accidents related to formal and informal motor propelled passenger vessels only.

2.2 FACTORS BEHIND WATER TRANSPORT ACCIDENTS

Accidents can not be caused by a single factor. Rather, it is a complex interaction of mechanical failure, human errors and natural causes. The factors that trigger the waterway accidents are described by Islam [4], BIWTA [7] and Chowdhury [8]. Table 1 summarises these factors and some causes behind the water transport accidents.

Table 1: Factors behind Water Transport Accidents.

Factors	Some Causes
Vessel design factor	• Faulty design and construction • Mechanical failure of the vessels • Insufficient and flawed navigational instruments
Operating environment factor	• Foggy weather condition • Excessive current and whirlpool • Cyclone and stormy weather
Human factor	• Overcrowding and overloading • Rush of passengers during embarking and disembarking • Incompetence of the Captain, Master and other professionals
Enforcement and educational factor	• Negligible amount of application and practice of vessel safety regulations • Deficiency in public awareness building programs • Deficiency in weather warning and counter measure system

3. DATA COLLECTION AND ANALYSIS

3.1 DATA COLLECTION

An authentic and comprehensive database is the cornerstone of all research and development activities and for accident research the need in absolutely crucial. One of the primary goals of this study is to compile and maintain a complete database which will work as a key for in depth accident analysis and research and that will help to come up with pragmatic recommendations and solutions in order to prevent such disasters. The accident data collected in this study came from various information sources as because the study dealt with incidents that occurred over a longer period of time. It has to be accepted, as seen from the analysis, that some accidents were underreported. This is because some accident reporting sources were descriptive in nature rather than technical and precise. The primary information sources for this study were national daily news papers and accident reports of BIWTA.

3.2 ACCIDENT TYPE

Five major types of accidents were identified in this study, such as overloading & cyclone, collision, excessive current, physical failure & others. Table 2 shows the distribution of accidents and Figure 2 shows their respective percentages. It is quite evident from the analysis that overloading & cyclone (43%) is the major cause behind the accidents. On the other hand, 29% of collision suggests the careless navigation and steering failure of vessels in the waterways. The rise in number of accidents over the years was the most alarming finding of this study. During 1995-1999 period there were 62 reported cases, but unfortunately the number has jumped to 137 for the period 2000-2005.

Table 2: Various Types of Accidents

Accident type	Frequency of occurrence		Total
	1995 – 1999	2000 - 2005	
Overloading & Cyclone	30 (35 %)	55 (65 %)	85
Collision	19 (33 %)	38 (67 %)	57
Excessive Current	7 (32 %)	15 (68 %)	22
Physical Failure	3 (30 %)	7 (70 %)	10
Others	3 (13 %)	20 (87 %)	23
Total	62 (31 %)	135 (69 %)	197

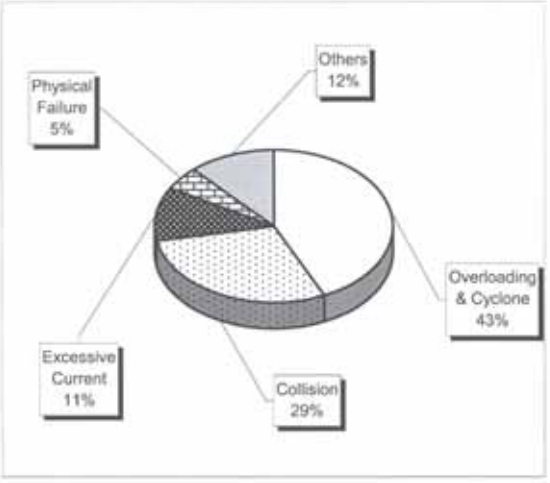

Figure 2: Distribution of Accidents on Type Basis

3.3 MONTHLY AND HOURLY DISTRIBUTION OF ACCIDENTS

Monthly distribution of accidents (Figure 3) suggests that most of the accidents have occurred during the monsoon season (March-July) and particularly in the month of October. The figure also suggests that the numbers of accident have increased significantly from 1995-1999 period to 2000-2005 period and the increase is more than twice in comparison to the previous period. However, for rest of the months the frequencies of accident were nearly equal.

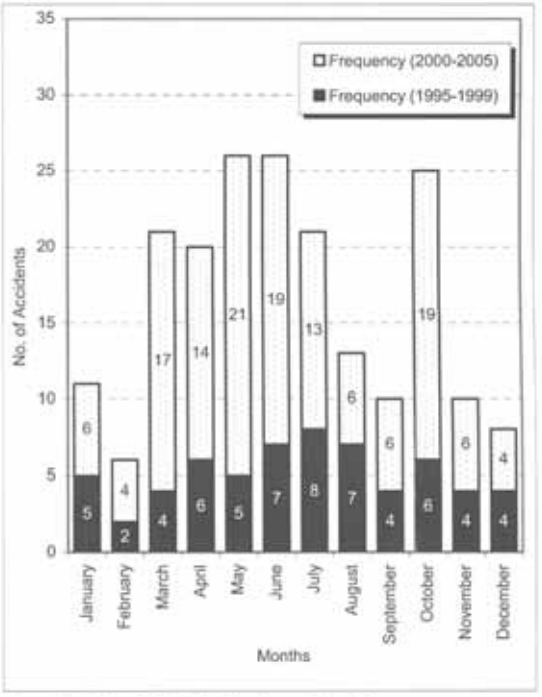

Figure 3: Monthly Distribution of Accidents

Table 3: Hourly Distribution of Accidents

Quarters	Frequency of occurrence		Total
	1995-1999	2000-2005	
00:00 – 05:59	1 (5 %)	20 (95 %)	21
06:00 – 11:59	19 (51 %)	18 (49 %)	37
12:00 – 17:59	16 (29 %)	39 (71 %)	55
18:00 – 23:59	17 (30 %)	39 (70 %)	56
Unreported	9 (32 %)	19 (68 %)	28
Total	62 (31 %)	135 (69 %)	197

The hourly distribution of accidents as shown in Table 3 suggests that most of the accidents have taken place in between 12:00 hrs to 23:59 hrs (55 + 56 = 111 accidents out of 197). It is learnt from the practical experience that most of the cyclones occur at or around 17:00 to 20:00 hrs. Therefore, it is evident from the findings that cyclone, storms and lack of sufficient navigational equipments are the reasons behind these accidents.

3.4 WEATHER CONDITION

Figure 4 illustrates accidents occurring on different types of weather conditions. It is reasonable to accept that a large percentage of accidents are supposed to occur during stormy weather. But a significant number of accidents occurring in fair weather suggest the involvement of human error, mechanical error and overall deficiency in safety regulation aspects during the voyages.

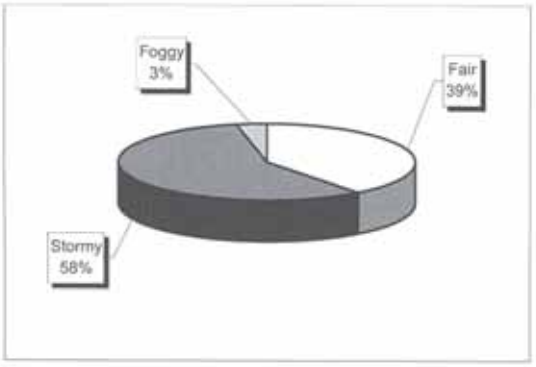

Figure 4: Accidents on the Basis of Weather Condition

3.5 ACCIDENT TYPE - HOUR CROSS - TABULATION

The analysis of accident type-hour cross-tabulation (Table 4) suggests that most of the overloading & cyclone type accidents have occurred 12:00 to 23:59 hrs. It was stated previously that most of the storms occur in the evening. Therefore, it is quite understandable to accept the fact. It also became apparent from the investigation that collisions have more occurred during the night time. This is probably due to ill functioning of search light, navigation light, captain's fatigue at late night and/or captain's incompetence in manoeuvring.

3.6 ACCIDENT TYPE-WEATHER CONDITION CROSS-TABULATION

The accident type-weather condition cross-tabulation clearly depicts that 100% of cyclone & overloading type accidents occurred in the stormy weather. However, a high percentage of collisions have occurred in fair weather condition. This is certainly a great concern and suggests that there is a great deal of human & mechanical error involved in these accidents. The other types of

Table 4: Accident Type-Hour Cross-Tabulation

Accident type	Frequency of occurrence				Unreported	Total
	00:00-05:59	06:00-11:59	12:00-17:59	18:00-23:59		
Overloading & Cyclone	6	19	31	24	5	85
Collision	8	9	10	22	8	57
Excessive Current	2	5	5	2	8	22
Physical Failure	2	2	3	0	3	10
Others	3	2	6	8	4	23
Total	21	37	55	56	28	197

Table 5: Accident Type-Weather Condition Cross-Tabulation

Accident type	Frequency of occurrence			Unreported	Total
	Fair	Stormy	Foggy		
Overloading & Cyclone	0	85	0	0	85
Collision	45	0	5	7	57
Excessive Current	3	0	0	19	22
Physical Failure	7	1	0	2	10
Others	5	1	0	17	23
Total	60	87	5	45	197

accidents are more or less evenly distributed over fair weather condition as shown in Table 5.

3.7 ACCIDENT TYPE-MONTH CROSS-TABULATION

Table 6 shows the month wise distribution of various types of accidents. As far as total numbers are concerned, it is quite clear from the table that overloading & cyclone type accidents have occurred more in the month May than any other months of the year. But in general, most of the accidents due to overloading and cyclone have occurred in the monsoon season (March-July).

The analysis of collision type accidents, on the other hand, suggests that most of the accidents have occurred in the month of October than other months of the year. However, the rest of the accidents seem to be more or less evenly distributed all over the year.

The affect of excessive current on water transport accidents are comparably less than other type of accidents. Nevertheless, the table suggest that this factor comes into act particularly in the months of June and July (7 + 7 = 14 accidents out of 22).

Table 6: Accident Type-Month Cross-Tabulation

Month	Frequency of occurrence according to accident type				Total
	Overloading & cyclone	Collision	Excessive current	Others	
January	0	6	1	4	11
February	0	3	0	3	6
March	14	7	0	0	21
April	12	6	0	2	20
May	19	4	2	1	26
June	7	3	7	9	26
July	10	3	7	1	21
August	4	5	2	2	13
September	4	4	2	0	10
October	10	11	1	3	25
November	3	2	0	5	10
December	1	3	0	3	8
Total	85	57	22	33	197

4. CONCLUDING REMARKS

4.1 RESEARCH FINDINGS

The research findings of this study may be summarised in the following manner:

- The predominant causes of accidents in water ways of Bangladesh are cyclone, overloading and collision of vessels.
- Accidents are more frequent in the monsoon season, particularly in the months March to July and in October. Most of the cyclone & overloading accidents have occurred in these months.
- During the study period most of the collision and cyclone type accidents took place in the evening and before midnight.
- Apart from accidents in stormy weather, a high percentage of accidents have occurred in fair weather.

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 these tragic events. This will save a lot of lives and relieve the nation off a huge quantity of economic losses. Recommendations for improvement of waterway safety situation on the basis of this study can be summarized as:

- Weather forecasting system has to be improved to reduce cyclone type of accidents. In addition, enforcements may be enhanced to guard against plying in a bad weather condition.
- Collision type of accidents can be reduced by avoiding foggy weather condition and ensuring searchlight in functioning condition. 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.
- Loading condition of the all passenger vessel may be checked before any voyage. Legislation regarding overloading can be revised if necessary. Inspection and enforcements may also be enhanced. Load certificate may be issued.
- The stability of a vessel is a very important criterion to operate it in different operating and loading conditions. From the beginning of the construction DOS/BIWTA may employ naval architects to supervise the dimensions of the vessel and quality of the materials used.
- DOS/BIWTA may enhance their enforcement facilities which will eventually ensure that each vessel is plying with properly trained and exactly required numbers of crew. Their competence and efficiency could be examined at regular schedule. It has to be strictly ensured that no one except the master navigates a vessel.
- 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.
- More in depth analysis of these accidents are required in order to come up with pragmatic solutions.

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