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# BMJ Open

## Context of water related disasters in Bangladesh: A mixed methods study

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## ABSTRACT

### Objectives:

To investigate the impact of natural disasters on communities in the Barisal division of Bangladesh, exploring community approaches to disaster preparedness and mitigation.

### Setting:

Communities in all districts of the Barisal division of Bangladesh.

### Participants:

Quantitative data was collected through a cross-sectional household survey (n=9263) with household heads, mothers and other adults aged 18 years and above. Qualitative data was collected through in-depth interviews (n=7) and focus group discussions (n=23) with key informants from the community residing in Barisal for at least six months prior to the study.

### Outcome measures:

Quantitative research recorded features of natural disaster events from the previous five years, documenting risk factors that increase vulnerability to disaster, the use of disaster warning systems, and evacuation processes at the time of disaster. Qualitative research investigated disaster risk perceptions, experiences during and following disaster, and disaster preparedness practices.

### Results:

The survey response rate was 94.7%. Exposure to disaster in the last five years was high (82%) with flooding followed by cyclones considered the greatest threats. Awareness of evacuation processes was low, and only 19% of respondents reported evacuating their homes at the time of disaster. Drowning during disaster was the primary concern (87%), followed by debt, livestock and crop loss (78%). The qualitative data amalgamated into four overarching themes: 1) Perceptions and consequences of disaster; 2) Insufficient support for the most vulnerable; 3) Community preparedness and practices; 4) Barriers to disaster response and improving resilience.



## INTRODUCTION

Internationally, there is an increasing focus on strengthening disaster risk reduction through improved surveillance, information exchange, early warning systems and capacity building in disaster prone countries. Bangladesh is highly prone to natural disasters, in particular flooding due to the annual monsoon rainfalls and extensive low lying floodplains that cover an estimated 80% of the densely populated country <sup>1</sup>. The consequences of flooding include the threat of diarrhoeal disease, lack of access to safe drinking water, loss of housing, livestock, crops, livelihood activities and drowning in floodwaters <sup>1 2</sup>. Additionally, tropical cyclones are an annual occurrence, which directly contribute to flooding and in turn, drowning-related mortality and morbidity <sup>2</sup>.

With a population of over 165 million, it is estimated that more than two thirds of people in Bangladesh live in regions at risk of floods and one quarter live in regions at risk of cyclone; this represents significant vulnerability to both fatal and non-fatal drowning <sup>2</sup>. Drowning is among the world's leading causes of injury-related death, of which more than 90% of drowning fatalities occurring in low and middle income countries (LMICs) <sup>3</sup>. Data on morbidity resulting from non-fatal drowning is not routinely collected, due to poor operational definitions and under-resourced surveillance systems; thereby the burden of serious injury and lifelong disability is difficult to quantify <sup>2-4</sup>. In Bangladesh, fatal and non-fatal drowning rates are considered higher than for other LMICs, indeed the fatal drowning rate is 15.8/100,000 per year, which is estimated to be 2-5 times higher than other LMICs <sup>3 4</sup>. Within Bangladesh, both fatal and non-fatal drowning disproportionately impacts children and males and is most likely to occur in rural communities and in close proximity to households <sup>4-6</sup>. Other risk factors for drowning include lower socio-economic status and lower educational attainment, with high rates of occupational drowning among workers in the fishing and water transport industries <sup>4</sup>.

From 2005 to 2015, governments around the world committed to implementing the Hyogo Framework for Action as a guideline for reducing disaster risk through resilience building at both the national and local levels <sup>7</sup>. In Bangladesh, since Cyclone Gorky in 1991, which claimed

138,000 lives there has been improvements in warning systems and increased shelter uptake over the last 20 years <sup>2 8</sup>; however there remains considerable challenges in fostering disaster resilience at all levels.

More recently, the Sendai Framework for Disaster Risk Reduction 2015-2030 was adopted by the United Nations member states in March 2015, and represents the next phase of targets and priorities globally, recognising the threat that climate change and disaster risk pose to achieving the Sustainable Development Goals (SDGs) <sup>9</sup>.

The threat of natural disasters in Bangladesh is anticipated to increase with changing weather patterns due to extreme vulnerability to climate change <sup>1 2 10 11</sup>. In the face of growing climate uncertainty, there is an urgent need to understand disaster practices and promote community disaster resilience. Therefore, this study aims to investigate the impact of natural disasters on communities in the Barisal division of Bangladesh, exploring community disaster preparedness, responses to disaster at time of onset, and health seeking behaviours following disaster events.

**METHODS**

**Study setting**

The Barisal division is located in south central Bangladesh and is comprised of six districts and 39 sub-districts. Crossed by numerous rivers, it is highly exposed to flooding due to annual monsoon rains and low lying flood plains.

**Study design**

The study used a concurrent mixed methods approach triangulating cross-sectional household survey data with qualitative in-depth interviews and focus group discussions.

**Patient and Public Involvement**

Drowning was identified as a priority health issue through the 2014 Bangladesh Demographic and Health Survey, which collected data from 18,000 residential households nation-wide. <sup>12</sup> Data collection instruments for this study were developed in alignment with Bangladesh Health and Injury Survey (BHIS) findings, designed to investigate notable drowning-related outcomes in

greater depth. All data collection tools were trialled with end users prior to their use in this study. Study results will be triangulated among key informants and consultations will be used to inform the development of pilot interventions for improving water safety and reducing drowning in community settings in Bangladesh.

## MATERIALS AND DATA COLLECTION

### Quantitative

The survey was conducted September 2016 – February 2017, using a multi-stage stratified sample. A subsample of households (n=9263) was randomly selected (every tenth household) from a larger cross-sectional household survey (n=92,616) that was conducted in all districts of the Barisal division of Bangladesh.

Trained data collectors used pre-tested structured questionnaires to collect information from household heads, mothers or any adult above 18 years through face-to-face interviews. An electronic data capture system (REDCap) was used on tablets for data collection<sup>13</sup>. To ensure data quality and accuracy trained supervisors observed and checked 10% of interviews and collected data, and re-interviewed 2% of households.

The survey consisted of questions on knowledge, attitudes and perceptions/practices for community drowning and disaster risk, and about experiences of natural disaster in the previous five years. Data were collected on demographic characteristics, and on socio-economic status using an index developed for the 2014 Bangladesh Demographic and Health Survey.<sup>12</sup>

### Qualitative

Purposive sampling was used to identify key informants from the community for in-depth interviews and focus group discussions. Inclusion criteria was that participants has been a resident of Barisal for at least six months prior to the study. Separate male and female discussion groups were arranged to align with cultural practices. The interviews and focus group discussions were semi-structured and conducted by trained research assistants in



community locations that were acceptable and accessible to participants. Consent was obtained prior to commencing data collection; interviews lasted between 40-60 minutes, whilst focus group discussions lasted between 1-1.5 hours. The interview and focus group discussion guides included questions related to: 1) disaster risk perceptions; 2) experiences of natural disaster; 3) disaster preparedness practices.

Interviews and focus group discussions were conducted in Bengali, audio-recorded, translated and transcribed in English. To minimise data loss, interviews were jointly translated and transcribed by the interviewing researcher and the translator, and a member of the research team checked the translated transcripts. Interviews ceased when saturation of meaning was considered to have occurred.

ANALYSIS

Quantitative

Descriptive analysis (counts and percentages) of variables relating to disaster knowledge, attitudes and behaviour variables. All data were analysed using SAS 9.4 with SAS/STAT 14.2 (SAS Institute, Cary, NC, USA).

Qualitative

Transcripts were imported into NVivo qualitative data analysis software (QSR International Pty Ltd. V.11, 2015). Content analysis was applied to the transcripts whereby overarching themes were initially developed. Thereafter, deductive thematic coding of the data was undertaken. NVivo was used to arrange the text according to codes and manage the codes in the interpretive phase. Two researchers independently conducted the coding and arrived at consensus on the analyses.

RESULTS

Quantitative results

A total of 95,124 households were visited of which 92,616 household representatives were available for completing the survey (n= 92616; response rate 94.7%), with an average

household size of 4.2 members. The socio-demographic characteristics of the disaster subsample were comparable to the full household survey sample and there were no meaningful differences between the samples (Table 1).

Table 1 Socio-demographics of the full household survey and disaster survey subsample

		Disaster subsample (n=38981)	Full household sample (n=385127)
<b>Age (years)</b>	Infant	2.0% ( 1.8 - 2.2)	2.0% ( 1.9 - 2.0)
	1-4	8.1% ( 7.8 - 8.5)	8.2% ( 8.0 - 8.3)
	5-9	11.0% (10.7 - 11.4)	10.7% (10.5 - 10.8)
	10-14	10.8% (10.5 - 11.1)	10.7% (10.6 - 10.9)
	15-17	5.9% ( 5.6 - 6.2)	6.0% ( 5.9 - 6.1)
	18-24	13.6% (13.1 - 14.1)	14.0% (13.8 - 14.2)
	25-39	24.6% (24.0 - 25.2)	24.1% (23.7 - 24.4)
	40-59	17.1% (16.6 - 17.5)	17.5% (17.3 - 17.7)
	60 +	6.8% ( 6.4 - 7.1)	6.9% ( 6.7 - 7.1)
<b>Sex</b>	Male	49.1% (48.5 - 49.8)	49.2% (48.8 - 49.5)
	Female	50.9% (50.2 - 51.5)	50.8% (50.5 - 51.2)
<b>Marital status</b>	Married	50.4% (49.9 - 50.9)	50.6% (50.3 - 51.0)
	Never Married	45.7% (45.2 - 46.2)	45.3% (45.1 - 45.6)
	Divorced	0.3% ( 0.2 - 0.4)	0.3% ( 0.3 - 0.4)
	Widow/Widower	3.4% ( 3.2 - 3.7)	3.5% ( 3.4 - 3.7)
	Separated	0.2% ( 0.1 - 0.2)	0.2% ( 0.2 - 0.2)
<b>Type of family</b>	Nuclear Family	67.5% (65.4 - 69.7)	66.6% (64.8 - 68.3)
	Extended Family	32.5% (30.3 - 34.6)	33.4% (31.7 - 35.2)
<b>Family size</b>	5 or less persons	78.6% (77.0 - 80.3)	78.6% (77.4 - 79.8)
	More than 5 persons	21.4% (19.7 - 23.0)	21.4% (20.2 - 22.6)
<b>Education completed</b>	Not applicable	16.3% (15.4 - 17.3)	16.2% (15.2 - 17.1)
	1 to 5 years	39.9% (38.9 - 40.9)	39.8% (39.0 - 40.7)
	6 to 8 years	17.9% (17.3 - 18.5)	17.6% (17.2 - 18.1)
	9 to 12 years	16.4% (15.6 - 17.3)	16.6% (16.0 - 17.2)
	13 to 17 years	3.7% ( 3.3 - 4.0)	3.7% ( 3.4 - 3.9)
	None	5.7% ( 4.8 - 6.7)	6.1% ( 5.2 - 7.0)
<b>Maternal education</b>	1 to 5 years	47.9% (46.4 - 49.5)	46.3% (45.1 - 47.5)
	6 to 8 years	20.6% (19.3 - 21.8)	20.5% (19.5 - 21.4)
	9 to 12 years	13.2% (12.1 - 14.4)	14.2% (13.5 - 15.0)
	13 to 17 years	1.5% ( 1.2 - 1.8)	1.4% ( 1.3 - 1.6)
	None	16.7% (15.3 - 18.2)	17.6% (16.4 - 18.8)
<b>Monthly income (Taka/month)</b>	<7000	9.0% ( 7.9 - 10.2)	9.2% ( 8.2 - 10.2)
	7000-8999	16.2% (14.8 - 17.6)	16.8% (15.8 - 17.7)
	9000-11999	25.8% (24.0 - 27.6)	25.9% (24.5 - 27.2)
	12000-14999	17.8% (16.4 - 19.2)	17.5% (16.6 - 18.4)

	15000	31.2% (28.6 - 33.7)	30.7% (28.6 - 32.7)
Primary occupation	Agriculture	6.4% ( 5.8 - 6.9)	6.3% ( 5.8 - 6.8)
	Business	5.9% ( 5.5 - 6.2)	5.8% ( 5.6 - 6.0)
	Student	27.9% (27.4 - 28.5)	27.5% (27.2 - 27.9)
	Domestic work	28.5% (28.1 - 28.8)	28.6% (28.4 - 28.9)
	Service	3.7% ( 3.4 - 4.1)	3.9% ( 3.7 - 4.2)
	Not working	3.2% ( 2.9 - 3.5)	3.3% ( 3.1 - 3.5)
	Skilled	3.8% ( 3.5 - 4.0)	3.7% ( 3.5 - 3.9)
	Unskilled	6.8% ( 6.3 - 7.3)	7.0% ( 6.5 - 7.4)
	Other	13.8% (13.4 - 14.3)	13.8% (13.6 - 14.1)

Types of disaster

The most common natural disaster events experienced by respondents were flooding/flash flooding (43%) and cyclone (35%). The majority of respondents (82%) reported experiencing one or more natural disasters in the previous five years and of these, two thirds believed flooding/flash flooding to be the greatest threat followed by cyclones/big storms.

Vulnerability and impact

Respondents were asked which members of the population were most likely to be impacted by natural disasters. Age was considered to be an important factor with older people (23%) and children (19%) considered to be most susceptible. Poor socioeconomic status (21%) was perceived to increase vulnerability to natural disasters. The types of work that was perceived to be most affected by the natural disaster were farming (32%), labourer jobs (31%) and fishing (20%).

Drowning during disaster was the primary concern for 87% of the respondents. A small proportion (10%), of respondents considered health to be a priority during disaster, while debt, livestock and crop loss were prevailing concerns among the majority of respondents (78%).

Risk and protective factors

The survey asked two separate questions with respect to weather forecast and warning signals. Only 18% of the respondents reported having received any type of weather forecast information prior to the most recent natural disaster that they had experienced (Figure 1). The

most frequent sources of weather forecast information mentioned were from television, alarm or loud speakers, and through friends, families or neighbours.

### Figure 1: Sources of weather forecast information (%)

A high proportion of respondents (70%) reported having received warning signals prior to the onset of natural disaster. Although almost all households (94.8%) had at least one member who owned a mobile phone, the most common source of warning signal was television followed by warnings from local authorities and volunteers (Figure 2).

### Figure 2: Sources of warning signal information (%)

The majority of respondents (94.8%) reported their household roof to be made of tin and only 3.9% reported to have a concrete roof. Walls were made of tin for 85.2% of households and brick and plaster for 11% of the households.

### Disaster preparedness practices

Among respondents who reported to have experienced a natural disaster, only 19% evacuated at the time of the disaster. Limited money followed by limited time were identified as the two most common barriers to disaster preparedness (data not shown). Of the 81% of respondents who reported not evacuating, 44% believed that it was not required and that an alternative shelter was not easily accessible, while 38% did not evacuate because of concerns about the security of their property (25%) and protection of livestock (13%). Less than 5% of community members were aware of evacuation processes or safe evacuation points/places.

Among respondents who had experienced disaster, only 22% reported moving to an alternate shelter during the most recent disaster. Of these, all were self-initiated with no rescues required from residences. Cyclone shelters (54%) were used most often followed by

educational institutions (23%), flood shelter (13%), relative’s home (9%) and community centre (1%).

**Qualitative results**

The interviewee characteristics are presented in Table 2. The four focus groups consisted of two male groups and two female groups, with characteristics presented in Table 3.

**Table 2 Characteristics of in-depth interview participants**

**Table 3 Characteristics of focus group discussion participants**

	Gender	Age range (years)	N in each group	Occupation
FGD1	M	30-60	6	Small business owners, fishermen, shop keepers
FGD2	M	Unknown	6	Business men and fishermen
FGD3	F	25-50	6	Housewives
FGD4	F	25-50	5	Housewives

Four overarching themes emerged from the qualitative data: 1) Perceptions and consequences of disaster; 2) Insufficient support for the most vulnerable (economically, geographically and personal physical attributes); 3) Community preparedness and practices; 4) Barriers to disaster response and improving resilience. The four overarching themes were drawn together from key sub themes, which are presented in Table 4 with illustrative quotes.

**Perceptions of risk and consequences of disaster**

Experiences of water-related disaster were common while community perceptions about the cause of such disasters were entrenched in beliefs that disasters were not preventable. This caused disaster-related death to be considered unavoidable, or to occur as a result of “Allah’s will”. However, there was also acknowledgment of the relationship between water-related disasters and climate uncertainty, which was attributed to the impacts of pollution.

A major concern for community members was the consequences of disaster on agriculture, with erosion and loss of crops and livestock having a devastating impact on communities. In particular, loss of livestock was a significant concern for farmers, and the need to protect livestock presented a major impediment to evacuation. Similarly, theft and looting were cited as both a consequence of disaster and an impediment to evacuation. In terms of health consequences, drowning and illness due to poor sanitation post-disaster were considered to be major contributors to disaster-related morbidity and mortality.

### **Insufficient support for the most vulnerable**

Respondents frequently reported on the structural weakness of existing dwellings and their inability to remain structurally sound during a disaster event. A number of personal characteristics were repeatedly associated with increased vulnerability to drowning. Many of these surrounded the notion of 'weakness' – an inability to move quickly, hold onto stationary objects when caught in flood waters, swim against currents, climb to safe areas above flood waters, or carry belongings overhead when crossing flood waters.

A number of characteristics were specific to women, such as the traditional clothing worn becoming heavy when wet, or long hair becoming caught on objects preventing escape from flood waters. Statements were made about the care a woman feels for her children, which made her a liability to the broader family and there were suggestions that women were less able than men to maintain calm or plan rationally in high pressure situations.

### **Community preparedness and practices**

Community members interpreted warning signals in different ways, each having their own thresholds for deciding when evacuation is necessary. Previous warning signals given for seemingly minor events caused many participants to be skeptical about the urgency of signals. Not all community members owned a TV or radio and as power is often lost during weather events, so loudspeaker announcements in village settings were considered to be most the

effective warning signal, which appear to be predominantly coordinated by NGOs. Warning signals were either based on a 10-point scale which indicates event severity, or are a simple call for evacuation, directing community members towards cyclone shelters and other protected areas of the community.

Many drowning deaths were reported to be caused by people evacuating their households after not responding to early warnings. Despite this, evacuation is considered an inconvenience to community members due to difficulties with transporting less-mobile people and the looting that frequently occurs when households are left unattended. One participant reported thieves staging false disaster warning signals for an opportunity to rob empty households.

**Barriers to disaster response and improving resilience**

Although there were a number of approaches documented towards disaster preparedness, management and relief, many of these were considered to be unreliable or unsustainable. Many participants discussed disaster management education provided by NGOs in community settings. Although useful, these education programs were reported to be sporadic and with varied content. A lack of resources limited the extent individuals were able implement the practices taught. Consequently, disaster preparedness was predominately managed by individual community members.

Government initiatives primarily focused on protection at time of disaster and relief post-disaster. A number of cyclone shelters had been built by government in community settings and were frequently used by the most vulnerable members of the community at the time of disaster. Despite this, cyclone shelters were reported to be difficult to access due to unsafe roads and long distances between shelters. Furthermore, shelters were reportedly often overcrowded, had poor structural quality, and potentially unsafe places for women. There was clearly lack of faith in governance and systems, with many comments concerning unequal distribution of government relief post-disaster, and examples of bribery and nepotism.



Government post-disaster relief was only available over short periods of time post-event and in some cases, was also provided sporadically by NGOs.

**Table 4: Key subthemes from qualitative analysis with illustrative quotes**

Theme	Key sub-themes		Illustrative quotes
<b>Perceptions of risk and consequences of disaster</b>	1. Perceived causes of disaster	1a. Beliefs	<i>"And why these happen, I cannot say. Allah wishes - that's why it happens brother. Everything happens when Allah wishes." (P2, M, fisherman and shop owner)</i>
		1b. Climate change	<i>"Car, launch, steamer; all these release smoke which is harmful for nature and for that reason disaster takes place." (FGD2, M, small business owners))</i>
	2. Outcomes of disaster	2a. Loss of human life	<i>"We saw many dead bodies of people beside the road." (FGD1, M, business men and fishermen)</i>
		2b. Loss of livestock, agricultural land and produce	<i>"What is more problem is, the fishes of the pond go away. Because of this, the people suffer from financial problems. They lose everything." (P6, F, social worker)</i>  <i>"The storm destroyed all the crops. I don't know whether we will get any rice or not from the grain." (FGD3, F, housewives)</i>
		2c. Damaged households	<i>"Now look at that broken house which is left there. That house was made newly, it was built only two to three months ago. Suddenly it was hit by the storm." (P7, F, housewife and NGO employee)</i>
		2d. Theft	<i>"We stay at home because if we leave the house the things will be stolen. We have nothing else than these things of the house. That's why we try to stay at the houses long as we can." (P3, M, agricultural worker)</i>
		2e. Damaged public infrastructure	<i>"Children cannot go to school and people have to swim to cross the roads. [The market] and cooking became a great problem." (FGD4, F, housewives)</i>
		2f. Illness	<i>"When water comes during calamity, if people drink that water, people suffer from many diseases." (P6, F, social worker)</i>
<b>Insufficient support for</b>	3. Increased vulnerability	3a. Gender issues	<i>"During this time [women] are considered as a burden by other members of the family. They cannot</i>



vulnerable			<i>move quickly, cannot come quickly.” (P6, F, social worker)</i>
		3b. Dependence on others	<i>“Women are in risk because they wear many clothes and they have long hair. That hair might be untied and get stuck or twisted with anything else. They don’t have that much strength. So they cannot free themselves.” (FGD2, M, businessmen and fishermen)</i>
		3c. Close proximity to water	<i>“All of us who were staying near the river bank, lost everything. Everything was broken down.” (P4, M, fisherman and labourer)</i>
Community preparedness and practices	4. Preparing for disaster	4a. Preparation of food and resources	<i>“And we arrange everything properly and tie up with the beam, so that later on we can get everything in proper order.” (FGD2, M, businessmen and fishermen)</i>
		4b. Modifications made to households	<i>“We put poles to support the house so that it doesn’t fall. We take a thick rope and tie up one end of that rope with the house and tie up the other end of rope with a big tree tightly, so that the house doesn’t fall during cyclone.” (FGD3, F, housewives)</i>
		4c. Self-made safety equipment	<i>“We make some floating materials with plastic bottle of soft drink, or plastic water bottle etc. I made those floating materials for all the members of my family.” (P6, F, social worker)</i>
		4d. Education provided by government and NGOs	<i>“Now everyone has got training. Everyone knows what is to be done, if there is cyclone. The people of coastal area have now become more conscious.” (P6, F, social worker)</i>
	5. Protection at time of disaster	5a. Heterogeneity in mode of communication	<i>“We receive information through radio and television. We even get to know what type of disaster is coming. We received signals during Aila. Mic was used in our area to aware people.” (P1, M, assistant teachers)</i>
		5b. Lack of compliance to warning systems	<i>“And another thing is people don’t want to go. As long as possible they try to stay in their own place. If they have left their things in that place then they might have lost their things. People don’t want to leave their resort in their entire life. That’s why</i>

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			<i>problem increases more and people get hurt more by drowning in water.” (FGD1, M, small business owners)</i>
		5c. Reliance on cyclone shelters for protection	<i>“If we get information about flood, then we will have to move to [the cyclone shelter]. Apart from this we don’t have any alternative.” (FGD3, F, housewives)</i>
		5d. Cyclone shelters not meeting community needs	<i>“Cyclone centres are located far from this place. If these are located near to us then it would be possible to go to cyclone centre.” (FGD2, M, business men and fishermen)</i>  <i>“Suppose there are two cyclone centres in our area. Already cracks have been developed in one building. Moreover they become filled up with people at the time when signal is shown.” (FGD2, M, business men and fishermen)</i>
		5e. Use of other resilient infrastructure for shelter	<i>“We took shelter in those people’s houses which were better means [than our house]. We took shelter in those houses which had strong foundation.” (FGD1, M, small business owners)</i>
		5f. Use of Indigenous floatation methods	<i>“We use banana tree to keep ourselves floating. When there is a flood, we cut down banana trees. This is the local method. By using these accessories, we can reduce drowning.” (P1, M, assistant teacher)</i>
<b>Barriers to disaster response and improving resilience</b>	6. Survival skills, rescue and resuscitation	6a. Lack of survival skills	<i>“A man in the north was totally puzzled and could decide which way to go with his old father. Then he was thinking whether he will save himself or will take his father. Then he tied up his father with a tree so that even if he dies at least his dead body will be found. Later on his father died tied up with that tree. Later, he was buried in the morning.” (FGD1, M, small business owners)</i>  <i>“My grandson was seven months old. We put quilt, pillow in a big metallic utensil and then put him there and then said, ‘We are old. We cannot go to the marshy land, we cannot take him. Let him float on water. If Allah grants him life line then somehow he will survive and if he has no life line, then he will not be in this world anymore.” (FGD3, F, housewives)</i>

		6b. Rescue is a high-risk practice	<i>"While saving anyone from drowning he may also die. They have also several risks, like trees or boughs may break and fall on them." (FGD4, F, housewives)</i>
		6c. Resuscitation using traditional methods	<i>'[A] clay pot is grinded like powder and that powder is rubbed on the body. Then body has to cover with cotton so that water can release from his body. And if his body is moved taking his body on head, then he will remain alive.'" (FGD3, F, housewives)</i>
		6d. Minimal access to health facilities post-event	<i>"If someone gets injured by accident then we have hospital here but don't have doctor. If someone gets seriously injured by accident in that case we have nothing to do." (FGD2, M, business men and fishermen)</i>
	7. Disaster relief	7a. Multiple parties are involved in relief	<i>"Then there were help from many places. Not only the government, but also many states of the world helped then. We helped people [too]; providing various relief: medicines, foods. We volunteered in these tasks." (P2, M, fisherman and shop owner)</i>
		7b. Bribery and nepotism control relief distribution	<i>"At that time [those] who could give money as bribe he got that house and money. But [those] who actually needed he did not get the house and money." (FGD1, M, small business owners)</i>
	8. Improving disaster resilience	8a. Improve community awareness	<i>"Here I would like to emphasize that if the people are given more training on calamity, then I think the risk might be reduced to some extent. Training has to be imparted to all." (P6, F, social worker)</i>
		8b. Provision of floatation devices and signals	<i>"People like us can try to survive if given a ring buoy or life jacket. By the grace of Allah we might be able to live." (FGD2, M, business men and fishermen)</i>
		8c. Generate political will	<i>"We don't have any idea who will do it for us. There is no benefit in asking to the members or the chairman. During the election they promise us a lot of things which ultimately they don't fulfil." (FGD4, F, housewives)</i>
		8d. Construct more cyclone centres	<i>"Cyclone centre are not constructed where they are supposed to be constructed. These are constructed in the area where people have power and influence. It would have been very helpful to the people if these centres could be built after every one and one and half kilometres." (FGD1, M, small business owners)</i>

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		8e. Improve housing standards	<i>"If good strong houses can be made, then they can stay much safer. See everyone don't have the ability to build strong a house. For them, suppose, if a strong firm house can be made after every 4<sup>th</sup> or 5<sup>th</sup> house, then they can take shelter there. Storm will not bother much then." (P2, M, fisherman and shop owner)</i>
		8f. Construct more embankment s, barriers and dams	<i>"If block made of cement or concrete can be thrown beside the river bank then the people who live beside the river will remain well. And flood water will not be able to come easily. The river is breaking down in such a way this place will not last long." (FGD1, M, small business owners)</i>
		8g. Provide post-disaster medical service in community	<i>"When there is a disaster or flood, then if a service centre is established, it will be very good for us. The sick need not to be taken to remote areas. Their treatment can be managed from here." (P2, M, fisherman and shop owner)</i>
		8h. Use mosques for warning signals and shelter	<i>"If anything is announced from mosque, people give more importance to it and obey it. Again if Imam discusses these things, then people will be able to know more." (FGD1, M, small business owners)</i>
		8i. Increase tree plantations	<i>"You can plant many trees on the coastal area. That will save us from the stormy wind. But people don't plant trees because many of them have no place, no land or no money." (FGD2, M, business men and fishermen)</i>

## DISCUSSION

This study has highlighted the considerable challenges confronting communities in disaster prone regions of Bangladesh in the face of inadequate warning systems, poor understanding and uptake of evacuation measures, and insufficient relief responses all of which are heightened for vulnerable sectors, populations in remote geographical areas and those who are economically deprived. Vulnerabilities to disaster emerged as a confluence of personal and household factors, and the impacts of disaster presented a heavy burden to communities in terms of housing, economic losses and the threat of drowning. Despite this, it was evident that disaster preparedness was not seen as a priority in the community, with a lack of preparedness

and ineffective disaster response. Conversely, this study has also identified community strengths that can be built upon as part of a comprehensive disaster resilience approach that fosters community self-management of risk.

A major impediment to effective disaster preparedness was the efficacy of warning systems. Despite high levels of mobile phone penetration in Bangladesh, the majority of participants did not receive warnings through this avenue. Furthermore, there was great heterogeneity in the understanding and heeding of warning signals, which partially related to reluctance to evacuate due to the threat of looting and thieves. Warning signal efficacy was also impacted by loss of electricity during flooding and poor community confidence in warning systems. This is consistent with Osti and Nakasu <sup>1</sup> review of inadequate warning systems as part of overall structural and non-structural interventions across 10 different southern and eastern Asian countries during 21 fatal flood events. The authors reported that flood warning systems were unreliable and that the content of the warnings was too technical for community members. Taken together, these findings have critical implications for future research relating to appropriate messaging and use of mobile technology in early warning systems.

There is significant unmet community need for effective disaster response, which must be addressed to move towards ensuring disaster resilience rather than recovery. While communities demonstrated strength with self-reliance, it emerged that communities require a systems level approach to be supported to develop disaster resilience. There is limited insight into the ongoing mental health effects of disaster and how this impacts community resilience in disaster prone regions <sup>14</sup>. However, the present findings confirm previous research that indicates disaster has a traumatic impact on families and communities. This signifies the need for a mental health workforce that are competent in disaster-related trauma and are responsive to the community in terms of culture, traditions, language and local practices <sup>15</sup>. Further research is critical to understanding the impact of psychological trauma, which women may be more affected by than men, on community disaster resilience



At the community level, there was considerable concern for preserving agriculture and ultimately livelihoods. Protecting livestock was cited as a major impediment to evacuation and contributed to disaster vulnerability. Individual and community level factors were key contributors to vulnerability, in particular house construction, age and gender.

Women were perceived to be more vulnerable than men, which was consistent with previous research<sup>8 16</sup>; however in high income settings, men have a higher mortality attributed to flood related-drowning<sup>6</sup>. This is indicative of the “socially determined” role of women in many LMICs and is aligned with an emerging focus in disaster literature on the role of women and how this contributes to vulnerability<sup>8 14 16</sup>. In Bangladesh, this is related to the socioeconomic status of women, health status and perpetration of violence against women<sup>16</sup>. A cross-sectional survey with mothers spanning two floods in Bangladesh in 2007, reported 86% of women experienced intimate partner violence (physical, emotional, sexual and sustenance abuse) during a flood<sup>17</sup>. This study also reported that both unintentional injury (cuts, falls, drowning etc.) and parental violence against children is increased during flooding disaster<sup>17</sup>. Perpetration of parental violence (physical, emotional and sustenance abuse) against children was highest in low socioeconomic families, in families with household unemployment and among mothers; particularly mothers engaged in domestic work (not employed) and those experiencing intimate-partner violence, all of which related to the extreme survival pressure. While women are seen as vulnerable to disaster and disaster-related trauma, there is great opportunity to empower and educate women in disaster preparedness and management practices to promote community resilience.<sup>14</sup>

Natural disasters have a number of long-term indirect impacts on vulnerable populations. Communities repeatedly exposed to disasters may experience forced migration, either to urban centres or onto other hazard prone land.<sup>18</sup> This contributes to rising land pressure, rapid urbanisation and a breakdown of community and social structures which disproportionately affects the poorest members of the population, increasing marginalisation.<sup>19</sup> A lack of stability and security establishes a poverty cycle<sup>20</sup> and enhances existing issues surrounding gender and

social inequality.<sup>21</sup> The under- age marriage and trafficking of young girls has been reported to increase following disaster as children lose their parents, parents are unable to afford education due to disaster repair costs, or as schools are destroyed during disaster, impacting social-determinants of health adversely.<sup>22</sup>

**Implication for practice**

**Improve commitment from government**

The Sendai Framework has one global target specific to LMICs which calls for adequate and sustainable support for disaster preparedness and management which complements existing national actions.

Given the population density and scarce resources in the context, greater investment in preparedness and education rather than management and recovery is needed in Bangladesh. Disaster management was primarily undertaken by the NGOs/ multi- laterals, which was reported to be inconsistent. There is a need for improved coordination between relevant government agencies and NGOs to: 1) prevent overlap of interventions in certain areas and support areas/communities currently without any interventions; 2) ensure the interventions available are consistent and offered to a high standard; 3) ensure post-disaster aid is distributed using regulated processes to areas of most need; and 4) ensure allocation of funding is fair and appropriate governance mechanisms in place for distribution of support. Indeed Government investment is essential to obtaining resources to improve basic public infrastructure (roads, dams and river embankments), constructing protective infrastructure, such as cyclone shelters and for improving the availability of emergency medical care post-disaster. In Bangladesh, increased Government ownership and coordination could see considerable gains, however better engagement with stakeholders at the community and policy level is needed to ensure a community owned approach to promoting disaster resilience.

**Build resilient communities by enabling self-management of disaster risk**

All initiatives implemented should focus on empowering communities to mitigate disaster risk locally. This will assist in the promotion of cost-effective, local approaches to disaster preparedness, such as homemade personal floatation devices made from community sourced and readily available materials. The findings report on how communities/society in rural Bangladesh have organized themselves to increase resilience and manage disasters more effectively.

Participants reported not using cyclone shelters, however over-crowding of shelters was also reported as a deterrent. Community ownership with respect to consultation on shelter location, feasibility and usability of infrastructure to access shelters might address some of the mistrust in governance/disaster management. This may be aided by building and using community infrastructures such as schools or mosques as disaster shelters, which would be an efficient and acceptable use of resources. Finally, whilst the community reported poor access to health services generally, this was compounded during disasters when it was clear that the health systems were non-existent; the need for resilient health systems cannot be over-stated.

Resilience will also depend upon the capacity of disaster management practices to be adjusted in a timely manner, in response to changing community priorities and the changing local environment. There should be a focus on reducing internal community conflicts caused by the provision of external resources to promote cohesive, united, community-based response to disaster. This would be aided by formal disaster committees, which would be helpful not only as an entity but for understanding and addressing concerns on distribution of resources within the population; however, to be effective this also needs to be monitored. The aim of these committees could be to prepare the local population for disaster and take leadership in assisting community members at the time of disaster. To be effective, committee members would need external training (provided by government and/or NGOs) at regular intervals on various aspects of disaster preparedness, rescue and relief. Importantly, these committees should consist of a diverse range of community members who are part of the committee at an



equal rank, including women and the elderly. Furthermore, committees should be Government resourced and be in regular contact with government agencies and NGOs operating locally.

**CONCLUSION**

This study has highlighted the challenges facing water-related disaster prone region of Bangladesh. The results confirm previous research that emphasize the vulnerability of communities in the face of inadequate warning systems and poorly coordinated disaster responses, particularly for vulnerable/disadvantaged sectors of the community including the elderly, women, low socioeconomic families and those whose livelihood is rooted in agriculture. This research calls for increased government investment in systems level responses that empower communities and promote resilience. Further research can support this by addressing the systems level challenges to promoting disaster resilience, and investigating how existing community strengths can be leveraged to implement locally-owned solutions.

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**AUTHORS' CONTRIBUTION**

JJ, AR, KB and RI conceived the study and its design. AR, FC and KB led the acquisition of study data. KB led the quantitative data analysis. PC, FC and CL performed initial qualitative data analysis. AR, RI, JJ and KB led data interpretation. All authors contributed to manuscript writing critically, for important intellectual content.

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**COMPETING INTERESTS**

The authors have declared that no competing interests exist. Royal National Lifeboat Institution funded the project with Centre for Injury Prevention and Research, Bangladesh as collaborators and The George Institute for Global Health as academic partners.

## DATA SHARING

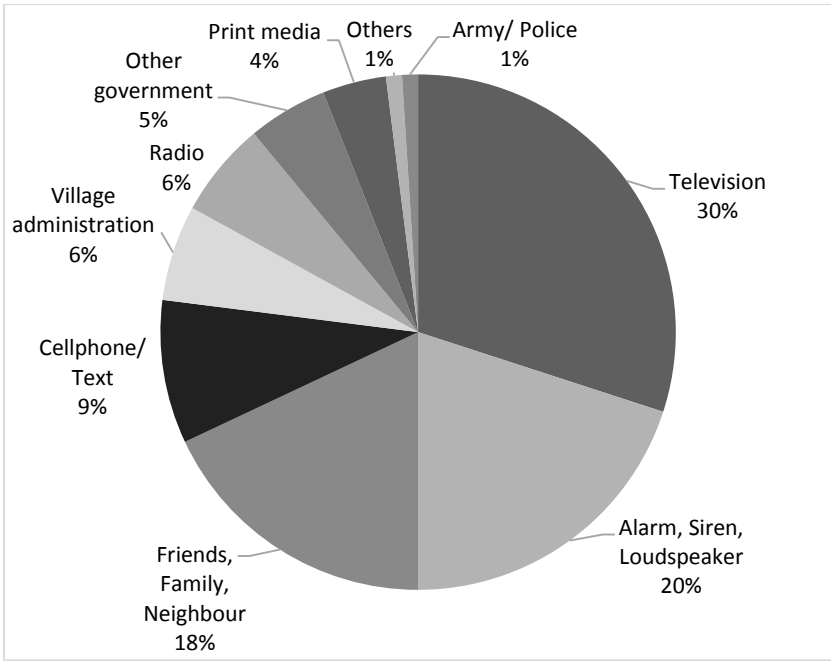
Requests for access to study data should be addressed to the corresponding author. Data will be made available to the scientific community with as few restrictions as feasible, while retaining exclusive use until the publication of major outputs.

## ETHICAL APPROVAL

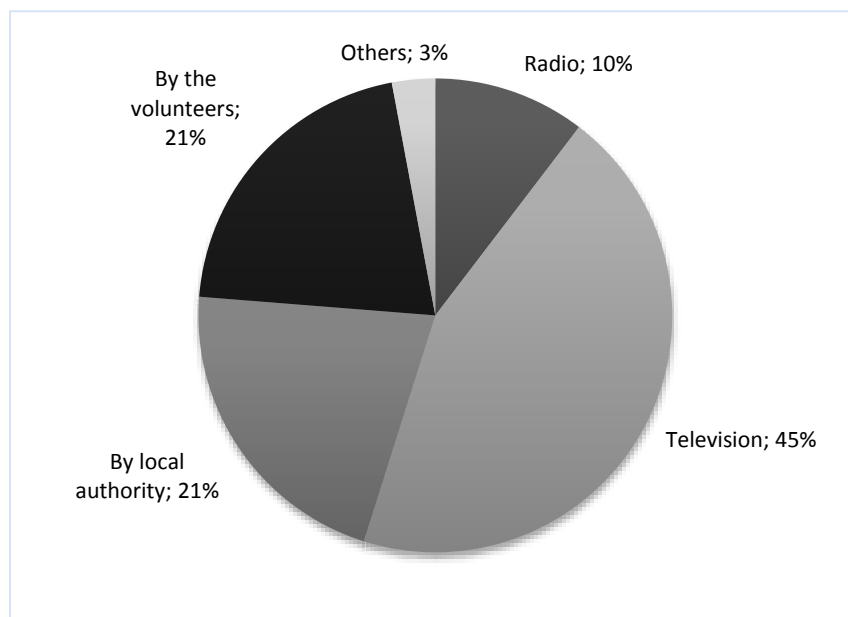
Ethical clearance for this study was obtained from the University of Sydney, Australia; and Ethical Review Committee – Centre for Injury Prevention and Research Bangladesh.

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# BMJ Open

## Context of water related disasters in Bangladesh: A mixed methods study

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## ABSTRACT

### Objectives:

To investigate the impact of natural disasters on communities in the Barisal division of Bangladesh, exploring community approaches to disaster preparedness and mitigation.

### Setting:

Communities in all districts of the Barisal division of Bangladesh.

### Participants:

Quantitative data was collected through a cross-sectional household survey with household heads, mothers and other adults aged 18 years and above (n=9,263 households visited, data collected for n= 38,981 individuals). Qualitative data was collected through in-depth interviews (n=7) and focus group discussions (n=23) with key informants from the community residing in Barisal.

### Outcome measures:

Quantitative research recorded features of natural disaster events from the previous five years, documenting risk factors that increase vulnerability to disaster, the use of disaster warning systems, and evacuation processes at the time of disaster. Qualitative research investigated disaster risk perceptions, experiences during and following disaster, and disaster preparedness practices.

### Results:

The survey response rate was 94.7%. Exposure to disaster in the last five years was high (82%) with flooding followed by cyclones considered the greatest threats. Awareness of evacuation processes was low, and only 19% of respondents reported evacuating their homes at the time of disaster. Drowning during disaster was the primary concern (87%), followed by debt, livestock and crop loss (78%). The qualitative data amalgamated into four overarching themes: 1) Perceptions and consequences of disaster; 2) Insufficient support for the most vulnerable; 3)

Community preparedness and practices; 4) Barriers to disaster response and improving resilience.

**Conclusions:**

Critical to achieving disaster resilience is increased government investment in infrastructure and systems level responses that empower communities. Further research can support this by addressing the community challenges to promoting disaster resilience, and investigating how existing community strengths can be leveraged to implement locally owned solutions.

**Trial registration:**

N/A

**Strengths and Limitations**

- To our knowledge, this is the first large scale study reporting on context of disasters, using mixed methods from a LMIC.
- This study was conducted in a LMIC prone to water-related disasters and the results may not be generalizable to other LMIC settings; however the qualitative focus group discussions and in-depth interviews spanned a diverse array of participants and yielded rich data that greatly contextualized the cross-sectional survey
- Consultations with government representatives are likely to have provided additional insight into existing government initiatives targeted at disaster preparedness and response

## INTRODUCTION

Climate-related disasters significantly impact the health, personal security and livelihood of individuals, communities and societies. Between 1998 and 2017, climate-related disasters were the cause of over 1.3 million deaths worldwide, and resulted in a further 4.4 billion people sustaining injuries, becoming homeless, displaced or requiring emergency assistance<sup>1</sup>. The impacts of climate related disaster are most severely experienced by those living in low- and middle-income countries (LMICs) who have a higher dependence on natural resources and who are exposed to higher rates of socio-economic disadvantage which prevents the development of coping capacity<sup>2</sup>. One such country is Bangladesh, which is highly prone to flooding due to the annual monsoon rainfalls and extensive low lying floodplains that cover an estimated 80% of the densely populated country<sup>3</sup>. With a population of over 165 million, it is estimated that more than two thirds of people in Bangladesh live in regions at risk of floods and one quarter live in regions at risk of cyclone<sup>4</sup>. The consequences of flooding in this context include the threat of diarrhoeal disease, lack of access to safe drinking water, loss of housing, livestock, crops, livelihood activities and drowning in floodwaters<sup>3 4</sup>. Additionally, tropical cyclones are an annual occurrence, which directly contribute to flooding and in turn, drowning-related mortality and morbidity<sup>4</sup>.

There is an increasing global focus on strengthening disaster risk reduction through improved surveillance, information exchange, early warning systems and capacity building in disaster prone countries. From 2005 to 2015, global governments committed to implementing the Hyogo Framework for Action as a guideline for reducing disaster risk through resilience building at both the national and local levels<sup>5</sup>. More recently, the Sendai Framework for Disaster Risk Reduction 2015-2030 was adopted by the United Nations member states in March 2015. The framework represents the next phase of targets and priorities globally, recognising the threat that climate change and disaster risk pose to achieving the Sustainable Development Goals (SDGs)<sup>6</sup>.

The risk of natural disasters in Bangladesh is projected to increase with changing weather patterns associated with extreme vulnerability to climate change<sup>3 4 7 8</sup>. In the face of growing climate uncertainty, there is an urgent need to understand disaster practices and promote community disaster resilience. In 1991, Cyclone Gorky struck Bangladesh, claiming the lives of 138,000 people. This event has spurred improvements in disaster warning systems and increased shelter uptake over the last 20 years<sup>4 9</sup> however, there remain considerable challenges in fostering disaster resilience at all levels. Currently, there is only fragmented information available on the consequences of natural disasters in Bangladesh and on existing practices associated with disaster mitigation. Through identifying gaps in current processes, targeted interventions may be implemented to strengthen existing approaches to disaster preparedness, with a focus on disaster risk reduction. Therefore, this study aims to investigate the impact of natural disasters on communities in the Barisal division of Bangladesh, exploring community disaster preparedness, responses to disaster at time of onset, and health seeking behaviours following disaster events. This information is anticipated to contribute to future disaster resilience planning activities for the region.

METHODS

Study setting

The Barisal division is located in south central Bangladesh and is comprised of six districts and 39 sub-districts (Figure 1). Crossed by numerous rivers, it is highly exposed to flooding due to annual monsoon rains and low lying flood plains.

Figure 1: Map of the Barisal division of Bangladesh

Study design

The study used a concurrent mixed methods approach, triangulating cross-sectional household survey data with qualitative in-depth interviews and focus group discussions. Both quantitative and qualitative data were collected as baseline measures of a larger intervention study which aims to significantly reduce drowning rates in the Barisal Division by 2020. As no previous

literature was available regarding Knowledge, Attitude and Practices for disaster resilience from LMICs, a mixed methods approach was used to gain an in-depth understanding of behaviors, perceptions and responses to disaster.

### Patient and Public Involvement

Drowning was identified as a priority health issue through the 2014 Bangladesh Demographic and Health Survey, which collected data from 18,000 residential households nation-wide.<sup>10</sup> Data collection instruments for this present study were developed by the project team in alignment with Bangladesh Health and Injury Survey findings<sup>11</sup>, designed to investigate notable drowning-related outcomes in greater depth. All data collection tools were trialled with end users prior to their use in this study, investigating their readability, clarity and the relevance of questions included. Study results were triangulated among key informants and consultations and were used to inform the development of pilot interventions for improving water safety and reducing drowning in community settings in Bangladesh.

## MATERIALS AND DATA COLLECTION

### Quantitative

The survey was conducted September 2016 – February 2017 (over a six month period), using a multi-stage cluster sampling method. The survey was conducted as a baseline measure for a larger intervention-based drowning reduction project to be implemented in selected districts of the Barisal division from 2017 to 2020. The sample size (n=385,000) was chosen based on the sample required for the previous Bangladesh Health and Injury Survey<sup>11</sup>, with the margins of 95% Confidence Intervals providing evidence of sufficient sample size.

Briefly, the sample selected represents all districts within the division. Upazilas from the districts were randomly selected to be included in the project, with further random selection used to identify villages/sites within each upazila for data collection. Within each village, households were selecting using the EPI sampling method<sup>12</sup>. The disaster subsample (10%, n=38,981) was selected from the main sampling frame by selecting every household with computer generated ID ending in '0'. Questions presented to participants within the disaster sub-sample were

primarily focused on post-disaster practices at the time of disaster to assess the acceptability, reliability and coverage of existing warning systems. The survey questions are available as Supplementary File 1.

Trained data collectors, local to each participating community, used pre-tested structured questionnaires to collect information from household heads, mothers or any adult above 18 years through face-to-face interviews. One adult was interviewed per household, who reported data on behalf of all household members. An electronic data capture system (REDCap) was used on tablets for data collection<sup>13</sup>. To ensure data quality and accuracy, trained supervisors observed and checked 10% collected data and re-interviewed 2% of households. The survey consisted of questions on knowledge, attitudes and perceptions/practices for community drowning and disaster risk, and about experiences of natural disaster in the previous five years. Data were collected on demographic characteristics, and on socio-economic status using an index developed for the 2014 Bangladesh Demographic and Health Survey.<sup>10</sup>

**Qualitative**

Purposive sampling was used to identify key informants from the community for in-depth interviews and focus group discussions. For inclusion in the study, participants were required to have resided within Barisal for at least six months prior to data collection. Separate male and female discussion groups were arranged to align with cultural practices. The interviews and focus group discussions were semi-structured and conducted by trained research assistants in community locations that were acceptable and accessible to participants. Consent was obtained prior to commencing data collection; interviews lasted between 40-60 minutes, whilst focus group discussions lasted between 1-1.5 hours. The interview and focus group discussion guides included questions related to: 1) disaster risk perceptions; 2) experiences of natural disaster; 3) disaster preparedness practices. Questions aimed to identify examples of good practice in disaster preparedness from community settings to include in future comprehensive disaster resilience planning activities. Further, questions aimed to explore gaps in current disaster preparation, management and relief processes that have potential be addressed

through targeted interventions. Interview and focus group discussion guides are available as Supplementary File 2.

Interviews and focus group discussions were conducted in Bengali, audio-recorded, translated and transcribed in English. To minimise data loss, interviews were jointly translated and transcribed by the interviewing researcher and the translator, and a member of the research team checked the translated transcripts for accuracy. Interviews ceased when saturation of meaning was considered to have occurred.

## ANALYSIS

### Quantitative

Descriptive analysis (counts and percentages) was performed on variables relating to disaster knowledge, attitudes and behaviour variables. All data were analysed using SAS 9.4 with SAS/STAT 14.2 (SAS Institute, Cary, NC, USA).

### Qualitative

Transcripts were imported into NVivo qualitative data analysis software (QSR International Pty Ltd. V.11, 2015). Content analysis was applied to the transcripts whereby overarching themes were initially developed followed by deductive thematic coding of the data. NVivo was used to arrange the text according to codes and manage the codes in the interpretive phase. Two researchers independently conducted the coding and arrived at consensus on the analyses.

## RESULTS

### Quantitative results

A total of 95,124 households were visited, of which 92,616 household representatives were available for completing the survey (this corresponded to data gathered for n= 385,127 individuals; response rate 94.7%). There was an average household size of 4.2 members. For the disaster toll sub- sample of (n=9,263 households visited, data collected for n= 38,981 individuals) was completed. There were no meaningful differences in the socio-demographic







<b>Monthly income (USD/month)</b>	<80	9.0% ( 7.9 - 10.2)	9.2% ( 8.2 - 10.2)
	80-99	16.2% (14.8 - 17.6)	16.8% (15.8 - 17.7)
	100-139	25.8% (24.0 - 27.6)	25.9% (24.5 - 27.2)
	140-179	17.8% (16.4 - 19.2)	17.5% (16.6 - 18.4)
	800+	31.2% (28.6 - 33.7)	30.7% (28.6 - 32.7)
<b>Primary occupation</b>	Agriculture	6.4% ( 5.8 - 6.9)	6.3% ( 5.8 - 6.8)
	Business	5.9% ( 5.5 - 6.2)	5.8% ( 5.6 - 6.0)
	Student	27.9% (27.4 - 28.5)	27.5% (27.2 - 27.9)
	Domestic work	28.5% (28.1 - 28.8)	28.6% (28.4 - 28.9)
	Service	3.7% ( 3.4 - 4.1)	3.9% ( 3.7 - 4.2)
	Not working	3.2% ( 2.9 - 3.5)	3.3% ( 3.1 - 3.5)
	Skilled	3.8% ( 3.5 - 4.0)	3.7% ( 3.5 - 3.9)
	Unskilled	6.8% ( 6.3 - 7.3)	7.0% ( 6.5 - 7.4)
	Other	13.8% (13.4 - 14.3)	13.8% (13.6 - 14.1)

### Types of disaster

Using a recall period of five years, the most common natural disaster events experienced by respondents were flooding/flash flooding (43%) and cyclones (35%). The majority of respondents (82%) reported experiencing one or more natural disasters in the previous five years. Of these respondents, two thirds believed flooding/flash flooding to be the greatest threat, followed by cyclones/big storms.

### Vulnerability and impact

Respondents were asked which members of the population were most likely to be impacted by natural disasters. Age was considered to be an important factor with older people (23%) and children (19%) considered to be most susceptible. Poor socioeconomic status (21%) was perceived to increase vulnerability to natural disasters. Occupations perceived to be most affected by the natural disaster were farming (32%), labourer jobs (31%) and fishing (20%).

Drowning during disaster was the primary concern for 87% of respondents. Debt, livestock and crop loss were prevailing concerns among the majority of respondents (78%), while just 10% of respondents considered health to be a priority issue during disaster

### Risk and protective factors

The survey asked two separate questions with respect to weather forecast and warning signals. Only 18% of the respondents reported having received any type of weather forecast information prior to the most recent natural disaster that they had experienced. The most frequent sources of weather forecast information mentioned were from television (30%), alarm or loud speakers (20%), and through friends, families or neighbours (18%).

A high proportion of respondents (70%) reported having received warning signals prior to the onset of natural disaster. Although almost all households (95%) had at least one member who owned a mobile phone, the most common source of warning signal was television (45%) followed by warnings from local authorities (21%) and volunteers (21%).

The majority of respondents (95%) reported their household roof to be made of tin and only 4% reported to have a concrete roof. Walls were made of tin for 85% of households and brick and plaster for 11% of the households.

**Disaster preparedness practices**

Among respondents who reported to have experienced a natural disaster, only 19% evacuated at the time of the event. Limited money followed by limited time were identified as the two most common barriers to disaster preparedness (data not shown). Of the 81% of respondents who reported not evacuating, 44% believed evacuation was not required, 38% believed an alternative shelter was not easily accessible, 25% did not evacuate due to concerns about the security of their property and 13% remained to protect livestock. Less than 5% of community members were aware of evacuation processes or safe evacuation points/places.

Among respondents who had experienced disaster, 22% reported moving to an alternate shelter during the most recent event. All reported moves were self-initiated with no rescues required from residences. Cyclone shelters (54%) were used most often used for evacuation followed by educational institutions (23%), flood shelters (13%), relative’s homes (9%) and community centres (1%).

## Qualitative results

Interviewee characteristics are presented in Table 2. Four focus groups were conducted consisting of two male groups and two female groups, with characteristics presented in Table 3.

**Table 2 Characteristics of in-depth interview participants**

	Gender	Age range (years)	Occupation	Disaster-related role
P1	M	35-39	Assistant teacher at high school	Opens the doors of the local cyclone centre and escorts people inside
P2	M	30-34	Fisherman and shop owner	Delivers disaster warning signal through mic in village
P3	M	30-34	Agricultural worker	Not specified
P4	M	35-39	Fisherman and labourer	Member of village disaster committee
P5	F	25-29	Assistant teacher at primary school	Opens the doors of the school building and escorts people inside for shelter
P6	F	35-39	Social worker	Educates villagers on disaster preparedness, assists in delivering warning signal, helps vulnerable people evacuate households, leads search parties
P7	F	25-29	Housewife and employee of family planning NGO	Vice president of village disaster committee (administrative role)

**Table 3 Characteristics of focus group discussion participants**

Gender	Age range (years)	N in each group	Occupation
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FGD1	M	30-60	6	Small business owners, fishermen, shop keepers
FGD2	M	Unknown	6	Business men and fishermen
FGD3	F	25-50	6	Housewives
FGD4	F	25-50	5	Housewives

Four overarching themes emerged from the qualitative data: 1) Perceptions and consequences of disaster; 2) Insufficient support for the most vulnerable (economically, geographically and personal physical attributes); 3) Community preparedness and practices; 4) Barriers to disaster response and improving resilience. The four overarching themes were drawn together from key sub themes which are available in Supplementary File 4, together with illustrative quotes.

Perceptions of risk and consequences of disaster

Community members perceived disasters to not be preventable and viewed disaster-related death as unavoidable, or to occur as a result of “Allah’s will”. There was some acknowledgment of the relationship between water-related disasters and climate uncertainty, which was attributed to the impact of pollution.

*“And why these happen, I cannot say. Allah wishes - that’s why it happens brother. Everything happens when Allah wishes.”* (P2, M, fisherman and shop owner)

A major concern for community members was the consequences of disaster on agriculture, with erosion and loss of crops and livestock having devastating impacts on livelihood.

*“The storm destroyed all the crops. I don’t know whether we will get any rice or not from the grain.”* (FGD3, F, housewives)

In particular, loss of livestock was a significant concern for farmers, and the need to protect livestock presented a major impediment to evacuation. Similarly, theft and looting were cited

as both a consequence of disaster and an impediment to evacuation. In terms of health consequences, drowning and illness due to poor sanitation post-disaster were considered to be major contributors to disaster-related morbidity and mortality.

### Insufficient support for the most vulnerable

Respondents frequently reported on the structural weakness of existing dwellings and their inability to withstand a disaster event. A number of personal characteristics were repeatedly associated with increased vulnerability to drowning. Many of these surrounded the notion of 'weakness' – an inability to move quickly, hold onto stationary objects when caught in flood waters, swim against currents, climb to safe areas above flood waters, or carry belongings overhead when crossing flood waters. Many of characteristics were specific to women, with traditional clothing worn becoming heavy when wet, or long hair becoming caught on objects preventing escape from flood waters.

*"Women are in risk because they wear many clothes and they have long hair. That hair might be untied and get stuck or twisted with anything else. They don't have that much strength. So they cannot free themselves."* (FGD2, M, businessmen and fishermen)

Statements were made about the care a woman feels for her children making her a liability to the broader family. There were mentions that women were less able than men to maintain calm or plan rationally in high pressure situations.

### Community preparedness and practices

Participants discussed a number of approaches to preparing their households prior to disaster. These included securing food and valuables in safe, waterproof storage places, reinforcing households with rope and tarp, and creating floatation devices for family members from empty plastic soft drink bottles in case of flooding.

*“We put poles to support the house so that it doesn’t fall. We take a thick rope and tie up one end of that rope with the house and tie up the other end of rope with a big tree tightly, so that the house doesn’t fall during cyclone.”* (FGD3, F, housewives)

A variety of sources were used to communicate warnings in community settings prior and during disasters. Not all community members owned a TV or radio, and as power is often lost during weather events, loudspeaker announcements in village settings were considered to be most the effective warning signal. These announcements appeared to be predominantly coordinated by NGOs. Warning signals were either based on a 10-point scale which indicates event severity, or were a simple call for evacuation, directing community members towards cyclone shelters and other protected areas of the community. Community members interpreted warning signals in different ways, with individuals having different thresholds for deciding when evacuation was necessary. Previous warnings given for seemingly minor events caused many participants to be skeptical about the urgency of signals.

*“And another thing is people don’t want to go. As long as possible they try to stay in their own place. If they have left their things in that place then they might have lost their things. People don’t want to leave their resort in their entire life. That’s why problem increases more and people get hurt more by drowning in water.”* (FGD1, M, small business owners)

Many drowning deaths were reported to be caused by people evacuating their households after not responding to early warnings. Despite this, evacuation was considered an inconvenience to community members due to difficulties with transporting less-mobile people and the looting that frequently occurs when households are left unattended. One participant reported thieves staging false disaster warning signals for an opportunity to rob empty households.

*“We stay at home because if we leave the house the things will be stolen. We have nothing else than these things of the house. That’s why we try to stay at the houses long as we can.”* (P3, M, agricultural worker)

## Barriers to disaster response and improving resilience

Although there were a number of approaches documented towards disaster preparedness, management and relief, many of these were considered to be unreliable or unsustainable. Many participants discussed disaster management education provided by NGOs in community settings. Although useful, these education programs were reported to be sporadic and with varied content. A lack of resources limited the extent individuals were able implement the practices taught. Consequently, disaster preparedness was predominately managed by individual community members.

Government initiatives were primarily focused on protection at time of disaster and relief post-disaster. A number of cyclone shelters had been built by government in community settings and were frequently used by the most vulnerable members of the community at the time of disaster. Despite this, cyclone shelters were reported to be difficult to access due to unsafe roads and long distances between shelters. Furthermore, shelters were reportedly overcrowded, with poor structural quality, and were potentially unsafe places for women.

*“Suppose there are two cyclone centres in our area. Already cracks have been developed in one building. Moreover they become filled up with people at the time when signal is shown.”* (FGD2, M, business men and fishermen)

There was a clear lack of faith in governance, with many comments concerning unequal distribution of government relief post-disaster, driven by bribery and nepotism.

*“At that time [those] who could give money as bribe he got that house and money. But [those] who actually needed he did not get the house and money.”* (FGD1, M, small business owners)

Government post-disaster relief was only available over short periods of time post-event and in some cases, was also provided sporadically by NGOs.



DISCUSSION

This study has highlighted the considerable challenges confronting communities in disaster prone regions of Bangladesh in the face of inadequate warning systems, poor understanding and uptake of evacuation measures, and insufficient relief responses. Each of these challenges are heightened for populations in remote geographical areas and those who are economically deprived. The impacts of disaster presented a heavy burden to communities in terms of housing, economic losses and the threat of drowning and illness. Identifying these issues highlights areas of priority to address through interventions. Increasing commitment from government to address disaster risk was viewed as a crucial step towards reducing disaster-related devastation. As a result, further investigation into policy interventions to improve governance surrounding this issue is required. Further, the need for community to self-manage disaster risk was considered a priority. This study identified several community strengths that could be built upon as part of a comprehensive disaster resilience plan that fosters this approach.

A major impediment identified to effective disaster preparedness was the efficacy of warning systems. Despite high levels of mobile phone penetration in Bangladesh, the majority of survey respondents did not receive warnings through this means and instead relied on television (45%) and warnings from local authorities and volunteers (21%). There was significant heterogeneity in understanding and heeding warning signals, which contributed to a reluctance for evacuation. Warning signal efficacy was impacted by loss of electricity during flooding and poor community confidence in warning systems. This is consistent with the Osti and Nakasu <sup>3</sup> review of inadequate warning systems across 10 southern and eastern Asian countries during 21 fatal flood events. The authors reported flood warning systems to be unreliable and the content of warnings to be too technical for community members. Taken together, these findings have critical implications for future research relating to appropriate messaging and the use of mobile technology as an avenue for early warning with high coverage.

There is significant unmet community need for effective disaster response, which must be addressed to move towards ensuring disaster resilience rather than recovery. While communities demonstrated strength with self-reliance, a systems level approach was required to support the development of disaster resilience. There is limited insight into the ongoing mental health effects of disaster and how this impacts community resilience in disaster prone regions <sup>14</sup>. However, the present findings confirm previous research that indicates disaster has a traumatic impact on families and communities. This signifies the need for a mental health workforce that are competent in disaster-related trauma and are responsive to the community in terms of culture, traditions, language and local practices <sup>15</sup>. Further research is critical to understanding the impact of psychological trauma, which women may be more affected by than men, on community disaster resilience

At the community level, there was considerable concern for preserving agriculture and ultimately livelihoods. Protecting livestock was cited as a major barrier to evacuation and a significant contributor to disaster vulnerability, with 78% of survey participants reporting prevailing concerns about debt, livestock and crop loss at the time of a disaster event. Individual and community level factors were key contributors to vulnerability, in particular house construction, age and gender.

Women were perceived to be more vulnerable than men, which was consistent with previous research <sup>9 16</sup>; however in high income settings, men have a higher mortality attributed to flood related-drowning <sup>17</sup>. This is indicative of the “socially determined” role of women in many LMICs and is aligned with an emerging focus in disaster literature on the role of women and how this contributes to vulnerability <sup>9 14 16</sup>. In Bangladesh, this is related to the socioeconomic status of women, health status and perpetration of violence against women <sup>16</sup>. A cross-sectional survey with mothers spanning two floods in Bangladesh in 2007, reported 86% of women experienced intimate partner violence (physical, emotional, sexual and sustenance abuse) during a flood <sup>18</sup>. This study also reported that both unintentional injury (cuts, falls, drowning etc.) and parental violence against children is increased during flooding disaster <sup>18</sup>.

Perpetration of parental violence (physical, emotional and sustenance abuse) against children was highest in low socioeconomic families, in families with household unemployment and among mothers; particularly mothers engaged in domestic work (not employed) and those experiencing intimate-partner violence, all of which related to the extreme survival pressure. While women are seen as vulnerable to disaster and disaster-related trauma, there is great opportunity to empower and educate women in disaster preparedness and management practices to promote community resilience.<sup>14</sup>

Natural disasters have a number of long-term indirect impacts on vulnerable populations. Communities repeatedly exposed to disasters may experience forced migration, either to urban centres or onto other hazard prone land.<sup>19</sup> This contributes to rising land pressure, rapid urbanisation and a breakdown of community and social structures which disproportionately affects the poorest members of the population, increasing marginalisation.<sup>20</sup> A lack of stability and security establishes a poverty cycle<sup>21</sup> and enhances existing issues surrounding gender and social inequality.<sup>22</sup> The under- age marriage and trafficking of young girls has been reported to increase following disaster as children lose their parents, parents are unable to afford education due to disaster repair costs, or as schools are destroyed during disaster, impacting social-determinants of health adversely.<sup>23</sup>

**Implication for practice**

**Improve commitment from government**

Given the population density and scarce resources in the context, greater investment in preparedness and education rather than management and recovery is needed in Bangladesh. Disaster management was primarily undertaken by the NGOs/ multi- laterals, which was reported to be inconsistent. There is a need for improved coordination between relevant government agencies and NGOs to: 1) prevent overlap of interventions in certain areas and support areas/communities currently without any interventions; 2) ensure the interventions available are consistent and offered to a high standard; 3) ensure post-disaster aid is distributed using regulated processes to areas of most need; and 4) ensure allocation of funding is fair and

appropriate governance mechanisms in place for distribution of support. Indeed Government investment is essential to obtaining resources to improve basic public infrastructure (roads, dams and river embankments), constructing protective infrastructure, such as cyclone shelters and for improving the availability of emergency medical care post-disaster. In Bangladesh, increased Government ownership and coordination could see considerable gains, however better engagement with stakeholders at the community and policy level is needed to ensure a community owned approach to promoting disaster resilience.

### **Build resilient communities by enabling self-management of disaster risk**

All initiatives implemented should focus on empowering communities to mitigate disaster risk locally. This will assist in the promotion of cost-effective, local approaches to disaster preparedness, such as homemade personal floatation devices made from community sourced and readily available materials. The findings report on how communities/society in rural Bangladesh have organized themselves to increase resilience and manage disasters more effectively.

Participants reported not using cyclone shelters, however over-crowding of shelters was also reported as a deterrent. Community ownership with respect to consultation on shelter location, feasibility and usability of infrastructure to access shelters might address some of the mistrust in governance/disaster management. This may be aided by building and using community infrastructures such as schools or mosques as disaster shelters, which would be an efficient and acceptable use of resources. Finally, whilst the community reported poor access to health services generally, this was compounded during disasters when it was clear that the health systems were non-existent; the need for resilient health systems cannot be over-stated.

Resilience will also depend upon the capacity of disaster management practices to be adjusted in a timely manner, in response to changing community priorities and the changing local environment. There should be a focus on reducing internal community conflicts caused by the provision of external resources to promote cohesive, united, community-based response to

disaster. This would be aided by formal disaster committees, which would be helpful not only as an entity but for understanding and addressing concerns on distribution of resources within the population; however, to be effective this also needs to be monitored. The aim of these committees could be to prepare the local population for disaster and take leadership in assisting community members at the time of disaster. To be effective, committee members would need external training (provided by government and/or NGOs) at regular intervals on various aspects of disaster preparedness, rescue and relief. Importantly, these committees should consist of a diverse range of community members who are part of the committee at an equal rank, including women and the elderly. Furthermore, committees should be Government resourced and be in regular contact with government agencies and NGOs operating locally.

**Strengths and limitations**

To our knowledge, this is the first large scale study reporting on the context of natural disasters, using mixed methods, from a LMIC. The qualitative research performed spanned a diverse range of participants and yielded rich data that greatly contextualized the cross-sectional survey. As the study was conducted in a country prone to water-related disasters, the results may not be generalizable to other LMIC settings. Secondly, the recall period was relatively large with 5 years which may influence the reliability of the findings. Consultations with government representatives are likely to have provided additional insight into existing government initiatives targeted at disaster preparedness and response, highlighting strengths and gaps in existing disaster mitigation policies.

**CONCLUSION**

This study has highlighted the challenges facing water-related disaster prone region of Bangladesh. The results confirm previous research that emphasize the vulnerability of communities in the face of inadequate warning systems and poorly coordinated disaster responses, particularly for vulnerable/disadvantaged sectors of the community including the elderly, women, low socioeconomic families and those whose livelihood is rooted in agriculture. This research calls for increased government investment in systems level responses that empower communities and promote resilience. Further research can support this by addressing

the systems level challenges to promoting disaster resilience, and investigating how existing community strengths can be leveraged to implement locally-owned solutions.

For peer review only

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## AUTHORS' CONTRIBUTION

JJ, AR, KB and RI conceived the study and its design. AR, FC and KB led the acquisition of study data. KB led the quantitative data analysis. PC, FC and CL performed initial qualitative data analysis. AR, RI, JJ and KB led data interpretation. All authors contributed to manuscript writing critically, for important intellectual content.

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## COMPETING INTERESTS

The authors have declared that no competing interests exist. Royal National Lifeboat Institution funded the project with Centre for Injury Prevention and Research, Bangladesh as collaborators and The George Institute for Global Health as academic partners.

**DATA SHARING**

Requests for access to study data should be addressed to the corresponding author. Data will be made available to the scientific community with as few restrictions as feasible, while retaining exclusive use until the publication of major outputs.

**ETHICAL APPROVAL**

Ethical clearance for this study was obtained from the University of Sydney, Australia; and Ethical Review Committee – Centre for Injury Prevention and Research Bangladesh.

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Image 1: Map for study area- Barisal division, Bangladesh

30x22mm (300 x 300 DPI)

COREQ (CONsolidated criteria for REporting Qualitative research) Checklist

A checklist of items that should be included in reports of qualitative research. You must report the page number in your manuscript where you consider each of the items listed in this checklist. If you have not included this information, either revise your manuscript accordingly before submitting or note N/A.

Topic	Item No.	Guide Questions/Description	Reported on Page No.
Domain 1: Research team and reflexivity			
Personal characteristics			
Interviewer/facilitator	1	Which author/s conducted the interview or focus group?	
Credentials	2	What were the researcher's credentials? E.g. PhD, MD	
Occupation	3	What was their occupation at the time of the study?	
Gender	4	Was the researcher male or female?	
Experience and training	5	What experience or training did the researcher have?	
Relationship with participants			
Relationship established	6	Was a relationship established prior to study commencement?	
Participant knowledge of the interviewer	7	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	
Interviewer characteristics	8	What characteristics were reported about the inter viewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	
Domain 2: Study design			
Theoretical framework			
Methodological orientation and Theory	9	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	
Participant selection			
Sampling	10	How were participants selected? e.g. purposive, convenience, consecutive, snowball	
Method of approach	11	How were participants approached? e.g. face-to-face, telephone, mail, email	
Sample size	12	How many participants were in the study?	
Non-participation	13	How many people refused to participate or dropped out? Reasons?	
Setting			
Setting of data collection	14	Where was the data collected? e.g. home, clinic, workplace	
Presence of non-participants	15	Was anyone else present besides the participants and researchers?	
Description of sample	16	What are the important characteristics of the sample? e.g. demographic data, date	
Data collection			
Interview guide	17	Were questions, prompts, guides provided by the authors? Was it pilot tested?	
Repeat interviews	18	Were repeat inter views carried out? If yes, how many?	
Audio/visual recording	19	Did the research use audio or visual recording to collect the data?	
Field notes	20	Were field notes made during and/or after the inter view or focus group?	
Duration	21	What was the duration of the inter views or focus group?	
Data saturation	22	Was data saturation discussed?	
Transcripts returned	23	Were transcripts returned to participants for comment and/or	

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Topic	Item No.	Guide Questions/Description	Reported on Page No.
		correction?	
<b>Domain 3: analysis and findings</b>			
<i>Data analysis</i>			
Number of data coders	24	How many data coders coded the data?	
Description of the coding tree	25	Did authors provide a description of the coding tree?	
Derivation of themes	26	Were themes identified in advance or derived from the data?	
Software	27	What software, if applicable, was used to manage the data?	
Participant checking	28	Did participants provide feedback on the findings?	
<i>Reporting</i>			
Quotations presented	29	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	
Data and findings consistent	30	Was there consistency between the data presented and the findings?	
Clarity of major themes	31	Were major themes clearly presented in the findings?	
Clarity of minor themes	32	Is there a description of diverse cases or discussion of minor themes?	

Developed from: Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

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BHASA (AFLOAT)  
Baseline Survey Questionnaire

Question	Respondent's answer																								
Section G - Natural Disaster Details অধ্যায় G এর জন্য সাক্ষাৎকারে অংশগ্রহণকারী উত্তরদাতার নাম																									
উত্তরদাতার নাম ( অধ্যায়-জি ) Name of respondent interviewed for Section G নাম																									
আপনি কি কি ধরনের প্রাকৃতিক দুর্যোগের কথা জানেন? How many kinds of natural disasters can you think of?  একাধিক উত্তর হতে পারে Multiple responses possible কি কি ধরনের প্রাকৃতিক দুর্যোগের	<table><tr><td>1</td><td>সাইক্লোন/বড় ধরনের ঝড় Cyclones/big storms</td><td>5</td><td>রোগ Disease</td></tr><tr><td>2</td><td>বন্যা Flooding</td><td>99</td><td>জানিনা Don't know</td></tr><tr><td>3</td><td>সুনামি Tsunami</td><td>97</td><td>অন্যান্য (উল্লেখ করুন) Others (specify)</td></tr><tr><td>4</td><td>ভূমিধস Landslide</td><td></td><td></td></tr></table>	1	সাইক্লোন/বড় ধরনের ঝড় Cyclones/big storms	5	রোগ Disease	2	বন্যা Flooding	99	জানিনা Don't know	3	সুনামি Tsunami	97	অন্যান্য (উল্লেখ করুন) Others (specify)	4	ভূমিধস Landslide										
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4	দুর্যোগগুলো কি কি? ( সর্বশেষ ঘটনা)	6	ভারী বর্ষন/অতি বৃষ্টি Heavy rainfall
5	What was the third most recent disaster event you	2	সাইক্লোন/বড় ধরনের ঝড় Cyclone
6	have experienced?	7	কালবৈশাখী Nor
7		8	নদী ভাঙ্গন Riverbank erosion
8		9	জলোচ্ছ্বাস Tidal surge
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10			(specify)
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13	অন্যান্য (উল্লেখ করুন)		
14	Others (Specify)		
15	তখন আপনি কোন সতর্কবার্তা (দুর্যোগের সতর্কবার্তা)	1	হ্যাঁ Yes
16	শুনেছিলেন কি?	2	না No
17		90	মনে নেই Can't
18	Did you receive any warning message for the most		remember
19	recent disaster you experienced?		
20	সতর্কবার্তা শুনেছিলেন		
21	হ্যাঁ হলে, কোথায় থেকে দুর্যোগের সতর্কবার্তা	1	রেডিও Radio
22	শুনেছিলেন ?	2	টেলিভিশন Television
23		3	স্থানীয় প্রশাসনের প্রচারণা Announcement by local authority
24	If yes, where did you get the message from?	4	স্বৈচ্ছাসেবীদের প্রচারণা যেমন রেডক্রিসেন্ট/ফায়ার সার্ভিস ও সিভিল ডিফেন্স
25	কোথা থেকে শুনেছিলেন		Announcement by the volunteers (Red crescent, fire service and civil defence
26			etc)
27		97	অন্যান্য (উল্লেখ করুন) Others (specify)
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31	অন্যান্য (উল্লেখ করুন)		
32	Others (Specify)		
33	দুর্যোগের সময় আপনারা কি কাছাকাছি কোন দুর্যোগ	1	হ্যাঁ Yes
34	সেন্টারে আশ্রয় নিয়েছিলেন?	2	না No
35	During the last disaster did you and your household		
36	members move to a nearby shelter?		
37	কোথাও আশ্রয় নিয়েছিলেন		
38	হ্যাঁ হলে কে / কারা আশ্রয় কেন্দ্রের ব্যবস্থা করেছে?	1	নিজ উদ্যোগে গিয়েছি Self-initiative
39	If yes, who put in place/organised the shelter?	4	এন জি ও NGO
40	কারা ব্যবস্থা করেছে	2	সরকারী আশ্রয় কেন্দ্র Government Shelter
41		97	অন্যান্য (উল্লেখ করুন)
42			Others (specify)
43		3	স্থানীয় প্রশাসন Local Administration
44		99	জানি না Don't know
45		90	মনে নেই Can't remember
46	অন্যান্য (উল্লেখ করুন)		
47	Others (Specify)		
48	তখন আপনি কোথায় গিয়েছিলেন?	1	বন্যার্তদের জন্য সহায়তা কেন্দ্রে <sup>a</sup> Flood
49	What type of centre did you go to?	4	কমিউনিটি কেন্দ্রে Community
50		5	আত্মীয়র বাড়িতে Relatives
51	কোথায় গিয়েছিলেন		homes
52		99	জানি না Don't know
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55	প্রধানত কি কারণে আপনি আশ্রয় কেন্দ্রে যেতে পারেন	1	প্রয়োজনে মনে করিনি Did not think it was
56	নি ?	4	এ ধরনের দুর্যোগ প্রায়ই হয়
57	What is the primary reason you did not go to the		Disaster is a common
58	shelter/centre?		phenomenon
59	কি কারণে যেতে পারেন নি	2	বাড়ীর জিনিস-পত্রের নিরাপত্তার কথা চিন্তা
60			করে For the security of property
		5	সাইক্লোন শেল্টার বেশ দূরে
			Shelter is far away
		97	অন্যান্য (উল্লেখ করুন) Others
			(specify)



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এ এলাকায় সাধারণত যে ধরনের অসুখ-বিসুখ হয় সে তুলনায় পানিতে ডুবা প্রতিরোধে কাজ করাটা কতটা গুরুত্বপূর্ণ বলে মনে করেন?  [একটি উত্তর দিতে পরামর্শ করুন ] Compared to other health problems you or your area face, how big a priority is it to reduce the risks associated with disasters that can lead to drowning? [Prompt for one response] গুরুত্বপূর্ণ বলে মনে করেন					
1	তেমন গুরুত্বপূর্ণ নয় Low priority				
2	কিছুটা গুরুত্বপূর্ণ Medium priority				
3	অতি গুরুত্বপূর্ণ High priority				
(উত্তর বলে দিবেন না, উত্তরদাতাকে সবচেয়ে বেশি ক্ষতি হয়েছে এমন তিনটি বিষয় নির্বাচন করুন Do not prompt, give the respondent time to think and mark up to 3 options) আপনার মতে এসকল প্রাকৃতিক দুর্যোগে কি ধরনের ক্ষতি সবচেয়ে বেশি হয়ে থাকে? What were the main effects of the most recent natural disaster you experienced?					
1	ইনজুরিজনিত অসুস্থতা Injury morbidity	6	আয় কমে যাওয়া Loss of income		
2	মৃত্যু Death	7	গবাদী পশু হারিয়ে যায়/মারা যায় Loss of livestock		
3	ঘর-বাড়ী ধসে পড়ে Damage to infrastructure	8	ঋণ গ্রস্ত হয়ে যায় Debt		
4	মূল্যবান সম্পদের ক্ষতি Loss of productive assets	9	বিভিন্ন অসুখ-বিসুখ Disease		
5	ফসলের ক্ষতি Loss of crops				
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		4	মূল্যবান সম্পদের ক্ষতি Loss of productive assets	9	বিভিন্ন অসুখ-বিসুখ Disease
		5	ফসলের ক্ষতি Loss of crops		
এই প্রাকৃতিক দুর্যোগে আপনার এলাকায় অবকাঠামোগত/ পরিবেশগত কি ধরনের ক্ষতি সবচেয়ে বেশি হয়েছে? What parts of your community infrastructure or environment are most affected by this natural disaster?  (উত্তর বলে দিবেন না, উত্তরদাতাকে সবচেয়ে বেশি ক্ষতি হয়েছে এমন তিনটি বিষয় বলতে বলুন Do not prompt; select 3 most affected) অবকাঠামোগত ক্ষতি		1	ঘর-বাড়ি Houses	7	পানি ও পয়ঃনিষ্কাশন ব্যবস্থা Water and sanitation facilities
		2	কৃষি জমি/ফসল Farmland	8	রাস্তা- ঘাট Roads
		3	মাছ ধরার সামগ্রী Fishing resources	9	ব্রিজ/কালভার্ট Bridges
		4	গাছ-পালা/বাগান Trees/forests/orchards	99	জানি না Don't know
		5	বিদ্যালয়- Schools	97	অন্যান্য (উল্লেখ করুন) Other
		6	স্বাস্থ্য কেন্দ্র/ চিকিৎসা কেন্দ্র Health facilities		
অন্যান্য (উল্লেখ করুন)Others (Specify)					
এই প্রাকৃতিক দুর্যোগে আপনার এলাকার কোন ধরনের পেশাজীবীরা সবচেয়ে বেশি ক্ষতিগ্রস্ত? What kind of work or jobs in this area are most affected by this natural disaster?  উত্তর বলে দিবেন না, উত্তরদাতার দেয়া প্রযোজ্য সব		1	জেলে Fisherman	6	ব্যবসায়ী Shopkeeper/businessman
		2	মাঝি Boatman	7	সরকারী চাকরীজীবী Government employee

কয়টি উত্তর নির্বাচন করুন (Do not prompt; select as many as apply) পেশাজীবীদের ক্ষতি	3	রাখাল Livestock herder	8	পুলিশ/সামরিক বাহিনীর সদস্য Police/army
	4	কৃষক Farmer	99	জানি না Don't know
	5	দিন মজুর Wage labourer	97	অন্যান্য (উল্লেখ করুন) Other
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এই প্রাকৃতিক দুর্যোগে কোন ধরনের লোকজন বেশি ক্ষতিগ্রস্ত হয়েছে বলে মনে করেন? What groups of people do you think are most affected in your area during this natural disaster? প্রম্পট করা যাবে না (যত বেশী সম্ভব উত্তর লিখুন) Do not prompt; select as many as apply লোকজনের ক্ষতি	1	বৃদ্ধরা Older people		
	2	প্রাপ্তবয়স্ক ব্যক্তিরা Adults		
	3	শিশুরা Children		
	4	পুরুষ Men		
	5	মহিলা Women		
	6	প্রতিবন্ধীরা People with disabilities		
	7	দুঃস্থ ও গরীব লোকেরা Poorer people		
	8	নদী/সাগর তীরবর্তী লোকেরা People living in certain areas (e.g. river islands, coastal areas)		
	99	জানি না Don't know		
	97	অন্যান্য (উল্লেখ করুন) Other (specify)		
অন্যান্য (উল্লেখ করুন) Others (Specify)				
প্রাকৃতিক দুর্যোগের সময় আপনি মূলত কোন বিষয়গুলো নিয়ে বেশি চিন্তিত থাকেন? In the event of a natural disaster, what are your main concerns?  (উত্তর দিতে পরামর্শ করুন, শীর্ষ ৩টি উত্তর চিহ্নিত করুন Mark top 3 choices, prompt for responses) চিন্তিত বিষয়গুলো	1	ব্যক্তিগত নিরাপত্তা নিয়ে Personal safety		
	2	খানার/পরিবারের সদস্যদের মৃত্যু নিয়ে Death of a family member		
	3	বাড়ী-ঘর নিয়ে Losing your house		
	4	বাড়ী-ঘরের জিনিসপত্র নিয়ে Losing your belongings		
	5	কাজ/চাকুরি হারানো নিয়ে Losing your work		
	6	ফসল নষ্ট হওয়া নিয়ে Crop failure		
	7	খানার/পরিবারের সদস্যদের সাথে না থাকতে পারা নিয়ে Not being able to get in touch with family		
	8	পানিতে ভেসে যাওয়া নিয়ে Being overwhelmed		
	9	কোন বিষয়ে উদ্বিগ্ন/চিন্তিত ছিলাম না I would not be concerned		
	97	অন্যান্য (উল্লেখ করুন) Other (specify)		
অন্যান্য (উল্লেখ করুন)Others (Specify)				
এই প্রাকৃতিক দুর্যোগের বিষয়ে আপনি কোথা থেকে প্রয়োজনীয় তথ্য বা পূর্বাভাস পেয়ে থাকেন? In the event of a natural disaster where do you get forecasts or information from?  (উত্তর বলে দিবেন না, উত্তরদাতার দেয়া প্রযোজ্য সব কয়টি উত্তর নির্বাচন করুন; Do not prompt, select all that apply) কোথা থেকে পূর্বাভাস পান	1	রেডিও Radio	7	অন্য কোন সরকারী প্রতিষ্ঠান Other government
	2	টেলিভিশন TV	8	এলার্ম/ সাইরেন/মাইক Alarm, siren, loudspeaker
	3	সংবাদপত্র/পত্রিকা Print media	9	মোবাইল/ম্যাসেজ Cellphone/Text
	4	বন্ধু-বান্ধবী/পরিবারের সদস্য/প্রতিবেশী Friends, family, neighbor	10	কোথাও থেকে পাইনি From nowhere
	5	গ্রাম পুলিশ/ গ্রাম্য পঞ্চায়েত Village administration	99	জানি না Don't know
	6	পুলিশ/ সামরিক বাহিনীর সদস্য Army/police	97	অন্যান্য (উল্লেখ করুন) Other (specify)
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	2	ফায়ার সার্ভিস Fire services		
	3	স্থানীয় এনজিও Local NGOs		

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information?  (শীর্ষ ৩টি উত্তর চিহ্নিত করুন) (Mark top 3 choices) ব্যক্তি/প্রতিষ্ঠানের মধ্যে বেশী কার্যকর	<table><tr><td>4</td><td>স্কুল/কলেজ School/Colleges</td></tr><tr><td>5</td><td>মসজিদ/মাদ্রাসা Mosque/Temple</td></tr><tr><td>6</td><td>গণ্যমান্য ব্যক্তি Community leader</td></tr><tr><td>7</td><td>স্থানীয় জনস্বাস্থ্য প্রতিষ্ঠান Public Health Department</td></tr><tr><td>8</td><td>স্থানীয় সরকারী/বেসরকারী প্রতিষ্ঠান/ ক্লিনিক/সাইক্লোন সেন্টারের মাঠকর্মী Clinic/Outreach worker Government agencies, Cyclone preparedness programme, Local disaster management committee</td></tr><tr><td>97</td><td>অন্যান্য (উল্লেখ করুন) Other (specify)</td></tr></table>	4	স্কুল/কলেজ School/Colleges	5	মসজিদ/মাদ্রাসা Mosque/Temple	6	গণ্যমান্য ব্যক্তি Community leader	7	স্থানীয় জনস্বাস্থ্য প্রতিষ্ঠান Public Health Department	8	স্থানীয় সরকারী/বেসরকারী প্রতিষ্ঠান/ ক্লিনিক/সাইক্লোন সেন্টারের মাঠকর্মী Clinic/Outreach worker Government agencies, Cyclone preparedness programme, Local disaster management committee	97	অন্যান্য (উল্লেখ করুন) Other (specify)										
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5	বন্ধু-বান্ধবী/ পরিবারের সদস্য Friends/Family																						
6	প্রতিবেশী Neighbors																						
7	গণ্যমান্য ব্যক্তি/ধর্মীয় নেতা (ইমাম/পুরোহিত/ঠাকুর) Community leaders/Religious leaders																						
8	মাঠকর্মী Outreach worker																						
9	স্বাস্থ্যকর্মী Community health workers																						
10	এনজিও কর্মী NGO workers																						
97	অন্যান্য (উল্লেখ করুন) Other (Specify)																						
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আপনার মতে, সংকটকালীন সময় সেবা ও তথ্য পাবার সম্ভাব্য বাধা/সমস্যাগুলো কি? What do you believe are potential barriers/problems to accessing emergencies services and information?	<table><tr><td>1</td><td>তথ্যের অভাব Lack of information</td></tr><tr><td>2</td><td>করণীয় সম্পর্কে জ্ঞানের অভাব Lack of knowledge of what to do</td></tr><tr><td>3</td><td>বর্তমান অবস্থান সম্পর্কে জ্ঞান না থাকা Lack of knowledge of current location</td></tr></table>	1	তথ্যের অভাব Lack of information	2	করণীয় সম্পর্কে জ্ঞানের অভাব Lack of knowledge of what to do	3	বর্তমান অবস্থান সম্পর্কে জ্ঞান না থাকা Lack of knowledge of current location																
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Ensignment Supérieur (ABES)

(উত্তরদাতা যে কয়টি বলবে, সবক'টি বৃত্তায়িত করুন Select all that apply) সম্ভাব্য বাধা/সমস্যাগুলো কি	<table border="1"> <tr> <td>4</td> <td>প্রাকৃতিক দুর্যোগের অবস্থান সম্পর্কে তথ্য না জানা এবং সম্ভাব্য গতিপথ সম্পর্কে ধারণা না থাকা Lack of knowledge where the natural disaster is located and/or where it is heading</td> </tr> <tr> <td>5</td> <td>যানবাহনের অভাব Lack of transportation</td> </tr> <tr> <td>6</td> <td>সম্পত্তির নিরাপত্তা Property security</td> </tr> <tr> <td>7</td> <td>ব্যক্তিগত নিরাপত্তা Personal safety</td> </tr> <tr> <td>97</td> <td>অন্যান্য (উল্লেখ করুন) Other (specify)</td> </tr> </table>	4	প্রাকৃতিক দুর্যোগের অবস্থান সম্পর্কে তথ্য না জানা এবং সম্ভাব্য গতিপথ সম্পর্কে ধারণা না থাকা Lack of knowledge where the natural disaster is located and/or where it is heading	5	যানবাহনের অভাব Lack of transportation	6	সম্পত্তির নিরাপত্তা Property security	7	ব্যক্তিগত নিরাপত্তা Personal safety	97	অন্যান্য (উল্লেখ করুন) Other (specify)												
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### Supplementary File 3. In-depth interview guide and focus group discussion guide for community members with disaster experience

Topics to address in this IDI guide:

- Investigate the impact of aquatic disasters (natural and human) on the community
- Explore current disaster preparedness practices/resilience
- Understand role and measure in disaster relief management associated with drowning
- Explore health seeking behaviours of disaster related drowning events

*(Questions only for volunteer leaders are underlined)*

Demographic questions		
1.	Gender of participant:	Male Female
2.	Age of participant (in years):	
3.	Occupation of participant:	
4.	Role in the community:	
5.	<u>Are you associated with any organisation? (if volunteering from an organisation)</u>	

Themes	Queries	Probe/ clarifications/remarks
Introduction		
<b>Background information</b>	Explore participant background information	<p>-Can you please tell me your name and for how long you have you lived in this community?</p> <p>-What is your position in the community? How long have you been in this position?</p> <p>-What are your main responsibilities within the community before/during/after a disaster?</p>
Investigate the impact of aquatic disasters (natural and human) on the community		
	Explore general perceptions of disasters	<p>-What do you know about disasters such as floods, cyclones etc? What do you think causes them?</p> <p>Have you ever received any education or training about natural disasters? If <b>yes</b>, from where/whom? What did you learn about? Was it useful?</p> <p>-Do you classify disasters as emergency situations? Why/why not?</p> <p>-Can the damage caused by a disaster be prevented/lessened? If <b>yes</b> or <b>no</b>, then why?</p>
Explore current disaster preparedness practices/resilience		
	Explore safety perception regarding disasters	<p>-What are some major safety issues that arise during a disaster? Please explain.</p> <p>-Do you think children/women/disabled people are safe during disasters? If <b>yes</b> or <b>no</b>, then why? What are the specific safety issues for these groups? How can their safety be improved during a disaster?</p> <p>-Do you know of any people who have drowned due to a disaster? If yes, please provide details. Do you think this could have been avoided? If <b>yes</b>, then how?</p>
	Existing practices to protect against disaster	<p>-What are some ways used for protecting people and households from flooding and other disasters? How did you and/or the community find out about this?</p>

1		-Do many community members use these methods? Do you use these methods? If <b>yes</b> or <b>no</b> , then why? Do you think they are adequate to keep your household and family safe?
2		-Do you assist community members in implementing disaster preparedness systems? If <b>yes</b> , do you receive any support from government for this?
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10	Existing practices during a disaster	-Does your community have a disaster management committee? If <b>yes</b> , who is part of it?
11		-Does your community have any kind of plan to deal with disasters? If <b>yes</b> , please describe. If <b>no</b> , why? Do you know if a risk assessment has ever been performed for the area?
12		-Has the community ever practiced responding to a disaster? Did you participate in this drill?
13		- Who do you think plays an important role in responding to disasters in your area?
14		-What systems are in place to warn community members when a disaster is approaching? If <b>yes</b> , who is responsible for running this?
15		-Do you have a role in warning the community? If <b>yes</b> , how do you know when to begin? Who leads the operation? How many other people work alongside you? What instructions do you provide community members with? Do you receive any support from government?
16		-What do community people generally do during a disaster? How do they try to stay safe?
17		-Do community people use local cyclone centres? If <b>no</b> , then why?
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38	Existing practices following a disaster	-What happens after the disaster? How does community come back to their day to day activities?
39		-Do you have a role in post-disaster clean-up? If <b>yes</b> , what does this involve? Who coordinates clean-up efforts? Do you receive any support from government?
40		-What is done if parts of the community are no longer safe to be in/around (unstable infrastructure, flooded areas etc)?
41		- What do you think your area needs to help it better prepare and respond to disasters?
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51	<b>Understand role and measure in disaster relief management associated with drowning</b>	
52	To identify key responsibilities and involvement with disaster and drowning	-Have you personally assisted with any drowning cases? If <b>yes</b> , please provide detail. How could you have been better supported to handle these people?
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56	<b>Explore health seeking behaviours of disaster related drowning events</b>	
57	Health seeking behaviours post-drowning due to disaster	-What health facilities are available during/directly following a disaster? Are these different from regular health facilities? Are they appropriate/adequate for the community's needs?
58		-What health facilities do you think are needed to treat community members following a disaster? What are
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		some important features these services should have? Do you have any thoughts or preferences about who could provide these? [ <i>Probe: government, NGO, other organisation</i> ]
<b>Exit Questions</b>		
During our conversation, you mentioned W, X, Y, Z measures that could be taken to improve disaster preparedness for the community (and or post disaster measures) during or directly following a disaster. If you were to rank these from 1 to 5 (1 being most helpful and 5 least helpful in your community), what would the order be? And why? [ <i>probe with high risk group- community need, feasibility, acceptability, sustainability</i> ]		

For peer review only

Topics to address in this FGD guide:
<ul style="list-style-type: none"><li>Investigate the impact of aquatic disasters (natural and human) on the community</li><li>Explore current disaster preparedness practices/resilience</li><li>Explore health seeking behaviours of disaster related drowning events</li><li>Understand role and measure in disaster relief management associated with drowning</li></ul>

Introduction	
<b>Introductory statement</b> Welcome, and thank you for agreeing to be part of today's focus group discussion. We appreciate your willingness to participate and the time you have taken out of your day to take part.  My name is.....and I am from the Centre for Injury Prevention and Research, Bangladesh in Dhaka. We are conducting these discussions with members of the Barisal community who have experienced natural or human disaster. Our aim is to understand your views and experiences in relation to disaster-related drowning so that we can find out the best way to reduce it in Bangladesh and in your communities. We would like to find out from you what your thoughts/opinions and concerns are about drowning and how we can work together with you to reduce drowning related deaths and disabilities in your communities.  First I would like to cover some general rules about how this discussion will run: <ol style="list-style-type: none"><li>We would like you all to do the talking and to hear from everyone in the group.</li><li>Only one person should speak at a time so please wait for the person talking to finish.</li><li>There are no right or wrong answers – every person's opinion and view is important and we would like to hear a range of different views.</li><li>Anything discussed in this room remains in this room. We want everyone to feel comfortable about discussing any sensitive issue.</li><li>We will be recording these discussions because we want to capture everything you have to say accurately. But please be assured that we do not identify anyone by name in any report and your identity will remain anonymous.</li><li>Does anyone have any questions?</li></ol>	
<b>Explore participant background information</b>	Now I would like everyone to introduce themselves. Can you please tell us your name, age, occupation if any, and for how long you have been in this community for?

Theme	Discussion point	Probes/clarifications
<b>Investigate the impact of aquatic disasters (natural and human) on the community</b>		
Awareness/ Perception - <u>general</u>	<ul style="list-style-type: none"><li>What are some major safety issues that arise during a disaster?</li><li>What about drowning? Who do you think is most at risk of drowning during a disaster?</li></ul>	<ul style="list-style-type: none"><li>When have you previously felt unsafe during a disaster?</li><li>Are children/women/disabled people more prone to drowning during disasters?</li></ul>
<b>Explore current disaster preparedness practices/resilience</b>		
Risk behaviours	<ul style="list-style-type: none"><li>What are some of the reasons community members drown during a disaster?</li></ul>	<ul style="list-style-type: none"><li>What types of disaster cause an increased risk of drowning?</li><li>Are there appropriate facilities and services available to prevent drowning/assist people who are drowning?</li></ul>
Current practices	<ul style="list-style-type: none"><li>How do you ensure that you and your family are prepared for a disaster?</li></ul>	<ul style="list-style-type: none"><li>What types of preparations do you make to your household prior to disaster? Where did you learn about these?</li><li>How do you receive warning when a disaster is approaching?</li></ul>

		<ul style="list-style-type: none"> <li>- Do you and your household have an evacuation plan? What is it?</li> </ul>
Barriers	<ul style="list-style-type: none"> <li>- What are the barriers to ensuring you are prepared for disaster?</li> </ul>	<ul style="list-style-type: none"> <li>- What are the main barriers to making appropriate safety preparations before a disaster occurs? How could these barriers be minimised?</li> </ul>
<b>Explore health seeking behaviours of disaster related drowning events</b>		
Experience of drowning events	<ul style="list-style-type: none"> <li>▪ Do you know of any people who have drowned due to a disaster? If yes, please describe the event. Please describe the situation. What happened? How and when did this happen?</li> </ul>	<ul style="list-style-type: none"> <li>- Do you know if anyone attempted to help them? If yes, who and how?</li> <li>- How do you think this could have been prevented?</li> </ul>
During drowning event	<ul style="list-style-type: none"> <li>- How are people usually rescued in drowning situations during a disaster?</li> </ul>	<ul style="list-style-type: none"> <li>- Who are the people involved in the rescue and what are the associated risks for them?</li> </ul>
Post drowning event	<ul style="list-style-type: none"> <li>- Do you know what the usual immediate practices are after a person is recovered from water?</li> </ul>	<ul style="list-style-type: none"> <li>- Would you personally be confident in administering these?</li> <li>- What health facilities are available to treat drowning during/directly following a disaster? Are these adequate/appropriate?</li> </ul>
<b>Understand role and measure in disaster relief management associated with drowning</b>		
	<ul style="list-style-type: none"> <li>- What can be done to reduce the impact of a natural disaster in your community?</li> </ul>	<ul style="list-style-type: none"> <li>- What sort of programs, resources or facilities would be required for this?</li> <li>- Who do you think are best placed for implementing and overseeing this?</li> </ul>
	<ul style="list-style-type: none"> <li>- What is currently available to the community to prepare them for disaster?</li> </ul>	<ul style="list-style-type: none"> <li>- Have you ever received any kind of information about natural disasters? If yes, from where/whom? What did you learn? Was it useful?</li> </ul>
<b>Exit question</b>		
<p>During our conversation, W, X, Y, Z measures were mentioned that could be taken to reduce drowning amongst fishermen. If you were to rank these from 1 to 5 (1 being most helpful and 5 least helpful for your community), what would the order be?</p> <p>Does anyone have any other questions or anything you would like to say or discuss further in this group?</p>		

Supplementary File 4. Key subthemes from qualitative analysis with illustrative quotes

Theme	Key sub-themes		Illustrative quotes
Perceptions of risk and consequences of disaster	1. Perceived causes of disaster	1a. Beliefs	<i>"And why these happen, I cannot say. Allah wishes - that's why it happens brother. Everything happens when Allah wishes." (P2, M, fisherman and shop owner)</i>
		1b. Climate change	<i>"Car, launch, steamer; all these release smoke which is harmful for nature and for that reason disaster takes place." (FGD2, M, small business owners))</i>
	2. Outcomes of disaster	2a. Loss of human life	<i>"We saw many dead bodies of people beside the road." (FGD1, M, business men and fishermen)</i>
		2b. Loss of livestock, agricultural land and produce	<i>"What is more problem is, the fishes of the pond go away. Because of this, the people suffer from financial problems. They lose everything." (P6, F, social worker)</i>  <i>"The storm destroyed all the crops. I don't know whether we will get any rice or not from the grain." (FGD3, F, housewives)</i>
		2c. Damaged households	<i>"Now look at that broken house which is left there. That house was made newly, it was built only two to three months ago. Suddenly it was hit by the storm." (P7, F, housewife and NGO employee)</i>
		2d. Theft	<i>"We stay at home because if we leave the house the things will be stolen. We have nothing else than these things of the house. That's why we try to stay at the houses long as we can." (P3, M, agricultural worker)</i>
		2e. Damaged public infrastructure	<i>"Children cannot go to school and people have to swim to cross the roads. [The market] and cooking became a great problem." (FGD4, F, housewives)</i>
		2f. Illness	<i>"When water comes during calamity, if people drink that water, people suffer from many diseases." (P6, F, social worker)</i>
Insufficient support for the most vulnerable	3. Increased vulnerability to disaster	3a. Gender issues	<i>"During this time [women] are considered as a burden by other members of the family. They cannot move quickly, cannot come quickly." (P6, F, social worker)</i>  <i>"Women are in risk because they wear many clothes and they have long hair. That hair might be untied and get stuck or twisted with anything else. They</i>

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			<i>don't have that much strength. So they cannot free themselves." (FGD2, M, businessmen and fishermen)</i>
		3b. Dependence on others	<i>"Children can't move alone and don't know how to swim. Someone is needed to guard them. Sometimes kids get lost when they are moving with their parents as we can hold something to stay safe, but the kids can't." (P3, M, agricultural worker)</i>
		3c. Close proximity to water	<i>"All of us who were staying near the river bank, lost everything. Everything was broken down." (P4, M, fisherman and labourer)</i>
<b>Community preparedness and practices</b>	4. Preparing for disaster	4a. Preparation of food and resources	<i>"And we arrange everything properly and tie up with the beam, so that later on we can get everything in proper order." (FGD2, M, businessmen and fishermen)</i>
		4b. Modifications made to households	<i>"We put poles to support the house so that it doesn't fall. We take a thick rope and tie up one end of that rope with the house and tie up the other end of rope with a big tree tightly, so that the house doesn't fall during cyclone." (FGD3, F, housewives)</i>
		4c. Self-made safety equipment	<i>"We make some floating materials with plastic bottle of soft drink, or plastic water bottle etc. I made those floating materials for all the members of my family." (P6, F, social worker)</i>
		4d. Education provided by government and NGOs	<i>"Now everyone has got training. Everyone knows what is to be done, if there is cyclone. The people of coastal area have now become more conscious." (P6, F, social worker)</i>
	5. Protection at time of disaster	5a. Heterogeneity in mode of communication	<i>"We receive information through radio and television. We even get to know what type of disaster is coming. We received signals during Aila. Mic was used in our area to aware people." (P1, M, assistant teachers)</i>
		5b. Lack of compliance to warning systems	<i>"And another thing is people don't want to go. As long as possible they try to stay in their own place. If they have left their things in that place then they might have lost their things. People don't want to leave their resort in their entire life. That's why problem increases more and people get hurt more by drowning in water." (FGD1, M, small business owners)</i>
		5c. Reliance on cyclone shelters for protection	<i>"If we get information about flood, then we will have to move to [the cyclone shelter]. Apart from this we don't have any alternative." (FGD3, F, housewives)</i>

		5d. Cyclone shelters not meeting community needs	<p><i>"Cyclone centres are located far from this place. If these are located near to us then it would be possible to go to cyclone centre." (FGD2, M, business men and fishermen)</i></p> <p><i>"Suppose there are two cyclone centres in our area. Already cracks have been developed in one building. Moreover they become filled up with people at the time when signal is shown." (FGD2, M, business men and fishermen)</i></p>
		5e. Use of other resilient infrastructure for shelter	<i>"We took shelter in those people's houses which were better means [than our house]. We took shelter in those houses which had strong foundation." (FGD1, M, small business owners)</i>
		5f. Use of Indigenous floatation methods	<i>"We use banana tree to keep ourselves floating. When there is a flood, we cut down banana trees. This is the local method. By using these accessories, we can reduce drowning." (P1, M, assistant teacher)</i>
<b>Barriers to disaster response and improving resilience</b>	6. Survival skills, rescue and resuscitation	6a. Lack of survival skills	<p><i>"A man in the north was totally puzzled and could decide which way to go with his old father. Then he was thinking whether he will save himself or will take his father. Then he tied up his father with a tree so that even if he dies at least his dead body will be found. Later on his father died tied up with that tree. Later, he was buried in the morning." (FGD1, M, small business owners)</i></p> <p><i>"My grandson was seven months old. We put quilt, pillow in a big metallic utensil and then put him there and then said, 'We are old. We cannot go to the marshy land, we cannot take him. Let him float on water. If Allah grants him life line then somehow he will survive and if he has no life line, then he will not be in this world anymore.'" (FGD3, F, housewives)</i></p>
		6b. Rescue is a high-risk practice	<i>"While saving anyone from drowning he may also die. They have also several risks, like trees or boughs may break and fall on them." (FGD4, F, housewives)</i>
		6c. Resuscitation using traditional methods	<i>"[A] clay pot is grinded like powder and that powder is rubbed on the body. Then body has to cover with cotton so that water can release from his body. And if his body is moved taking his body on head, then he will remain alive." (FGD3, F, housewives)</i>



		6d. Minimal access to health facilities post-event	<i>"If someone gets injured by accident then we have hospital here but don't have doctor. If someone gets seriously injured by accident in that case we have nothing to do." (FGD2, M, business men and fishermen)</i>
	7. Disaster relief	7a. Multiple parties are involved in relief	<i>"Then there were help from many places. Not only the government, but also many states of the world helped then. We helped people [too]; providing various relief: medicines, foods. We volunteered in these tasks." (P2, M, fisherman and shop owner)</i>
		7b. Bribery and nepotism control relief distribution	<i>"At that time [those] who could give money as bribe he got that house and money. But [those] who actually needed he did not get the house and money." (FGD1, M, small business owners)</i>
	8. Improving disaster resilience	8a. Improve community awareness	<i>"Here I would like to emphasize that if the people are given more training on calamity, then I think the risk might be reduced to some extent. Training has to be imparted to all." (P6, F, social worker)</i>
		8b. Provision of floatation devices and signals	<i>"People like us can try to survive if given a ring buoy or life jacket. By the grace of Allah we might be able to live." (FGD2, M, business men and fishermen)</i>
		8c. Generate political will	<i>"We don't have any idea who will do it for us. There is no benefit in asking to the members or the chairman. During the election they promise us a lot of things which ultimately they don't fulfil." (FGD4, F, housewives)</i>
		8d. Construct more cyclone centres	<i>"Cyclone centre are not constructed where they are supposed to be constructed. These are constructed in the area where people have power and influence. It would have been very helpful to the people if these centres could be built after every one and one and half kilometres." (FGD1, M, small business owners)</i>
		8e. Improve housing standards	<i>"If good strong houses can be made, then they can stay much safer. See everyone don't have the ability to build strong a house. For them, suppose, if a strong firm house can be made after every 4<sup>th</sup> or 5<sup>th</sup> house, then they can take shelter there. Storm will not bother much then." (P2, M, fisherman and shop owner)</i>
		8f. Construct more embankment s, barriers and dams	<i>"If block made of cement or concrete can be thrown beside the river bank then the people who live beside the river will remain well. And flood water will not be able to come easily. The river is breaking down in</i>



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			<i>such a way this place will not last long.” (FGD1, M, small business owners)</i>
		8g. Provide post-disaster medical service in community	<i>“When there is a disaster or flood, then if a service centre is established, it will be very good for us. The sick need not to be taken to remote areas. Their treatment can be managed from here.” (P2, M, fisherman and shop owner)</i>
		8h. Use mosques for warning signals and shelter	<i>“If anything is announced from mosque, people give more importance to it and obey it. Again if Imam discusses these things, then people will be able to know more.” (FGD1, M, small business owners)</i>
		8i. Increase tree plantations	<i>“You can plant many trees on the coastal area. That will save us from the stormy wind. But people don’t plant trees because many of them have no place, no land or no money.” (FGD2, M, business men and fishermen)</i>

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# BMJ Open

## Exploring the impact, response and preparedness to water-related natural disasters in the Barisal division of Bangladesh: A mixed methods study

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5 **Exploring the impact, response and preparedness to water-related natural disasters in the**

6 **Barisal division of Bangladesh: A mixed methods study**

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## ABSTRACT

### Objectives:

To investigate the impact of natural disasters on communities in the Barisal division of Bangladesh, exploring community approaches to disaster preparedness and mitigation.

### Setting:

Communities in all districts of the Barisal division of Bangladesh.

### Participants:

Quantitative data was collected through a cross-sectional household survey (n=9,263 households; n=38,981 individuals). Qualitative data was collected through in-depth interviews (n=7) and focus group discussions (n=23) with key informants.

### Outcome measures:

Quantitative research recorded features of natural disaster events from the previous five years, documenting risk factors that increase vulnerability to disaster, use of disaster warning systems and evacuation processes. Qualitative research investigated disaster risk perceptions, experiences during and following disaster, and disaster preparedness practices.

### Results:

The survey response rate was 94.7%. Exposure to disaster in the last five years was high (82%) with flooding and cyclones considered the greatest threats. Awareness of evacuation processes was low; and only 19% of respondents evacuated their homes at the time of disaster. Drowning during disaster was the primary concern (87%), followed by debt, livestock and crop loss (78%). The qualitative findings indicated prevailing fatalistic perceptions towards natural disasters among community. The consequences of disasters included significant loss of livelihoods and exposure to infections due to poor sanitation. There was also insufficient support for the most vulnerable, particularly women, children and the elderly. Although several community preparedness and practices existed, there was a lack of response to early warning systems.

Barriers to disaster response and resilience included financial insecurities, loss of livelihoods, and cultural concerns regarding women’s privacy.

**Conclusions:**

Critical to achieving disaster resilience is increased government investment in infrastructure and systems-level responses that empower communities. Further research can support this by addressing community challenges to promoting disaster resilience and how to leverage existing community strengths to implement locally-owned solutions.

**Trial registration:**

N/A

**Strengths and Limitations**

- To our knowledge, this is the first large scale study reporting on context of disasters, using mixed methods from a LMIC.
- This study was conducted in a LMIC prone to water-related disasters and the results may not be generalizable to other LMIC settings; however, the qualitative focus group discussions and in-depth interviews spanned a diverse array of participants and yielded rich data that greatly contextualized the cross-sectional survey
- Consultations with government representatives are likely to have provided additional insight into existing government initiatives targeted at disaster preparedness and response

## INTRODUCTION

Climate-related disasters significantly impact the health, personal security and livelihood of individuals, communities and societies. Between 1998 and 2017, climate-related disasters were the cause of over 1.3 million deaths worldwide, and resulted in a further 4.4 billion people sustaining injuries, becoming homeless, displaced or requiring emergency assistance<sup>1</sup>. The impacts of climate related disaster are most severely experienced by those living in low- and middle-income countries (LMICs) who have a higher dependence on natural resources and who are exposed to higher rates of socio-economic disadvantage which prevents the development of coping capacity<sup>2</sup>. One such country is Bangladesh, which is highly prone to flooding due to the annual monsoon rainfalls and extensive low lying floodplains that cover an estimated 80% of the densely populated country<sup>3</sup>. With a population of over 165 million, it is estimated that more than two thirds of people in Bangladesh live in regions at risk of floods and one quarter live in regions at risk of cyclone<sup>4</sup>. The consequences of flooding in this context include the threat of diarrhoeal disease, lack of access to safe drinking water, loss of housing, livestock, crops, livelihood activities and drowning in floodwaters<sup>3,4</sup>. Additionally, tropical cyclones are an annual occurrence, which directly contribute to flooding and in turn, drowning-related mortality and morbidity<sup>4</sup>.

There is an increasing global focus on strengthening disaster risk reduction through improved surveillance, information exchange, early warning systems and capacity building in disaster prone countries. From 2005 to 2015, global governments committed to implementing the Hyogo Framework for Action as a guideline for reducing disaster risk through resilience building at both the national and local levels<sup>5</sup>. More recently, the Sendai Framework for Disaster Risk Reduction 2015-2030 was adopted by the United Nations member states in March 2015. The framework represents the next phase of targets and priorities globally, recognising the threat that climate change and disaster risk pose to achieving the Sustainable Development Goals (SDGs)<sup>6</sup>.

The risk of natural disasters in Bangladesh is projected to increase with changing weather patterns associated with extreme vulnerability to climate change<sup>3 4 7 8</sup>. In the face of growing climate uncertainty, there is an urgent need to understand disaster practices and promote community disaster resilience. In 1991, Cyclone Gorky struck Bangladesh, claiming the lives of 138,000 people. This event has spurred improvements in disaster warning systems and increased shelter uptake over the last 20 years<sup>4 9</sup> however, there remain considerable challenges in fostering disaster resilience at all levels. Currently, there is only fragmented information available on the consequences of natural disasters in Bangladesh and on existing practices associated with disaster mitigation. Through identifying gaps in current processes, targeted interventions may be implemented to strengthen existing approaches to disaster preparedness, with a focus on disaster risk reduction. Therefore, this study aims to investigate the impact of natural disasters on communities in the Barisal division of Bangladesh, exploring community disaster preparedness, responses to disaster at time of onset, and health seeking behaviours following disaster events. Given the complex nature of this topic, a mixed methods approach was used to facilitate a comprehensive understanding of the impact of and practices that surround natural disasters in the Bangladesh context. This information is anticipated to contribute to future disaster resilience planning activities for the region.

METHODS

Study setting

The Barisal division is located in south central Bangladesh and is comprised of six districts and 39 sub-districts (Figure 1). Crossed by numerous rivers, it is highly exposed to flooding due to annual monsoon rains and low-lying flood plains.

Figure 1: Map of the Barisal division of Bangladesh (Source: Royal National Lifeboat Institution, UK. Figure used with permission of the copyright holders)

Study design



The study used a concurrent mixed methods approach, triangulating cross-sectional household survey data with qualitative in-depth interviews and focus group discussions. Both quantitative and qualitative data were collected as baseline measures of a larger intervention study which aims to significantly reduce drowning rates in the Barisal Division by 2020. As no previous literature was available regarding Knowledge, Attitude and Practices for disaster resilience from LMICs, a mixed methods approach was used to gain an in-depth understanding of behaviors, perceptions and responses to disaster.

## MATERIALS AND DATA COLLECTION

### Quantitative

The survey was conducted September 2016 – February 2017 (over a six month period), using a multi-stage cluster sampling method. The survey was conducted as a baseline measure for a larger intervention-based drowning reduction project to be implemented in selected districts of the Barisal division from 2017 to 2020. The sample size (n=385,000) was chosen based on the sample required for the previous Bangladesh Health and Injury Survey<sup>10</sup>, with the margins of 95% Confidence Intervals providing evidence of sufficient sample size.

Briefly, the sample selected represents all districts within the division. Upazilas from the districts were randomly selected to be included in the project, with further random selection used to identify villages/sites within each upazila for data collection. Within each village, households were selecting using the EPI sampling method<sup>11</sup>. The disaster subsample (10%, n=38,981) was selected from the main sampling frame by selecting every household with computer generated ID ending in '0'. Questions presented to participants within the disaster sub-sample were primarily focused on post-disaster practices at the time of disaster to assess the acceptability, reliability and coverage of existing warning systems. The survey questions are available as Supplementary File 1.

Trained data collectors, local to each participating community, used pre-tested structured questionnaires to collect information from household heads, mothers or any adult above 18 years through face-to-face interviews. One adult was interviewed per household, who reported

data on behalf of all household members. An electronic data capture system (REDCap) was used on tablets for data collection <sup>12</sup>. To ensure data quality and accuracy, trained supervisors observed and checked 10% collected data and re-interviewed 2% of households. The survey consisted of questions on knowledge, attitudes and perceptions/practices for community drowning and disaster risk, and about experiences of natural disaster in the previous five years. Data were collected on demographic characteristics, and on socio-economic status using an index developed for the 2014 Bangladesh Demographic and Health Survey.<sup>13</sup>

**Qualitative**

Purposive sampling was used to identify key informants from the community for in-depth interviews and focus group discussions. For inclusion in the study, participants were required to have resided within Barisal for at least six months prior to data collection. Separate male and female discussion groups were arranged to align with cultural practices. The interviews and focus group discussions were semi-structured and conducted by trained research assistants in community locations that were acceptable and accessible to participants. Consent was obtained prior to commencing data collection; interviews lasted between 40-60 minutes, whilst focus group discussions lasted between 1-1.5 hours. The interview and focus group discussion guides included questions related to: 1) disaster risk perceptions; 2) experiences of natural disaster; 3) disaster preparedness practices. Questions aimed to identify examples of good practice in disaster preparedness from community settings to include in future comprehensive disaster resilience planning activities. Further, questions aimed to explore gaps in current disaster preparation, management and relief processes that have potential be addressed through targeted interventions. Interview and focus group discussion guides are available as Supplementary File 2.

Interviews and focus group discussions were conducted in Bengali, audio-recorded, translated and transcribed in English. To minimise data loss, interviews were jointly translated and transcribed by the interviewing researcher and the translator, and a member of the research

team checked the translated transcripts for accuracy. Interviews ceased when saturation of meaning was considered to have occurred.

## ANALYSIS

### Quantitative

Descriptive analysis (counts and percentages) was performed on variables relating to disaster knowledge, attitudes and behaviour variables. All data were analysed using SAS 9.4 with SAS/STAT 14.2 (SAS Institute, Cary, NC, USA).

### Qualitative

Transcripts were imported into NVivo qualitative data analysis software (QSR International Pty Ltd. V.11, 2015). Content analysis was applied to the transcripts whereby overarching themes were initially developed followed by inductive thematic coding of the data. NVivo was used to arrange the text according to codes and manage the codes in the interpretive phase. Two researchers independently conducted the coding and arrived at consensus on the analyses.

### Patient and Public Involvement

Drowning was identified as a priority health issue through the 2014 Bangladesh Demographic and Health Survey, which collected data from 18,000 residential households nation-wide.<sup>13</sup>

Data collection instruments for this present study were developed by the project team in alignment with Bangladesh Health and Injury Survey findings<sup>10</sup>, designed to investigate notable drowning-related outcomes in greater depth. All data collection tools were trialled with end users prior to their use in this study, investigating their readability, clarity and the relevance of questions included. Study results were triangulated among key informants and consultations and were used to inform the development of pilot interventions for improving water safety and reducing drowning in community settings in Bangladesh.

## RESULTS

### Quantitative results

A total of 95,124 households were visited, of which 92,616 household representatives were available for completing the survey (this corresponded to data gathered for n= 385,127 individuals; response rate 94.7%). There was an average household size of 4.2 members. For the disaster toll sub- sample of (n=9,263 households visited, data collected for n= 38,981 individuals) was completed. There were no meaningful differences in the socio-demographic characteristics of the full household survey sample and the disaster subsample (Table 1). All following results reported are for the survey disaster sub-sample. These findings are reported in line with the Consolidated Criteria for Reporting Qualitative Research statement, which supports transparency in reporting qualitative research (Supplementary File 3).

**Table 1.** Socio-demographics of the full household survey and disaster survey subsample

		Disaster subsample n=38,981 (95%CI)	Full household sample n=385,127, (95%CI)
Age (years)	Infant	2.0% ( 1.8 - 2.2)	2.0% ( 1.9 - 2.0)
	1-4	8.1% ( 7.8 - 8.5)	8.2% ( 8.0 - 8.3)
	5-9	11.0% (10.7 - 11.4)	10.7% (10.5 - 10.8)
	10-14	10.8% (10.5 - 11.1)	10.7% (10.6 - 10.9)
	15-17	5.9% ( 5.6 - 6.2)	6.0% ( 5.9 - 6.1)
	18-24	13.6% (13.1 - 14.1)	14.0% (13.8 - 14.2)
	25-39	24.6% (24.0 - 25.2)	24.1% (23.7 - 24.4)
	40-59	17.1% (16.6 - 17.5)	17.5% (17.3 - 17.7)
	60 +	6.8% ( 6.4 - 7.1)	6.9% ( 6.7 - 7.1)
Sex	Male	49.1% (48.5 - 49.8)	49.2% (48.8 - 49.5)
	Female	50.9% (50.2 - 51.5)	50.8% (50.5 - 51.2)
Marital status	Married	50.4% (49.9 - 50.9)	50.6% (50.3 - 51.0)
	Never Married	45.7% (45.2 - 46.2)	45.3% (45.1 - 45.6)
	Divorced	0.3% ( 0.2 - 0.4)	0.3% ( 0.3 - 0.4)
	Widow/Widower	3.4% ( 3.2 - 3.7)	3.5% ( 3.4 - 3.7)
	Separated	0.2% ( 0.1 - 0.2)	0.2% ( 0.2 - 0.2)
Type of family	Nuclear Family	67.5% (65.4 - 69.7)	66.6% (64.8 - 68.3)
	Extended Family	32.5% (30.3 - 34.6)	33.4% (31.7 - 35.2)
Family size	5 or less persons	78.6% (77.0 - 80.3)	78.6% (77.4 - 79.8)
	More than 5 persons	21.4% (19.7 - 23.0)	21.4% (20.2 - 22.6)
Education completed	Not applicable	16.3% (15.4 - 17.3)	16.2% (15.2 - 17.1)
	1 to 5 years	39.9% (38.9 - 40.9)	39.8% (39.0 - 40.7)
	6 to 8 years	17.9% (17.3 - 18.5)	17.6% (17.2 - 18.1)
	9 to 12 years	16.4% (15.6 - 17.3)	16.6% (16.0 - 17.2)

	13 to 17 years	3.7% ( 3.3 - 4.0)	3.7% ( 3.4 - 3.9)
	None	5.7% ( 4.8 - 6.7)	6.1% ( 5.2 - 7.0)
<b>Maternal education</b>	1 to 5 years	47.9% (46.4 - 49.5)	46.3% (45.1 - 47.5)
	6 to 8 years	20.6% (19.3 - 21.8)	20.5% (19.5 - 21.4)
	9 to 12 years	13.2% (12.1 - 14.4)	14.2% (13.5 - 15.0)
	13 to 17 years	1.5% ( 1.2 - 1.8)	1.4% ( 1.3 - 1.6)
	None	16.7% (15.3 - 18.2)	17.6% (16.4 - 18.8)
<b>Monthly income (USD/month)</b>	<80	9.0% ( 7.9 - 10.2)	9.2% ( 8.2 - 10.2)
	80-99	16.2% (14.8 - 17.6)	16.8% (15.8 - 17.7)
	100-139	25.8% (24.0 - 27.6)	25.9% (24.5 - 27.2)
	140-179	17.8% (16.4 - 19.2)	17.5% (16.6 - 18.4)
	800+	31.2% (28.6 - 33.7)	30.7% (28.6 - 32.7)
<b>Primary occupation</b>	Agriculture	6.4% ( 5.8 - 6.9)	6.3% ( 5.8 - 6.8)
	Business	5.9% ( 5.5 - 6.2)	5.8% ( 5.6 - 6.0)
	Student	27.9% (27.4 - 28.5)	27.5% (27.2 - 27.9)
	Domestic work	28.5% (28.1 - 28.8)	28.6% (28.4 - 28.9)
	Service	3.7% ( 3.4 - 4.1)	3.9% ( 3.7 - 4.2)
	Not working	3.2% ( 2.9 - 3.5)	3.3% ( 3.1 - 3.5)
	Skilled	3.8% ( 3.5 - 4.0)	3.7% ( 3.5 - 3.9)
	Unskilled	6.8% ( 6.3 - 7.3)	7.0% ( 6.5 - 7.4)
	Other	13.8% (13.4 - 14.3)	13.8% (13.6 - 14.1)

## Types of disaster

Using a recall period of five years, the most common natural disaster events experienced by respondents were flooding/flash flooding (43%) and cyclones (35%). The majority of respondents (82%) reported experiencing one or more natural disasters in the previous five years. Of these respondents, two thirds believed flooding/flash flooding to be the greatest threat, followed by cyclones/big storms.

## Vulnerability and impact

Respondents were asked which members of the population were most likely to be impacted by natural disasters. Age was considered to be an important factor with older people (23%) and children (19%) considered to be most susceptible. Poor socioeconomic status (21%) was perceived to increase vulnerability to natural disasters. Occupations perceived to be most affected by the natural disaster were farming (32%), labourer jobs (31%) and fishing (20%).

Drowning during disaster was the primary concern for 87% of respondents. Debt, livestock and crop loss were prevailing concerns among the majority of respondents (78%), while just 10% of respondents considered health to be a priority issue during disaster

### **Risk and protective factors**

The survey asked two separate questions with respect to weather forecast and warning signals. Only 18% of the respondents reported having received any type of weather forecast information prior to the most recent natural disaster that they had experienced. The most frequent sources of weather forecast information mentioned were from television (30%), alarm or loud speakers (20%), and through friends, families or neighbours (18%).

A high proportion of respondents (70%) reported having received warning signals prior to the onset of natural disaster. Although almost all households (95%) had at least one member who owned a mobile phone, the most common source of warning signal was television (45%) followed by warnings from local authorities (21%) and volunteers (21%).

The majority of respondents (95%) reported their household roof to be made of tin and only 4% reported to have a concrete roof. Walls were made of tin for 85% of households and brick and plaster for 11% of the households.

### **Disaster preparedness practices**

Among respondents who reported to have experienced a natural disaster, only 19% evacuated at the time of the event. Limited money followed by limited time were identified as the two most common barriers to disaster preparedness (data not shown). Of the 81% of respondents who reported not evacuating, 44% believed evacuation was not required, 38% believed an alternative shelter was not easily accessible, 25% did not evacuate due to concerns about the security of their property and 13% remained to protect livestock. Less than 5% of community members were aware of evacuation processes or safe evacuation points/places.

Among respondents who had experienced disaster, 22% reported moving to an alternate shelter during the most recent event. All reported moves were self-initiated with no rescues required from residences. Cyclone shelters (54%) were used most often used for evacuation followed by educational institutions (23%), flood shelters (13%), relative's homes (9%) and community centres (1%).

### Qualitative results

Interviewee characteristics are presented in Table 2. Four focus groups were conducted consisting of two male groups and two female groups, with characteristics presented in Table 3.

**Table 2 Characteristics of in-depth interview participants**

	Gender	Age range (years)	Occupation	Disaster-related role
P1	M	35-39	Assistant teacher at high school	Opens the doors of the local cyclone centre and escorts people inside
P2	M	30-34	Fisherman and shop owner	Delivers disaster warning signal through mic in village
P3	M	30-34	Agricultural worker	Not specified
P4	M	35-39	Fisherman and labourer	Member of village disaster committee
P5	F	25-29	Assistant teacher at primary school	Opens the doors of the school building and escorts people inside for shelter
P6	F	35-39	Social worker	Educates villagers on disaster preparedness, assists in delivering warning signal, helps vulnerable people evacuate households, leads search parties
P7	F	25-29	Housewife and employee of family	Vice president of village disaster committee (administrative role)



planning NGO

**Table 3 Characteristics of focus group discussion participants**

	Gender	Age range (years)	N in each group	Occupation
FGD1	M	30-60	6	Small business owners, fishermen, shop keepers
FGD2	M	Unknown	6	Business men and fishermen
FGD3	F	25-50	6	Housewives
FGD4	F	25-50	5	Housewives

Four overarching themes emerged from the qualitative data: 1) Perceptions and consequences of disaster; 2) Insufficient support for the most vulnerable (economically, geographically and personal physical attributes); 3) Community preparedness and practices; 4) Barriers to disaster response and improving resilience. The four overarching themes were drawn together from key sub themes which are available in Supplementary File 4, together with illustrative quotes.

**Perceptions of risk and consequences of disaster**

Community members perceived disasters to not be preventable and viewed disaster-related death as unavoidable, or to occur as a result of “Allah’s will”. There was some acknowledgment of the relationship between water-related disasters and climate uncertainty, which was attributed to the impact of pollution.

*“And why these happen, I cannot say. Allah wishes - that’s why it happens brother. Everything happens when Allah wishes.” (P2, M, fisherman and shop owner)*

A major concern for community members was the consequences of disaster on agriculture, with erosion and loss of crops and livestock having devastating impacts on livelihood.

*"The storm destroyed all the crops. I don't know whether we will get any rice or not from the grain."* (FGD3, F, housewives)

In particular, loss of livestock was a significant concern for farmers, and the need to protect livestock presented a major impediment to evacuation. Similarly, theft and looting were cited as both a consequence of disaster and an impediment to evacuation. In terms of health consequences, drowning and illness due to poor sanitation post-disaster were considered to be major contributors to disaster-related morbidity and mortality.

### **Insufficient support for the most vulnerable**

Respondents frequently reported on the structural weakness of existing dwellings and their inability to withstand a disaster event. A number of personal characteristics were repeatedly associated with increased vulnerability to drowning. Many of these surrounded the notion of 'weakness' – an inability to move quickly, hold onto stationary objects when caught in flood waters, swim against currents, climb to safe areas above flood waters, or carry belongings overhead when crossing flood waters. Many of characteristics were specific to women, with traditional clothing worn becoming heavy when wet, or long hair becoming caught on objects preventing escape from flood waters.

*"Women are in risk because they wear many clothes and they have long hair. That hair might be untied and get stuck or twisted with anything else. They don't have that much strength. So they cannot free themselves."* (FGD2, M, businessmen and fishermen)

Statements were made about the care a woman feels for her children making her a liability to the broader family. There were mentions that women were less able than men to maintain calm or plan rationally in high pressure situations.

### **Community preparedness and practices**

Participants discussed a number of approaches to preparing their households prior to disaster. These included securing food and valuables in safe, waterproof storage places, reinforcing households with rope and tarp, and creating floatation devices for family members from empty plastic soft drink bottles in case of flooding.

*“We put poles to support the house so that it doesn’t fall. We take a thick rope and tie up one end of that rope with the house and tie up the other end of rope with a big tree tightly, so that the house doesn’t fall during cyclone.”* (FGD3, F, housewives)

A variety of sources were used to communicate warnings in community settings prior and during disasters. Not all community members owned a TV or radio, and as power is often lost during weather events, loudspeaker announcements in village settings were considered to be most the effective warning signal. These announcements appeared to be predominantly coordinated by NGOs. Warning signals were either based on a 10-point scale which indicates event severity, or were a simple call for evacuation, directing community members towards cyclone shelters and other protected areas of the community. Community members interpreted warning signals in different ways, with individuals having different thresholds for deciding when evacuation was necessary. Previous warnings given for seemingly minor events caused many participants to be skeptical about the urgency of signals.

*“And another thing is people don’t want to go. As long as possible they try to stay in their own place. If they have left their things in that place then they might have lost their things. People don’t want to leave their resort in their entire life. That’s why problem increases more and people get hurt more by drowning in water.”* (FGD1, M, small business owners)

Many drowning deaths were reported to be caused by people evacuating their households after not responding to early warnings. Despite this, evacuation was considered an inconvenience to community members due to difficulties with transporting less-mobile people and the looting that frequently occurs when households are left unattended. One participant

reported thieves staging false disaster warning signals for an opportunity to rob empty households.

*"We stay at home because if we leave the house the things will be stolen. We have nothing else than these things of the house. That's why we try to stay at the houses long as we can."* (P3, M, agricultural worker)

### Barriers to disaster response and improving resilience

Although there were a number of approaches documented towards disaster preparedness, management and relief, many of these were considered to be unreliable or unsustainable. Many participants discussed disaster management education provided by NGOs in community settings. Although useful, these education programs were reported to be sporadic and with varied content. A lack of resources limited the extent individuals were able implement the practices taught. Consequently, disaster preparedness was predominately managed by individual community members.

Government initiatives were primarily focused on protection at time of disaster and relief post-disaster. A number of cyclone shelters had been built by government in community settings and were frequently used by the most vulnerable members of the community at the time of disaster. Despite this, cyclone shelters were reported to be difficult to access due to unsafe roads and long distances between shelters. Furthermore, shelters were reportedly overcrowded, with poor structural quality, and were potentially unsafe places for women.

*"Suppose there are two cyclone centres in our area. Already cracks have been developed in one building. Moreover they become filled up with people at the time when signal is shown."* (FGD2, M, business men and fishermen)

There was a clear lack of faith in governance, with many comments concerning unequal distribution of government relief post-disaster, driven by bribery and nepotism.

*“At that time [those] who could give money as bribe he got that house and money. But [those] who actually needed he did not get the house and money.”* (FGD1, M, small business owners)

Government post-disaster relief was only available over short periods of time post-event and in some cases, was also provided sporadically by NGOs.

**DISCUSSION**

This study has highlighted the considerable challenges confronting communities in disaster prone regions of Bangladesh in the face of inadequate warning systems, poor understanding and uptake of evacuation measures, and insufficient relief responses. Each of these challenges are heightened for populations in remote geographical areas and those who are economically deprived. The impacts of disaster presented a heavy burden to communities in terms of housing, economic losses and the threat of drowning and illness. Identifying these issues highlights areas of priority to address through interventions. Increasing commitment from government to address disaster risk was viewed as a crucial step towards reducing disaster-related devastation. As a result, further investigation into policy interventions to improve governance surrounding this issue is required. Further, the need for community to self-manage disaster risk was considered a priority. This study identified several community strengths that could be built upon as part of a comprehensive disaster resilience plan that fosters this approach.

A major impediment identified to effective disaster preparedness was the efficacy of warning systems. Despite high levels of mobile phone penetration in Bangladesh, the majority of survey respondents did not receive warnings through this means and instead relied on television (45%) and warnings from local authorities and volunteers (21%). There was significant heterogeneity in understanding and heeding warning signals, which contributed to a reluctance for evacuation. Warning signal efficacy was impacted by loss of electricity during flooding and poor community confidence in warning systems. This is consistent with the Osti and Nakasu <sup>3</sup> review of inadequate warning systems across 10 southern and eastern Asian countries during 21 fatal

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2  
3 flood events. The authors reported flood warning systems to be unreliable and the content of  
4 warnings to be too technical for community members. Taken together, these findings have  
5 critical implications for future research relating to appropriate messaging and the use of mobile  
6 technology as an avenue for early warning with high coverage.  
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12 There is significant unmet community need for effective disaster response, which must be  
13 addressed to move towards ensuring disaster resilience rather than recovery. While  
14 communities demonstrated strength with self-reliance, a systems level approach was required  
15 to support the development of disaster resilience. There is limited insight into the ongoing  
16 mental health effects of disaster and how this impacts community resilience in disaster prone  
17 regions<sup>14</sup>. However, the present findings confirm previous research that indicates disaster has a  
18 traumatic impact on families and communities. This signifies the need for a mental health  
19 workforce that are competent in disaster-related trauma and are responsive to the community  
20 in terms of culture, traditions, language and local practices<sup>15</sup>. Further research is critical to  
21 understanding the impact of psychological trauma, which women may be more affected by  
22 than men, on community disaster resilience  
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34 At the community level, there was considerable concern for preserving agriculture and  
35 ultimately livelihoods. Protecting livestock was cited as a major barrier to evacuation and a  
36 significant contributor to disaster vulnerability, with 78% of survey participants reporting  
37 prevailing concerns about debt, livestock and crop loss at the time of a disaster event.  
38 Individual and community level factors were key contributors to vulnerability, in particular  
39 house construction, age and gender.  
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47 Women were perceived to be more vulnerable than men, which was consistent with previous  
48 research<sup>9 16</sup>; however in high income settings, men have a higher mortality attributed to flood  
49 related-drowning<sup>17</sup>. This is indicative of the “socially determined” role of women in many  
50 LMICs and is aligned with an emerging focus in disaster literature on the role of women and  
51 how this contributes to vulnerability<sup>9 14 16</sup>. In Bangladesh, this is related to the socioeconomic  
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status of women, health status and perpetration of violence against women <sup>16</sup>. A cross-sectional survey with mothers spanning two floods in Bangladesh in 2007, reported 86% of women experienced intimate partner violence (physical, emotional, sexual and sustenance abuse) during a flood <sup>18</sup>. This study also reported that both unintentional injury (cuts, falls, drowning etc.) and parental violence against children is increased during flooding disaster <sup>18</sup>. Perpetration of parental violence (physical, emotional and sustenance abuse) against children was highest in low socioeconomic families, in families with household unemployment and among mothers; particularly mothers engaged in domestic work (not employed) and those experiencing intimate-partner violence, all of which related to the extreme survival pressure. While women are seen as vulnerable to disaster and disaster-related trauma, there is great opportunity to empower and educate women in disaster preparedness and management practices to promote community resilience. <sup>14</sup>

Natural disasters have a number of long-term indirect impacts on vulnerable populations. Communities repeatedly exposed to disasters may experience forced migration, either to urban centres or onto other hazard prone land.<sup>19</sup> This contributes to rising land pressure, rapid urbanisation and a breakdown of community and social structures which disproportionately affects the poorest members of the population, increasing marginalisation.<sup>20</sup> A lack of stability and security establishes a poverty cycle<sup>21</sup> and enhances existing issues surrounding gender and social inequality.<sup>22</sup> The under- age marriage and trafficking of young girls has been reported to increase following disaster as children lose their parents, parents are unable to afford education due to disaster repair costs, or as schools are destroyed during disaster, impacting social-determinants of health adversely.<sup>23</sup>

**Implication for practice**

**Improve commitment from government**

Given the population density and scarce resources in the context, greater investment in preparedness and education rather than management and recovery is needed in Bangladesh. Disaster management was primarily undertaken by the NGOs/ multi- laterals, which was



reported to be inconsistent. There is a need for improved coordination between relevant government agencies and NGOs to: 1) prevent overlap of interventions in certain areas and support areas/communities currently without any interventions; 2) ensure the interventions available are consistent and offered to a high standard; 3) ensure post-disaster aid is distributed using regulated processes to areas of most need; and 4) ensure allocation of funding is fair and appropriate governance mechanisms in place for distribution of support. Indeed Government investment is essential to obtaining resources to improve basic public infrastructure (roads, dams and river embankments), constructing protective infrastructure, such as cyclone shelters and for improving the availability of emergency medical care post-disaster. In Bangladesh, increased Government ownership and coordination could see considerable gains, however better engagement with stakeholders at the community and policy level is needed to ensure a community owned approach to promoting disaster resilience.

### **Build resilient communities by enabling self-management of disaster risk**

All initiatives implemented should focus on empowering communities to mitigate disaster risk locally. This will assist in the promotion of cost-effective, local approaches to disaster preparedness, such as homemade personal floatation devices made from community sourced and readily available materials. The findings report on how communities/society in rural Bangladesh have organized themselves to increase resilience and manage disasters more effectively.

Participants reported not using cyclone shelters, however over-crowding of shelters was also reported as a deterrent. Community ownership with respect to consultation on shelter location, feasibility and usability of infrastructure to access shelters might address some of the mistrust in governance/disaster management. This may be aided by building and using community infrastructures such as schools or mosques as disaster shelters, which would be an efficient and acceptable use of resources. Finally, whilst the community reported poor access to health services generally, this was compounded during disasters when it was clear that the health systems were non-existent; the need for resilient health systems cannot be over-stated.

Resilience will also depend upon the capacity of disaster management practices to be adjusted in a timely manner, in response to changing community priorities and the changing local environment. There should be a focus on reducing internal community conflicts caused by the provision of external resources to promote cohesive, united, community-based response to disaster. This would be aided by formal disaster committees, which would be helpful not only as an entity but for understanding and addressing concerns on distribution of resources within the population; however, to be effective this also needs to be monitored. The aim of these committees could be to prepare the local population for disaster and take leadership in assisting community members at the time of disaster. To be effective, committee members would need external training (provided by government and/or NGOs) at regular intervals on various aspects of disaster preparedness, rescue and relief. Importantly, these committees should consist of a diverse range of community members who are part of the committee at an equal rank, including women and the elderly. Furthermore, committees should be Government resourced and be in regular contact with government agencies and NGOs operating locally.

**Strengths and limitations**

To our knowledge, this is the first large scale study reporting on the context of natural disasters, using mixed methods, from a LMIC. The qualitative research performed spanned a diverse range of participants and yielded rich data that greatly contextualized the cross-sectional survey. As the study was conducted in a country prone to water-related disasters, the results may not be generalizable to other LMIC settings. Secondly, the recall period was relatively large with 5 years which may influence the reliability of the findings. Consultations with government representatives are likely to have provided additional insight into existing government initiatives targeted at disaster preparedness and response, highlighting strengths and gaps in existing disaster mitigation policies.

**CONCLUSION**

This study has highlighted the challenges facing water-related disaster prone region of Bangladesh. The results confirm previous research that emphasize the vulnerability of communities in the face of inadequate warning systems and poorly coordinated disaster responses, particularly for vulnerable/disadvantaged sectors of the community including the elderly, women, low socioeconomic families and those whose livelihood is rooted in agriculture. This research calls for increased government investment in systems level responses that empower communities and promote resilience. Further research can support this by addressing the systems level challenges to promoting disaster resilience, and investigating how existing community strengths can be leveraged to implement locally-owned solutions.

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## AUTHORS' CONTRIBUTION

JJ, AR, KB and RI conceived the study and its design. AR, FC and KB led the acquisition of study data. KB led the quantitative data analysis. PC, FC and CL performed initial qualitative data analysis. AR, RI, JJ and KB led data interpretation. All authors contributed to manuscript writing critically, for important intellectual content.

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## COMPETING INTERESTS

The authors have declared that no competing interests exist. Royal National Lifeboat Institution funded the project with Centre for Injury Prevention and Research, Bangladesh as collaborators and The George Institute for Global Health as academic partners.

**DATA SHARING**

Requests for access to study data should be addressed to the corresponding author. Data will be made available to the scientific community with as few restrictions as feasible, while retaining exclusive use until the publication of major outputs.

**ETHICAL APPROVAL**

Ethical clearance for this study was obtained from the University of Sydney, Australia; and Ethical Review Committee – Centre for Injury Prevention and Research Bangladesh.

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Image 1: Map for study area- Barisal division, Bangladesh

30x22mm (300 x 300 DPI)



COREQ (CONsolidated criteria for REporting Qualitative research) Checklist

A checklist of items that should be included in reports of qualitative research. You must report the page number in your manuscript where you consider each of the items listed in this checklist. If you have not included this information, either revise your manuscript accordingly before submitting or note N/A.

Topic	Item No.	Guide Questions/Description	Reported on Page No.
Domain 1: Research team and reflexivity			
Personal characteristics			
Interviewer/facilitator	1	Which author/s conducted the interview or focus group?	
Credentials	2	What were the researcher's credentials? E.g. PhD, MD	
Occupation	3	What was their occupation at the time of the study?	
Gender	4	Was the researcher male or female?	
Experience and training	5	What experience or training did the researcher have?	
Relationship with participants			
Relationship established	6	Was a relationship established prior to study commencement?	
Participant knowledge of the interviewer	7	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	
Interviewer characteristics	8	What characteristics were reported about the inter viewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	
Domain 2: Study design			
Theoretical framework			
Methodological orientation and Theory	9	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	
Participant selection			
Sampling	10	How were participants selected? e.g. purposive, convenience, consecutive, snowball	
Method of approach	11	How were participants approached? e.g. face-to-face, telephone, mail, email	
Sample size	12	How many participants were in the study?	
Non-participation	13	How many people refused to participate or dropped out? Reasons?	
Setting			
Setting of data collection	14	Where was the data collected? e.g. home, clinic, workplace	
Presence of non-participants	15	Was anyone else present besides the participants and researchers?	
Description of sample	16	What are the important characteristics of the sample? e.g. demographic data, date	
Data collection			
Interview guide	17	Were questions, prompts, guides provided by the authors? Was it pilot tested?	
Repeat interviews	18	Were repeat inter views carried out? If yes, how many?	
Audio/visual recording	19	Did the research use audio or visual recording to collect the data?	
Field notes	20	Were field notes made during and/or after the inter view or focus group?	
Duration	21	What was the duration of the inter views or focus group?	
Data saturation	22	Was data saturation discussed?	
Transcripts returned	23	Were transcripts returned to participants for comment and/or	

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Topic	Item No.	Guide Questions/Description	Reported on Page No.
		correction?	
<b>Domain 3: analysis and findings</b>			
<i>Data analysis</i>			
Number of data coders	24	How many data coders coded the data?	
Description of the coding tree	25	Did authors provide a description of the coding tree?	
Derivation of themes	26	Were themes identified in advance or derived from the data?	
Software	27	What software, if applicable, was used to manage the data?	
Participant checking	28	Did participants provide feedback on the findings?	
<i>Reporting</i>			
Quotations presented	29	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	
Data and findings consistent	30	Was there consistency between the data presented and the findings?	
Clarity of major themes	31	Were major themes clearly presented in the findings?	
Clarity of minor themes	32	Is there a description of diverse cases or discussion of minor themes?	

Developed from: Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

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BHASA (AFLOAT)  
Baseline Survey Questionnaire

Question	Respondent's answer																								
Section G - Natural Disaster Details অধ্যায় G এর জন্য সাক্ষাৎকারে অংশগ্রহণকারী উত্তরদাতার নাম																									
উত্তরদাতার নাম ( অধ্যায়-জি ) Name of respondent interviewed for Section G নাম																									
আপনি কি কি ধরনের প্রাকৃতিক দুর্যোগের কথা জানেন? How many kinds of natural disasters can you think of?  একাধিক উত্তর হতে পারে Multiple responses possible কি কি ধরনের প্রাকৃতিক দুর্যোগের	<table><tr><td>1</td><td>সাইক্লোন/বড় ধরনের ঝড় Cyclones/big storms</td><td>5</td><td>রোগ Disease</td></tr><tr><td>2</td><td>বন্যা Flooding</td><td>99</td><td>জানিনা Don't know</td></tr><tr><td>3</td><td>সুনামি Tsunami</td><td>97</td><td>অন্যান্য (উল্লেখ করুন) Others (specify)</td></tr><tr><td>4</td><td>ভূমিধস Landslide</td><td></td><td></td></tr></table>	1	সাইক্লোন/বড় ধরনের ঝড় Cyclones/big storms	5	রোগ Disease	2	বন্যা Flooding	99	জানিনা Don't know	3	সুনামি Tsunami	97	অন্যান্য (উল্লেখ করুন) Others (specify)	4	ভূমিধস Landslide										
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5	What was the third most recent disaster event you	2	সাইক্লোন/বড় ধরনের ঝড় Cyclone
6	have experienced?	7	কালবৈশাখী Nor
7		8	নদী ভাঙ্গন Riverbank erosion
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9		97	অন্যান্য (উল্লেখ করুন) Others
10			(specify)
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13	অন্যান্য (উল্লেখ করুন)		
14	Others (Specify)		
15	তখন আপনি কোন সতর্কবার্তা (দুর্যোগের সতর্কবার্তা)	1	হ্যাঁ Yes
16	শুনেছিলেন কি?	2	না No
17		90	মনে নেই Can't
18	Did you receive any warning message for the most		remember
19	recent disaster you experienced?		
20	সতর্কবার্তা শুনেছিলেন		
21	হ্যাঁ হলে, কোথায় থেকে দুর্যোগের সতর্কবার্তা	1	রেডিও Radio
22	শুনেছিলেন ?	2	টেলিভিশন Television
23		3	স্থানীয় প্রশাসনের প্রচারণা Announcement by local authority
24	If yes, where did you get the message from?	4	স্বৈচ্ছাসেবীদের প্রচারণা যেমন রেডক্রিসেন্ট/ফায়ার সার্ভিস ও সিভিল ডিফেন্স
25	কোথা থেকে শুনেছিলেন		Announcement by the volunteers (Red crescent, fire service and civil defence
26			etc)
27		97	অন্যান্য (উল্লেখ করুন) Others (specify)
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31	অন্যান্য (উল্লেখ করুন)		
32	Others (Specify)		
33	দুর্যোগের সময় আপনারা কি কাছাকাছি কোন দুর্যোগ	1	হ্যাঁ Yes
34	সেন্টারে আশ্রয় নিয়েছিলেন?	2	না No
35	During the last disaster did you and your household		
36	members move to a nearby shelter?		
37	কোথাও আশ্রয় নিয়েছিলেন		
38	হ্যাঁ হলে কে / কারা আশ্রয় কেন্দ্রের ব্যবস্থা করেছে?	1	নিজ উদ্যোগে গিয়েছি Self-initiative
39	If yes, who put in place/organised the shelter?	4	এন জি ও NGO
40	কারা ব্যবস্থা করেছে	2	সরকারী আশ্রয় কেন্দ্র Government Shelter
41		97	অন্যান্য (উল্লেখ করুন)
42			Others (specify)
43		3	স্থানীয় প্রশাসন Local Administration
44		99	জানি না Don't know
45		90	মনে নেই Can't remember
46	অন্যান্য (উল্লেখ করুন)		
47	Others (Specify)		
48	তখন আপনি কোথায় গিয়েছিলেন?	1	বন্যার্তদের জন্য সহায়তা কেন্দ্রে Flood
49	What type of centre did you go to?	4	কমিউনিটি কেন্দ্রে Community
50		2	সাইক্লোন শেল্টারে Cyclone shelter
51	কোথায় গিয়েছিলেন	5	আত্মীয়র বাড়িতে Relatives
52			homes
53		3	শিক্ষা প্রতিষ্ঠানে Educational institution
54		99	জানি না Don't know
55	প্রধানত কি কারণে আপনি আশ্রয় কেন্দ্রে যেতে পারেন	1	প্রয়োজনে মনে করিনি Did not think it was
56	নি ?	4	এ ধরনের দুর্যোগ প্রায়ই হয়
57	What is the primary reason you did not go to the		Disaster is a common
58	shelter/centre?		phenomenon
59	কি কারণে যেতে পারেন নি	2	বাড়ীর জিনিস-পত্রের নিরাপত্তার কথা চিন্তা
60			করে For the security of property
		5	সাইক্লোন শেল্টার বেশ দূরে
			Shelter is far away
		97	অন্যান্য (উল্লেখ করুন) Others
			(specify)

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এ এলাকায় সাধারণত যে ধরনের অসুখ-বিসুখ হয় সে তুলনায় পানিতে ডুবা প্রতিরোধে কাজ করাটা কতটা গুরুত্বপূর্ণ বলে মনে করেন?  [একটি উত্তর দিতে পরামর্শ করুন ] Compared to other health problems you or your area face, how big a priority is it to reduce the risks associated with disasters that can lead to drowning? [Prompt for one response] গুরুত্বপূর্ণ বলে মনে করেন	<table><tr><td>1</td><td>তেমন গুরুত্বপূর্ণ নয় Low priority</td></tr><tr><td>2</td><td>কিছুটা গুরুত্বপূর্ণ Medium priority</td></tr><tr><td>3</td><td>অতি গুরুত্বপূর্ণ High priority</td></tr></table>				1	তেমন গুরুত্বপূর্ণ নয় Low priority	2	কিছুটা গুরুত্বপূর্ণ Medium priority	3	অতি গুরুত্বপূর্ণ High priority															
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কয়টি উত্তর নির্বাচন করুন (Do not prompt; select as many as apply) পেশাজীবীদের ক্ষতি	3	রাখাল Livestock herder	8	পুলিশ/সামরিক বাহিনীর সদস্য Police/army
	4	কৃষক Farmer	99	জানি না Don't know
	5	দিন মজুর Wage labourer	97	অন্যান্য (উল্লেখ করুন) Other
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	2	প্রাপ্তবয়স্ক ব্যক্তিরা Adults		
	3	শিশুরা Children		
	4	পুরুষ Men		
	5	মহিলা Women		
	6	প্রতিবন্ধীরা People with disabilities		
	7	দুঃস্থ ও গরীব লোকেরা Poorer people		
	8	নদী/সাগর তীরবর্তী লোকেরা People living in certain areas (e.g. river islands, coastal areas)		
	99	জানি না Don't know		
	97	অন্যান্য (উল্লেখ করুন) Other (specify)		
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	2	খানার/পরিবারের সদস্যদের মৃত্যু নিয়ে Death of a family member		
	3	বাড়ী-ঘর নিয়ে Losing your house		
	4	বাড়ী-ঘরের জিনিসপত্র নিয়ে Losing your belongings		
	5	কাজ/চাকুরি হারানো নিয়ে Losing your work		
	6	ফসল নষ্ট হওয়া নিয়ে Crop failure		
	7	খানার/পরিবারের সদস্যদের সাথে না থাকতে পারা নিয়ে Not being able to get in touch with family		
	8	পানিতে ভেসে যাওয়া নিয়ে Being overwhelmed		
	9	কোন বিষয়ে উদ্বিগ্ন/চিন্তিত ছিলাম না I would not be concerned		
	97	অন্যান্য (উল্লেখ করুন) Other (specify)		
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	2	টেলিভিশন TV	8	এলার্ম/ সাইরেন/মাইক Alarm, siren, loudspeaker
	3	সংবাদপত্র/পত্রিকা Print media	9	মোবাইল/ম্যাসেজ Cellphone/Text
	4	বন্ধু-বান্ধবী/পরিবারের সদস্য/প্রতিবেশী Friends, family, neighbor	10	কোথাও থেকে পাইনি From nowhere
	5	গ্রাম পুলিশ/ গ্রাম্য পঞ্চায়েত Village administration	99	জানি না Don't know
	6	পুলিশ/ সামরিক বাহিনীর সদস্য Army/police	97	অন্যান্য (উল্লেখ করুন) Other (specify)
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প্রাকৃতিক দুর্যোগকালীন জরুরী সতর্কবার্তা প্রচারের জন্য আপনার কাছে ব্যক্তি/প্রতিষ্ঠানের মধ্যে কোনটি বেশী কার্যকর মনে হয়? In the event of a natural disaster, what person or organisation is your preferred source of	1	পুলিশ Police		
	2	ফায়ার সার্ভিস Fire services		
	3	স্থানীয় এনজিও Local NGOs		



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information?  (শীর্ষ ৩টি উত্তর চিহ্নিত করুন) (Mark top 3 choices) ব্যক্তি/প্রতিষ্ঠানের মধ্যে বেশী কার্যকর	<table><tr><td>4</td><td>স্কুল/কলেজ School/Colleges</td></tr><tr><td>5</td><td>মসজিদ/মাদ্রাসা Mosque/Temple</td></tr><tr><td>6</td><td>গণ্যমান্য ব্যক্তি Community leader</td></tr><tr><td>7</td><td>স্থানীয় জনস্বাস্থ্য প্রতিষ্ঠান Public Health Department</td></tr><tr><td>8</td><td>স্থানীয় সরকারী/বেসরকারী প্রতিষ্ঠান/ ক্লিনিক/সাইক্লোন সেন্টারের মাঠকর্মী Clinic/Outreach worker Government agencies, Cyclone preparedness programme, Local disaster management committee</td></tr><tr><td>97</td><td>অন্যান্য (উল্লেখ করুন) Other (specify)</td></tr></table>	4	স্কুল/কলেজ School/Colleges	5	মসজিদ/মাদ্রাসা Mosque/Temple	6	গণ্যমান্য ব্যক্তি Community leader	7	স্থানীয় জনস্বাস্থ্য প্রতিষ্ঠান Public Health Department	8	স্থানীয় সরকারী/বেসরকারী প্রতিষ্ঠান/ ক্লিনিক/সাইক্লোন সেন্টারের মাঠকর্মী Clinic/Outreach worker Government agencies, Cyclone preparedness programme, Local disaster management committee	97	অন্যান্য (উল্লেখ করুন) Other (specify)										
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Ensignment Supérieur (ABES)



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6	এখানে প্রাকৃতিক দুর্যোগ হবে বলে মনে করি না Don't think that disaster will occur here																						
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<p>এই প্রাকৃতিক দুর্যোগে যদি আপনার খানায় ক্ষতি হয়, তাহলে আপনি সাহায্যের জন্য কার উপর ভরসা করবেন? If your household suffered as a result of [this natural disaster], who could you rely on to help you?</p> <p>(উত্তর বলে দিবেন না, উত্তরদাতা যে কয়টি বলবে, সবকটি বৃত্তায়িত করুন Do not prompt, select all that apply) সাহায্যের জন্য কার উপর ভরসা করবেন</p>	<table><tr><td>1</td><td>বন্ধু বা প্রতিবেশী Friends or neighbours</td></tr><tr><td>2</td><td>আত্মীয় - স্বজন Relatives</td></tr><tr><td>3</td><td>এলাকার সম্ভ্রান্ত/ধনী মানুষ Elite/rich people in the area</td></tr><tr><td>4</td><td>ধর্মীয় নেতৃবৃন্দ Religious leaders</td></tr><tr><td>5</td><td>সরকারী কর্তৃপক্ষ Government authorities</td></tr><tr><td>6</td><td>উদ্ধারকারী দল/ স্বেচ্ছাসেবক দল Savings groups / self-help groups</td></tr><tr><td>7</td><td>এন.জি.ও সমূহ NGOs</td></tr><tr><td>8</td><td>কারো কাছ থেকে নয় Nobody</td></tr><tr><td>99</td><td>জানি না Don't know</td></tr><tr><td>97</td><td>অন্যান্য Other (specify)</td></tr></table>	1	বন্ধু বা প্রতিবেশী Friends or neighbours	2	আত্মীয় - স্বজন Relatives	3	এলাকার সম্ভ্রান্ত/ধনী মানুষ Elite/rich people in the area	4	ধর্মীয় নেতৃবৃন্দ Religious leaders	5	সরকারী কর্তৃপক্ষ Government authorities	6	উদ্ধারকারী দল/ স্বেচ্ছাসেবক দল Savings groups / self-help groups	7	এন.জি.ও সমূহ NGOs	8	কারো কাছ থেকে নয় Nobody	99	জানি না Don't know	97	অন্যান্য Other (specify)
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### Supplementary File 3. In-depth interview guide and focus group discussion guide for community members with disaster experience

Topics to address in this IDI guide:

- Investigate the impact of aquatic disasters (natural and human) on the community
- Explore current disaster preparedness practices/resilience
- Understand role and measure in disaster relief management associated with drowning
- Explore health seeking behaviours of disaster related drowning events

*(Questions only for volunteer leaders are underlined)*

Demographic questions		
1.	Gender of participant:	Male                      Female
2.	Age of participant (in years):	
3.	Occupation of participant:	
4.	Role in the community:	
5.	<u>Are you associated with any organisation? (if volunteering from an organisation)</u>	

Themes	Queries	Probe/ clarifications/remarks
Introduction		
<b>Background information</b>	Explore participant background information	<p>-Can you please tell me your name and for how long you have you lived in this community?</p> <p>-What is your position in the community? How long have you been in this position?</p> <p>-What are your main responsibilities within the community before/during/after a disaster?</p>
Investigate the impact of aquatic disasters (natural and human) on the community		
	Explore general perceptions of disasters	<p>-What do you know about disasters such as floods, cyclones etc? What do you think causes them?</p> <p>Have you ever received any education or training about natural disasters? If <b>yes</b>, from where/whom? What did you learn about? Was it useful?</p> <p>-Do you classify disasters as emergency situations? Why/why not?</p> <p>-Can the damage caused by a disaster be prevented/lessened? If <b>yes</b> or <b>no</b>, then why?</p>
Explore current disaster preparedness practices/resilience		
	Explore safety perception regarding disasters	<p>-What are some major safety issues that arise during a disaster? Please explain.</p> <p>-Do you think children/women/disabled people are safe during disasters? If <b>yes</b> or <b>no</b>, then why? What are the specific safety issues for these groups? How can their safety be improved during a disaster?</p> <p>-Do you know of any people who have drowned due to a disaster? If yes, please provide details. Do you think this could have been avoided? If <b>yes</b>, then how?</p>
	Existing practices to protect against disaster	<p>-What are some ways used for protecting people and households from flooding and other disasters? How did you and/or the community find out about this?</p>

1		-Do many community members use these methods? Do you use these methods? If <b>yes</b> or <b>no</b> , then why? Do you think they are adequate to keep your household and family safe?
2		-Do you assist community members in implementing disaster preparedness systems? If <b>yes</b> , do you receive any support from government for this?
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10	Existing practices during a disaster	-Does your community have a disaster management committee? If <b>yes</b> , who is part of it?
11		-Does your community have any kind of plan to deal with disasters? If <b>yes</b> , please describe. If <b>no</b> , why? Do you know if a risk assessment has ever been performed for the area?
12		-Has the community ever practiced responding to a disaster? Did you participate in this drill?
13		- Who do you think plays an important role in responding to disasters in your area?
14		-What systems are in place to warn community members when a disaster is approaching? If <b>yes</b> , who is responsible for running this?
15		-Do you have a role in warning the community? If <b>yes</b> , how do you know when to begin? Who leads the operation? How many other people work alongside you? What instructions do you provide community members with? Do you receive any support from government?
16		-What do community people generally do during a disaster? How do they try to stay safe?
17		-Do community people use local cyclone centres? If <b>no</b> , then why?
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38	Existing practices following a disaster	-What happens after the disaster? How does community come back to their day to day activities?
39		-Do you have a role in post-disaster clean-up? If <b>yes</b> , what does this involve? Who coordinates clean-up efforts? Do you receive any support from government?
40		-What is done if parts of the community are no longer safe to be in/around (unstable infrastructure, flooded areas etc)?
41		- What do you think your area needs to help it better prepare and respond to disasters?
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51	<b>Understand role and measure in disaster relief management associated with drowning</b>	
52	To identify key responsibilities and involvement with disaster and drowning	-Have you personally assisted with any drowning cases? If <b>yes</b> , please provide detail. How could you have been better supported to handle these people?
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56	<b>Explore health seeking behaviours of disaster related drowning events</b>	
57	Health seeking behaviours post-drowning due to disaster	-What health facilities are available during/directly following a disaster? Are these different from regular health facilities? Are they appropriate/adequate for the community's needs?
58		-What health facilities do you think are needed to treat community members following a disaster? What are
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		some important features these services should have? Do you have any thoughts or preferences about who could provide these? [ <i>Probe: government, NGO, other organisation</i> ]
<b>Exit Questions</b>		
During our conversation, you mentioned W, X, Y, Z measures that could be taken to improve disaster preparedness for the community (and or post disaster measures) during or directly following a disaster. If you were to rank these from 1 to 5 (1 being most helpful and 5 least helpful in your community), what would the order be? And why? [ <i>probe with high risk group- community need, feasibility, acceptability, sustainability</i> ]		

For peer review only

Topics to address in this FGD guide:

- Investigate the impact of aquatic disasters (natural and human) on the community
- Explore current disaster preparedness practices/resilience
- Explore health seeking behaviours of disaster related drowning events
- Understand role and measure in disaster relief management associated with drowning

Introduction

Introductory statement

Welcome, and thank you for agreeing to be part of today's focus group discussion. We appreciate your willingness to participate and the time you have taken out of your day to take part.

My name is.....and I am from the Centre for Injury Prevention and Research, Bangladesh in Dhaka. We are conducting these discussions with members of the Barisal community who have experienced natural or human disaster. Our aim is to understand your views and experiences in relation to disaster-related drowning so that we can find out the best way to reduce it in Bangladesh and in your communities. We would like to find out from you what your thoughts/opinions and concerns are about drowning and how we can work together with you to reduce drowning related deaths and disabilities in your communities.

First I would like to cover some general rules about how this discussion will run:

1. We would like you all to do the talking and to hear from everyone in the group.
2. Only one person should speak at a time so please wait for the person talking to finish.
3. There are no right or wrong answers – every person's opinion and view is important and we would like to hear a range of different views.
4. Anything discussed in this room remains in this room. We want everyone to feel comfortable about discussing any sensitive issue.
5. We will be recording these discussions because we want to capture everything you have to say accurately. But please be assured that we do not identify anyone by name in any report and your identity will remain anonymous.
6. Does anyone have any questions?

Explore participant background information

Now I would like everyone to introduce themselves. Can you please tell us your name, age, occupation if any, and for how long you have been in this community for?

Theme	Discussion point	Probes/clarifications
Investigate the impact of aquatic disasters (natural and human) on the community		
Awareness/ Perception - <u>general</u>	<ul style="list-style-type: none"><li>▪ What are some major safety issues that arise during a disaster?</li><li>▪ What about drowning? Who do you think is most at risk of drowning during a disaster?</li></ul>	<ul style="list-style-type: none"><li>- When have you previously felt unsafe during a disaster?</li><li>- Are children/women/disabled people more prone to drowning during disasters?</li></ul>
Explore current disaster preparedness practices/resilience		
Risk behaviours	<ul style="list-style-type: none"><li>▪ What are some of the reasons community members drown during a disaster?</li></ul>	<ul style="list-style-type: none"><li>- What types of disaster cause an increased risk of drowning?</li><li>- Are there appropriate facilities and services available to prevent drowning/assist people who are drowning?</li></ul>
Current practices	<ul style="list-style-type: none"><li>▪ How do you ensure that you and your family are prepared for a disaster?</li></ul>	<ul style="list-style-type: none"><li>- What types of preparations do you make to your household prior to disaster? Where did you learn about these?</li><li>- How do you receive warning when a disaster is approaching?</li></ul>



		<ul style="list-style-type: none"> <li>- Do you and your household have an evacuation plan? What is it?</li> </ul>
Barriers	<ul style="list-style-type: none"> <li>- What are the barriers to ensuring you are prepared for disaster?</li> </ul>	<ul style="list-style-type: none"> <li>- What are the main barriers to making appropriate safety preparations before a disaster occurs? How could these barriers be minimised?</li> </ul>
<b>Explore health seeking behaviours of disaster related drowning events</b>		
Experience of drowning events	<ul style="list-style-type: none"> <li>▪ Do you know of any people who have drowned due to a disaster? If yes, please describe the event. Please describe the situation. What happened? How and when did this happen?</li> </ul>	<ul style="list-style-type: none"> <li>- Do you know if anyone attempted to help them? If yes, who and how?</li> <li>- How do you think this could have been prevented?</li> </ul>
During drowning event	<ul style="list-style-type: none"> <li>- How are people usually rescued in drowning situations during a disaster?</li> </ul>	<ul style="list-style-type: none"> <li>- Who are the people involved in the rescue and what are the associated risks for them?</li> </ul>
Post drowning event	<ul style="list-style-type: none"> <li>- Do you know what the usual immediate practices are after a person is recovered from water?</li> </ul>	<ul style="list-style-type: none"> <li>- Would you personally be confident in administering these?</li> <li>- What health facilities are available to treat drowning during/directly following a disaster? Are these adequate/appropriate?</li> </ul>
<b>Understand role and measure in disaster relief management associated with drowning</b>		
	<ul style="list-style-type: none"> <li>- What can be done to reduce the impact of a natural disaster in your community?</li> </ul>	<ul style="list-style-type: none"> <li>- What sort of programs, resources or facilities would be required for this?</li> <li>- Who do you think are best placed for implementing and overseeing this?</li> </ul>
	<ul style="list-style-type: none"> <li>- What is currently available to the community to prepare them for disaster?</li> </ul>	<ul style="list-style-type: none"> <li>- Have you ever received any kind of information about natural disasters? If yes, from where/whom? What did you learn? Was it useful?</li> </ul>
<b>Exit question</b>		
<p>During our conversation, W, X, Y, Z measures were mentioned that could be taken to reduce drowning amongst fishermen. If you were to rank these from 1 to 5 (1 being most helpful and 5 least helpful for your community), what would the order be?</p> <p>Does anyone have any other questions or anything you would like to say or discuss further in this group?</p>		



**Supplementary File 4.** Key subthemes from qualitative analysis with illustrative quotes

Theme	Key sub-themes		Illustrative quotes
<b>Perceptions of risk and consequences of disaster</b>	1. Perceived causes of disaster	1a. Beliefs	<i>“And why these happen, I cannot say. Allah wishes - that’s why it happens brother. Everything happens when Allah wishes.” (P2, M, fisherman and shop owner)</i>
		1b. Climate change	<i>“Car, launch, steamer; all these release smoke which is harmful for nature and for that reason disaster takes place.”(FGD2, M, small business owners))</i>
	2. Outcomes of disaster	2a. Loss of human life	<i>“We saw many dead bodies of people beside the road.” (FGD1, M, business men and fishermen)</i>
		2b. Loss of livestock, agricultural land and produce	<i>“What is more problem is, the fishes of the pond go away. Because of this, the people suffer from financial problems. They lose everything.” (P6, F, social worker)</i>  <i>“The storm destroyed all the crops. I don’t know whether we will get any rice or not from the grain.” (FGD3, F, housewives)</i>
		2c. Damaged households	<i>“Now look at that broken house which is left there. That house was made newly, it was built only two to three months ago. Suddenly it was hit by the storm.” (P7, F, housewife and NGO employee)</i>
		2d. Theft	<i>“We stay at home because if we leave the house the things will be stolen. We have nothing else than these things of the house. That’s why we try to stay at the houses long as we can.” (P3, M, agricultural worker)</i>
		2e. Damaged public infrastructure	<i>“Children cannot go to school and people have to swim to cross the roads. [The market] and cooking became a great problem.” (FGD4, F, housewives)</i>
		2f. Illness	<i>“When water comes during calamity, if people drink that water, people suffer from many diseases.” (P6, F, social worker)</i>
<b>Insufficient support for the most vulnerable</b>	3. Increased vulnerability to disaster	3a. Gender issues	<i>“During this time [women] are considered as a burden by other members of the family. They cannot move quickly, cannot come quickly.” (P6, F, social worker)</i>  <i>“Women are in risk because they wear many clothes and they have long hair. That hair might be untied and get stuck or twisted with anything else. They</i>

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			<i>don't have that much strength. So they cannot free themselves." (FGD2, M, businessmen and fishermen)</i>
		3b. Dependence on others	<i>"Children can't move alone and don't know how to swim. Someone is needed to guard them. Sometimes kids get lost when they are moving with their parents as we can hold something to stay safe, but the kids can't." (P3, M, agricultural worker)</i>
		3c. Close proximity to water	<i>"All of us who were staying near the river bank, lost everything. Everything was broken down." (P4, M, fisherman and labourer)</i>
<b>Community preparedness and practices</b>	4. Preparing for disaster	4a. Preparation of food and resources	<i>"And we arrange everything properly and tie up with the beam, so that later on we can get everything in proper order." (FGD2, M, businessmen and fishermen)</i>
		4b. Modifications made to households	<i>"We put poles to support the house so that it doesn't fall. We take a thick rope and tie up one end of that rope with the house and tie up the other end of rope with a big tree tightly, so that the house doesn't fall during cyclone." (FGD3, F, housewives)</i>
		4c. Self-made safety equipment	<i>"We make some floating materials with plastic bottle of soft drink, or plastic water bottle etc. I made those floating materials for all the members of my family." (P6, F, social worker)</i>
		4d. Education provided by government and NGOs	<i>"Now everyone has got training. Everyone knows what is to be done, if there is cyclone. The people of coastal area have now become more conscious." (P6, F, social worker)</i>
	5. Protection at time of disaster	5a. Heterogeneity in mode of communication	<i>"We receive information through radio and television. We even get to know what type of disaster is coming. We received signals during Aila. Mic was used in our area to aware people." (P1, M, assistant teachers)</i>
		5b. Lack of compliance to warning systems	<i>"And another thing is people don't want to go. As long as possible they try to stay in their own place. If they have left their things in that place then they might have lost their things. People don't want to leave their resort in their entire life. That's why problem increases more and people get hurt more by drowning in water." (FGD1, M, small business owners)</i>
		5c. Reliance on cyclone shelters for protection	<i>"If we get information about flood, then we will have to move to [the cyclone shelter]. Apart from this we don't have any alternative." (FGD3, F, housewives)</i>

		5d. Cyclone shelters not meeting community needs	<p><i>"Cyclone centres are located far from this place. If these are located near to us then it would be possible to go to cyclone centre." (FGD2, M, business men and fishermen)</i></p> <p><i>"Suppose there are two cyclone centres in our area. Already cracks have been developed in one building. Moreover they become filled up with people at the time when signal is shown." (FGD2, M, business men and fishermen)</i></p>
		5e. Use of other resilient infrastructure for shelter	<i>"We took shelter in those people's houses which were better means [than our house]. We took shelter in those houses which had strong foundation." (FGD1, M, small business owners)</i>
		5f. Use of Indigenous floatation methods	<i>"We use banana tree to keep ourselves floating. When there is a flood, we cut down banana trees. This is the local method. By using these accessories, we can reduce drowning." (P1, M, assistant teacher)</i>
<b>Barriers to disaster response and improving resilience</b>	6. Survival skills, rescue and resuscitation	6a. Lack of survival skills	<p><i>"A man in the north was totally puzzled and could decide which way to go with his old father. Then he was thinking whether he will save himself or will take his father. Then he tied up his father with a tree so that even if he dies at least his dead body will be found. Later on his father died tied up with that tree. Later, he was buried in the morning." (FGD1, M, small business owners)</i></p> <p><i>"My grandson was seven months old. We put quilt, pillow in a big metallic utensil and then put him there and then said, 'We are old. We cannot go to the marshy land, we cannot take him. Let him float on water. If Allah grants him life line then somehow he will survive and if he has no life line, then he will not be in this world anymore.'" (FGD3, F, housewives)</i></p>
		6b. Rescue is a high-risk practice	<i>"While saving anyone from drowning he may also die. They have also several risks, like trees or boughs may break and fall on them." (FGD4, F, housewives)</i>
		6c. Resuscitation using traditional methods	<i>"[A] clay pot is grinded like powder and that powder is rubbed on the body. Then body has to cover with cotton so that water can release from his body. And if his body is moved taking his body on head, then he will remain alive." (FGD3, F, housewives)</i>

		6d. Minimal access to health facilities post-event	<i>"If someone gets injured by accident then we have hospital here but don't have doctor. If someone gets seriously injured by accident in that case we have nothing to do." (FGD2, M, business men and fishermen)</i>
	7. Disaster relief	7a. Multiple parties are involved in relief	<i>"Then there were help from many places. Not only the government, but also many states of the world helped then. We helped people [too]; providing various relief: medicines, foods. We volunteered in these tasks." (P2, M, fisherman and shop owner)</i>
		7b. Bribery and nepotism control relief distribution	<i>"At that time [those] who could give money as bribe he got that house and money. But [those] who actually needed he did not get the house and money." (FGD1, M, small business owners)</i>
	8. Improving disaster resilience	8a. Improve community awareness	<i>"Here I would like to emphasize that if the people are given more training on calamity, then I think the risk might be reduced to some extent. Training has to be imparted to all." (P6, F, social worker)</i>
		8b. Provision of floatation devices and signals	<i>"People like us can try to survive if given a ring buoy or life jacket. By the grace of Allah we might be able to live." (FGD2, M, business men and fishermen)</i>
		8c. Generate political will	<i>"We don't have any idea who will do it for us. There is no benefit in asking to the members or the chairman. During the election they promise us a lot of things which ultimately they don't fulfil." (FGD4, F, housewives)</i>
		8d. Construct more cyclone centres	<i>"Cyclone centre are not constructed where they are supposed to be constructed. These are constructed in the area where people have power and influence. It would have been very helpful to the people if these centres could be built after every one and one and half kilometres." (FGD1, M, small business owners)</i>
		8e. Improve housing standards	<i>"If good strong houses can be made, then they can stay much safer. See everyone don't have the ability to build strong a house. For them, suppose, if a strong firm house can be made after every 4<sup>th</sup> or 5<sup>th</sup> house, then they can take shelter there. Storm will not bother much then." (P2, M, fisherman and shop owner)</i>
		8f. Construct more embankment s, barriers and dams	<i>"If block made of cement or concrete can be thrown beside the river bank then the people who live beside the river will remain well. And flood water will not be able to come easily. The river is breaking down in</i>

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			<i>such a way this place will not last long.” (FGD1, M, small business owners)</i>
		8g. Provide post-disaster medical service in community	<i>“When there is a disaster or flood, then if a service centre is established, it will be very good for us. The sick need not to be taken to remote areas. Their treatment can be managed from here.” (P2, M, fisherman and shop owner)</i>
		8h. Use mosques for warning signals and shelter	<i>“If anything is announced from mosque, people give more importance to it and obey it. Again if Imam discusses these things, then people will be able to know more.” (FGD1, M, small business owners)</i>
		8i. Increase tree plantations	<i>“You can plant many trees on the coastal area. That will save us from the stormy wind. But people don’t plant trees because many of them have no place, no land or no money.” (FGD2, M, business men and fishermen)</i>

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