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ORIGINAL ARTICLE

Impacts of climatic disasters in coastal Bangladesh: why does private adaptive capacity differ?

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Abstract This paper quantitatively assesses the influences of various demographic and socio-economic factors, past adaptive behavioral factors, access to weather/climate information, and spatial/locational factors on coastal populations' perceived adaptive capacity against major impacts of hydro-meteorological disasters on their livelihood. A total of 285 respondents from three coastal villages in Bangladesh were randomly interviewed between January and April 2009. Respondents rated their perceived adaptive capacity against 25 anticipated impacts of sea-level rise (SLR)-induced events on their livelihood. By employing the principal component analysis (PCA), perceived adaptive capacity was grouped into five major categories. Then, an adaptive capacity index for each of five major impacts, namely, "infrastructure damage and disrupted mobility," "food and nutritional insecurity," "low earning and higher cost of maintenance," "loss of employment in offshore activities," and "crisis of potable water and public health risk," was prepared. How adaptive capacity against each of these major five categories of impacts differs due to the influence of various factors was assessed by employing the multivariate analysis of variance (MANOVA) technique. The MANOVAs show that age, sex, level of education, type of occupation, farmland holdings, past adaptive behavior against rainfall, salinity intrusion, freshwater crises, use of radio for weather information, and the distance of the homestead from the shoreline have varying levels of influence on respondents' perceived adaptive capacity against each of the five major categories of impacts. Others factors have moderate to limited influences. The policy implication is that specific programs, rather than a generic one-size fits all program, must be initiated for enhancement of adaptive capacity against specific impacts.

Keywords Adaptive capacity · Climate change · Hydro-meteorological events · Livelihood security · Bangladesh

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Introduction

This paper addresses why individuals' perceived adaptive capacity against various impacts of different hydro-meteorological disastrous events differs in coastal Bangladesh? A growing body of literature suggests that an accelerated sea-level rise (SLR) would amplify both the frequency and intensity of many of the disastrous events that already occur, such as cyclones, storm surges, coastal flooding, and salinity intrusion (Mirza 2002; O'Brien et al. 2006; van Aalst 2006; IPCC 2007; Wilbanks et al. 2007). These may pose a formidable challenge for natural resource-dependent communities in small island countries (SICs) and countries with low-lying deltaic coasts (Nicholls et al. 1995, 1999; Mimura 1999; Klein et al. 2001; Barnett and Adger 2003; Stern 2006; van Aalst 2006; Mimura et al. 2007). Bangladesh is one of the countries most susceptible to SLR-induced hydro-meteorological disasters, including floods, cyclones, tidal surges, and salinity intrusions (Castro Ortiz 1994; Ali and Chowdhury 1997; Huq et al. 1998; Ali 1999; Ali Khan et al. 2000; Singh et al. 2001, UNDP 2004).

The vulnerability of Bangladesh is related to its higher exposure and sensitivity and poor resiliency to an SLR and the associated disastrous events (World Bank 2000; Agrawala et al. 2003). Higher exposure is attributed to its geographic location and physiographic condition (Islam et al. 1998). For instance, it experiences heavy rainfall induced by Indian monsoons at the same time that it receives an enormous amount of glacier-melted water from northern Himalayan catchments. As the combined flow exceeds the discharge capacity of the river system, it experiences massive flooding (Singh et al. 2001). It is anticipated that the flood situation may become even worse due to an accelerated SLR, as one-fifth of the country's landmass is only one meter above the mean sea level (Nicholls et al. 1995; Islam et al. 1998). On the other hand, the Bay of Bengal, which is historically the breeding ground of Indian-ocean cyclones, would make Bangladesh more prone to cyclones and storm surges (Ali 1999). Exposure to salinity intrusion is high due to tidal influence (Huq et al. 1998).

Higher exposure to most disasters is related to complex geo-physiographical conditions, and there is little room for exposure minimization through capital-intensive measures because the country's economic base is poorly developed (World Bank 2000; Agrawala et al. 2003; CARE 2003). Therefore, it is often argued that adaptive capacity enhancement through minimization of sensitivity and enhancement of resiliency can help address these future catastrophes more than cost-intensive measures do (Pielke 1998; World Bank 2000; Khan 2008). Accordingly, many studies, for instance, Cannon (2002), CARE (2003), Choudhury et al. (2005) and Thomalla et al. (2005), have prescribed adaptive capacity enhancement; however, they have failed to place adequate focus on questions regarding, for instance, adaptive capacity enhancement for whom and against what.

Our study differs from those studies at least in two ways. First, it does not make a generalization that economically marginalized people always possess low adaptive capacity, although many earlier studies have claimed so. Second, it does not consider that individual adaptive capacity is one-dimensional, as most studies have. Our position is that an individual with low adaptive capacity against some impacts of various hydro-meteorological events may still possess higher adaptive capacity for some other dimensions of impacts. That is, this study is grounded on the premise that the adaptive capacity of an individual is multidimensional. Before initiating any program for adaptive capacity enhancement, we must know what characteristics are associated with low adaptive capacity against each broad category of impacts. This will help us, first, to avoid suggesting a "one size fits all" measure to enhance adaptive capacity. Second, it will help target individuals who have low adaptive capacity against some specific impacts with specific interventions, as opposed to a generic intervention. Therefore, it is expected that the findings will help policy makers, planners, and practitioners devise an intervention mechanism for building a resilient coastal community through enhanced adaptive capacity.

The theoretic and empiric bases of the research and the hypothesis

Actual (objective) versus perceived adaptive capacity against livelihood insecurity: a macro–micro paradox

An individual's livelihood is considered secure when the person can cope with and recover from stresses and shocks and maintain or enhance capabilities and assets both now and in the future, while not undermining the natural resources base (Scoones 1998). Livelihood insecurity in the context of climate change refers to susceptibility to the circumstance of not being able to sustain a livelihood (Adger and Winkels 2007). Circumstances that make natural resource-dependent coastal people's livelihood insecure are various hydro-meteorological disastrous events that damage agriculture, forestry, fisheries, settlements, infrastructures, and other avenues of earning and cause health hazards (Mirza 2002; Wilbanks et al. 2007; Saroar and Routray 2010a). A family's livelihood security depends on the adaptive capacity of the key members against major impacts of disasters. In other words, how intelligently its key members utilize their own capabilities and various assets, including psycho-social assets, such that the family can earn a living, meet their consumption and economic needs, cope with uncertainties, and respond to new opportunities, largely determines the family's livelihood security (Chambers and Conway 1992; Ellis 2000; Allison and Ellis 2001; de Haan and Zoomers 2005; Adger 2006; Thomalla et al. 2006; Reidsma et al. 2009). Accordingly, the livelihoods of families with better adaptive capacity against major impacts are more secure than others having low adaptive capacity.

From a micro perspective, it is widely believed that a person's adaptive capacity against livelihood insecurity is context-and hazard-specific, yet many studies have conceptualized adaptive capacity in isolation with any hazardous events. From macro perspective, they used GDP, technology use, literacy rates, health status, civil liberties, and governance, among others, as indicators of adaptive capacity for cross-country comparison (Yohe and Tol 2002; Brooks et al. 2005). Although a unitless index of a country's adaptive capacity, which was prepared from published national statistics, suggests that countries with poor socio-economic standing possess less adaptive capacity than developed countries (Hewitt 1996; Burton 1997; Smit et al. 2000; McCarthy et al. 2001; Wisner et al. 2004), this relative index has questionable importance for adaptive capacity enhancement at the micro level because, ultimately, it is the people, not the country, who suffer because of their poor adaptive capacity. Therefore, for enhancing individuals' adaptive capacity against particular impacts that make their livelihood insecure, it is more logical to assess the adaptive capacity of people, not the country.

However, assessment of individuals' actual (objective) adaptive capacity, as has been done in many studies at the country level, would lead us to the wrong conclusion, at least for three reasons. First, objective adaptive capacity of a country can be computed (for example see, Yohe and Tol 2002; Brooks et al. 2005 [who used vulnerability ranking as a reverse proxy of adaptive capacity], Haddad 2005) using some macro indicators, and this makes sense. However, for an individual whose adaptive capacity includes behavioral (or psycho-social) aspects in addition to socio-economic elements, objective adaptive capacity tells only half of the story, as it ignores behavioral elements (Grothmann and Reusswig 2006). Second, published government statistics do not often cover all necessary items required to assess individual objective adaptive capacity. Finally, even if such statistics were available, the assessment of an individual's objective adaptive capacity would arguably be conceptually problematic because such conceptualization assumes that a person with low adaptive capacity is vulnerable to every impact of disaster, and vice versa. In reality, this is not the case; one individual may possess low adaptive capacity against some impacts and a higher capacity against other impacts.

Therefore, this research, following Grothmann and Patt (2005), argues in support of perceived adaptive capacity of individuals, as this adaptive capacity duly addresses behavioral elements as well, which are not available in published government statistics. Assessment of perceived adaptive capacity is basically an individual's own appraisal of his/her *perceived adaptation efficacy* (a belief that a specific adaptive action would work) and *perceived self-efficacy* (a belief that he/she has the ability and resource, including psycho-social resources to carry out that specific adaptive action) (Grothmann and Patt 2005). While actual (objective) adaptive capacity is built on the premise of a socio-economic model only, perceived adaptive capacity is grounded in a socio-cognitive model of private adaptive response (for details, see Grothmann and Patt 2005) in addition to the socio-economic model. Use of perceived adaptive capacity against the anticipated impacts of an SLR and its associated events makes sense, because we assume that an individual may demonstrate better adaptive capacity against some impacts over other impacts. Another advantage of the use of perceived adaptive capacity is that respondents assess their adaptive capacity considering the full context, i.e., what to adapt, when to adapt, and how to adapt. In doing so, respondents compare perceived threats with perceived adaptation efficacy and self-efficacy. There exists the risk of a mismatch between perceived adaptive capacity and capacity to implement in actual [disaster] situations due to optimistic biases (e.g., unrealistic optimism, as observed by Weinstein 1989) and availability heuristics (Teversky and Kahneman 1974), as these two phenomena lead to underestimation of risk or over estimation of perceived adaptive capacity. Nonetheless, perceived adaptive capacity is considered invaluable in case of adaptation against disastrous events that threaten individuals' livelihoods (Bandura 2000) because an individual's adaptive potential largely determines the realized adaptive capacity against livelihood insecurity (Fankhauser et al. 1999; Perry 2007). Therefore, the issue of private adaptive capacity is inseparable from the issues of livelihood security (Schipper and Pelling 2006).

Determinants of private adaptive capacity and the research hypothesis

There is no one-size-fits-all indicator for measuring adaptive capacity, but some researchers, for instance, Yohe and Tol (2002) and Smithers and Smit (1997), have identified a possible set of indicators that are assumed to be useful in a global or national context rather than a local context. These indicators are related to, among other things, resources and their distribution, human capital, social capital, a risk-spreading system, information management, technological options, and institutional structure. Among these, the indicators that signify the possession of only material resources are often used for local-level adaptive capacity assessment. The argument here is that a person without these material resources can at most initiate a maladaptive response (Blaikie et al. 1994; Smithers and Smit 1997; Wisner et al. 2004; Pelling and High 2005; Thomalla et al. 2006). The importance of material resources for adaptive response is undeniable. The point is that if possession of material resources is the only way to enhance adaptive capacity, then there is nothing that can be done other than to make everyone rich, which is an elusive task (Grothmann and Patt 2005).

Only recently some scholars felt that psycho-social, behavioral, and knowledge-related factors are important for adaptive capacity assessment; they emphasize assessment of perceived adaptive capacity rather than actual (objective) or realized adaptive capacity of individuals. Due to this paradigm shift, use of climate information sources, beliefs about one's own ability to adapt, risk-experience appraisal, and past adaptive responses, for example, have appeared as important elements of perceived adaptive capacity.

Empiric evidence suggests that timely access to weather/climate information helps individuals to prepare for anticipatory adaptation against various disasters, such as tsunamis (Kurita et al. 2006), tornados (Collins and Kapucu 2008), and cyclones (Saroar and Routray 2010b). The credibility of the information source is as important as the information itself. For instance, Weber (1997) found that US farmers' adaptive response (to incorporating climate information in farming decisions) depends on whether they receive the same information from multiple sources. Similarly, distrust of information providers appeared to have a negative influence on farmers' adaptive response to a resettlement program in Mozambique (Patt and Schroter 2008). For similar reasons, no adaptive response (i.e., not switching to millet from maize) was observed among farmers in Zimbabwe (Grothmann and Patt 2005). In the same Zimbabwean context, Patt and Gwata (2002) earlier found that difficulty in understanding the climate forecast also influences farmers' adaptive response. Beliefs about one's own ability to adapt and the effectiveness of such (adaptive) responses also influence adaptive capacity. Blennow and Persson (2009), for instance, in a Swedish context found that the strength of belief in one's own adaptive capacity against climatic impacts correlates with the realized adaptive capacity of private forest owners. On the other hand, although all respondents in the USA knew that energy use contributes to climate change, half of them did not reduce energy use because of the belief that change in individual behavior would not solve the problem (lack of adaptation efficacy) (Semenza et al. 2008). Similarly, risk-experience appraisal and past adaptation experience, i.e., experience-driven knowledge (Grothmann and Patt 2005; Leiserowitz 2006), influence an individual's perceived adaptive capacity.

Another often ignored determinant that some scholars believe has influence on adaptive capacity is the spatial/location factor. Some locations, because of their geographic/morphologic characteristics, are more exposed to recurrent natural hazards (Mimura 1999; Nicholls et al. 1999; Klein et al. 2001; Tol et al. 2008; Patt et al. 2010). Individuals who have been living in these marginalized areas in a densely populated country are often the disadvantaged groups (Patt et al. 2010), who possess very little physical and financial capital, although they have a lot of adaptation experience. Apart from the above determinants, various demographic and socio-economic factors, many of which are used in human development indexes, are often counted as cross-cutting elements of adaptive capacity (Kelly and Adger 2000; Adger et al. 2003, 2007, 2009; Moser and Satterthwaite 2009). Therefore, adaptive capacity is influenced by a number of factors, some of which are contextual, while many others are generic in nature. For this research, we first hypothesize that in the SLR-induced disaster context, individual adaptive capacity against various impacts differs. Our second hypothesis is that individual adaptive capacity against various impacts is influenced differently by four groups of factors: demographic and socio-economic, adaptive behavioral, knowledge of and access to hazard/weather information, and spatial/locational aspects. Hypothesis tests would help to identify various sets of determinants that differently influence individual adaptive capacity against various types of impacts. This eventually would help target-specific determinants, such that individuals' low adaptive capacity against specific impacts might be addressed to secure the livelihood of natural resource-dependent coastal communities in Bangladesh and elsewhere in the Asia Pacific region.

Research design

Selection of study area, respondents, and survey procedure

The Bangladesh coastal zone covers 19 districts in three major regions. The Patuakhali district is one of the coastal districts most prone to an SLR and its associated events, such as coastal flooding, salinity intrusion, cyclones, and storm surges (Castro Ortiz 1994; Ahmed and Alam 1998; Huq et al. 1998; Ali 1999; Ali Khan et al. 2000; Singh et al. 2001). The "Kalapara" upazila (sub-district) of Patuakhali, which covers most parts of exposed coast along the Bay of Bengal, was purposively selected as the study area (Fig. 1). One village from each of "Dulasar," "Mithaganj," and "Nilganj" Union Parishad (UP), the lowest-tier government unit of "Kalapara," was randomly selected. Although the studied villages are within 5–15 km from the shoreline, the entire study area is nearly flat. The key considerations for selection of the study area were proneness to multiple natural hazards, susceptibility to an SLR and its associated events, proximity to the exposed coast and how representative of a typical coastal area it was in terms of the diversity of occupations. Based on the estimates provided in the National Adaptation Programme of Action of Bangladesh (GOB 2005), the experts conservatively estimate that the entire study area may experience 10–15, 20–25, and 30–40 cm inundation from an accelerated SLR by the year 2020–30, 2050–75, and 2080–2100, respectively.

The total number of families in the study area is 991. Taking 0.05 as the precision level and following Yamane (1967), the sample size was determined, which is 285 (~29% of total households). As the settlements are scattered and there are no registered identification numbers for

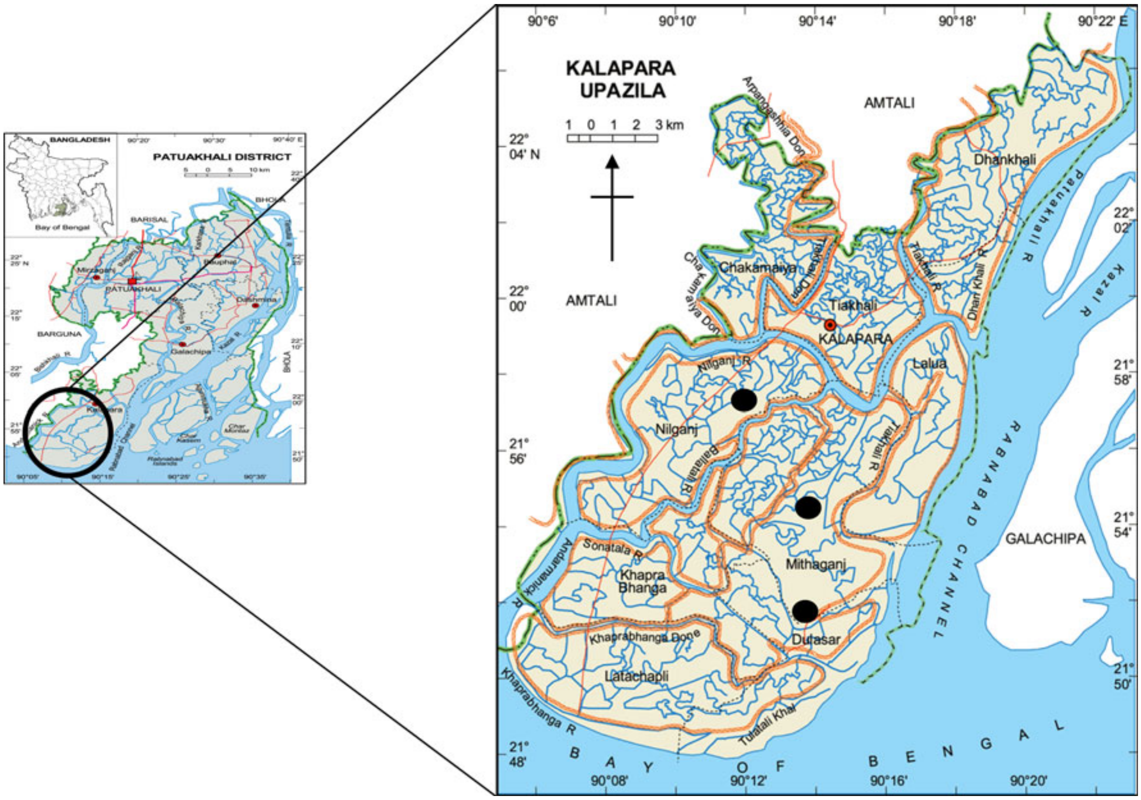

Fig. 1 Study sites (*marked with black circle*) at *Dulasar*, *Mithaganj, and Nilganj* "Union Parishad" of Kalapara Sub-district in coastal Bangladesh

households, we judiciously avoided a true random sampling. Rather, we followed a systematic random sampling, wherein every third household was selected as a sample unit. A survey was conducted during January–April 2009 using a semi-structured questionnaire. Usually, household heads were interviewed; in absence of a head of household, the most senior household member available was interviewed. The Bengali version of the questionnaire was administered, and surveyors were at liberty to explain the questions to the extent that they would not influence the respondents' replies.

Selection of method of measuring risk perception and perceived adaptive capacity

Unlike experts' technical estimates, laypersons' judgments of risk relate more to characteristics of hazards, such as catastrophic potential, fatal outcomes, and lack of control (Slovic and Weber 2002). For assessing laypersons' perceptions of risk and ability to moderate (in our study–perceived adaptive capacity) such risks, many researchers suggested a psychometric method of measurement, which we have followed here. In a psychometric approach, basically, psychophysical scaling and multivariate analysis techniques are used to produce quantitative representations of risk perceptions and risk-minimizing attitudes (in our case, a surrogate measure of perceived adaptive capacity) (Fischhoff et al. 1978; Slovic et al. 1984; Weber 2001). In doing so, a taxonomy for impacts of hazards is prepared. Respondents rate their responses against each of the listed impacts. Many of the qualitative risk characteristics (taxonomy of impacts) tend to be highly correlated with each other. Therefore, factor analysis is conducted to reduce the identified set of risk characteristics to a smaller set of higher-order factors (Slovic and Weber 2002). Then, multivariate analysis is conducted in accordance with the objective of the study and the hypothesis to be tested (for a comprehensive review, see Luce and Weber 1986 and Weber 2001).

Measuring perceived adaptive capacity against major impacts

During the pilot survey, we observed that people generally have a fair understanding of the impacts of cyclones, tidal surges, coastal inundation, and salinity intrusion on their livelihoods, yet they are unfamiliar with the phenomena of global warming, climate change, and an accelerated SLR. We gave the respondents an idea of likely scenarios of an SLR and SLR-induced hydro-meteorological disastrous events. We asked them to identify the impacts that they consider would affect their livelihood if farmlands next to their homesteads were to submerge into knee-deep water (30–40 cm), if the intensity and frequency of cyclones were to increase, and if the surge height were to increase a few meters more than it had in the past. The use of plausible climate-change scenarios to study the perceptions of people is a widely accepted method (cf. Ford et al. 2010).

To aid the respondents, following a psychometric method, a taxonomy of impacts of an SLR and its associated disasters was presented to the respondents. Such a taxonomy of impacts was prepared from a review of climate literature that focuses globally (see Smith 1997; IPCC 2001; van Aalst 2006; Wilbanks et al. 2007) as well as regionally on the Asia Pacific realm (see Twigg and Bhatt 1998; Luna 2001; Choudhury et al. 2005; Allen 2006; GOB 2006, 2008; De Silva and Yamao 2007). Respondents were asked to rate their perceived adaptive capacity against each of these 25 impacts on a simple 3-point scale (low to high), giving due consideration to the following aspects.

1. Adaptive behaviors: whether they possess past adaptation experiences and can utilize them;
2. Disposition of economic resources: whether they can afford the cost of adaptive response;
3. Human/cultural capital: whether they have an understanding of the benefit of adaptive response and the possible harm of a maladaptive/non-response;
4. Social capital: whether they have a strong network, bonding or social ties that can be useful to initiate an adaptive response;
5. Informational resources: whether they have channels of climate information that might help them to initiate an adaptive response;
6. Technological options: whether they have both modern and indigenous knowledge and technologies to initiate an adaptive response;
7. Institutional structures: whether they have easy access to local institutions that they believe would help to form an adaptive response.

To classify their responses in 25 categories into a few major workable/functional categories, principal component analysis (PCA) was conducted. The PCA method of factor analysis is preferred because it brings elements with maximum correlation into the same group. To determine the number of broad categories of impacts, the Kaiser criterion, i.e., only factors/components with eigenvalues >1, was followed. To avoid collinearity or multicollinearity (i.e., $r > 0.80$), a situation in which a single factor (here, impact) groups into two or more broad categories (of impacts) simultaneously, the Varimax (orthogonal) rotation was performed (Hair et al. 2006). Therefore, each of the 25 impacts was grouped into only one of the five broad categories of impacts that PCA returned. These five broad categories of impacts explain 78% of the variance of the construct *perceived adaptive capacity* against the impacts of hydro-meteorological disasters on livelihood security (Table 1).

A closer examination of each of the five impacts that heavily load (see boldface italic r values in Table 1) under the first component can be termed *adaptive capacity against infrastructure damage and disrupted mobility*. In the same way, the second group, which constitutes six impacts, can be termed *adaptive capacity against food and nutritional insecurity*. The third group perhaps relates to *adaptive capacity against low earning and higher maintenance cost*, which includes seven impacts. The fourth group, *adaptive capacity against loss of employment in offshore activities,* includes four impacts. The fifth group, which includes three impacts, can be termed *adaptive capacity against crisis of potable water and public health risk*. Our factor analysis is statistically valid because the value of the determinant of the correlation matrix was found to greater than zero, the Kaiser–Meyer–Olkin value for sampling adequacy was found to be 0.76 (0.60 and above is acceptable), the Bartlett's test of sphericity was significant at $p < 0.0001$, and the average communality was >0.500 (for a comprehensive review of these criteria, see Field 2005; George and Mallery 2006; and Hair et al. 2006).

Construction of perceived adaptive capacity index

To test our research hypotheses, we first assess whether perceived adaptive capacity against each of the major five groups of impacts (identified through PCA) differs significantly among the respondents; second, we identify the determinants that cause such differences. Because we have to address five dependent variables (e.g., the adaptive capacity against major five groups of impacts) simultaneously, we preferred to use Multivariate Analysis of Variance (MANOVA) instead of five separate univariate analyses. To fulfill the basic requirements of the application of MANOVA (i.e., interval-dependent variables), five separate indexes were prepared for the five groups of adaptive capacity of each respondent. Because adaptive capacity against each of the 25 impacts was measured on the same scale (1–3), it was not necessary to standardize the scores to prepare each of the five major adaptive capacity indexes. Therefore, following the balanced weighted average approach of Sullivan (2002), each of the five adaptive capacity indexes (ACI) was prepared using the formula stated below (for a detailed illustration of a similar formula, see Hahn et al. 2009).

$$ACI_{mg} = \frac{\sum_{i=1}^{n} Vi}{n} \quad (1)$$

Table 1 Rotated factor loading matrix [extraction method: principal component analysis; rotation method: varimax with Kaiser normalization (rotation converged at 14th iteration)] of PCA, which has grouped respondent's perceived adaptive capacity against 25 specific impacts under five major impacts on livelihood security

Variable: perceived adaptive capacity against specific impacts	Factors (major categories of impact)				
	1	2	3	4	5
Damage of road infrastructure	***0.90***				
Difficulty in carrying goods and commodities	***0.90***				
Damage of social physical infrastructure, e.g., market, school,	***0.89***				
Difficulty in physical mobility	***0.88***				
Limited supply and stock of foodstuff in the market	***0.67***				
Difficulty in animal/poultry husbandry		***0.81***			
Seasonal shortage of fodder		***0.77***	−0.39		
Complete harvest failure	−0.46	***0.74***			
Degradation of pastureland		***0.73***	−0.47		
Increase cost of agricultural production	0.33	***0.71***	−0.34		
Loss of crop production	−0.57	***0.69***			
Damage of stock of food, biomass fuel, and fodder		−0.47	***0.75***		
Physical damage of settlement		−0.45	***0.74***		
Decrease number of earning/productive day			***0.72***	0.36	
Cost of maintenance/rebuilding of private infrastructure		−0.38	***0.71***		
Over bank flow of fishponds/fish farm			***−0.67***		
Fluctuation/decline in wage rate	−0.54		***0.61***		
Limited scope of festival and social gathering			***−0.40***		
Higher risk in offshore fishing				***0.93***	
Difficulty in preserving fish				***0.91***	
Increase number of non-fishing day				***0.90***	
Decrease in catch per go				***0.90***	
Spread of contaminated water					***0.91***
Prevalence of waterborne diseases					***0.88***
Lack of saline-free fresh water for drinking	−0.43	−0.32			***0.54***
Variance (%)	***21.48***	***16.79***	***15.85***	***15.72***	***8.09***
Cumulative variance (%)	***21.48***	***38.26***	***54.12***	***69.83***	***77.92***

Bold Italicized value corresponding to adaptive capacity against a specific impact falls under the same factor (i.e., adaptive capacity against a major group of impacts)

where ACI_{mg} = adaptive capacity against one of the five major groups of impacts, Vi represents the adaptive capacity scores against specific impacts that make up the respective major groups of adaptive capacity, and n is the total number of impacts that constitute that particular major group/category of impacts. Literally, ACI_{mg} is the arithmetic mean of the scores of adaptive capacity against respective impacts that constitute a particular group of impacts (among the five major groups). Finally, $\sum_{i=1}^{n} Vi$ is the sum of perceived adaptive capacity scores against i number of impacts (that fall under a major impact category).

For illustrative purposes, let us consider the index of adaptive capacity against the impacts related to a *crisis of potable water and public health risk* (i.e., the fifth major group of impacts identified through PCA: Table 1). This major impact includes three individual impacts: "spread of contaminated water," "prevalence of waterborne diseases," and "lack of saline-free water." Therefore, for a particular respondent (out of a total of 285), the ACI against the "crisis of potable water and public health risk" = $\sum$(adaptive capacity score against spread of contaminated water + adaptive capacity score against prevalence of waterborne diseases + adaptive capacity score against lack of saline-free water)/3. Each of these five indexes (continuous/interval variable) of adaptive capacity is used as a dependent variable in MANOVA in later sections of this article (see "Result and discussion" section).

Table 2 Levene's test for homogeneity of variances and test of normality

Dependent variables: adaptive capacity	Value of $F(281, 3)$	Sig.	Skewness	Kurtosis
Against the impacts related to infrastructure damage and disrupted mobility	0.323	0.973	0.30	−1.05
Against the impacts related to food and nutritional security	11.954	0.031	−0.16	−1.53
Against the impacts related to low earning and higher cost of maintenance	2.524	0.244	0.62	−0.93
Against the impacts related to loss of employment in offshore activities	1.944	0.327	−0.74	−1.26
Against the impacts related to crisis of potable water and public health risk	1.765	0.363	0.43	−0.39

Result and discussion

Determinant of adaptive capacity: model specification for MANOVA

To test our first hypothesis—if individual's adaptive capacity against various impacts differs significantly—and our second hypothesis—whether such differences are due to the influence of demographic and socio-economic factors, past adaptive behavioral factors, access to climate/weather information, and spatial/locational attributes—a total of 22 variables were identified and used as independent variables in the MANOVA procedure. Among these 22 variables, 11 are demographic and socio-economic factors, four are past adaptive behavioral factors, four are related to access to climate/weather information, and the remaining three are related to location/spatial aspects. Most independent variables are categorical or binary coded (following Hardy and Bryman 2004); they were used as fixed factors in MANOVA. Several interval variables, such as education, income, amount of farmland holdings, and distance from the shoreline, which are believed to have influence on adaptive capacity, were categorized into a few workable categories to use in MANOVA as fixed factors rather than as controlling variables in a MANCOVA model (see Table 4).

Usually, the result of MANOVA is considered robust if the assumptions of categorical independent variables, continuous/interval-dependent variables, normal distribution of dependent variables, and homogeneity of variances (or covariances) are met. In our case, the first two assumptions are met. The Shapiro–Wilk test for normality showed that the results are significant (at $p < 0.05$), meaning the dependent variables are not normally distributed (the Kolmogorov–Smirnov test was not conducted, as the sample size was relatively small, i.e., less than 2,000). However, the skewness and kurtosis are almost within ± 1 (Table 2) for all five dependent variables, which means the data are near normal, even with a conservative estimate (because some researchers consider a near normal range to be ± 2). Moreover, neither of the dependent variables have too many outliers (i.e., extreme values at both ends). Near normal data that do not have too many outliers are used in MANOVA if conservative multivariate statistics, such as Pillai's trace, are used (Bryman and Cramer 2001; Hair et al. 2006; Garson 2009). Because we made a compromise with having perfectly normal data, we could not use the Box M test or Bartlett's test of sphericity (as these two tests are extremely sensitive to normality) to test our last assumption–homogeneity of variance. Instead, we used Levene's test at a level of 0.05, as suggested by Hair et al. (2006).

The Levene test was found to be insignificant for four out of five dependent variables (Table 2), meaning we violated the assumption of homogeneity of variance for only one variable. Almost all (four out of five) dependent variables met the assumption of homogeneity of variance across groups of independent variables; therefore, for the post hoc test of the MANOVA, we used a Bonferroni-corrected test rather than Tamhane's T2 test. In fact, to determine the exact nature of differences in dependent variables for each explanatory/independent variable in MANOVA as a post hoc test, a univariate pair-wise comparison was made. Here, we have applied the Bonferroni correction at the $p = 0.001$ level to reduce the risk of making a type-I error (i.e., assuming a difference exists when it actually does not) (Hair et al. 2006).

The overall MANOVA result shows that among the 11 demographic and socio-economic factors, Pillai's trace statistics are significant for eight factors: age [$F(10, 508) = 2.37$, $p < 0.01$], sex [$F(5, 253) = 2.27$, $p < 0.05$], education [$F(10, 508) = 1.86$, $p < 0.05$], occupation [F(5, 253 = 28.13, $p < 0.001$], landholding [$F(15, 765) = 6.06$, $p < 0.001$], membership status [$F(5, 253) = 3.52$, $p < 0.01$], assistance from relatives [$F(5, 253) = 2.85$, $p < 0.05$], and income poverty level [$F(5, 253) = 10.30$, $p < 0.001$]. Among past adaptive behavioral factors, Pillai's trace statistics are significant for rainfall [$F(5, 253) = 4.71$, $p < 0.001$], salinity intrusion [$F(5, 253) = 2.12$, $p < 0.001$], and fresh water crisis [$F(5, 253) = 2.27.85$, $p < 0.05$]. Similarly, among the four accessible weather/climate information factors, this statistic is significant for radio [$F(5, 253) = 2.32$, $p < 0.05$]. Finally, among the spatial/locational factors, Pillai's trace statistics are significant for distance from shoreline [$F(10, 508) = 1.91$, $p < 0.05$] and accessibility to safe shelter [$F(5, 253) = 2.85$, $p < 0.05$] (Table 3). Significant Pillai's trace statistics support our

Table 3 MANOVA statistics show the model validity of four groups of factors that significantly influence the respondents' perceived adaptive capacity against five major categories of impacts of climatic disasters on their livelihood

Demographic and socio-economic factors	Pillai's trace statistic			Adaptive behavioral factors	Pillai's trace statistic			Access to climate/weather information	Pillai's trace statistic			Spatial/locational factors	Pillai's trace statistic		
	F(hdf, edf)[a]	Sig.	Partial η^2 (power)[b]		*F*(hdf, edf)[a]	Sig.	Partial η^2 (power)[b]		*F*(hdf, edf)[a]	Sig.	Partial η^2 (power)[b]		*F*(hdf, edf)[a]	Sig.	Partial η^2 (power)
Age	2.37** (10, 508)	0.009	0.05 (0.94)	Rainfall	4.71*** (5, 253)	0.000	0.09 (0.98)	Radio	2.32* (5, 253)	0.044	0.04 (0.74)	Distance from coast	1.91* (10, 508)	0.041	0.04 (0.87)
Sex	2.27* (5, 253)	0.048	0.04 (0.73)	Flood	2.12 (5, 253)	0.064	0.04 (0.70)	Television	0.66 (5, 253)	0.653	0.01 (0.24)	Change of settlement	0.60 (5, 253)	0.701	0.01 (0.22)
Education	1.858* (10, 508)	0.05	0.04 (0.85)	Salinity intrusion	14.52*** (5, 253)	0.000	0.22 (1.00)	Peer network	0.91 (5, 253)	0.477	0.02 (0.32)	Accessibility to safe shelter	2.60* (5, 253)	0.026	0.05 (0.80)
Occupation	28.13*** (5, 253)	0.000	0.36 (1.00)	Fresh water crisis	2.27* (5, 253)	0.048	0.04 (0.73)	Official contact	1.30 (5, 253)	0.264	0.03 (0.46)				
Landholding	6.06*** (15, 765)	0.000	0.11 (1.00)												
Membership status	3.52** (5, 253)	0.004	0.07 (0.91)												
Assistance from relative	2.85* (5, 253)	0.016	0.05 (0.84)												
Income poverty level	10.30*** (5, 253)	0.000	0.17 (1.00)												
Loss of income/earning day	0.88 (5, 253)	0.494	0.02 (0.31)												
Beneficiary of social safety nets	1.29 (5, 253)	0.267	0.03 (0.46)												
Post disaster relief	0.98 (5, 253)	0.431	0.02 (0.35)												

* Significant at 0.05 level; ** significant at 0.01 level; *** significant at 0.001 level

[a] *hdf* Hypothesis degree of freedom, *edf* error degree of freedom, total responses = 285

[b] In parenthesis power is presented: 0.80 and above power indicates higher strength of relationship; partial η^2 (eta square) explains the percent of variance: the larger the partial η^2 (eta square) the higher the influence (dominant factor)

first hypothesis, i.e., adaptive capacity against all five major groups of impacts (dependent variables) differs simultaneously due to the influence of the above-cited four groups of factors (independent variables). Next, we were interested in what factors are significantly associated with low adaptive capacity against each of the five major groups of impacts. This is presented in the following sections.

Why does adaptive capacity against damaged infrastructure and disrupted mobility differ?

Table 4 reports that respondents' perceived adaptive capacity against the impacts that relate to infrastructure damage and disrupted mobility is significantly influenced by the level of education [$F(2, 257) = 3.12$, $p < 0.05$], type of occupation [$F(1, 257) = 71.33$, $p < 0.001$], farmland holdings [$F(3, 257) = 5.99$, $p < 0.001$], level of income poverty [$F(1, 257) = 12.09$, $p < 0.001$], use of radio [$F(1, 257) = 4.53$, $p < 0.05$], and accessibility to safe shelter [$F(1, 257) = 10.09$, $p < 0.01$]. However, partial η^2 (eta square–analogous to r^2 in a regression model) and power (indicates the strength of association) analysis revealed that occupational engagement (partial $\eta^2 = 0.22$) is the most dominant factor, followed by landholdings (partial $\eta^2 = 0.07$), level of income poverty (partial $\eta^2 = 0.05$), level of education (partial $\eta^2 = 0.02$), and habit of radio use (partial $\eta^2 = 0.02$). Furthermore, results from post hoc analysis (Table 5) show that in this case, perceived adaptive capacity is significantly higher among illiterate respondents than their educated counterparts. Agricultural and allied occupational groups, such as peasant farmers, sharecroppers, day laborers, and fishermen, possess significantly higher perceived adaptive capacity than individuals engaged in non-agricultural occupations. Similarly, landless individuals possess significantly higher adaptive capacity in this regard than those having varying amounts of landholdings. Likewise, individuals who live below the \$2 poverty line possess significantly higher perceived adaptive capacity against the impacts that relate to infrastructure damage and disrupted mobility than individuals above \$2 poverty line.

Overall, perceived adaptive capacity against the impacts that relate to infrastructure damage and disrupted mobility decrease with a higher level of socio-economic standing. This finding is somewhat different from conventional belief. There can be several possible explanations. First, people of poor socio-economic standing (usually characterized by low levels of education, little landholdings, low incomes, and agricultural-subsistence occupations) hardly care about mobility problems resulting from disastrous event such as coastal flooding and salinity intrusion, as they are used to these. In fact, they use country boats or banana-trunk rafts throughout the period of inundation, as their sphere of physical mobility is limited (Martin and Taher 2001). Therefore, they consider themselves sufficiently capable of overcoming potential problems of infrastructure damage and disrupted mobility in the same ways as they did in the past. Second, individuals of higher socio-economic standing (usually characterized by high levels of education, large landholdings, high incomes, and non-agricultural occupations, such as business, petty trade, transport work, and NGO work) are used to means of transport that include bicycles, motorcycles, and private cars in addition to public buses, which cannot operate smoothly during disasters. Because educated individuals, due to the nature of their jobs, are less exposed to harsh environmental conditions, their adaptive capacity against infrastructure damage and disrupted mobility is low. Hence, it is reasonable to conclude that individuals of higher socio-economic standing, with a large sphere of physical mobility, are rather afraid of damage to infrastructure and disrupted mobility. These findings offer a few lessons. First, marginalized people (i.e., people with poor socio-economic standing) would not always be the primary victims of climate-related impacts, as they are usually thought to be. In fact, they can cope and adapt to certain situations, such as impacts related to infrastructure damage and disrupted mobility, better than people of high socioeconomic standing. Second, demographic and socio-economic attributes of individuals are the key determinants of individual perceived adaptive capacity against infrastructure damage and disrupted mobility.

Why does perceived adaptive capacity against food and nutritional security differ?

Respondents' perceived adaptive capacity against the impacts that relate to food and nutritional security is significantly affected by their respective occupational engagements [$F(1, 257) = 31.64$, $p < 0.001$], farmland holdings [$F(3, 257) = 30.83$, $p < 0.001$], memberships in social organizations [$F(1, 257) = 10.04$, $p < 0.01$], past adaptive behavior against rainfall [$F(1, 257) = 8.62$, $p < 0.01$], salinity intrusion [$F(1, 257) = 63.69$, $p < 0.001$], and fresh water crises [$F(1, 257) = 4.86, p < 0.05$]. However, partial η^2 (eta square) and power analysis show that landholding has the strongest influence (partial $\eta^2 = 0.27$), followed by individuals' past adaptive behavior against salinity intrusion (partial $\eta^2 = 0.20$), occupational engagement (partial $\eta^2 = 0.11$), and social membership (partial $\eta^2 = 0.04$). All other factors related to access to climate/weather information, and spatial/locational aspects of population settlements do not significantly affect the perceived adaptive capacity against impacts related to food and nutritional security (Table 4).

Further post hoc analysis revealed that agricultural and allied occupational groups, such as peasant farmers,

Table 4 MANOVA model shows the level of influence of significant factors on respondents' perceived adaptive capacity against five major categories of impacts of climatic disasters on their livelihood

	Perceived adaptive capacity against infrastructure damage and disrupted mobility			Perceived adaptive capacity against food and nutritional security			Perceived adaptive capacity against low earning and higher maintenance cost			Perceived adaptive capacity against loss of employment in offshore activities			Perceived adaptive capacity against crisis of potable water and public health risk		
	F(hdf, edf)[a]	Sig.	Partial η^2 (power)[b]	*F*(hdf, edf)[a]	Sig.	Partial η^2 (power)[b]	*F*(hdf, edf)[a]	Sig.	Partial η^2 (power)[b]	*F*(hdf, edf)[a]	Sig.	Partial η^2 (power)[b]	*F*(hdf, edf)[a]	Sig.	Partial η^2 (power)[b]
Demographic and socio-economic factors															
Age	1.05 (2, 257)	0.353	0.01 (0.23)	0.69 (2, 257)	0.503	0.01 (0.17)	1.48 (2, 257)	0.229	0.01 (0.32)	5.06** (2, 257)	0.007	0.04 (0.82)	4.00* (2, 257)	0.02	0.03 (0.71)
Sex	2.07 (1, 257)	0.152	0.01 (0.30)	0.61 (1, 257)	0.434	0.00 (0.12)	3.96* (1, 257)	0.048	0.02 (0.51)	0.40 (1, 257)	0.527	0.00 (0.10)	4.65* (1, 257)	0.032	0.02 (0.57)
Education	3.12* (2, 257)	0.046	0.02 (0.60)	0.28 (2, 257)	0.757	0.00 (0.09)	3.44* (2, 257)	0.033	0.03 (0.64)	0.15 (2, 257)	0.864	0.00 (0.07)	1.38 (2, 257)	0.254	0.01 (0.30)
Occupation	71.33*** (1, 257)	0.000	0.22 (1.00)	31.64*** (1, 257)	0.000	0.11 (1.00)	7.26** (1, 257)	0.008	0.03 (0.77)	14.25*** (1, 257)	0.000	0.05 (0.96)	0.23 (1, 257)	0.632	0.00 (0.08)
Landholding	5.99*** (3, 257)	0.001	0.07 (0.96)	30.83*** (3, 257)	0.000	0.27 (1.00)	9.87*** (3, 257)	0.000	0.10 (1.00)	2.68* (3, 257)	0.047	0.03 (0.65)	1.50 (3, 257)	0.216	0.02 (0.39)
Membership status	2.32 (1, 257)	0.129	0.01 (0.33)	10.04** (1, 257)	0.002	0.04 (0.88)	3.23 (1, 257)	0.073	0.01 (0.43)	2.75 (1, 257)	0.099	0.01 (0.38)	5.25* (1, 257)	0.023	0.02 (0.63)
Assistance from relative	0.01 (1, 257)	0.932	0.00 (0.05)	1.88 (1, 257)	0.171	0.01 (0.28)	0.92 (1, 257)	0.339	0.00 (0.16)	12.18*** (1, 257)	0.001	0.05 (0.94)	0.50 (1, 257)	0.48	0.00 (0.11)
Income poverty level	12.09*** (1, 257)	0.001	0.05 (0.98)	0.70 (1, 257)	0.403	0.00 (0.13)	3.46 (1, 257)	0.064	0.01 (0.46)	2.17 (1, 257)	0.142	0.01 (0.31)	38.35*** (1, 257)	0.000	0.13 (1.00)
Loss of income/ earning day	2.46 (1, 257)	0.118	0.01 (0.35)	0.65 (1, 257)	0.422	0.00 (0.13)	0.30 (1, 257)	0.587	0.00 (0.08)	0.01 (1, 257)	0.919	0.00 (0.05)	0.47 (1, 257)	0.494	0.00 (0.11)
Beneficiary of social safety nets	0.05 (1, 257)	0.826	0.00 (0.06)	1.04 (1, 257)	0.309	0.00 (0.17)	0.23 (1, 257)	0.63	0.00 (0.08)	2.55 (1, 257)	0.112	0.01 (0.36)	2.05 (1, 257)	0.153	0.01 (0.30)
Post disaster relief	0.86 (1, 257)	0.354	0.00 (0.15)	0.18 (1, 257)	0.668	0.00 (0.07)	0.06 (1, 257)	0.802	0.00 (0.06)	0.28 (1, 257)	0.596	0.00 (0.08)	3.61 (1, 257)	0.059	0.01 (0.47)
Adaptive behavioral factors															
Rainfall	0.50 (1, 257)	0.48	0.00 (0.11)	8.62** (1, 257)	0.004	0.03 (0.83)	2.18 (1, 257)	0.142	0.01 (0.31)	7.59** (1, 257)	0.006	0.03 (0.78)	9.66** (1, 257)	0.002	0.04 (0.87)
Flood	0.25 (1, 257)	0.621	0.00 (0.08)	2.23 (1, 257)	0.136	0.01 (0.32)	0.00 (1, 257)	0.995	0.00 (0.05)	5.81* (1, 257)	0.017	0.02 (0.67)	1.94 (1, 257)	0.165	0.01 (0.28)
Salinity intrusion	0.65 (1, 257)	0.42	0.00 (0.13)	63.69*** (1, 257)	0.000	0.20 (1.00)	2.16 (1, 257)	0.143	0.01 (0.31)	9.80** (1, 257)	0.002	0.04 (0.88)	0.92 (1, 257)	0.339	0.00 (0.16)

Table 4 continued

	Perceived adaptive capacity against infrastructure damage and disrupted mobility			Perceived adaptive capacity against food and nutritional security			Perceived adaptive capacity against low earning and higher maintenance cost			Perceived adaptive capacity against loss of employment in offshore activities			Perceived adaptive capacity against crisis of potable water and public health risk		
	F(hdf, edf)[a]	Sig.	Partial η^2 (power)[b]	*F*(hdf, edf)[a]	Sig.	Partial η^2 (power)[b]	*F*(hdf, edf)[a]	Sig.	Partial η^2 (power)[b]	*F*(hdf, edf)[a]	Sig.	Partial η^2 (power)[b]	*F*(hdf, edf)[a]	Sig.	Partial η^2 (power)[b]
Fresh water crisis	0.85 (1, 257)	0.359	0.00 (0.15)	4.86* (1, 257)	0.028	0.02 (0.59)	0.00 (1, 257)	0.959	0.00 (0.05)	4.96* (1, 257)	0.027	0.02 (0.60)	0.01 (1, 257)	0.936	0.00 (0.05)
Access to climate/weather information															
Radio	4.53* (1, 257)	0.034	0.02 (0.56)	0.01 (1, 257)	0.945	0.00 (0.05)	0.27 (1, 257)	0.604	0.00 (0.08)	4.91* (1, 257)	0.028	0.02 (0.60)	0.06 (1, 257)	0.804	0.00 (0.06)
Television	0.60 (1, 257)	0.44	0.00 (0.12)	0.70 (1, 257)	0.402	0.00 (0.13)	0.42 (1, 257)	0.516	0.00 (0.10)	0.48 (1, 257)	0.489	0.00 (0.11)	0.21 (1, 257)	0.649	0.00 (0.07)
Peer network	0.97 (1, 257)	0.325	0.00 (0.17)	0.85 (1, 257)	0.359	0.00 (0.15)	0.44 (1, 257)	0.509	0.00 (0.10)	1.13 (1, 257)	0.288	0.00 (0.19)	0.08 (1, 257)	0.775	0.00 (0.06)
Official contact	0.18 (1, 257)	0.674	0.00 (0.07)	0.00 (1, 257)	0.963	0.00 (0.05)	1.01 (1, 257)	0.316	0.00 (0.17)	0.51 (1, 257)	0.474	0.00 (0.11)	4.44* (1, 257)	0.036	0.02 (0.56)
Spatial/locational factors															
Distance from coast	0.07 (2, 257)	0.931	0.00 (0.06)	0.19 (2, 257)	0.824	0.00 (0.08)	2.15 (2, 257)	0.119	0.02 (0.44)	4.99** (2, 257)	0.008	0.04 (0.81)	1.89 (2, 257)	0.154	0.01 (0.39)
Change of settlement	0.82 (1, 257)	0.367	0.00 (0.15)	0.00 (1, 257)	0.996	0.00 (0.05)	0.68 (1, 257)	0.411	0.00 (0.13)	0.00 (1, 257)	0.971	0.00 (0.05)	0.92 (1, 257)	0.338	0.00 (0.16)
Accessibility to safe shelter	10.09** (1, 257)	0.002	0.04 (0.89)	0.01 (1, 257)	0.921	0.00 (0.05)	0.15 (1, 257)	0.703	0.00 (0.07)	0.02 (1, 257)	0.883	0.00 (0.05)	2.26 (1, 257)	0.134	0.01 (0.32)

* Significant at 0.05 level; ** significant at 0.01 level; *** significant at 0.001 level

[a] *hdf* Hypothesis degree of freedom, *edf* error degree of freedom, total responses = 285

[b] In parenthesis power is presented: 0.80 and above power indicates higher strength of relationship; partial η^2 (eta square) explains the percent of variance: the larger the partial η^2 (eta square) the higher the influence (dominant factor)

Table 5 MANOVA model shows the characteristics of respondents having varying levels of perceived adaptive capacity against five major categories of impacts of climatic disasters on their livelihood

Factors	Process of comparison	Reference (I) versus comparison (J) groups	Mean differences in perceived adaptive capacity against impacts related to									
			Infrastructure damage and disrupted mobility		Food and nutritional security		Low earning and higher cost of maintenance		Loss of employment in offshore activities		Crisis of potable water and public health risk	
			(I-Ji)[b]	Sig.	(I-Ji)[b]	Sig.	(I-Ji)[b]	Sig.	(I-Ji)[b]	Sig.	(I-Ji)[b]	Sig.
Demographic and socio-economic factors[a]												
Age: 3 levels 1. Below 35: Young 2. 35–50: middle age 3. 50 and above: older	First, young respondents' mean adaptive capacity is compared with that of other 2 age groups	Young (I) versus Middle age (J1)	n/a[c]		n/a[c]		n/a[c]		−0.04	1.00	0.09	1.00
		Young (I) versus Older (J2)	n/a		n/a		n/a		−0.36*	0.054	0.28*	0.038
	Second, middle-aged respondents' mean adaptive capacity is compared with that of older	Middle age (I) versus older (J2)	n/a		n/a		n/a		−0.32**	0.009	0.18	0.059
Sex: 2 levels 1. Male 2. Female	Male respondents' mean adaptive capacity is compared with that of female	Male (I) versus female (J1)	n/a		n/a		−0.08*	0.04	n/a[c]		−0.13*	0.03
Education: 3 levels 1. Illiterate 2. Up to secondary 3. Tertiary	First illiterate respondents' mean adaptive capacity is compared with that of other 2 educated groups	Illiterate (I) versus educated up to secondary level (J1)	0.13	0.07	n/a		0.003	1.00	n/a		n/a[c]	
		Illiterate (I) versus educated up to tertiary level (J2)	0.13	0.15	n/a		−0.16	0.06	n/a		n/a	
	Second, mean adaptive capacity of secondary level educated respondents is compared with that of tertiary level graduates	Up to secondary (I) versus tertiary level (J2)	0.001	1.00	n/a		−0.16*	0.05	n/a		n/a	
Occupation: 2 levels 1. Agriculture and allied 2. Non-agriculture and similar	Mean adaptive capacity of respondents engaged in agriculture and allied activities is compared with that of other respondents engaged in non-agricultural occupations	Agriculture and allied (I) versus non-agriculture and similar (J1)	0.50***	0.000	−.39***	0.000	0.16**	0.008	−0.44***	0.000	n/a	
Landholding: 4 levels 1. Landless 2. Functionally landless (land <0.20 ha) 3. Peasant farmer (land 0.20 to 1 ha) 4. Large farmer/holding (land > 1 ha)	First, landless respondents' mean adaptive capacity is compared with that of other 3 classes of respondents having farmland	Landless (I) versus functionally landless (J1)	0.21**	0.01	0.60***	0.000	−0.24**	0.002	−0.27	0.203	n/a	
		Landless (I) versus peasant farmer (J2)	0.32**	0.004	0.94***	0.000	−0.45***	0.000	−0.42	0.129	n/a	
		Landless (I) versus large farmer (J3)	0.42***	0.001	1.02***	0.000	−0.55***	0.000	−0.56	0.065	n/a	
	Second, functionally landless respondents' mean adaptive capacity is compared with that of other 2 higher classes of landholders	Functionally landless (I) versus peasant farmer (J2)	0.11	0.89	0.33***	0.001	−0.20*	0.04	−0.14	1.00	n/a	
		Functionally landless (I) versus large farmer (J3)	0.21	0.16	0.41**	0.002	−0.30**	0.015	−0.28	0.857	n/a	
	Third, peasant farmers' mean adaptive capacity is compared with that of large farmers/landlords	Peasant farmer (I) versus large farmer (J3)	0.10	1.00	0.08	1.00	−0.09	1.00	−0.13	1.00	n/a	

Table 5 continued

Factors	Process of comparison	Reference (I) versus comparison (J) groups	Mean differences in perceived adaptive capacity against impacts related to									
			Infrastructure damage and disrupted mobility		Food and nutritional security		Low earning and higher cost of maintenance		Loss of employment in offshore activities		Crisis of potable water and public health risk	
			$(I-Ji)^b$	Sig.	$(I-Ji)^b$	Sig.	$(I-Ji)^b$	Sig.	$(I-Ji)^b$	Sig.	$(I-Ji)^b$	Sig.
Membership: 2 levels 1. Member 2. Non-member	Mean adaptive capacity of respondents who are member of any social group is compared with that of other respondents who are not member of such group	Member (I)versus non-member (J1)	n/a		0.34**	0.002	n/a		n/a		−0.29*	0.023
Assistance from relatives: 2 levels 1. Always get 2. Hardly get	Mean adaptive capacity of respondents who always get assistance from relatives/neighbors is compared with that of other respondents who do not get so frequent	Always get assistance (I) versus hardly get (J1)	n/a		n/a		n/a		−0.42***	0.001	n/a	
Income poverty level: 2 levels 1. Below 2$ poverty line 2. Above 2$ poverty line	Mean adaptive capacity of respondents who fall below 2$ poverty line is compared with that of other respondents who are above 2$ poverty line	2$ poor (I) versus above 2$ poverty line (J1)	0.24***	0.001	n/a		n/a		n/a		−0.62***	0.000
Adaptive behavioral factors												
Rainfall: 2 levels 1. Frequently adapt 2. Non-frequently adapt	Mean adaptive capacity of respondents who frequently adapt to rainfall is compared with that of other respondents who adapt occasionally	Adapted frequently (I) versus not frequently (J1)	n/a		0.16**	0.004	n/a		−0.26**	0.006	−0.21**	0.002
Flood: 2 levels 1. Frequently adapt 2. Non-frequently adapt	Mean adaptive capacity of respondents who frequently adapt to flood is compared with that of other respondents who adapt occasionally	Adapted frequently (I) versus not frequently (J1)	n/a		n/a		n/a		0.25*	0.017	n/a	
Salinity intrusion: 2 levels 1. Frequently adapt 2. Non-frequently adapt	Mean adaptive capacity of respondents who frequently adapt to salinity intrusion is compared with that of other respondents who adapt occasionally	Adapted frequently (I) versus not frequently (J1)	n/a		−0.44***	0.000	n/a		0.29**	0.002	n/a	
Fresh water crisis: 2 levels 1. Frequently adapt 2. Non-frequently adapt	Mean adaptive capacity of respondents who frequently adapt to freshwater crisis is compared with that of other respondents who adapt occasionally	Adapted frequently (I) versus not frequently (J1)	n/a		−0.12*	0.028	n/a		0.20*	0.027	n/a	

Table 5 continued

Factors	Process of comparison	Reference (I) versus comparison (J) groups	Mean differences in perceived adaptive capacity against impacts related to									
			Infrastructure damage and disrupted mobility		Food and nutritional security		Low earning and higher cost of maintenance		Loss of employment in offshore activities		Crisis of potable water and public health risk	
			(I-Ji)[b]	Sig.	(I-Ji)[b]	Sig.	(I-Ji)[b]	Sig.	(I-Ji)[b]	Sig.	(I-Ji)[b]	Sig.
Access to climate/weather information												
Radio: 2 levels 1. Always follow 2. Rarely follow	Mean adaptive capacity of respondents who mostly follow climate/weather information of radio is compared with that of other respondents who rarely follow radio	Always follow (I) versus rarely follow (J1)	−0.09*	0.034	n/a		n/a		−0.19*	0.028	n/a	
Official contact: 2 levels 1. Always maintain 2. Rarely maintain	Mean adaptive capacity of respondents who mostly maintain contact with local official for climate/weather information is compared with that of other respondents who rarely maintain such contact	Always maintain (I) versus Rarely maintain (J1)	n/a		n/a		n/a		n/a		0.23*	0.036
Spatial/locational factors												
Distance from coast: 3 levels 1. Within 5 km 2. Within 5–10 km 3. Within 10–15 km	First, mean adaptive capacity of respondents who live within 5 km from the shoreline is compared with that of other respondents who live further inland	Within 5 km (I) versus Within 5–10 km (J1)	n/a		n/a		n/a		−0.23	0.077	n/a	
		Within 5 km (I) versus Within 10–15 km (J2)	n/a		n/a		n/a		−0.33**	0.007	n/a	
	Second, mean adaptive capacity of respondents who live within 5–10 km from the shoreline is compared with that of other respondents who live further inland	Within 5–10 km (I) versus Within 10–15 km (J2)	n/a		n/a		n/a		−0.10	0.98	n/a	
Accessibility to safe shelter: 2 levels 1. Convenient 2. Inconvenient	Mean adaptive capacity of respondents who have convenient access to safe (cyclone/flood) shelter is compared with that of other respondents who do not have such convenient access	Convenient (I) versus Inconvenient (J1)	−0.14**	0.002	n/a		n/a		n/a		n/a	

* Significant at 0.05 level; ** significant at 0.01 level; *** significant at Boferroni corrected 0.001 level

[a] Elaborated form of the factors/variables that are shown in Table 3

[b] Mean difference in adaptive capacity between reference group (I) and comparison group (s) (Ji); Ji = J1, J2, J3, ….Jn. Reference group is always indicated by (I)

[c] indicates computation of mean difference in adaptive capacity between reference group (I) and comparison group(s) is not necessary since in earlier Table 6 it is shown that the influence of that particular factor on that particular dimension of adaptive capacity is not significant even at 0.05 level. For illustrative purpose let us consider factor/variable "age". Table 6 reports that only adaptive capacity against "loss of employment in offshore activities" and "crisis of potable water and public health risk" are significantly influenced by "age". That means respondent's "age" does not have any significant influence on other 3 major dimensions impacts of SLR on livelihood (see Table 6). Therefore, in Table 7 mean difference in adaptive capacity (against that 3 major categories) among various age groups are not computed (marked as "n/a")

sharecroppers, day laborers, fishermen, and other farm workers, possess significantly lower perceived adaptive capacity against food and nutritional security than individuals engaged in non-agricultural occupations, such as business, petty trade, transport work, NGO work, government jobs, and other off-farm activities (Table 5). One possible reason might be that for a single episode of a disaster such as a flood, storm surge, or salinity intrusion, agricultural and allied occupational groups lose their earnings for an entire harvest cycle (Khan 2008). Because it is not always possible to replant (if affected during a growing period of crops) or early harvest (when crops that are almost ready to harvest are affected), they fail to sustain their livelihoods for significantly long periods of time (i.e., until the next harvest). This makes them food-insecure, as they often do not have means to buy food for a long time. In contrast, individuals engaged in non-agricultural occupations can protect their sources of earning by various means. For example, individuals engaged in salaried jobs are assured a salary regardless of what the disaster is. This kind of entitlement gives groups who do not engage in agriculture a higher leverage to secure food and nutritional security against the impacts of hydro-meteorological disasters. This finding offers an important lesson, i.e., a gradual shift from a natural resource-dependent livelihood to [engagement in] a more formal economy would help reduce the risk of livelihood insecurity.

The study reports a few other interesting findings. Respondents who are members of social groups, such as (NOGs), farmer clubs, or women's committees, possess significantly higher perceived adaptive capacities against impacts that relate to food and nutritional insecurity. This finding conforms to the findings of many others. For instance, Allen (2006), in a similar coastal context in the Philippines, and De Silva and Yamao (2007) in Sri Lanka earlier found that NGOs' members posses higher adaptive capacity than others against food and nutritional insecurity. In our case, the higher adaptive capacity of members of social groups is probably related to certain factors. First, NGOs' beneficiaries are more disciplined at managing their assets to secure their livelihoods. For instance, they have developed the habit of regularly saving to ensure maximum possible livelihood security during a period of crisis; they utilize their backyard/courtyard for seasonal vegetables and fruit production alongside poultry and duck rearing for supplementary income. The female members are especially adaptive; they prefer duck rearing than chicken rearing, as ducks can survive with salinity intrusion and flooding. Similar findings are observed in some other parts of the southwestern coast of Bangladesh (for details, see Patt et al. 2009). Second, bridging and bonding ties give them higher leverage during a crisis. Therefore, they are more confident they will overcome future food and nutritional insecurity. This finding offers an important lesson about how social networking influences individual behavior while gaining access to and making use of limited assets to secure livelihood.

The respondents who have the experience of adapting to repetitive exposure to excessive rainfall posses significantly higher adaptive capacity against impacts related to food and nutritional insecurity. This is probably due to their accumulated experience of knowing the timing of rainfall; they can therefore adjust their cropping calendar accordingly (i.e., early seed-bed preparation, early transplantation, early harvest or delay in the above tasks) to avoid harvest loss or failure. Here, accumulated experience gives them leverage (Grothmann and Patt 2005). However, this is not always the case. For instance, respondents who experience repetitive exposure to salinity intrusion and fresh water crises demonstrate significantly low adaptive capacity. This finding contradicts the conventional wisdom that individuals with a long experience of adaptation possess higher adaptive capacity (Fankhauser et al. 1999; Tompkins and Adger 2004). It is probably because, unlike rainfall, impacts of salinity intrusion and fresh water crises persist for a long time and have cumulative impacts on food production, as saline-affected soil cannot support conventional varieties of crops. Therefore, respondents who are affected recurrently by salinity intrusion view their coping and adaptive capacity as being exhausted (Blaikie et al. 1994; Oppenheimer and Todorov 2006). Any new exposure, they believe, may even exceed their coping threshold and thus make them even less adaptive to food and nutritional insecurity in future disasters. This kind of fear (due to oversimplification of a complex phenomenon), which is labeled *availability heuristic* (Teversky and Kahneman 1974; Crocker 1981), although not always realized, erodes the perceived self-efficacy of affected individuals. These findings offer one interesting lesson: in the case of a rapid onset of disastrous events such as torrential rainfall, affected individuals still consider their adaptive capacity against food and nutritional insecurity to be high. In contrast, in the case of gradual/slow-onset hazards such as salinity intrusion and fresh water crises, the impacts of which are perpetual, affected individuals consider their adaptive capacity to sustain a modest livelihood to be poor.

Why does perceived adaptive capacity against low earning and higher cost of maintenance differ?

From Table 4, it is evident that only demographic and socio-economic factors such as the respondent's sex [$F(1, 257) = 3.96$, $p < 0.05$], education, [$F(2, 257) = 3.44$, $p < 0.05$], occupational engagement [$F(1, 257) = 7.26$ $p < 0.01$, and farmland holdings [$F(3, 257) = 9.87$, $p < 0.001$] statistically significantly affect perceived adaptive capacity against the impacts that relate to low earnings and higher costs of maintenance. All other factors do not have any significant influence.

Further post hoc analysis shows that in this respect women have a significantly higher adaptive capacity (Table 5), although many studies with compelling narratives portray women as having lower adaptive capacity in general, compared to their male counterparts (Ikeda 1995; Cannon 2002). To support such findings (or arguments), they present the higher death rate of women (there are exceptions, of course, a higher death rate of men resulted from Hurricane Mitch; see Bradshaw 2004) and point out that women cannot survive water-related disasters as well because of the use of the "sari" (a traditional cloth that makes running and swimming more difficult during water-related disasters) (Ikeda 1995; Cannon 2002) or because of their caregiver role (Patt et al. 2009). While these hold true in some disaster situations, perhaps in our case, risk-aversion attitudes of women (Arch 1993) help them have a higher perceived adaptive capacity against impacts related to low-income situations. Risk-aversion behavior motivates women to save some of the family earnings or food to manage low/no-income periods to ensure the family's welfare (Patt et al. 2009). This finding also offers an interesting lesson. The better a woman's earning position is, the better her family's welfare will be during a disaster situation. This also conforms to the proposition of Lambrou and Piana (2006), who argued for capacity-building efforts specifically aimed at women.

Post hoc analysis further revealed that respondents with no land or limited land possess significantly low adaptive capacity against low-income situations. Similarly, educated individuals have significantly higher adaptive capacity in this regard than uneducated people. This is mainly because they are engaged mostly in salaried jobs, where a monthly payment schedule remains effective regardless of what the disaster is; therefore, their perceived adaptive capacity against higher costs of maintenance is higher than for uneducated individuals, whose flow of income is interrupted (e.g., fishermen take days off during disasters/bad weather and receive no income) during disasters. This finding is consistent with the finding of De Silva and Yamao (2007) that coastal resource-dependent communities would suffer the most due to climate change in Sri Lanka.

Why does perceived adaptive capacity against loss of employment in offshore activities differ?

Respondents' perceived adaptive capacity against the impacts that relate to loss of employment in offshore activities is significantly affected by their age composition [$F(2, 257) = 5.06$, $p < 0.01$], occupational engagement [$F(1, 257) = 14.25$, $p < 0.001$], past adaptation experience with rainfall $F(1, 257) = 7.59$, $p < 0.01$], flood [$F(1, 257) = 5.81$, $p < 0.05$], salinity intrusion [$F(1, 257) = 9.80$, $p < 0.01$], fresh water crisis [$F(1, 257) = 4.96$, $p < 0.05$], habit of use of radio [$F(1, 257) = 4.91$, $p < 0.05$], and distance of homestead from the shoreline [$F(2, 257) = 4.99$, $p < 0.01$]. Although a very diverse set of factors influence this adaptive capacity, no single factor appeared to be very dominant (i.e., partial η^2 is not more than 0.05 in all cases) (Table 4).

Table 5 reports the results of post hoc analysis. It appeared that older respondents have significantly higher adaptive capacity than middle-aged and young respondents. There may be several explanations. One possible reason is older people have a long experience of adaptation. They can predict almost with a high level of certainty whether the nearby Bay of Bengal will have hostile weather. They can manage their offshore fishing activities against a certain level of gusty winds, as they are familiar with the weather patterns of the Bay of Bengal. In contrast, younger people, although they like adventure, prefer not to go offshore/deep-sea fishing without a good navigation system if weather conditions are bad. Therefore, the incomes of young and middle-aged individuals from offshore activities fall between April and May as well as October and December because most cyclonic episodes occur over these two periods (Singh et al. 2001).

Respondents who have past experience adapting to floods, salinity intrusions, and fresh water crises possess significantly higher adaptive capacity against loss of income from offshore activities (Table 5). In fact, their long experience gives them such leverage. For instance, respondents who have past experience adapting to salinity intrusion are more likely to intensify their brackish-water shrimp farming to harness the benefit of salinity intrusion in the lowlands, although there is doubt about the sustainability of this (Azad et al. 2009; Ito 2009). Therefore, individuals in this category demonstrate higher adaptive capacity against impacts related to loss of income from offshore activities, as they can switch to brackish-water shrimp farming more easily.

Respondents who live further inland from the shoreline possess significantly higher adaptive capacity against the impacts related to loss of income from offshore activities. This finding conforms to Cannon (1994) and a more recent study of Tacoli (2009), who unveiled that because the scope of diversification of income is higher further inland than in the shoreline areas, individuals who live far away from the shoreline have higher adaptive capacity against disasters, as their livelihood avenues are less affected. One possible explanation might be that individuals who depend on income from activities available only near the shoreline are more vulnerable than others during disaster situations. This finding offers an important lesson that individuals may relocate inland to ensure a smoother flow of income from diversified sources if hydro-meteorological events intensify.

Contrary to general expectations, it is found that respondents who follow radio messages possess significantly low adaptive capacity against the loss of income from offshore activities. Because followers of radio messages refrain from going offshore or deep-sea fishing throughout the cyclonic period, they lose income but reduce the risk of death (Badjeck et al. 2010). This finding is in agreement with other studies conducted in Bangladesh and elsewhere. For example, Ito (2009) makes the point that artisan fishermen in southwestern coastal Bangladesh sell their labor at a cheap rate to shrimp farms to offset the income lost from non-fishing during bad weather. Similar scenarios are portrayed by De Silva and Yamao (2007) in Sri Lanka and Kalikoski et al. (2010) in Brazil.

Why does perceived adaptive capacity against potable water crisis and public health risk differ?

Table 4 reports that respondents' perceived adaptive capacity against the impacts of potable water crisis and public health risk is significantly influenced by their age composition [$F(2, 257) = 4.00$, $p < 0.05$], sex [$F(1, 257) = 4.65$, $p < 0.05$], membership in social organizations [$F(1, 257) = 5.25$, $p < 0.05$], level of income [$F(1, 257) = 38.35$, $p < 0.001$], past experience of adaptation against floods [$F(1, 257) = 9.66$, $p < 0.01$], and the habit of maintaining contact with local officials [$F(1, 257) = 4.44$, $p < 0.05$]. Among these factors, respondents' level of income is the strongest factor (partial $\eta^2 = 0.13$), followed by respondents' past experience adapting to rainfall (partial $\eta^2 = 0.04$) and their age composition (partial $\eta^2 = 0.03$) (Table 4).

The results of post hoc analysis show that in this regard, young people have significantly higher perceived adaptive capacity than their older counterpart. This finding is consistent with the findings of others, such as Filiberto et al. (2009), who argue that elderly people possess less adaptive capacity against climatic impacts on health due to less mobility, weak physiology, and poor access to resources.

Similarly, women demonstrate significantly higher adaptive capacity in this regard than men do, although many qualitative studies have portrayed women as more vulnerable (see Matin and Taher 2001; Cannon 2002; CARE 2003). The reasons for this apparently inconsistent finding can probably be attributed to the health awareness-raising program conducted by the European Commission (EC) and a few other NGOs such as BRAC, SPEED Trust. Under this program, the risks of using contaminated water are well communicated to the beneficiary members, most of whom are female. As women are keener on receiving new ideas (or advice) than men and are good followers of those ideas (or advice) than men (Patt et al. 2009), the *social amplification of risk* may have sensitized women to the welfare (e.g., health safety issues) of their children and other family members (Kasperson et al. 1998), which eventually helps them to attain a higher adaptive capacity. Similarly, respondents who maintain direct contact with local officials demonstrate higher perceived adaptive capacity. Despite contextual differences and the differences in methodology adopted, this finding supports the finding of Bodin and Crona (2009), which concludes that direct contact and face-to-face communication/networking open up opportunities for sharing adaptation knowledge that helps to enhance adaptive capacity.

Concluding remarks

This paper has examined the influence of various factors on coastal populations' perceptions of their adaptive capacity against major impacts of SLR-induced disastrous events. First, individual perceptions about adaptive capacity against 25 impacts were assessed; then, by employing the PCA technique, 25 impacts were reduced to five major categories to develop five adaptive capacity indexes. Therefore, after PCA, a (perceived) adaptive capacity index was determined for impacts related to *infrastructure damage and disrupted mobility*, *food and nutritional insecurity*, *low earnings and higher costs of maintenance*, *loss of employment in offshore activities,* and *crises of potable water and public health risk*. Because we were more interested in identifying enhancements in adaptive capacity for whom and against what categories of impacts, we chose a MANOVA model, whereby four theoretically derived groups of variables were used as explanatory (independent) variables, and each of the five adaptive capacity indexes were used as dependent variables. The four groups of independent variables are related to respondents' demographic and socio-economic aspects, past adaptive behavior, access to weather/climate information, and place of living in relation to the shoreline (spatial/locational aspect).

MANOVA results are robust. Adaptive capacity against the impacts related to *food and nutritional insecurity* is significantly low for individuals dependent on agriculture and allied activities for livelihood, who have no involvement with any social organization, and who experience frequent exposure to salinity intrusion and fresh water crises. On the other hand, adaptive capacity against the impacts related to *low earning and high cost of maintenance* is significantly low among men, illiterate or less educated, landless or possess limited land (<1 hector), and engaged in non-agricultural occupations. Similarly, individuals with low adaptive capacity against the impacts that relate to *loss of employment in offshore activities* are characterized as young and middle aged, dependent on agriculture and allied activities, landless, frequently exposed to torrential and prolong rainfall, frequent users of radio, and reside along the shoreline. Finally, individuals with low adaptive capacity against the impacts that relate to *crises of potable water and public health risk* are characterized as elderly, male, living below the $2 poverty line, frequently exposed to torrential and prolong rainfall, and having poor or no contact with local officials.

The above findings present a number of interesting insights. First, individuals of a lower socioeconomic standing have lower adaptive capacity in general, but their adaptive capacity against infrastructure damage and disrupted mobility is high. Notwithstanding this fact, certain physical resources, such as the amount of land in possession and level of income, play an overwhelmingly important role in adaptive capacity enhancement. As an intervention for adaptive capacity enhancement, the issue of landlessness of a large number of people must be well addressed. Field observations unveiled that the present distribution of land is very much skewed; only a handful of landlords control most parcels of arable land.

Second, demographic and socio-economic aspects, such as age and sex composition, level of education, and nature of occupation, significantly influence the adaptive capacity against many impacts of disastrous events. Age and gender-specific adaptive capacity enhancement programs can be launched based on the needs already identified. Educated individuals engaged in occupations that contribute toward a high adaptive capacity against most impacts. Therefore, a program for making higher and skill-based education accessible to all as a long-term strategy to shift livelihood earnings of the majority of people from natural resource-dependent activities toward a more formal economy should be launched. This is important, partly because recurrent exposure to disasters makes uneducated natural resource-dependent individuals less adaptive against most impacts as their resource bases are degraded. On the other hand, educated individuals have a diversity of knowledge and skills that they can utilize to enlarge their income potential.

Third, although access to climate/weather information in some cases makes individuals less confident about their ability to deal with disastrous events, access to such information must be ensured to help them accurately assess risk and take prudent measures for adaptive capacity enhancement. In this connection, we specifically support the idea of establishment of a community-operated radio for dissemination of climate/weather information in a way that is understandable to all on a priority basis. As we observed, radio is still a popular source of weather information because one can keep it on while working on a farm or fishing in offshore/deep-sea waters. Moreover, it can be operated by a simple battery and involves few technicalities. However, the credibility of the messages delivered needs to be high.

Fourth, a few socio-cognitive (socio-psychologic) aspects, such as appraisal of past experience of adaptive behavior against torrential rainfall, salinity intrusion, and fresh water crises, which are often ignored in mainstream research, have emerged as important determinants of adaptive capacity against many impacts. Creating a venue for sharing such experiences at the community level might help others who possess less adaptive capacity against a particular impact. In fact, learning from insiders may make more significant breakthroughs than learning from outsiders. This is important because earlier research unveils that outsider views are not always as welcomed/trusted by men as compared to women (Patt et al. 2009). These issues need to be well addressed while framing any future program of adaptive capacity enhancement. Apart from these, a few spatial/locational factors have strong-to-limited influence on the different adaptive capacities of coastal individuals. Individuals who live further inland from the shoreline possess a higher adaptive capacity. Therefore, it is highly likely that by using social/kinship networks, some individuals can migrate away from the fragile coast. To avoid any uncontrolled displacement, a long-term and well-coordinated program needs to be initiated.

Finally, though it is believed that the habit of recurrent coping and adaptation is the cause of winning the battle of the resource-poor coastal population of Bangladesh against various hydro-meteorological disasters throughout history, their adaptive capacity cannot be infinite (Adger et al. 2009). Their expertise regarding the use of accumulated traditional/indigenous knowledge to battle hydro-meteorological disastrous events needs to be upgraded. This may be partly because some of the known pattern of disastrous events may behave very differently than in previous occasions, which may make individuals less adaptive. Therefore, it is concluded that in light of the research findings, specific programs rather than a generic program (i.e., "one size fits all") must be initiated for adaptive capacity enhancement for individuals vulnerable to specific impacts.

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