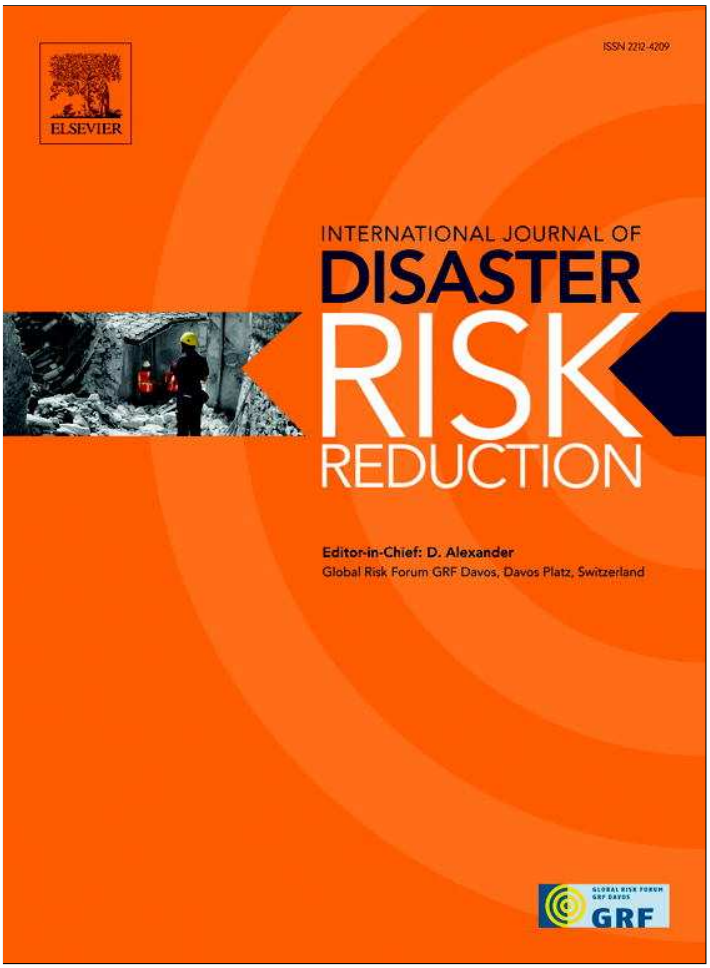

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Women in natural disasters: A case study from southern coastal region of Bangladesh

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ABSTRACT

Natural disasters are frequent phenomena in the coastal regions of Bangladesh, causing significant damage to the coastal community and environment. The present study was conducted in southern coastal region of Bangladesh with the aim to explore women's preparedness, risk and loss, cultural and conditional behaviour, adaptability and recovery capacity from the natural disasters. During disaster a kind of functional disorder gets created where women had to face challenges different from men. Women have to face loss of livelihood opportunities, deprivation from relief materials, sexual harassment and enjoy little scope of participation in any response or management activities. Likewise, they also suffer from inverse care law after disaster. Contrary to that, disaster also creates a condition to accrue diverse positive and constructive impacts including women's transformative role which often do not get reported. Disaster leads the planners to follow not merely the compensatory principle but also restoration and augmentation principles which give more benefits to the low income group of the coast. Nevertheless, in the coast the higher is the loss of property, the lower is the tendency among the dwellers to invest which has a long-lasting effect on capital formation and social development.

1. Introduction

Current climate shocks and stresses already have a devastating impact on the vulnerability of the world's poor due to its long-term implications and adverse effects on economic, social and development activities [1]. Increasing frequency and intensity of weather-related extremes, and gradual changes in the average temperature will exacerbate these impacts [2]. Global Climate Risk Index (CRI) reported that from the year of 1992–2011, globally more than 530,000 people died as a direct consequence of almost 15,000 extreme weather events, causing economic losses to more than USD 2.5 trillion [3]. United Nations International Strategy for Disaster Reduction (UNISDR) Secretariat noted that the climate change and disasters are interlinked and likely to increase the number and scale of disasters with more extreme weather events [4]. Low-and middle-income countries are especially vulnerable to natural disasters (e.g., coastal flooding, cyclones and storm surges, prolonged droughts and sea level rise) [5–8] due to their strong reliance on natural resources causing human, material, economic and environmental losses, and affecting human development [4].

Most of the coastal areas of the world are at risk from natural disasters, and meteorological disturbances originated from climate change [9]. The coastal areas of Bangladesh facing the Bay of Bengal are comprised of 19 coastal districts [10] which make the country one of the most disaster prone [11]. As the Bay of Bengal is a perfect breeding ground for tropical cyclones where on an average annually 12–13 depressions are formed, and at least one or

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two powerful cyclone strikes Bangladesh each year, for example, cyclones *Sidr* and *Aila* [12–14] and recent (on May 16, 2013) cyclone *Mahasen* struck the southern coast of Bangladesh. In addition to the geophysical characteristics of Bangladesh coast, the poor socioeconomic conditions of coastal inhabitants also contribute to increasing the vulnerability of inhabitants to cyclones and storm surges [15]. Livelihoods of coastal population are highly dependent on ecosystems linked to agriculture, fishery, forestry and salt farming, etc. Therefore, the increasing trend of cyclones will certainly affect the livelihoods of vulnerable population living in low-lying coastal Bangladesh [16,17]. During the years 1797–2009, a total of 65 devastating cyclones swept over Bangladesh and cause immense harm to the people [9] and about 80–90% of global losses and 53% of total cyclone-related deaths worldwide occurred in Bangladesh [13,14,17].

Women, adolescent girl and children are supposed to be the most vulnerable in natural disasters [2,18] accounting for more than 75% of displaced persons [17]. Even in the time of hurricane *Katrina*, USA experienced the biggest survival obstacles for her population—mostly the female section of the society—especially of Afro-American origin [19–22]. Due to lack of health care facilities in disaster periods women are vulnerable to reproductive and sexual health problem, and increased rates of sexual and domestic violence [23]. In post-disaster, women are not getting proper support from the government and non-governmental organizations but their indigenous coping attitudes are appreciable [12]. Due to loss of houses and assets, sometimes women have to migrate to cities for better living but it increases the rate of urban unemployment, immoral activities and urban slums, etc. [24].

Climate Change Cell (CCC) of Bangladesh recorded that the women are even more vulnerable to the adverse impacts of climate variability and changes as they are often not allowed to participate in the public sphere, and are therefore, less likely to receive critical information for emergency preparedness [25]. Moreover, most climate change and disaster issues, policies and programmes are not gender neutral [26] and several areas like gender specific resource-use patterns; gender-specific effects of climate change; gender related pattern of vulnerability; women's capacity to cope with climate change; gender and decision-making on climate change; and gender aspects of adaptation and mitigation deserve attention [18,25]. Ahmad [27] reported that gender-responsive disaster management in Bangladesh achieved improved results where the study shows that in 1991 cyclone, the number of death was over 140,000 and the male: female ratio of death was 1:14 but with the improved gender-responsive disaster management in 2007 *Sidr*, the male: female ratio has gone down to 1:5 and the number of death was around 3000 only. During cyclone *Mahasen*, the number of death was around 50 only where 17 were women and rest was children. Same trend also observed in the Asian *tsunami*, where women died more than three times compared to men [22,28]. Similarly, in industrialized countries more women died during the 2003 European heat wave.

Gender disaggregated research is required to shed more light on vulnerability level and coping mechanisms of men and women in the coast. Initial attempts to link gender and climate change may seem rather far-fetched and there have been only a few publications to establish this linkage. Both the Kyoto Protocol and the UN Framework Convention on Climate Change (UNFCCC) overlooked even to mention gender concerns [29]. An analysis of women's condition in natural disasters in a coastal area of Bangladesh is, therefore, imperative covering the following preeminent objectives: identify the women's vulnerability and risk in terms of natural disaster management; figure out the women's responses to natural disasters as well as cultural and conditional behaviour of women in pre-, during and after disasters; loss and gain from disaster; and finally, enabling to draw out the effective strategies for women to cope with the natural disasters with and without support of their counterpart male. The study also used a three-dimensional perspective—a time-trend situation analysis; a twin perspective of behavioural change; and underlined a way forward through adaptive and recovery capacity of women in natural disaster. It has covered some new examples, evidences and data such as disaster ranking taking into account people's perception, cultural and conditional behaviour of women, women's gain from the disaster, developing resilience of ecosystem by women, women's disaster coping capacity, miracles in the case of disaster, recovery capacity, and transformative impact of disaster on women.

2. Materials and methods

2.1. Profile of the study area

The study was conducted in Patharghata Upazila (sub-district, administrative entity) of Barguna District in south-western Bangladesh. Barguna District is a part of the Barisal Division—a coast district in Bangladesh, with an area of 1831.31 sq. km. of which 399.74 sq. km. was riverine and 97.18 sq. km. was under forest. It lies between 21°48′ and 22°29′N and between 89°52′ and 90°22′E. Barguna is bounded on the north by Barisal and Patuakhali Districts, on the east by Patuakhali District, on the south by the Bay of Bengal and on the west by Pirojpur and Khulna Districts [30–31].

The study area—Patharghata Upazila—occupies an area of 387.36 sq. km. with 37.29 sq. km. of forest (Fig. 1). It is located between 21°58′ and 22°14′N and between 89°53′ and 90°05′E. The main rivers of the area are Bishkhali and Haringhata [30]. Patharghata Upazila comprises of seven Unions (the lowest administrative entity); among those Patharghata Union was chosen as the study area as the union is situated on the coastline of southern Bangladesh. Various disasters like cyclone, storm surge, coastal floods and erosion, drought, salinity intrusion, etc. are common which affected the area frequently and severely.

2.2. Methods

Data were obtained through a series of field visits using survey and various participatory approaches (Table 1). Documents, studies and reports related to climate change induced disasters—and women role in disaster management were reviewed and necessary data were collected.

2.2.1. Selection of the studied villages

Based on the preliminary idea gathered from the secondary sources and consultation with the local NGOs'

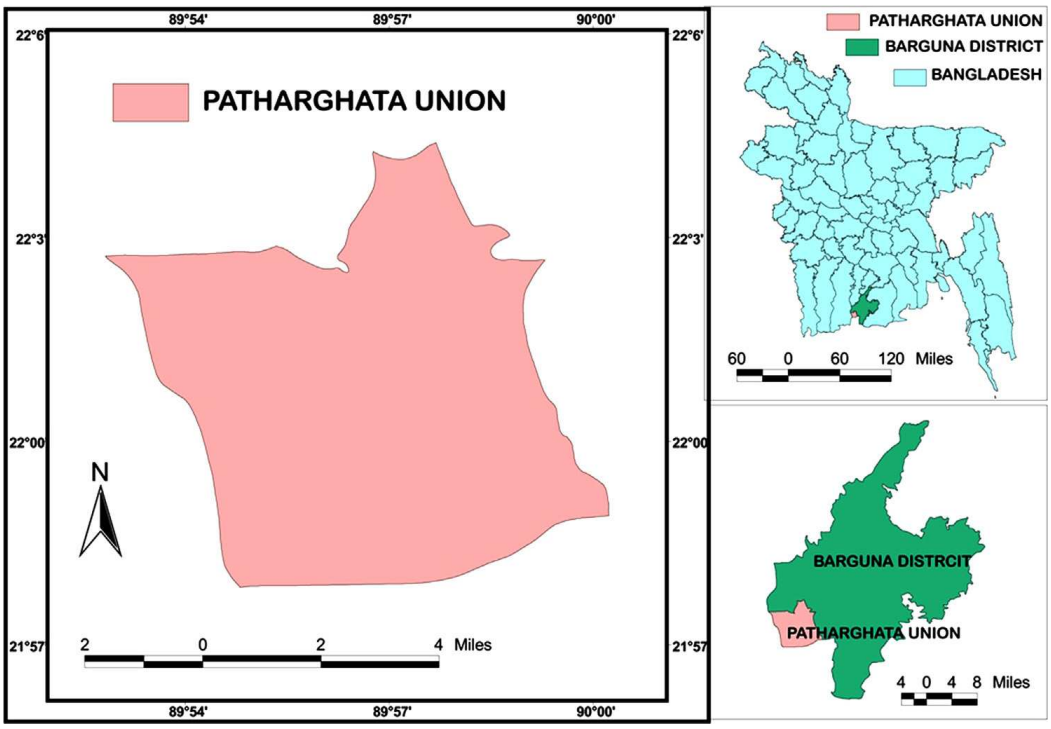

Fig. 1. Location map of the study area.

Table 1
Sample size of the study.

Tools	Participants	Sample Size
HH questionnaire	Vulnerable women	105
FGD	Community people from different groups, occupations, knowledgeable persons and local NGOs' officials	4
KII	Union Parishad (UP) Chairman, UP members (both male–female), UP secretary, schoolteacher and social workers/volunteers	10
Public consultation	Community people from different groups, occupations, incomes and knowledgeable persons	Series
Case study	Vulnerable women	6

officials and persons involved in administrations, out of nine wards three wards (spread over four villages) were selected for survey. From the three wards three villages namely Boro Tengra, Char Padma and Char Lathimara were selected purposively for the survey, which were reportedly most affected by the natural disasters. The occupations of these villagers were fishing, dry fish processing, crop production, seasonal vegetables cultivation, day labouring, rickshaw, rickshaw-van pulling and motorcycle driving; shop-keeping and service-providing.

2.2.2. Field survey techniques and data collection

Primary information were collected by using checklist and semi-structured questionnaire along with field observations to know people's views about the disaster risk, women's vulnerability, response, identify the similarities and differences in gender perceptions about disaster response, etc. Under FGDs and KIIs poor men and women, representatives from local government, elites and NGO officials were interviewed. Public consultations were carried out at the local tea stalls where local people gathered spontaneously in the afternoon after their daily works. During the HHs survey, household head (male or female) along with family members (if possible) were interviewed during the daytime. The HHs survey and KIIs output were validated during the FGDs. In order to achieve the objectives, 105 HHs, ten KIIs, four FGDs, six case studies (two from each village) and a series of public consultations were carried out (Table 1). Surveys were conducted in the month of February to April 2013.

2.2.3. Data analysis

Collected data were processed and analyzed using computer aided programs like MS Excel and SPSS (Statistical Package for Social Sciences, version 17.0). Before reaching to any conclusion different variables were checked and cross-checked; and then processed data were analyzed using both qualitative and quantitative approaches. A five point assessment scale (i.e. 5 for very high, 4 for high, 3 for moderate, 2 for low and 1 for very low) for problem matrix was developed which was used by the FGD participants. At the same time problem frequency was collected; and score was calculated by multiplying the problem values with problem frequency.

Table 2
Chi-square test of relationship between demographic features of the women in the study area.

Parameters	Respondents/village (%)				χ^2	*P*	φ_c
	Char Padma	Char Lathimara	Boro Tengra	Total			
Age classification							
< 30	40.00	51.43	54.29	48.57	62.571	0.572	0.178
31–40	28.57	14.29	20.00	20.95			
41–50	14.29	14.29	17.14	15.24			
51–60	17.14	14.29	5.71	12.38			
> 60	–	5.71	2.86	2.86			
Educational status							
Illiterate	48.57	45.71	31.43	41.90	112.886	0.525	0.208
Primary	40.00	34.29	42.86	39.05			
Secondary	5.71	11.43	20.00	12.38			
SSC	5.71	2.86	5.71	4.76			
HSC	–	2.86	–	0.95			
Graduation	–	2.86	–	0.95			
Occupational status							
Housewife	74.29	54.29	68.57	65.71	95.648	0.111	0.222
Day labour	5.71	5.71	14.29	8.57			
Service holder	11.43	8.57	2.86	7.62			
Fishing	8.57	31.43	14.29	18.10			
Monthly income (Tk.)							
< 5000	77.14	82.86	74.29	78.10	97.886	0.896	0.072
5000–10,000	20.00	14.29	20.00	18.10			
> 10,000	2.86	2.86	5.71	3.81			
Housing condition							
Tin shed	51.43	48.57	48.57	49.52	76.448	0.336	0.180
Thatched	45.71	37.14	45.71	42.86			
Semi-building	2.86	5.71	5.71	4.76			
Building	–	8.57	–	2.86			
Source of house							
Family income	65.71	66.67	70.59	67.62	55.771	0.573	0.118
NGOs' support	25.71	13.89	14.71	18.10			
Relief	8.57	16.67	17.65	14.29			

Women vulnerability and capacity analysis was assessed through Anderson's [32] approach. Chi-squared tests (χ^2) with a 5% level of significance were used to examine whether respondents' responses were uniformly distributed or more leaned toward particular categories of answers. Cramer's phi (φ_c) statistic [33] was used as a measure of strength of association between rows and columns in contingency tables and applied to goodness of fit of chi-squared test giving a value between 0 and +1. The φ_c statistic is defined as:

$$\varphi_c = \sqrt{\frac{\chi^2}{N(k-1)}}$$

Where, n is the number of observations and k is the number of rows or columns, whichever is the smaller.

3. Results

3.1. Basic socio-economic features of the respondents

The surveyed respondents were mainly from age group < 30 years (48.57%) followed by 31–40 years (20.95%) (χ^2 = 62.571, *df* = 4, P = 0.572, φ_c = 0.178); about 41.90% respondents were illiterate where 39.05% completed their elementary education and 12.38% completed their secondary education (χ^2 = 112.886, *df* = 5, *P* = 0.525, φ_c = 0.208). Occupationally they were housewife (65.71%) and used to catch fish fry and process dry fish (18.10%); presently they are also working as NGO workers and schoolteachers (7.62%) (χ^2 = 95.648, *df* = 3, *P* = 0.111, φ_c = 0.222) (Table 2).

The study recorded four types of living status where 78.10% respondents lived with their husband, 12.38% were the head of the household who lost their husbands in disaster, 6.67% lived with their son's family and only 1.90% lived with their fathers. Monthly income of the most of the households (78.10%) were less than Tk.[2] 5000 where only 3.81% households monthly income were more than Tk. > 10,000 (χ^2 = 97.886, *df* = 2, *P* = 0.896, φ_c = 0.072). Four types of house structures were found which include: CI sheet shed (49.52%), thatched (42.86%), semi-pucca building (4.76%) and building (2.86%) (χ^2 = 76.448, *df* = 3, P = 0.336, φ_c = 0.180) dominated by temporary structures (92.38%). Out of which 80.95% built their houses on *khas* land (government land) and the rest on their own land (19.05%). Among the surveyed households all (100%) got

[2] Tk. means Taka, Bangladeshi currency. 1USD equal to Tk. 80 as of October 2013

Table 3
Environmental hazards observed in the study area and their ranking matrix.

Parameters	Response	Respondents/village (%)				χ^2	*P*	φ_c	Frequency/year	Intensity[a]	Score[b]	Rank
		Char Padma	Char Lathimara	Boro Tengra	Total							
Cyclone												
	Yes	100	100	100	100				2	5	10	1
	No											
	No comments											
Coastal flood/tidal surge												
	Yes	88.57	91.43	88.57	89.52	149.314	0.938	0.062	2	5	10	1
	No	2.86	2.86	5.71	3.81							
	No comments	8.57	5.71	5.71	6.67							
Nor'wester												
	Yes	82.86	77.14	74.29	78.10	95.371	0.936	0.063	1	4	4	4
	No	5.71	8.57	8.57	7.62							
	No comments	11.43	14.29	17.14	14.29							
Coastline erosion												
	Yes	80.00	74.29	77.14	77.14	90.743	0.827	0.085	2	3	6	3
	No	14.29	11.43	11.43	12.38							
	No comments	5.71	14.29	11.43	10.48							
Water logging												
	Yes	40.00	34.29	37.14	37.14	19.200	0.924	0.066	1	3	3	5
	No	45.71	54.29	45.71	48.57							
	No comments	14.29	11.43	17.14	14.29							
Sand carpeting												
	Yes	68.57	74.29	82.86	75.24	82.971	0.621	0.112	2	3	6	3
	No	14.29	11.43	11.43	12.38							
	No comments	17.14	14.29	5.71	12.38							
Drought												
	Yes	94.29	91.43	91.43	92.38	164.800	0.460	0.131	2	4	8	2
	No	2.86	8.57	2.86	4.76							
	No comments	2.86	–	5.71	2.86							
Hail storm												
	Yes	71.43	68.57	60.00	66.67	52.857	0.832	0.084	1	2	2	6
	No	14.29	11.43	17.14	14.29							
	No comments	14.29	20.00	22.86	19.05							
Heavy fog and cold												
	Yes	65.71	71.43	71.43	69.52	62.114	0.681	0.105	1	3	3	5
	No	20.00	8.57	11.43	13.33							
	No comments	14.29	20.00	17.14	17.14							
Salinity intrusion												
	Yes	85.71	80.00	80.00	81.90	111.829	0.928	0.065	2	5	10	1
	No	5.71	5.71	8.57	6.67							
	No comments	8.57	14.29	11.43	11.43							

[a] Intensity code: 1-very low or no risk, 2-low, 3-medium, 4-high, 5-very high;
[b] Score: value of intensity × frequency.

some kinds of relief materials after disasters like dry foods, blanket, water purifying tablet, medicines, oral saline, etc. and 32.39% received house structures. House structures were made mainly from family income (67.62%), relief/grant fund received after disaster (14.29%) and NGOs' support under early disaster recovery (18.10%) ($\chi^2=55.771$, $df=2$, $P=0.573$, $\varphi_c=0.118$) (Table 2). For making house structures, people collect wood and bamboo from nearby Sundarbans forest following both legal and illegal means.

Findings suggest that a kind of asset vulnerability was reported which was rooted in the repeated incidence of disaster. The higher the intensity of disaster the more is the asset vulnerability; in turn, less interest for asset accumulation by the community.

3.2. Common environmental hazard in the study area

Respondents mentioned about common environmental hazards observed in the study area which include cyclone (100%), coastal flood/tidal surge (89.52%, $\chi^2=149.314$, $df=2$, $P=0.938$, $\varphi_c=0.062$) and salinity intrusion (81.90%, $\chi^2=111.829$, $df=2$, $P=0.928$, $\varphi_c=0.065$) as the most dominant among all hazards. Some 92.38% ($\chi^2=164.800$, $df=2$, $P=0.460$, $\varphi_c=0.131$) respondents ranked drought as the second most severe environmental hazards; coastline erosion (77.14%, $\chi^2=90.743$, $df=2$, $P=0.827$, $\varphi_c=0.085$) and sand carpeting (75.24%, $\chi^2=82.971$, $df=2$, $P=0.621$, $\varphi_c=0.112$) were ranked as the third most environmental hazards in the study area (Table 3).

Table 4
Primary sources of early warning of disasters (multiple responses).

Sources of early warning	Respondents/village (%)			
	Char Padma	Char Lathimara	Boro Tengra	Total
Radio	65.52	87.50	86.67	75.00
Television	6.90	12.50	23.33	13.64
Newspaper	–	8.33	20.00	9.09
Red Crescent society volunteers	89.66	95.83	100.00	89.77
Local government, NGOs	44.83	62.50	73.33	56.82
Word-of-mouth	96.55	100.00	100.00	93.18

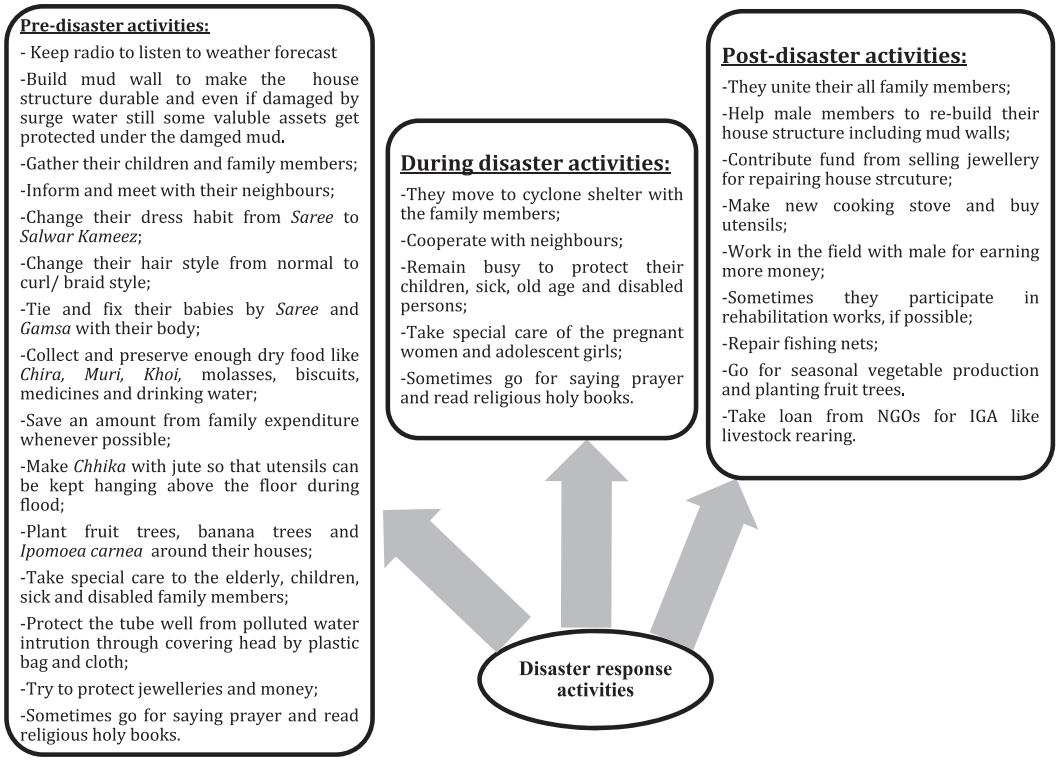

Fig. 2. Women's response at the time of pre-, during and post disastrous situation.

3.3. Source of early warning of disaster

Some 79.05% respondents mentioned that they know before about any upcoming disaster, 11.43% did not know/ heard; where 9.52% were not sure or forgotten about it. Sometimes people did not have any trust in official warnings for several reasons which include: lack of understanding of cyclone warnings, past experience about warning failure, lack of scope of earning at the shelter house, and pressure from an employer to continue fishing ignoring signal. Common sources of early warning (Table 4) include radio (75%), television (13.64%), newspapers (9.09%), Red Crescent Society volunteers (89.77%), local government and NGOs (56.82%) and word-of-mouth from neighbours or relatives (93.183%). Persons from whom first heard about upcoming disaster include family members like husband (87.62%) followed by son (4.76%), father and brother (2.86% each) plus self (1.90%). Women are, in general, dependent on male family members who take decision to go to safe places, cyclone shelters, and big strong houses or remain at home.

3.4. Disaster preparedness of women

Disasters affect life and livelihood of women whose participation were limited in its management. Immediate shelter and food arrangement were the main issues of disaster preparedness and risk for the community people. Their resources and income were limited due to many uncertainties associated with the living conditions in the coastline as they could not invest much to reduce risk. Women differ widely with men in the case of preparedness where they play a complementary rather than an independent role. It is claimed that the higher the access to information of women, the better is the preparation. Considering possible inconveniences during disaster, women used to make portable stove, pile up firewood, collect dry food like *Chira*, *Muri* and *Khoi* (each made from paddy), molasses and biscuits, essential medicines, save an amount from their family expenditure whenever possible, prepare *Chhika* (jute made reticulate bag hanging from wall or ceiling) so that utensils could be kept hanging above the floor during flood. They also plant trees specifically

Table 5
Cultural and conditional behaviour of women in pre-, during and post-disaster period.

Situation	Cultural behaviour	Conditional behaviour
Pre-disaster	• Women normally neglect the cyclone signals or remain unaware about it • Male members are not interested to take women to cyclone shelter due to insecure and no privacy environment • Due to inadequate or no information they have little/no option to discuss with the neighbours about the upcoming disaster • They try to unite and keep their children and aged family members together • Set free livestock inside the homestead • Try to protect only jewelleries and important documents	• Currently carefully consider each cyclone signals • Prepare themselves to go to cyclone shelter with other family members • Share and discuss with the neighbours about upcoming disaster • Keep closer their children, sick and aged family members • Search safe places like dam and cyclone shelter for livestock • Try their level best to protect their assets as many as possible
During disaster	Keep themselves with adolescent girls at home and sometimes move to a cyclone shelter with male family members	They carefully consider each cyclone signals and prepare themselves with family members to take shelter in the cyclone shelter
Post disaster	• Help male members in indoor activities • Repairing fishing nets • Collect water from nearby pond and tube well • Save money and other assets for the future	• Help male members in rehabilitation works; working outside home for cash earning e.g., in agricultural field, cash for work programme, etc. • Involving themselves in collection of fish fingerlings, fish processing and drying activities • Collect safe drinking and household water from far away • Less interest for savings and collecting furniture and jewelleries due to fear of any sudden disaster • Try to earn more money from homestead vegetable gardening, betel leaf cultivation and planting trees in homestead and roadside

fruit, banana and *Ipomoea carnea* around their houses as part of disaster risk reduction (DRR) approach. Women also cover tube well with plastic to prevent saline water intrusion and sometimes dig earthen hole to deposit their jewelleries and valuable documents under the soil (Fig. 2). Moreover, women also have separate cultural and conditional behaviours in pre-, during and post-disaster periods (Table 5). Presently women's disaster preparation techniques have changed to a considerable extent with learning lessons from cyclones *Sidr* and *Aila* and disaster preparedness trainings received from the NGOs.

3.5. Problems faced in the cyclone shelter

Most of the respondents mentioned that they took shelter in cyclone shelters (75.24%), stayed in houses (12.38%), school buildings (5.71%) and raised embankment/dam (6.67%) during disasters. Although they took shelter in cyclone shelters but they also mentioned several factors responsible for their unwillingness to go to cyclone shelter which include: poor road network to reach (63.81%), long distance of cyclone shelter from residence (74.29%), fear of theft (81.90%), lack of trust in signal (88.57%), fatalism (75.24%), too old to move (8.57%), and inadequate capacity of cyclone shelters (60.95%). Moreover, respondents faced several problems as a woman during taking shelter in the cyclone shelter (Table 6) such as no separate toilet and washroom facility (89.52%) (χ^2=149.200, df=2, P=0.829, φ_c=0.084), insufficient food supply (76.19%) (χ^2=87.943, df=2, P=0.700, φ_c=0.102), insufficient medicine supply (36.19%) (χ^2=5.543, df=2, P=0.402, φ_c=0.139), lack of fresh water supply (78.10%) (χ^2=95.829, df=2, P=0.837, φ_c=0.083), not enough space for livestock (86.67%) (χ^2=134.914, df=2, P=0.949, φ_c=0.059), lack of coordination among organizations (74.29%) (χ^2=80.400, df=2, P=0.693, φ_c=0.103), unfair relief distribution (77.14%) (χ^2=92.743, df=2, P=0.635, φ_c=0.110), harassment of pregnant and adolescent girls including unwelcome body touch, urges to physical touch, unwanted physical contact, taking advantage of physical proximity of a young girl, look intently at female organs (60.00%) (χ^2=34.114, df=2, P=0.564, φ_c=0.119), chance of theft (60.95%) (χ^2=43.600, df=2, P=0.722, φ_c=0.099), and not considered women's special need such as separate toilet, privacy for altering wet cloth, lactating purpose, change of sanitary napkin and washing menstrual cloth (89.52%) (χ^2=149.314, df=2, P=0.929, φ_c=0.064).

3.6. Adverse effect of disaster on women

A list of adverse effects of disasters on women has been recorded based on respondents' view (Table 7) which include: negative effect of disaster on pregnant women such as difficult to walk along muddy rural roads under stormy conditions, and delivery in the shelter houses without arrangement or medical care (38.10%; χ^2=13.086, df=2, P=0.845, φ_c=0.081), adolescent girls (25.71%; χ^2=47.543, df=2, P=0.318, φ_c=0.150) and old age women (70.48%; χ^2=65.543, df=2, P=0.612, φ_c=0.113). Disaster has negative effect on demographic family unity (42.86%; χ^2=11.371, df=2, P=0.562, φ_c=0.119), family food security (90.48%; χ^2=154.286, df=2, P=0.927, φ_c=0.065), women's occupation (87.62%; χ^2=139.600, df=2, P=0.869, φ_c=0.077), women's health (79.05%; χ^2=100.171, df=2, P=0.741, φ_c=0.097) and sexual harassment of women and adolescent girls (51.43%; χ^2=18.686, df=2, P=0.617, φ_c=0.112). Young women and adolescent girls are harassed at a

Table 6
Problems faced by women in cyclone shelter.

Parameters	Response	Respondents/village (%)				χ^2	P	φ_c
		Char Padma	Char Lathimara	Boro Tengra	Total			
No separate toilet and washroom facility								
	Yes	91.43	91.43	85.71	89.52	149.200	0.829	0.084
	No	5.71	2.86	5.71	4.76			
	No comments	2.86	5.71	8.57	5.71			
Insufficient food supply								
	Yes	71.43	82.86	74.29	76.19	87.943	0.700	0.102
	No	17.14	14.29	17.14	16.19			
	No comments	11.43	2.86	8.57	7.62			
Insufficient medicine supply								
	Yes	42.86	37.14	28.57	36.19	5.543	0.402	0.139
	No	28.57	42.86	51.43	40.95			
	No comments	28.57	20.00	20.00	22.86			
Lack of fresh water supply								
	Yes	77.14	82.86	74.29	78.10	95.829	0.837	0.083
	No	14.29	14.29	17.14	15.24			
	No comments	8.57	2.86	8.57	6.67			
Not enough space for livestock								
	Yes	85.71	88.57	85.71	86.67	134.914	0.949	0.059
	No	8.57	8.57	11.43	9.52			
	No comments	5.71	2.86	2.86	3.81			
Lack of coordination among organizations								
	Yes	71.43	71.43	80.00	74.29	80.400	0.693	0.103
	No	22.86	17.14	11.43	17.14			
	No comments	5.71	11.43	8.57	8.57			
Unfair relief distribution								
	Yes	74.29	74.29	82.86	77.14	92.743	0.635	0.110
	No	17.14	22.86	11.43	17.14			
	No comments	8.57	2.86	5.71	5.71			
Harassment of pregnant and adolescent girls								
	Yes	65.71	60.00	54.29	60.00	34.114	0.564	0.119
	No	25.71	20.00	22.86	22.86			
	No comments	8.57	20.00	22.86	17.14			
Chance of theft								
	Yes	57.14	65.71	60.00	60.95	43.600	0.722	0.099
	No	37.14	22.86	31.43	30.48			
	No comments	5.71	11.43	8.57	8.57			
Not considered women's special need								
	Yes	91.43	85.71	91.43	89.52	149.314	0.929	0.064
	No	2.86	5.71	2.86	3.81			
	No comments	5.71	8.57	5.71	6.67			

Table 7
Adverse effects of disaster on women in view of respondents.

Parameters	Response	Respondents/village (%)				χ^2	P	φ_c
		Char Padma	Char Lathimara	Boro Tengra	Total			
Effect on pregnant women								
	Yes	37.14	42.86	34.29	38.10	13.086	0.845	0.081
	No	42.86	45.71	45.71	44.76			
	No comments	20.00	11.43	20.00	17.14			
Effect on adolescent girls								
	Yes	31.43	25.71	20.00	25.71	47.543	0.318	0.150
	No	51.43	65.71	74.29	63.81			
	No comments	17.14	8.57	5.71	10.48			
Effect on old age women								
	Yes	77.14	65.71	68.57	70.48	65.543	0.612	0.113
	No	17.14	20.00	14.29	17.14			

Table 7 (*continued*)

Parameters	Response	Respondents/village (%)				χ^2	*P*	φ_c
		Char Padma	Char Lathimara	Boro Tengra	Total			
	No comments	5.71	14.29	17.14	12.38			
Impact on family unity								
	Yes	54.29	45.71	42.86	47.62	11.371	0.562	0.119
	No	31.43	25.71	37.14	31.43			
	No comments	14.29	28.57	20.00	20.95			
Family food insecurity								
	Yes	94.29	88.57	88.57	90.48	154.286	0.927	0.065
	No	2.86	5.71	5.71	4.76			
	No comments	2.86	5.71	5.71	4.76			
Impact on women occupation								
	Yes	91.43	85.71	85.71	87.62	139.600	0.869	0.077
	No	2.86	5.71	2.86	3.81			
	No comments	5.71	8.57	11.43	8.57			
Impact on women health								
	Yes	82.86	77.14	77.14	79.05	100.171	0.741	0.097
	No	11.43	20.00	14.29	15.24			
	No comments	5.71	2.86	8.57	5.71			
Sexual harassment								
	Yes	48.57	45.71	60.00	51.43	18.686	0.617	0.112
	No	28.57	37.14	28.57	31.43			
	No comments	22.86	17.14	11.43	17.14			

Table 8
Partial and full loss of women during disasters (multiple response).

Parameter	Partial loss/village (%)				Fully loss/village (%)			
	Char Padma	Char Lathimara	Boro Tengra	Total	Char Padma	Char Lathimara	Boro Tengra	Total
Life loss	8.57	2.86	2.86	4.76	11.43	2.86	2.86	5.71
Household resources	31.43	11.43	11.43	18.10	68.57	88.57	88.57	81.90
Occupation	45.71	60.00	57.14	54.29	54.29	40.00	42.86	45.71
Farm equipment	31.43	31.43	14.29	25.71	68.57	68.57	85.71	74.29
Fishing and cultivation	54.29	45.71	22.86	40.95	45.71	54.29	77.14	59.05
Life security	82.86	71.43	65.71	73.33	14.29	25.71	34.29	24.76
Education of family members	88.57	91.43	80.00	86.67	11.43	8.57	20.00	13.33
Important document	34.29	5.71	17.14	19.05	65.71	94.29	82.86	80.95
Loss of other assets	42.86	31.43	34.29	36.19	57.14	68.57	65.71	63.81
Family unity	34.29	37.14	40.00	37.14	–	–	–	–

disadvantageous situation even in normal time but during the disaster the risk goes high mainly because they get isolated, separated from other family members, does not remain under attention or observation, ask for support or become other male dependent, and remaining at physical proximity of other male members.

3.7. Loss of women due to disaster

Loss of women in disaster has been divided into two segments—partial and full loss (Table 8) where partial losses include education of their family members (86.67%), followed by life security (73.33%) and loss of homestead based occupation (54.29%). On the other hand, 81.90% respondents mentioned about full loss of their household resources followed by important/necessary documents (80.95%), farm equipments (74.29%) and loss of other assets (63.81%). A total of 11 respondents (10%) lost their family members during the disasters where among them seven were from Char Padma village, two each from Char Lathimara and Boro Tengra villages. People believe that each disaster leaves behind a miracle. Case studies showed that five respondents' family members came back miracally within one to 3 months after disasters where among them three from Char Padma village, one each from Char Lathimara and Boro Tengra villages. Those who came back to their families, they partially and/or temporarily lost their memory and did not remember the past life or the location during their missing period. Same type of miracle story also recorded by Alam [15], where the study shows that one person survived miracally after getting stuck up by a branch of a tall tree when he was floating in the rush water to Bay of Bengal where all other five members of his family died. Likewise, in another case all 13 family members including

Table 9
Common adaptation strategies involving women in the study area.

Adaptation strategy	Classification[a]			Village[b]		
	Ma	Me	Mi	CP	CL	BT
Tree plantation in heap and make drain surrounding the root		√		√	√	√
Tree plantation surrounding the pond bank and homestead to reduce affect of disaster and loss of income		√		√	√	
Enriched homestead gardening through seasonal vegetables (red amaranth, pumpkin, bean, spinach, lady's finger, green chili, and tomato) for seasonal income			√		√	√
Planting fruit tree species (papaya, banana, lemon, guava, mango, coconut, star fruit, jujube, and betel nut) to reduce affect of disaster and enhance seasonal income			√	√	√	√
Seasonal vegetable cultivation (potato, onion, garlic, watermelon, bitter gourd, cucumber, eggfruit, ginger, cauliflower, and cabbage) in the farming land for seasonal income			√		√	√
Cultivation of betel leaf in the homestead garden for subsistence income			√		√	
Cultivation of fodder grass like Napier grass (*Pennisetum purpurerum*) in the marshy land		√		√		
Collection of water hyacinth for fuel and livestock	√			√	√	
Alternative farming like sunflower, pulses, pea and maize cultivation in the cropping land		√		√	√	√
Coconut seedlings plantation along river bank to reduce wind speed affect		√		√	√	
Roadside and pond bank plantation of *Phoenix sylvestris* and *Borassus flabellifer* for sap collection and to reduce disaster affect		√		√	√	√
Involving in collection of fish fingerlings (round the year), fish processing and drying (during season)			√	√	√	
Collection of cow dung and prepare compost for crop production	√			√	√	√
Preservation of crops and vegetable seeds on a routine basis	√				√	√
Make cooking stove, collection of firewood and cow dung for cooking	√			√	√	√
Collection and selling of cotton seed	√			√		
Making fishing net		√		√		
Taken loan for livestock rearing	√				√	√
Involved with cash for work programmes	√			√	√	
Collection of drinking and cooking water from filter	√			√	√	√
Uses of medicinal plants for treatment			√	√	√	√
Use of mosquito net to prevent malaria		√		√	√	√

[a] Classification: Ma-Materials adaptation, Me-Methodical adaptation, Mi-Mixed adaptation.
[b] Village: CP-Char Padma, CL-Char Lathimara, BT-Boro Tengra.

relatives died where two persons survived when the rush water push them on the branch of a tall tree.

3.8. Coping with disaster

To improve the livelihood and enhance family income as well as to recover disaster induced losses women adapt several coping/adaptation strategies in the coastal areas of Bangladesh. Study recorded a number of adaptation strategies practiced by them to triumph over adverse impacts of disasters and climate change (Table 9). Some strategies are applied by only women while some are with the help of male family members or with the support of NGOs working in the study area.

3.9. Role of NGOs in disaster management and women empowerment

A good number of NGO has been working in the study area where most of them started their activities after cyclone *Sidr* and *Aila* with donors' support. After disasters, NGOs activities mainly focused on the first aid, rebuilding house structures, providing fresh water, extending health and sanitation facilities as well as livelihood supports with ameliorating women empowerment. About 75% of surveyed respondents are member of any NGO; and got different types of support from them which include:

- reconstruction of educational and religious institutions, cyclone shelters, roads, dams and culverts;
- supply of fishing boats and nets;
- road side strip plantation and social forestry programme through fast growing species like: *Acacia* spp., *Albizia richardiana*, etc. with involving women beneficiary;
- roadside and pond bank plantation of *Cocos nucifera*, *Phoenix sylvestris* and *Borassus flabellifer* with involving women beneficiaries;
- alternative farming like sunflower, pulses, pea and maize cultivation in the agricultural field and fodder grass cultivation involving women beneficiaries;
- salt and drought tolerant crop technology development like cultivation of salt tolerant BR-47 rice variety;
- organic fertilizer based crop production;
- vocational training for both men and women;
- distribution of motor cycle, rickshaw and rickshaw-van to the affected women family members;
- financial support for small scale business like grocery shop; and
- educational programs like pre-primary and non-formal primary programme, night school and camp programme, etc.

4. Discussion

4.1. Women in natural disaster

Women experience differential outcomes in every sector in Bangladesh particularly during natural disasters, but the problems get much more magnified in coastal and *char* (newly accredited land) areas where life is more

challenging and orthodoxy is more prominent. Women of these areas are practically house-bound and hardly participate with men outside their families [34]. Traditional subordinate position of women in the society and limited access to economic resources results to higher risk which becomes crucial during any disaster in Bangladesh [35-36]. Frequently cited risks include: high rate of mortality (48.57%), inadequate health facilities (70.48%), increase workload (88.57%), loss of livelihood opportunities (66.67%), deprivation from relief materials (82.86%), victim of sufferings e.g., loss of vital family members and assets like cattle and fishing boats, shortage of drinking water, food and medicines, domestic violence, and health hazard (73.33%) and mostly they cannot participate in any response or management activities (89.52%). Several studies [12–14,23,27,35–42] found the similar findings that in natural disasters women, the elderly, and children suffer more.

With changing environment women perceive their increased workload, which has been traditionally ascribed based on gender-based division of labour. Their achieved role in the family and community is still recognized as marginal. Study found that during disasters like cyclones and floods a lot of pressure is put on women whose responsibility is to keep family members together, caretaking for those affected by disasters, and manage food to feed them [43–44]; and women's vulnerability is further increased by the loss of male family head and/or livelihoods. During the Asian *tsunami* women who attempted to save their children could not swim well, in turn, succumbed to death [45]. In post-disaster women more likely to seek out more relief materials especially food, water and medicine for their family members but suffer from discrimination [46–48]. Similarly, in India's Tamil Nadu state, after *tsunami* it was found that elderly women were excluded from some relief materials due to mistaken assumptions that they required little food for their survival [49].

In developing countries like Bangladesh, women receive less medical support, food, physical protection, and have scanty resources and rights resulting to higher death rate [43–44,50]. They also suffer mostly because of their traditional dress—the *saree*—which limits their ability to move; normative views, and childcare responsibilities [44,47–48]. Women need more health care than male during disaster but they receive the least compared to the demand that they come to see. Female health workers remain unavailable during disaster for which they do not get required health care. Although women express more mental health problems, such as stress, depression and anxiety emanated from affect of disasters [51] but they can better cope in disaster with their flexibility—and adaptability skills—in family management [52–53]. Women had to perform all the routine works despite remaining in the most disadvantageous situation like shelter-less. They get inadequate relief materials not being considered as the main breadwinner of the family [54]. In the study area although women responded first to protect disaster affected people such as old age, children, and person with disability where male remains busy to protect assets; they were not involved in planning and management of institutional relief and rehabilitation activities due to gender discrimination.

Women from local community although the worse suffer, some of them get training on disaster preparedness and very few of them acquire some capacity to work as volunteer during disaster. Under Bangladesh Disaster Management Act 2012 a Union (lowest administrative tier) Disaster Management Committee (UDMC) is formed involving women as member where it only pays attention to emergency evacuation and rehabilitation of women, children and disabled persons. One third of the Cyclone Preparedness Programme (CPP) volunteers are women. In post-disaster programmes, especially in the recovery stage, the targeted beneficiaries are mainly women, who were more than 70% of the total beneficiaries. UNICEF trained adolescent girls to increase their swimming skills during disasters. However, women's participation and leadership are not enough in DRR field.

4.2. Women's vulnerability and recovery capacity

Women possess less physical strength for fighting with natural calamities which further downfalls them with adverse subordinate position in the society [26,42]. Socially, families or the communities rarely take note of women's views as women enjoy almost no right to take decision. They cannot apply risk reduction related skills or knowledge in real life situation because of lack of knowledge or scope of the same. Moreover, they have almost no opportunity to earn cash income; have limited control over and access to their own or family assets, in turn, cannot invest to reduce disaster induced risks. A woman's swimming, running and climbing trees are prohibited socially and therefore, they are less used to. Similar problem also faced by Sri Lankan women during *tsunami* where men easily swim and climbed trees to escape the thrush of water but women unable to do it [37]. Women cannot go to shelter leaving their houses unprotected or children unattended [55]. They protect them with others while male protect self first. A study of World Bank [27] reveals that gender-sensitive planning and preparation for early warning or response to a disaster can reduce mortality and morbidity rates as well as facilitate equitable distribution of emergency relief, improve safety conditions in shelter houses, and improve mitigation. This will help to reduce the inequity in relief distribution [56]. Gender-specific capacities of women deriving from their social roles proved to be beneficial for their whole community during disaster. With their knowledge, they can shape adaptive mechanisms in vulnerable areas [57]. IPCC [18] also noted that in Bangladesh women's traditional knowledge and skills helped their family and community to cope with natural disasters but they need to be self-confident and use networking skills for increasing recovery capacity. Likewise, male needed to be oriented on gender aspects of disaster to make them socially equipped to address any catastrophe more inclusively. A study by Fordhman et al. [58] showed that, in Honduras the Garifuna women reduce their exposure to hazards, socioeconomic vulnerability and dependence on external aid through the protection and development of their livelihood opportunities [1]. Table 10 contains women's loss and recovery capacity matrix based on field observation:

Table 10
Women's vulnerability and recovery capacity matrix.

Vulnerability	Recovery capacity	Category[a]
Physical/material		
Loss of homestead land and structures	Some were supported from Government and NGOs where others were rebuilt by self with family members	Typical
Loss of agricultural production	Taken loan and training from NGOs for cultivation of seasonal vegetables and alternative farming	Typical
Lack of basic services (education, health, safe drinking water, shelter, sanitation, electricity, and communication)	Government and NGOs provided basic services where women actively participated	Typical
Insecure sources of livelihood	Searching for more diverse source of livelihood rather than traditional ones	Transformative
Lack of access to and control over production (land, farm inputs, animals, and capital)	Taken loan from NGOs for farming, livestock rearing and buy fishing boat and agricultural equipments	Typical
Dependency on moneylenders, usurers, etc.	Doing hard work including outside home to pay back the borrowed money in time	Typical
Acute or chronic food shortage	Livestock rearing, planting fruit tree species, seasonal vegetable cultivation and alternative farming	Typical
High mortality, malnutrition and diseases	Consult with the local physicians, herbal practitioner and go to community clinic	Typical
Overexploited natural resources	Give up over-exploitation of natural resources if income generation supports are given	Transformative
Increased domestic violence and community conflicts due mental stress	Increased women's economic contribution through self-employment reduce the mental stress caused from hardship	Transformative
Social/organizational		
Weak family/kinship structures due to loss of male family members	Increased local employment opportunity for the women	Typical
Lack of leadership, initiative, organizational structures to solve problems or conflicts	Educated and employed women playing increased role to minimize these problems	Transformative
Unequal participation of women in community affairs	Most of the girls are now going to school, hopefully they will fall less into bad state	Typical
Injustice and lack of access to political processes	Education and employment of women can reduce these gaps, in turn, reduce violence against women	Transformative
Social harassment	Education, employment and formation of women group can reduce the social wretched	Transformative
Motivational/attitudinal		
Negative attitude towards change and no fighting spirit	Disaster preparedness training and education can prepare women better against disaster	Transformative
Negative beliefs/orthodoxy	Training on disaster can improve the knowledge on causes and consequences of it	Transformative
Unawareness about hazards and consequences	Awareness and disaster management related training improves knowledge about hazards and consequences	Transformative
Dependence on external support/dole-out mentality	Involving themselves in different off-farm and on-farm income generation activities	Typical

[a] Category: typical means supporting practical needs; transformative means supporting strategic interests.

4.3. *Women's gain from disaster*

Disaster changes the worldview of the people living around them as everyone feels to live together. Women significantly contribute to improve the resilience of ecosystem through plantation in and around the houses, reconstructed roads and dams, and protect the ground water from pollution by covering tube well heads before disaster. Thus, disaster not only creates despair, it also creates opportunity for them. For example, disaster open eyes of the policy-makers and investors to give fresh thought on to invest more in the coast to protect them and thereby, to protect the economy as a whole. However, some literatures also found similar results and suggest that disasters may not always have a negative effect on economic growth and development [59–61]. Those studies reported that disasters have been considered helpful to increase economic growth in the short term as well as spur positive economic growth and technological renewal in the longer term—depending on the domestic capacity of nations to rebuild and the inflow of international assistance. Women in the study area although lost life and property in disasters but also could make gain of some kind of resources for livelihood, access to work and opportunities. Women's gains from disaster are as follows:

Direct gain:
- float materials deposited to their nearest places like plank, wooden materials, CI sheets, house building materials, and coconut;
- increased float fish in the pond and ditches deposited with flash water or tidal surges; and
- submersed vegetables in the nearby agricultural field.

Indirect gain (material):
- in some fields shrimp cultivation becomes easier due to increased salinity in the field water;
- get new house structure as replacement of old thatched one from the aid-giving agencies;

- get eco-sun toilet and solar panel system;
- increased maternal and child health care services;
- enriched homestead gardening, road side and pond bank plantation and social forestry;
- alternative farming in the agricultural field and fodder grass cultivation;
- receive cattle and hen from NGOs;
- deep tube well, filter installation and ponds for rain water harvesting in each village;
- interest free loan and vocational training;
- motor cycle, rickshaw and rickshaw van for income generation purposes;
- cash for work programmes e.g., road repairing involving women.

Indirect gain (non-material/ institutional):

- development of 'Village Development Committee' involving women; and
- educational programmes through night school and camp programme for child labour.

4.4. Lessons learned from the study

Some important lessons have been learned from the disaster impacts which include:

- women tend to ask for support during evacuation, not mainly for physical reason rather more for social reasons as customarily in rural Bangladesh they cannot leave the house without husband's or other guardian's permission;
- women are treated as less resistant to or more prone to adverse impacts of natural hazard which does not apply to all as particularly young educated women are better resistant then the old, pregnant, disabled and sick one;
- affect to means of livelihood leads to affect to the food security which are taken care of by women;
- Together Everyone Avoid More (TEAM approach) during and after disaster;
- a positive relation of women employment with disaster is there;
- comprehensive disaster management can lead to more women empowerment, widening social and institutional facilities, yields more capacity and benefits from NGOs also;
- women play the higher role in protection of life and property compare to their counterpart men as because they collect most valuable assets of their houses like ornaments, documents, cash money, valuable cloths; and take care of all vulnerable members of their families;
- men normally try to save boats, fishing nets, cattle and protect house structures by fixing additional bamboo and wood or tiding with strong trees using jute rope or iron cables;
- makes one to one plan as who should take care of what and whom to protect themselves and other around them;
- plays dominant role in protecting those items which are essential for meeting up-coming crisis;
- plays dominant role in protecting the vulnerable members of the family like children and sick persons;
- plays important role in improving the resilience of ecosystem and protect the ground water from pollution.
- during post-disaster women *lead* the rehabilitation activities at home first as rehabilitation begins with women.

5. Conclusion

Women in general not only prone to adverse disaster impacts but carry forward their resilience capacity to address all miseries. They accumulate many positive impacts of disaster through land resources (agriculture, horticulture, fish farming, plantation, etc.) as women have higher dependency on land resources rather than the water resources at the coastline. Disaster has differential consequences like female experiences increased opportunity of social inclusion as it tends to promote gender equality in terms of employment, access to economic opportunities and resources. It does not mean that the disaster is an effective means of female inclusion rather it has an inverse transformative impact on women. For example, in the study area women in general were not allowed to work outside the home particularly in the farming land, but after disaster it was changed for meeting the challenge of their livelihood. This social transformation has taken place under compulsion more than emanating it from social progresses the community so far made. It also increases scope of wage work which has some kind of transformative impact on women's life including on occupational structure. There is increased evidence of development works, enhanced loan distribution or resource transfer and increased participation in formal and informal organizations like NGOs. Disaster leads the planners to follow not merely the compensatory principle but also restoration and augmentation principles which give more benefits to the low income group of the coast. Despite many crises in their life all efforts to address the adverse effect of disaster adds to certainty in their uncertain life. Planners need to persistently adhere to it as disaster is a natural course of action to destroy what we ardently nurture.

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