

EXPLORING SOCIO-ECONOMIC VULNERABILITY OF DISADVANTAGED PEOPLE IN BANGLADESH: THE CONTEXT OF CYCLONE AND TIDAL SURGE

Md. Sadequr Rahman^{1,*}, Pedro Arcos Gonzalez² and Rafael Castro Delgado²

¹*Department of Sociology, University of Barishal, Barishal, Bangladesh*

²*Unit for Research in Emergency and Disaster, Department of Medicine and Health Sciences, University of Oviedo, Oviedo, Spain*

Abstract

This paper examines the nature, intensity, trends, risk, hazard, vulnerability and consequences of cyclone and tidal surge disaster. The qualitative research methodological tools and techniques, i.e, content analysis and historical method were employed as methods of data collection in this study. Moreover some data and information were drawn from secondary sources. The research findings reveal that disasters reinforce, perpetuate and increase gender inequality, create adverse, vulnerable and destitute situations for women, girl, child, aged, disable and poor people. The study observed that the people of all socio-economic group, especially the marginal groups like poor women, girl, child, aged, disable and poor are the most vulnerable groups to concurrent disasters and hazards. Sometimes they are excluded group of people due to their poverty, their attitudes, social norms, and marginal position in the social system. This study further explored to assess the condition of marginal people during the onset of disasters and aftermath of disasters. This study also assess the vulnerabilities and coping mechanism of disaster affected people in the context of institutional arrangements, disaster risk reduction, mitigation during and post-disastrous hazardous situation.

Keywords: Disaster, cyclone, tidal surge, vulnerability, marginal people, poverty

Introduction

Bangladesh is a low-lying riverine, deltaic, and disaster-prone country covering an area of 147570 square kilometre and supporting about 160.80 (July 2016) million people with a most densely populated country of 1090 per square kilometre (BBS, 2017). Bangladesh is called to be one of the most vulnerable countries of the world in terms of natural and anthropogenic hazards. The 'World Risk Report 2017' has been identified that Bangladesh is the fifth top-most natural disaster-prone country among 171 countries in the world (UNISDR, 2017). The geographical setting and meteorological characteristics has made the country vulnerable to different geo-hazards and hydro-meteorological

*Corresponding author's e-mail: sadeksociology2000@yahoo.com

hazards. These hazards often lead to various disasters. The major disasters concerned in the country are floods, cyclones, droughts, tidal surges, tornadoes, nor'-wester, earthquakes, river erosion, arsenic contamination of ground water, water logging, water and soil salinity, cold wave, fire, building collapse, epidemic, and various forms of pollution etc. At the same time, the country faces most at risk from the adverse effects of climate change and variability. Climate change will exacerbate many of the natural hazards/disasters in the country that already faces and brings about a significant challenges for future development. According to Bangladesh Disaster Statistics 2015 Report, about 24.44% household are affected by flood, followed by 15.10% by cyclone, 10.59% by thunderstorm, 8.42% by hailstorm, 6.13% by tidal surge, 10.49% by drought, 9.84% by water logging respectively between 2009 and 2014. On the other hand, out of the total BDT 184247.34 million damage and loss in 2009-2014, the highest 23.23% damage and losses are caused by flood, followed by 19.76% due to river/coastal erosion, 15.41% cyclone, 6.88% tidal surge, 6.23% hailstorm, 5.94% thunderstorm (total 34.46% are damaged by storm related disasters), 8.72% water logging, 5.74% drought, 3.30% salinity, 0.14% landslides and other categories have 2.34% in 2009-2014 (BBS, 2016). The livelihood of the community is already under tremendous pressure due to disasters. A large number of poor people live in vulnerable areas of the southern coastal belt of Bangladesh. People of all socio-economic groups especially the marginal people like gender or women, girl, child, aged, disable and poor are the most vulnerable to disasters. The vulnerability is so deplorable or miserable that they have to migrate in the newly accreted land of the Bay of Bengal and its surrounding areas which is occasionally hit by tidal surge or devastating cyclone.

The present study tries to assess the nature, intensity, trends, causes and consequences of cyclone and tidal surge in Bangladesh from last six decades to the present day. However, the study has some specific objectives:

1. To explore the challenges and socio-economic vulnerabilities of marginal groups (women, girls, child, aged and disabled) who are prone to disasters
2. To find out coping mechanism, adaptation, mitigation, resilience to disasters related to cyclone and tidal surge
3. To suggest appropriate policy formulation in addressing such disasters.

Materials and Methods

The qualitative research methodology including content analysis and historical method were employed as the method of data collection. Moreover, secondary sources of data were the predominant source of information to depict and compare the vulnerable, hazardous people and challenging situation of various disasters in Bangladesh. The data were collected from relevant books, journal, articles, archival records, formal studies and reports, public documents, newspapers, internet websites etc. The study also considers possible ways to address or mitigate the vulnerable or destitute situation of disastrous people of cyclone and tidal surge.

Disasters in Bangladesh: An Overview

Bangladesh experienced a long history of various natural disasters. Between 1950 and 2017, it experienced 326 natural disasters causing over 633614 death toll, 446231103 households were affected and US\$19.536780 billion in total damage (EM-DAT, CRED, 2017). The country is exposed to various disasters such as floods, cyclones, storm surge, river bank erosion, earthquake, drought, salinity intrusion and tsunami due to climate change, the geographical location, land characteristics and multiplicity of rivers which leads the people to go highly vulnerable. Cyclones and floods particularly caused massive damages intrusion and tsunami due to climate change, the geographical location, land characteristics and multiplicity of rivers which leads the people to go highly vulnerable. Cyclones and floods particularly caused massive damages.

Table 1. Top 10 disasters by total damage, total affected and total death from 1950 to 2017. *

Disaster No	Type	Date	Total damage ('000 US\$) with rank	Total Affected**	Total Death**
1998-203	Flood	05-07-98	4300000 (1)	15000050 (10)	
2007-556	Storm	15-11-07	2300000 (2)		
2004-298	Flood	20-06-04	2200000 (3)	36000000 (3)	
1988-242	Flood	00-6-1988	2137000 (4)	45000000 (1)	
1991-120	Storm	29-04-91	1780000 (5)	15438849 (9)	138866 (2)
1995-82	Storm	15-05-95	800000 (6)		
1987-319	Flood	00-8-1987	727500 (7)		
2016-175	Storm	21-05-16	600000 (8)		
1974-34	Flood	00-7-1974	579200 (9)	38000000 (2)	28700 (4)
2004-659	Earthquake	26-12-04	500000 (10)		
1984-41	Flood	00-5-1984		30000000 (4)	
1987-132	Flood	22-07-87		29700000 (5)	
1982-9350	Drought	00-7-1983		20000000 (6)	
1968-54	Flood	00-7-1968		15889616 (7)	
1965-28	Storm	11-05-65		15600000 (8)	36000 (3)
1970-63	Storm	12-11-70			300000 (1)
1963-13	Storm	28-05-63			22000 (5)
1985-63	Storm	24-05-85			15000 (6)
1965-34	Storm	00-6-1965			12047 (7)
1961-4	Storm	09-05-61			11000 (8)
1960-1	Flood	00—1960			10000 (9)
1960-31	Storm	30-10-60			5149 (10)

*Source: (EM-DAT, CRED, 2017)

**Ranks with parenthesis.

From the above table it can be said that the April 29 of 1991 tropical cyclone or storm brings severe devastation considering the top ten total death, total damages and total affected of the household in Bangladesh from the period of 1950 to 2017.

Cyclone

Cyclone and storm-surges are common annual or recurrent events during the pre-monsoon and retreating monsoon periods along the coastal belt of Bangladesh. In Bangladesh, nearly 46,41,060 people are exposed in areas under the threat of cyclones with ranking at 6th among the 89 countries analysed in 2014 (Hassan, 2016; Rahman et al., 2017). The term cyclone is derived from the Greek word 'kyklos' meaning coil of snakes. Technically, a cyclone is an area of low pressure where strong winds blow around a centre in anticlockwise direction in the northern hemisphere and clockwise direction in the southern hemisphere (Choudhury, 2009).

Tropical cyclones are spinning marine storms that significantly affect the coastal areas. The primary characteristics of these events are their deadly combination of high winds, heavy rainfall, and coastal storm surges. People sustained maximum surface winds of less than 39 mh or 62 kmh with tropical cyclones that are called tropical depressions. Once attaining sustained winds of at least 39 mh they are typically called tropical storms and assigned a name. If winds reach 74 mh or 119 kmh, they are called Hurricanes in the American continent, Typhoons in the Far East and cyclones in the South Asian sub-continent (Coppola, 2011).

When ocean temperature is warmed basically greater than 26.5°C, then cyclones are formed. A cyclone derives its spinning motion from the coriolis force arising out of the rotation of the earth. A cyclone can extend up to a height of 15 km. The frequency and strength of the cyclone are on the increase as a result of global warming (Choudhury, 2009).

Cyclone look likes 'eye'. The eye is small and almost circular, it coincides with the area of lowest pressure having a diameter ranging from 8-50 km. The eye is warmer than the rest of the storm. The more violent is the storm, the warmer is the eye.

The main cyclone is often accompanied by a long tail having more than one band, the whole thing making a spiral structure, and look like an inverted comma. The tail may extend upto a few hundred kilometre. The wind speed in a cyclone is more towards the right hand side of a cyclone track and less on the left hand side (Choudhury, 2009).

The Saffir-Simpson Hurricane Scale identifies the ratings of 1–5 to cyclonic storms based upon a measurement of the storm's current intensity. The measurement scale is designed

for hurricanes but can be used for any cyclonic storm, typhoons and is used to give an estimation of the potential property damage and tidal surge expected along the affected coastal and inland regions. Wind speed is the determinant factor in the scale because storm surge values are highly dependent on the slope of the continental shelf in the landfall region.

- Tropical Depression: Wind speed: <39 mph.
- Tropical storm. Wind speed: 39–73 mph. Minor wind and water-related damage. A storm is given a name at this point.
- Category 1. Wind speed: 74–95 mph. No damage to buildings. Damage to unanchored mobile homes. Some damage to poorly constructed signs, coastal flooding and minor pier damage.
- Category 2. Wind speed: 96–110 mph. Some damage to building roofs, doors and windows. Considerable damage to mobile homes. Flooding damages piers. Some trees blown down.
- Category 3. Wind speed: 111–130 mph. Some structural damage to small residences, utility buildings. Large trees blown down. Mobile homes and poorly built signs destroyed. Flooding near the coast destroys smaller structures; larger structures damaged by floating debris.
- Category 4. Wind speed: 131–155 mph. More extensive curtain wall failures with some complete roof structure failure on small residences. Major erosion of beach areas. Terrain may be flooded well inland.
- Category 5. Wind speed: 156 mph and up. Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Flooding causes major damage to lower floors of all structures near the shoreline. Massive evacuation of residential areas may be required (Coppola, 2011).

Cyclones and flood took many thousands of lives in Bangladesh, disrupt normal economic activities and brings the severe problems of poverty, health and quality of life (Brammer and Jones, 1993). In addition, cyclones have impacts on general public health, livelihoods, infrastructure, the economy and socio-cultural foundations. They can affect badly in access to food and drinking water and also increase the transmission risks of infectious diseases such as diarrhoea, hepatitis, malaria, dengue, pneumonia, eye infections and skin diseases which contributes to the hampers of livelihoods (Haque et al., 2012). Surface water becomes contaminated by saline intrusion and poor sanitation systems (Haque et al., 2012; Haque and Blair, 1992). Open and bamboo-wooden

structured latrines and poor sanitation are common in rural and coastal areas of Bangladesh and cyclones make this situation worse (Haque and Blair, 1992). Water borne diseases break out and sometimes spread out after the disaster of cyclone and tidal surge due to the lack of safe drinking water. Other causes are impacted indirectly such as damaged infrastructure, population displacement, reduced food production and the release of contamination of water (e.g. from storage and waste disposal sites). Malnutrition of child happens seriously for the loss of crops and reduced access to fish in Bangladesh. Indirect health-related impacts such as increased suicide, theft, burglary and crime rates, and adverse pregnancy outcomes are clearly associated with cyclones (Paul, 2008). Post-traumatic disorder, stress and depression occurs during the disaster and post disaster of cyclone period. Due to disruption of schooling for children and losses of houses and infrastructure the literacy rates are impacted badly and poor knowledge of environmental health issues creates additional problems after the cyclone.

During the period 1950–2017, approximately 162 cyclones formed in the Bay of Bengal, causing extensive loss of life around 567886, total negatively affected about 81769010 and destruction of property near about 6026380 thousand US dollars (EM-DAT, CRED, 2017). The cyclone of 1876, 1919, 1961, 1963, 1965, 1970, 1991 and 2007 were severe in nature.

The severe cyclone of 12 November 1970 took a toll of 300,000 human lives and put property damages to more than one billion US dollars in Bangladesh. About 46000 inland fishermen lost their lives (Rahman et al., 2017; Choudhury, 2009). The April 1991 cyclone inflicted a material damage was about USD 2.4 billion and human casualties numbered around 138,882 (Choudhury, 2009).

Cyclone Sidr hit the coastal areas on 15 November 2007 with winds of 250 kmh and a five meter sea surged killing more than 3,300 people. Millions of people were affected, injured 55,282, approximately one million tons of rice crop were lost, and by January 2008 nearly 500,000 people were lived in temporary accommodation (Rahman et al. 2017; Hassan 2016).

Cyclone Aila hit the Bangladesh on 25 May 2009 and damaged substantially across areas of southern Bangladesh. It caused 190 immediate deaths, injuries to 7,103 people and more than 500,000 people become homeless. The total damage was USD 270 million (Rahman et al., 2017; Choudhury, 2009).

Cyclone Mahasen made landfall on 16th May 2013 and brought a havoc in 8 coastal districts; 17 people were killed, 102 were injured, 26577 houses were fully and 124428 were partly damaged and 386221 people were affected by this cyclone. Large tracts of

standing crops were flattened and numerous fish ponds and fish culture washed away. Women, children, elderly and the disabled were the most affected and arisen more difficulties to maintain their regular routines and remain secure in new dwellings (IFRC, 2013; Disaster Report, 2013, 2014).

Cyclone Mora struck in Bangladesh on 30 May 2017 with wind speeds of 120 kmh or more. There were at least six lives lost, 136 people injured, about 52,000 houses were damaged or destroyed and leaving 260,000 people in possible need of shelter (ECHO, 2017). About 3.3 million people have been affected and 540,000 people are estimated to require humanitarian assistance like health, water, sanitation and hygiene promotion (WASH); shelter, food security and livelihoods. 70% of shelters as well as latrines, clinics and other infrastructure damaged. According to UNICEF, children are at risk of exploitation, abuse, violation and immediate taking shelters. This could increase their vulnerability and exposure to risks. Cox's Bazar District faced the highest impact with an estimated 335,000 people affected (UNICEF, 2017).

Table 2. Risk of exploitation, abuse, violation and immediate taking shelters. *

Estimated affected Population (UNICEF estimates calculated based on Inter-agency SitReps, March 2016; MIRA, December 2016; and projection for 2016 based on BBS census 2011)			
	Total	Male	Female
Total Affected Population	708,743	359968	348775
Children Affected under 18	358602	182098	176504
Children under Five	109105	55403	53702
Pregnant women	26932	N/A	26932

*Source: (UNICEF, 2017)

Table 3. Some major cyclones that hit the Bangladesh coast.*

Date	Maximum Wind speed (kmh)	Storm height (metres)	Surge	Death Toll
30 October 1960	210	4.6- 6.1		5149
28 May 1963	203	4.2-5.2		11520
11 May 1965	161	3.7-7.6		19,279
15 December 1965	217	2.4-3.6		873
01 October 1966	139	6.0-6.7		850
12 November 1970	224	6.0-10.0/20-30 ft		300,000
25 May 1985	154	3.0-4.6		11,069
29 April 1991	225	6.0-7.6		138,882
19 May 1997	232	3.1-4.6		155
15 November 2007 (Sidr)	223	6.1-7.6		3363
27 October 2008 (Rashmi)	85	5-7 feet (ft)		15
April 2009 (Bijli)	95	2.1-3 m/7-10 ft		7
25 May 2009 (Aila)	92	4.0-4.6		190
16 May 2013 (Mahasen)	95	1 m/3.3 ft		17
29 July 2015 (Komen)	100	1-2/3.3-6.6 ft		45
21 May 2016 (Roanu)	-	0.9-1.2m/3-4 ft		21
30 May 2017 (Mora)	130	1.2-1.5/4-5 ft		6

*Source: (EM-DAT, 2017; Bangladesh Meteorological Department, 2017)

Storm/Tidal Surge

Storm surges are oscillations of the water level in a coastal or inland water body in periods ranging from a few minutes to few days, resulting from atmospheric forces in the weather system. A storm surge is partly caused by the pressure differences within a cyclonic storm and partly by high winds acting directly on the water. This results in a mass of water, a huge wave, moving at the same speed as the cyclone. In the northern bay of Bengal, a unique combination of high tides, a funneling coastal configuration, the low

flat terrain of coastal districts, and a high population density have produced some of the highest mortality figures associated with storm surges (Khalil, 1992; Flierl and Robinson, 1972; Khan, 2017). Storm surges are generated by two principal factors: pressure drop and wind stress. Atmospheric pressure drop below normal raises the water through 'inverted barometer effect' by a nominal amount, i.e. about 1 cm per 1 Mb drop of pressure. Wind is the main force for the generation of storm surges. The amplitude of the wave depends directly on the strength of the wind (Khan, 2017).

Most of the casualties in cyclones are caused by the associated storm surge, not by the high winds. The storm surge in 1991 is estimated to 6m above normal high tide level. Wind speeds exceeded 200 kmh. Apart from huge human and livestock losses, substantial damage was caused to houses, trees, crops, fishing boats and shrimp farms. Larger parts of the coastal embankment were destroyed, leaving cropland behind it exposed to saltwater flooding during the following monsoon, until breaches could be repaired (Choudhury, 2009).

The Surge Decay Coefficient (SDC) is calculated as follows:

$$SDC = \frac{\text{Surge height} - \text{Avg. elevation of the land at the end of the surge}}{\text{Width total inundated area} - \text{Width area with constant surge}} \quad (\text{Damen and Van Westen})$$

Due to storm surges about 60% of all deaths have occurred in the low-lying arable southern coastal areas of Bangladesh bordering the bay of Bengal and another 40% storm surge struck the adjoining the Andaman sea (Murty et al., 1986).

Vulnerability

Vulnerability is exposed with populations and sets susceptible to hazards. For example, weak buildings or human beings like the aged, children, disable, or women, who cannot offer any resilience to the potential hazard are vulnerable (Commonwealth of Learning, 2004). The concept of vulnerability is defined as a measure of the propensity of an object, area, individual, group, community, country, or other entity to incur the consequences of a hazard (Coppola, 2011). Generally, there are four different types of vulnerabilities: physical, social, economic, and environmental. Each of these vulnerability ingredients is interconnected. Economic vulnerability can lead to social vulnerability, which causes populations to build on dangerous land, causing environmental vulnerability and physical vulnerability (Coppola, 2011).

Women, disable, older people and children may be much more vulnerable than active adults. Poor people has less capital resources and suffer more from the effects of hazards such as flood invasion of their homes. Some ethnic groups may be much less able to take

advantage of the assistance offered because of communication problems and cultural differences (Coppola, 2011).

Disaster and the Challenges and Vulnerabilities of Marginal People

When a tropical storm struck in any community the women are getting more vulnerable in their lives and livelihoods. The major challenges for the women were, and still are, sustaining, participating and empowering in decision making. A major challenge was how to engage the poorest and most vulnerable communities and how to handle the marginalized females. Another challenge is that grassroots women tend to see themselves as 'trainees' rather than 'trainers'. The last challenge was, and still is that: the grassroots communities need financial and institutional support to scale up the initiative. The disadvantaged women were more vulnerable for their feminine issues like health, pregnancy, menstrual hygiene management etc. (ACF, UNISDR, 2015). Women, adolescent girls and women with disadvantageous position (excluded women, elderly women, widow, the disabled) etc. were more vulnerable in the context of during and post disastrous precarious health condition especially skin, water and vector-borne diseases. Even mortality of women and adolescent girl, the bitter experiences at workplace, subjection to violence, state interventions during and after disasters, their restricted access to resources, power structures, education, and unevenly relief distribution system (Rahman, 2013).

Challenges of Socio-Political Empower of Marginal Group due to Cyclone and Tidal Surge

The rural communities especially women, children and youth are marginalized to empower the decision making. The coastal belt women are vulnerable and destitute during disasters because they were not culturally ready, properly educated or even encouraged to work to support themselves. Additionally, many women, especially widows and single women, found themselves competing with other male relatives for relief and property rights. Girls and women were and are fixed at spaces for kitchen, utilities, water storage, worship (shrine rooms), separate male and female halls specific to Muslim communities, were some of the ideas that emerged from gender-inclusive community discussions (Rahman, 2013; Caritas India, ISDR, 2017; PODA, UNISDR, 2017). Many women are more vulnerable for their lack of access to emergency information, decision-making power in disaster prevention and preparedness programs and some of them are excluded from disaster recovery operations and planning at national level (Rahman, 2013).

Many people in Bangladesh-probably 10 million- live in highly vulnerable areas, prone to cyclone or storm surges areas where rescue and relief services is difficult to send. Ideally people should not live (be allowed to live) in such hazardous areas (Maddrell, 1993).

Disasters have made the worsen situation of women and instigated the vulnerabilities on women's health, agricultural livelihoods, water access and use, wage labour, migration and conflicts related with the deterioration of the environmental conditions (Rahman, 2013; Broady, 2008).

WHO notes, women and children are particularly affected by disasters and counted as more than 75% of displaced. Added that due to natural disaster and lack of health care, women faces challenge in managing reproductive health and sexual health problems, and sexual and domestic violence. Moreover, gender roles shape the identity of women become the primary caretakers for those affected by disasters- including children, the injured and sick, and the elder people (Rahman, 2013; Dasgupta et al., 2010).

In Bangladesh, women are more calorie-deficient than men. Poor health and deficiency of calorie intake food make women further vulnerable during disasters that leads to catastrophes. Women also receive less and poor quality of health care in comparison to men. These situation has obstructed to women's resilience during and aftermath of disasters, their adoptive capability and capacity to cope with disasters (Rahman, 2013).

Mortality and Morbidity due to Cyclone and Tidal Surge

Women and girls suffer disproportionately in nearly all disasters. Due to cyclone, flood and tidal surge, the mortality and morbidity rates go to a staggering disproportion and discrepancies in terms of their impacts on the gender/sexes. The vulnerability of women, children and elder to the disaster and post disaster casualties is 14 times greater than those of men (Araujo et al., 2007). During cyclone and flood of 1991 in Bangladesh, the mortality rate of women increased fivefold than men, and out of 138,882 casualties many of whom were women and older than 40 years. Besides, many children, elder people, disable people, ethnic or minority people and poor people were deceased with bitter experience (Rahman, 2013; Rohr, 2006). Women were killed three times more compared to men in the Asian tsunami of 2004. Even, more women were died in hurricane Katrina 2005 in USA (Rahman, 2013; Dasgupta et al., 2010). Moreover, the majority of women and children do not know how to swim. Also the kind of wearing clothes of women could restrict their mobility and during an emergency situation like cyclonic storm surge disastrous situation can become difficult to quick escape for them (Mehta, 2007; Rahman, 2013; Dasgupta et al., 2010).

Challenges of Health Care Access

Women's health condition deteriorates alarmingly aftermath of disasters for some reasons. The community looks at the health and hygienic needs of women with differently and avoid addressing the issue of providing institutional assistance. Socialization factors and patriarchal socio-economic structures neglect these basic needs of women that play adversely in determining their health condition. Women faces more nutritional deficiencies (especially the pregnant or breastfeeding period), and in some cultures these are lower on the priority of household food intake. In some regions, women's nutrition is particularly precarious. In South and Southeast Asia about 45 to 60% women are underweight in their reproductive period and 80% of pregnant women have iron deficiencies (Rahman, 2013; Davis et al., 2005). Social taboos and norms about menstruation and proper behavior have contributed to health problems for young women in disaster situations. A study of WHO (2005) reported that during the 1998 flood in Bangladesh there was an increase in perinea rashes and urinary tract infections in adolescent girls because they were not able to properly wash and dry their menstrual rags (WHO, 2005; Rahman, 2013). Pregnant, breastfeeding and menstruating women are at risk of health during and after disasters. Scarcity of suitable places for baby's breastfeeding, proper sanitary materials such as women's underwear pose great hazards for their health condition during and post disasters. Health care access or the list of essential medical goods and services like contraceptives, birth control pills etc. are found insufficient. These increase the chance of sexually transmitted diseases (Rahman, 2013; Dasgupta et al., 2010). Another problem in refugee camps is the common absence of hygienic facilities for women and adolescent girls. Lack of privacy at latrines, unavailability of separate toilets, showers, and tents for women, men and adolescent girls are seen and sometimes these unresolved issues are failed to solve the crisis in the society (Mehta, 2007; Rahman, 2013; Dasgupta et al., 2010).

Women frequently use water to care for children, the elderly and the sick, as well as to carry out many household tasks. Women, girls and child carry the highest risk of getting in contact with polluted or contaminated water and falling sick during and post disasters (Rahman, 2013; Mehta, 2007; Dasgupta et al., 2010).

Economic Insecurity due to Cyclone and Tidal Surge

Women experience a significant increase in their workload of agriculture, cultivation of cereal and livestock farming after disasters of cyclone, tidal surge and flood due to the damage and loss of economic activities in these sectors. Besides, girls and women have to perform their home duties such as preparation of food, fetching water, collecting firewood and waste disposal. Moreover, household workload can increase to such a

degree that female child could be forced to leave the school to help with domestic chores during and after disasters (Rahman, 2013).

Cyclone and flood increase women's burden and hardship in domestic chores and farming activities in Bangladesh. The damage and loss of utensils, property, and other household essentials is a great hardship and dependence on economic activities of women (Rahman, 2013; Hossain, 1996). Losses of harvest and livestock have a disproportionate impact on women, many of whom rely on food processing, cattle, and chickens for their cash income. Child, women and girls faced much more difficulties for these. However, their role was largely unrecognized (Nasreen, 2012).

Women and girls have limited access to resources in social networks, transportation, information, skills, literacy, control over land and other economic resources, personal mobility, secure housing and employment, free from violence and decision making power (Dasgupta et al., 2010; Rahman, 2013).

Women, girl, disable and aged people are at higher economical vulnerability than men, able and young or adult arduous people. They have limited access to get job and developing entrepreneurial skills, literacy and education levels, less ability to access financial and local resources like credit, savings or pensions, less ability to buy and own land, are paid less if paid at all, and their income is less secure (Rahman, 2013, Dasgupta et al., 2010). The incidence of poverty is found significantly for female headed households which is estimated at 19.9% in 2016 in Bangladesh (BBS, 2017). They are involved in the informal sector which is often the worst hit by disasters. They are less able to recover from the effects of disasters due to their low levels of capital accumulation, and weaker access to credit and information (Rahman, 2013).

In Bangladesh, about 19.9% households in 2016 are female headed and 95% of these are considered to be below the poverty line and feminization of poverty. These female headed households are more vulnerable and deplorable during and aftermath of disasters. The housing quality, a location on raised ground, adequate preservation for food – all are crucial to self-protection, but are more difficult for poor women to achieve (Rahman, 2013).

Due to lack of communication and transportation facilities disable, child, aged people and girls or women without men, pregnant or elderly women fail to receive relief though their names are listed. Sometimes, cultural barriers can discourage women to present compensation claims for damages resulting from disasters (Flierl and Robinson, 1972).

Domestic and Sexual Violence against Women, Girl and Disable People

Women face numerous problems due to their gender identity. Throughout the lifecycle of marginal people like poor women, child or aged, disable people suffer more than men, adult and able person from poverty, hunger, malnutrition, economic crises, environmental degradation and disaster related problems. They become victims of violence and political instability (Rahman, 2013; Nasreen, 2010).

Violence against women, girl and disable people are some challenging scenario during and aftermath of disasters. The physical and emotional violence occur within the households and in the flood and cyclone shelters or refugee camps. Many women or girls in various regions often have witnessed an increase of eve-teasing, domestic and public sexual harassments and violence during and aftermath of disasters. Infrastructure conditions in refugee camps may expose women and girls to sexual violence, for example long ways to toilets or showers and inadequate access to closing tents are the predicaments to women's safety and security (Rahman, 2013; Mehta, 2007; Dasgupta et al., 2010). Incidents such as rape or abduction of young girls and women (by the robbers) also occur during flood and exist in cyclone shelter (Dasgupta et al., 2010; Rahman, 2013).

Challenges of Education, Livelihood, and Inability to Meteorological Forecasting

During disaster or even after a disaster, many children and girls are forced to drop out of school to help with domestic chores or to save money. Lower levels of education reduce the ability of women and girls to access information, including meteorological forecasting, early warning mechanisms and resources, or to make their voices heard. This poses an extra- challenge when women want to look for their livelihood strategies (Rahman, 2013).

Conclusion and Recommendation

Bangladesh is known as one of the disaster prone countries of the world with extremely limited resources. Among them, cyclone and flood are devastating, recurrent and severe in nature due to the damage of houses, property, losses of life and injuries. Cyclone, tornado and nor'-wester occurs in April-May and though cyclone occurs in October-November (Rahman et al., 2017). People of all classes especially the marginal people like gender or women, girl, child, aged, disable and poor are the most vulnerable group to experience those disasters and sometimes they are socially excluded due to their poverty, their attitudes, social norms, and marginal position in the social system. National policies, institutional frameworks and adaptation measures are also responsible for marginal people in vulnerable and socially excluded positions. Bangladesh is striving hard to

establish an elaborate and experienced disaster management system from national to community level (top down approach) to mitigate the effects of disasters.

During last six decades, Bangladesh has learnt how to adapt to recurrent cyclones and has succeeded significantly by reducing deaths. This has been achieved by modernizing early warning systems, developing shelters and evacuation plans, constructing coastal embankments, maintaining and improving coastal forest cover and raising awareness at the community level. Considering the population density, the requirement for two or multi storied cyclone shelters and multipurpose buildings within a 2 km walking distance of households should be developed. Schools, mosques, local government buildings or other locations where people congregate for shelters should be given the highest priority in cyclone-preparedness programmes. There is a real need to coordinate transport, including the emergency boats. Recommendations are being formulated to improve forecasting and early warning systems. Geographic Information Systems and remote sensing technology should be used to determine the best locations in terms of factors such as access, road networks and population density (Haque et al., 2012; Maddrell, 1993; Haque and Blair, 1992).

Disaster Managers should have to focus and empower local communities through introducing a sustainable community risk management system; building DRR skills; and linking local communities with local government authorities such as the Union Parishad. Women should have practice the disaster preparedness measures so that they will protect their lives and livelihoods on their own initiative without the intervention of the national disaster management system. Initiatives to collect and store drinking water should also be considered. Reforestation/afforestation should be carried out to mitigate cyclone risk. Coastal embankment projects should be extended to all coastal areas. Existing embankments should be repaired and maintained. Careful planning with sufficient sluice gates should be established so that they will protect against both flash floods and storm surges during a cyclone, and will also help protect cropland, fisheries and livestock (Haque et al., 2012). Awareness should focus on public health and hygiene issues. Need to arrange meeting, comprehensive training module and public awareness program with community people by providing assistance. Under the cyclone preparedness program, Bangladesh needs to implement the awareness campaigns to disseminate information about cyclone warning signals and preparedness measures, using meetings, discussion, posters, leaflets film-shows and demonstration performances. Donor agencies, politicians and planners in Bangladesh should take this into account in future planning of coastal zones (Haque et al., 2012). Moreover, public awareness work helped create shared understanding about women's vulnerability within communities. A gender-inclusive

approach should be prioritized to encourage women and to participate in organised meetings and discuss their needs and opinions (ACF, UNISDR, 2015).

Acknowledgments

This work was financial supported by the Education, Audiovisual, and Culture Executive Agency of the European Commission (EACEA) by the name of MSc. programme ‘Erasmus Mundus Masters in Public Health in Disasters (EMMPHID)’ as an Erasmus Mundus Scholars. I would also like to express my sincere gratitude and appreciation to my supervisors Dr. Pedro Ignacio Arcos González, Director, and Dr. Rafael Castro Delgado, MD, MPH, Coordinator, from the Unit for Research in Emergency and Disaster, Department of Medicine and Health Sciences, University of Oviedo, Spain for their continuous support with their patience, guidance, motivation, encouragement, constructive critiques and immense knowledge for my master dissertation.

References

- Action Against Hunger (ACF). 2015. Bangladesh. Female household heads protect lives, livelihoods in remote cyclone-prone villages [Internet]. Thailand: UNISDR, United Nations; 2015 [cited 2017 Jun 12]. Available from: http://www.unisdr.org/files/42882_42882womensleadershipinriskresilien.pdf
- Araujo, A. and Quesada-Aguilar, A. 2007. Gender Equality and Adaptation: Women's Environment and Development Organization [Internet]. World Conservation Union (IUCN). Available from: www.genderandenvironment.org/admin/admin_biblioteca/documentos/Factsheet%20Adaptation.pdf.
- Bangladesh Bureau of Statistics (BBS). 2016. *Bangladesh Disaster-related Statistics 2015: Climate Change and Natural Disaster Perspectives* [Internet]. Dhaka, Bangladesh: Bangladesh Bureau of Statistics (BBS), Statistics and Informatics Division (SID), Ministry of Planning, Government of the People's Republic of Bangladesh. Available from: http://203.112.218.65:8008/WebTestApplication/userfiles/Image/National%20Account%20Wing/Disaster_Climate/Disaster_Climate_Statistics%2015.pdf
- Bangladesh Bureau of Statistics (BBS). 2017. Bangladesh Sample Vital Statistics 2016. Government of the People's Republic of Bangladesh. [Internet] Available from: http://bbs.portal.gov.bd/sites/default/files/files/bbs.portal.gov.bd/page/6a40a397_6ef7_48a3_80b3_78b8d1223e3f/SVRS_REPORT_2016.pdf
- Brammer, H. and S. Jones. 1993. Protecting Bangladeshi community against floods and cyclones. In: *Natural Disasters: Protecting Vulnerable Communities*. London: Thomas Telford Services Ltd.

- Broady, A., J. Demetriades, and E. Esplen. 2008. Gender and climate change: Mapping the linkages. A Scoping Study on Knowledge and Gaps. Brighton [Internet]. Available from: www.bridge.ids.ac.uk/reports_general.htm
- Caritas India. 2017. Enabling Women to Play a Lead Role in Disaster – Affected Marginal Communities. In: *Gender Perspective: Working Together for Disaster Risk Reduction*. Geneva: ISDR.
- Choudhury, A. M. 2009. *Protecting Bangladesh from Natural Disasters*. Dhaka 1209, Bangladesh: Academic Press and Publishers Library.
- Coppola, D. P. 2011. *Introduction to International Disaster Management*. Burlington, MA 01803, USA.: Elsevier Inc.
- Damen, M. and C. J. Van Westen. Modelling Cyclone Hazard in Bangladesh. International Institute Geo-Information Science and Earth Observation (ITC) Netherland. Available from: http://www.adpc.net/casita/Case_studies/Coastal%20hazard%20assessment/Modelling%20cyclone%20hazard%20in%20Bangladesh/Modelling_Cyclone_Hazard_Bangladesh.pdf
- Dasgupta, S., S. Ismail and D. P. Sarathi. 2010. *Women's encounter with disaster*. In India: Front page Publications Ltd.
- Davis, I., De Costa, P. Kala, K. Alam, M. Ariyabandhu, and M. Bhatt. 2015. *Tsunami, Gender and Recovery: Special issue for International day for disaster risk reduction*. Available from: www.gdnonline.org/resource/tsunami%20-genderandrecovery.pdf
- EM-DAT, Guha-Sapir D, Hoyois P, Wallemacq P, Below R. 2017. EMDAT- The Emergency Events Database, The International Disaster Database [Internet]. Brussels, Belgium: Centre for Research on the Epidemiology of Disasters (CRED), Institute of Health and Society (IRSS), Université Catholique de Louvain; September [cited 2017 Sep 12]. Available from: <http://www.emdat.be/database>
- European Civil Protection and Humanitarian Aid Operations (ECHO). 2017. EU provides € 1.5 million in assistance to victims of Tropical Cyclone Mora in Bangladesh and Myanmar [Internet]. July. Available from: <https://reliefweb.int/report/bangladesh/eu-provides-15-million-assistance-victims-tropical-cyclone-mora-bangladesh-and>
- Flierl, G. R., and A. R. Robinson. 1972. Deadly surges in the Bay of Bengal: Dynamics and storm tide tables. *Nature*. 22; **239**:213–5.
- Government of the People's Republic of Bangladesh. 2014. *Disaster Report 2013* [Internet]. Dhaka-1212, Bangladesh: Department of Disaster Management, Ministry of Disaster Management and Relief, Government of the People's Republic of Bangladesh; OctoberP. 1–71. Available from: <https://reliefweb.int/report/bangladesh/disaster-report-2013>

- Haque, C., and D. Blair. 1992. Vulnerability to tropical cyclones: evidence from the April 1991 cyclone in coastal Bangladesh. *Disasters*. September; **16** (3):217–29.
- Haque, U., M. Hashizume, K. N. Kolihras, H. J. Overgaard, B. Das, and T. Yamamoto. 2012. Reduced death rates from cyclones in Bangladesh: what more needs to be done? *Bulletin of World Health Organization*. **90**:150–6.
- Hassan, S. 2016. The Natural Disaster in Bangladesh. [Cited 2016 Nov 30]; Available from: https://www.academia.edu/12499625/The_Natural_Disaster_in_Bangladesh
- Hossain, K. M. 1996. Women and Floods in Bangladesh. *International Journal of Mass Emergencies and Disasters*. **14**(3):281–92.
- International Federation of Red Cross and Red Crescent Societies (IFRC). 2013. Bangladesh: Tropical Cyclone Mahasen. 2013 June 6; Available from: <https://reliefweb.int/sites/reliefweb.int/files/resources/Bangladesh%20Tropical%20Cyclone%20Mahasen%20Emergency%20Appeal%20n%20MDRBD013%20Operation%20Update%20no%201.pdf>
- Khalil, G. M. 1992. Cyclones and Storm Surges in Bangladesh: Some Mitigative Measures. Kluwer Academic Publications, Netherland. **6**(1):11–24.
- Khan, S. R. 2017. Cyclone Hazard in Bangladesh. Available from: www.adpc.net/.../coastal%20hazard%20assessment/modelling%20cyclone%20hazard%20in%20bangladesh/background...
- Maddrell, R. J. 1993. Alleviation of Natural Disasters in the Southwestern Area of Bangladesh. In: *Natural Disasters: Protecting Vulnerable Communities*. London: Thomas Telford Services Ltd.
- Mehta, M. 2007. Gender Matters: Lessons for Disaster Risk Reduction in South Asia. ICIMOD Kathmandu, Nepal [Internet]. Available from: www.gdnonline.org/resource/Gender&disaster-preparednessICIMOD.pdf
- Murty, T. S., R. A. Flather, and R. F. Henry. 1986. The Storm Surge Problem in the Bay of Bengal. *ELSEVIER, Progress in Oceanography*. **16**(4):195–233.
- Nasreen, M. 2010. Rethinking Disaster Management: Violence against Women during Floods in Bangladesh. In: *Women's Encounter with Disaster*. eds. Dasgupta S., Ismail Siriner, and Partha sharathi De. p. 232–44.
- Nasreen, M. 2012. *Women and Girls: Vulnerable or Resilient?* University of Dhaka, Bangladesh: Institute of Disaster Management and Vulnerability Studies.
- Paul, R., A. Ahmed, A. Richardson. 2008. Bangladesh to build 2000 cyclone shelters. January 8; Available from: <http://www.reuters.com/article/2008/01/08/us-bangladesh-cyclone-shelters-idUSDHA10588420080108>

- Potohar Organization for Development Advocacy (PODA). 2017. Pakistan. Promoting, Protecting Women's and Girls' Rights among Disaster Survivors. In: *Gender Perspective: Working Together for Disaster Risk Reduction*. Geneva: UNISDR, United Nations.
- Rahman, M. S. 2013. Climate Change, Disaster and Gender Vulnerability: A Study on Two Divisions of Bangladesh. *American Journal of Human Ecology, World Scholars*. 2(2):72–82.
- Rahman, M. H., M. S. Rahman, and M. M. Rahman. 2017. Disasters in Bangladesh: Mitigation and Management. *Barisal University Journal Part 1*, Bangladesh. 4(1):139–63.
- Rohr, U. 2006. Gender and Climate Change. *Tiempo*. 2006 April;59:3–7. Available From: www.tiempocyberclimate.org/portal/archive/pdf/tiempo59high.pdf.
- The Commonwealth of Learning. 2004. *Disaster Management*. Gazipur, Bangladesh: Publishing Printing & Distribution Division, Bangladesh Open University.
- UNICEF. 2017. Bangladesh Humanitarian Situation [Internet]. Dhaka, Bangladesh; June, Report No: 2. Available from: <https://reliefweb.int/sites/reliefweb.int/files/resources/UNICEF%20Bangladesh%20Humanitarian%20SitRep%20No.%202%2C%2020%20June%202017.pdf>
- UNISDR. 2017. World Risk Report Analysis and Prospects 2017 [Internet]. Berlin, Germany: Bündnis Entwicklung Hilft; P. 1–56. Available from: http://weltrisikobericht.de/wp-content/uploads/2017/11/WRR_2017_E2.pdf