



# *In situ* adaptation against sea level rise (SLR) in Bangladesh: does awareness matter?

Sea level rise  
in Bangladesh

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## Abstract

**Purpose** – The paper aims to identify and assess quantitatively the influences of a few dimensions of climate awareness on people's preference for adaptation against sea level rise (SLR).

**Design/methodology/approach** – From the literature survey “familiarity with”, “perception about” and “intuitive knowledge about” climate change-sea level rise (CC-SLR) have been identified as dimensions of “climate awareness”. Empirical research was done through administering questionnaires among 285 respondents selected randomly from three coastal villages in Bangladesh. After principal component analysis, data sufficiency and colinearity test, a total of 18 variables were entered into a multinomial logistic regression model. The reference category “evacuation” was compared with other two choices, i.e. *in situ* adaptation with “same occupation” and “changed occupation”.

**Findings** – For the SLR scenario of 2050-2075 occupational engagement, use of radio for climate information, exposure to rainfall, salinity and perception about CC-SLR appeared as the most significant predictors of people's preference for evacuation or *in situ* adaptation ( $LR \chi^2 = 183.38$ , pseudo  $R^2 = 0.54$ ,  $p < .001$ ). Similarly, for the SLR scenario of 2080-2100, in addition to the factors cited above, some other factors such as educational attainment, exposure to flood, climate perception and familiarity appeared as the most significant predictor of respondent's preference ( $LR \chi^2 = 202.08$ , pseudo  $R^2 = 0.60$ ,  $p < 0.001$ ).

**Originality/value** – Two dimensions of climate awareness, i.e. familiarity with and perception about CC-SLR may significantly influence the people's preference for adaptation choice. Launching a programme to enhance climate awareness without further delay may help people planning for anticipatory *in situ* adaptation against CC-SLR.

**Keywords** Global warming, Sea water, Bangladesh

**Paper type** Research paper

## 1. Introduction

This paper is intended to find out the influence of climate awareness on people's preference for adaptation strategies against the impact of climate change-sea level rise (CC-SLR) in coastal Bangladesh. Climate change is viewed as a gradual change in long-term average conditions, greater variability within the range of “normal conditions” and changes in the types of extreme events which are possible or probable (Hare, 1991). Such change could

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be due to natural variability or as a result of human activity (intergovernmental panel on climate change (IPCC), 1996, p. 56). Climate change is manifested through changes in global mean temperature, drought, pattern of precipitation, storm surge, winter storm, amount of melting of snow and ice and rising global (mean) sea level (Neren *et al.*, 2006; Leal Filho and Mannke, 2009). Despite the uncertainty about the extent of such changes in future, current scientific understanding has established a clear link among global warming, climate change and SLR (Houghton, 2004).

The third assessment report of the IPCC has projected a SLR of as high as 88 cm by the end of this century (IPCC: WG I, 2001). This has posed a formidable challenge for low-lying deltaic coasts (Warner *et al.*, 2009). In 22 coast-lying countries 170 million people would be affected due to CC-SLR (Middleton, 1999). The most severely affected countries will be Bangladesh, Kiribati, Marshall Islands, Antigua and Benin (Nicholls, 1995; Nicholls *et al.*, 1995). Drawing from the study of Ahmed and Alam (1998) and (The World Bank (2000, p. 11) has shown a projected (high-end scenario) SLR of 30-40 and 50 cm for the year 2030 and 2050, respectively, along Bangladesh's coast. For every year average rise is 1 cm. However, projected SLR of 12, 32 and 88 cm along the Bangladesh's coast for the year 2030, 2050 and 2100, respectively, are shown in the National Adaptation Program of Action for Bangladesh (GOB, 2005, 2006, p. 6). These figures are the basis of storyline used later of this paper.

Following the fourth assessment report of the IPCC (IPCC: WG II, 2007), CC-SLR has been considered to be the most pressing problem against which the people of Bangladesh in general and the coastal people in particular have to adapt in this century (GOB, 2008). Adaptation involves some processes and actions in order to better cope with, manage or adjust to some changing conditions, stresses, hazards, risks or opportunities (Smith, 1997; Fankhauser *et al.*, 1999; Smit and Pilifosova, 2001; Smit and Skinner, 2002; Brooks *et al.*, 2005; Smit and Wandel, 2006). In a climate change context, IPCC viewed adaptation as an adjustment in natural or human systems in response to actual or expected climate stimuli or their effects, which moderate harm or exploit beneficial opportunities (McCarthy *et al.*, 2001, p. 982). For adaptation against the impacts of SLR there are only three options: protection, accommodation and retreat (evacuation) (Klein *et al.*, 2001). Experts already warn that for a land scarce country like Bangladesh, which may even lose one-third of her landmass due to SLR, evacuation may not be a sustainable solution. Rather, protection and accommodation are considered to be suitable options as these do not require displacement (Ortiz, 1994). These two responses are basically *in situ* (in place) adaptation which often do not take place automatically.

*In situ* adaptation by and large depends on three important elements: timely recognition of the need to adapt, an incentive to adapt and ability to adapt (Fankhauser *et al.*, 1999; Adger *et al.*, 2005). Unless the people are aware about the dynamics of CC-SLR they cannot comprehend the need for adaptation. Again their adaptation is not only contingent on their understanding of need to adapt but also depend on their abilities to adapt. When the question of ability to adapt arises, the conventional literature points a finger to the physical or other capital that a person possesses (Blaikie *et al.*, 1994, Smithers and Smith, 1997, Pelling and High, 2005). Psycho-social and behavioural aspects have also recently emerged as important dimensions in this regard (Patt and Gwata, 2002; Grothmann and Patt, 2005; Grothmann and Reusswig, 2006; Oppenheimer and Todorov, 2006). Some scholars even put higher emphasis on people's access to climate information and communication as means to enhance their climate knowledge, which in turn will help

them to adapt (Phillips, 2003; Leal Filho, 2009; Leal Filho and Mannke, 2009; Nerlich *et al.*, 2010). Climate awareness has therefore, emerged as an important sub-dimension of adaptation research.

Despite availability of the literature on adaptation in general, literature concerning the influence of climate awareness on people's preference for adaptation strategy is very scanty, if not absent. Indeed, only a few qualitative attempts are observed; focused primarily in the policy arena of climate communication and relevant for developed countries (Dela Vega-Leinert and Nicholls, 2008; Kont *et al.*, 2008; Sterr, 2008; Tol *et al.*, 2008; Leal Filho, 2009; Moser and Satterthwaite, 2009). In this respect, notable exceptions are Weber (1997), Grothmann and Patt (2005), Grothmann and Reusswig (2006), Semenza *et al.* (2008) and Blennow and Persson (2009) who have used quantitative approaches. Despite having very good explanatory power while dealing with climatic issues, the common limitation is neither of them focused exclusively on SLR.

Few works have been done so far on issues relating to adaptation in Bangladesh; most notable of which are "reduction of vulnerability to climate change" (RVCC, 2003; Schaerer and Ahmed, 2004; Thomalla *et al.*, 2005). These are centred on qualitative inquiry. In fact, no study is observed to assess quantitatively the explanatory power of various factors, especially explanatory power of climate awareness to explain the variances in coastal people's preference for adaptation strategies against the impact of SLR on their livelihoods. The goal, here, is to assess quantitatively the influences of various dimensions of climate awareness on people's preference for adaptation strategies against the impact of future SLR. In fact, livelihood securities of coastal people in Bangladesh are in constant threat of CC-SLR. The policy implication of the findings is these will help policy makers and planners to initiate programmes for encouraging *in situ* adaptation against the SLR.

## 2. Research hypothesis

Earlier works cited in the previous section have confirmed that various socio-demographic, economic, cultural, information communication and contextual (spatial) factors influence local people's preferences for adaptation options against the impacts of climate change. The hypothesis of this research is that various dimensions of climate awareness are important determinants of coastal people's preferences for adaptation choices against the impact of future SLR.

## 3. Research design

### 3.1 Selection of study area, respondents and survey procedures

Among the coast-lying areas of Bangladesh, "Kalapara Upazila" (sub-district) of Patuakhali District is worst affected by storm, surge, salinity intrusion, tidal flood and may continue to experience the same given the reality of SLR (Ortiz, 1994; Ali and Chowdhury, 1997; Huq *et al.*, 1998; Ali, 1999; Ali Khan *et al.*, 2000; (The) World Bank, 2000; Singh *et al.*, 2001). Three coastal villages from three "Union Parishad (UP)" (lowest tier of local government unit) of "Kalapara Upazila" were selected. Study villages of "Dulasar", "Mithaganj" and "Nilganj" UP are 5-15 km from the Bay of Bengal and 10-15 to 30-40 cm (about one foot contour) above mean sea level. The whole area is criss-crossed by numerous natural canals and creeks having link with three river systems and the Bay of Bengal. People living here are, historically, prone to various natural calamities. The area may experience 10-15 to 30-40 cm inundation within the time frame of 2020-2080

(Saroar and Routray, in press). Randomly selected 285 respondents from various occupation categories, age groups and gender composition (175 male and 110 female) were interviewed using semi-structured questionnaires during January-April 2009 Figure 1.

3.2 Operational indicators of “climate awareness” – the variable of interest

The word “awareness” has different connotations. In the disaster literature awareness means increasing levels of consciousness about risks and reduction of exposure to hazards (ISDR, 2004, p. 6). In the context of CC-SLR, people having some understandings about the changing climatic events, plausible rise of sea level, and probable impacts of CC-SLR are considered as aware about climate change. Awareness about climate change is very fundamental for a person to accurately appraise the level of future threat without which one cannot advance with rational choice of adaptation (Grothmann and Patt, 2005, p. 203). Thus, climate awareness is considered as an indispensable component while dealing with the issues of adaptation against the SLR.

However, the literature on climate awareness is still in its infancy stage. Concrete and agreed guidance as to how climate awareness can be assessed is yet to be developed, although a range of indicators have been identified that are assumed to be useful. Weber (1997) and Semenza *et al.* (2008), for instance, use “familiarity with climate change/weather extreme phenomena” as an indicator of awareness about climate change. Likewise, Grothmann and Patt (2005), Grothmann and Reusswig (2006) and Blennow and Persson

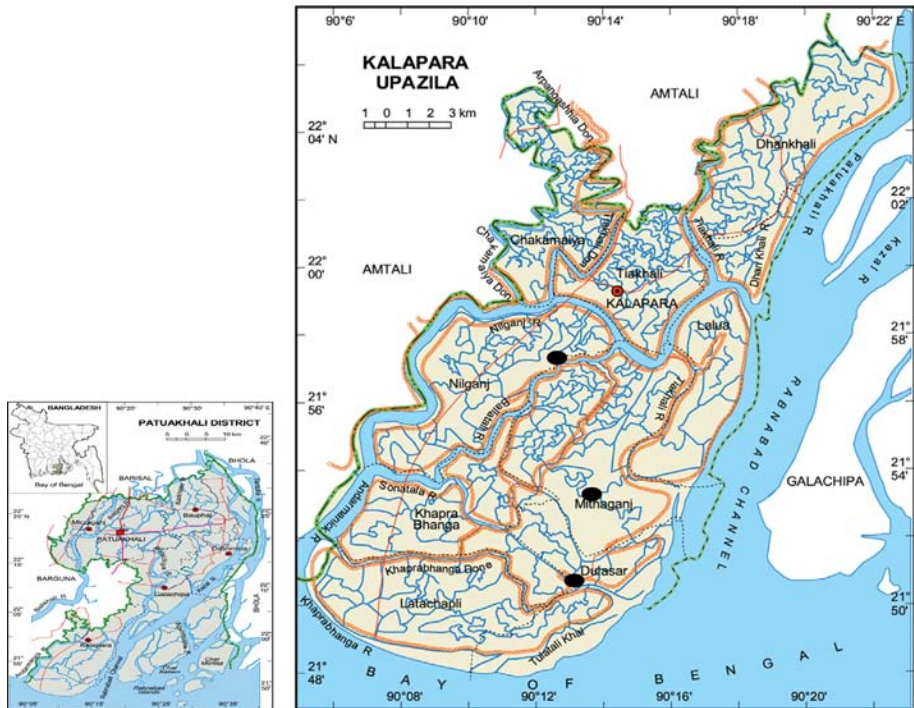


Figure 1. Study sites: in “Dulasar”, “Mithaganj” and “Nilganj”

Source: Islam (2003)

(2009), use “perception/belief” about climate change-related event as an indicator of climate awareness. While others, for example, Vedwan and Rhoades (2001) and Steel *et al.* (2005), use ideas very similar to “tacit/intuitive knowledge” as an indicator of climate awareness. This is because these indicators are in some ways related with determinants of many dimensions of climate awareness, such as familiarity with weather/climate extreme, belief/perception about climatic event and understanding about the impact of accelerated SLR. In this analysis, climate awareness is operationalized as a bundle of “familiarity with weather/climate extreme signal”, “perception/belief about climatic event” and “tacit/intuitive knowledge about the impact of SLR”. In the following section, specific indicators of the above three dimensions of climate awareness are operationalized.

*3.2.1 Indicator of “familiarity with weather/climate extreme signal”.* Climate change/weather extreme phenomena are often felt by people living in any area for long time due to their interaction with local environments. In fact, their familiarities are often associated with particularly important outcomes. For example, a farmer gets used to planting a particular crop during the monsoon can easily notice if the rainy days are deviated from their traditional mental map of seasonal calendar. The way traditional mental map of seasonal calendar is used by apple grower to adjust with climatic variation in the “Kullu” valley in Himalayan India is well illustrated by Vedwan and Rhoades (2001). Of course, some of the signals of climatic variation and weather extreme phenomena are intrinsically noticeable; for example, drastic reduction of migratory birds during recent winters from a decade or so ago in tropical climates.

Keeping in mind the mental mapping technique (Vedwan and Rhoades, 2001), a set of ten questions was prepared to assess the “familiarity with weather/climate extreme signal” of the respondents (Table I). Inquiry was centred on climate-related aspects that have some degree of “visual silence”. Visual silence is the intrinsic property of the phenomenon which allows the phenomenon to be felt/more observable (Vedwan and Rhoades, 2001). However, IPCC’s report (IPCC: WG II, 2001, p. 15), Adger *et al.* (2003, pp. 182-3), Dessler and Parson (2006) and Neren *et al.* (2006) have been appeared as very instrumental while framing the indicators/questions. Each response was originally rated in a four-point scale: “no idea/can not remember if heard about”, “heard from others but do not agree”, “heard from others and agree” and “observed/felt by own”. However, for this paper the central two original responses, i.e. “heard from others but do not agree” and “heard from others and agree” are collapsed into one “heard from others” to maintain a three-point uniform scale across three indices of climate awareness. For each of the respondents average “climate familiarity score” is computed to develop a “familiarity index”. The process of development of “index” is discussed later of this paper (Table II).

*3.2.2 Indicator of “perception/belief about the event of CC-SLR”.* Perception is seen as enduring and transposable disposition of an individual which functions as the generative basis of structured, objectively unified practice (Bourdieu, 1977; Gregory, 1999). For building climate awareness, prevailing perception about climate change can be a determinant factor. However, constant flow of information, recurrent exposure to some unusual realities and in some cases value forming psycho-social elements can change the prevailing wrong perception (O’Riordan and Jordan, 1999, p. 88). Hence, knowing people’s perception about CC-SLR is just the beginning of any intervention. Following Blennow and Persson (2009, p. 101), a set of five questions related with obvious outcomes of CC-SLR (Wilbanks *et al.*, 2007) were prepared for knowing their perception about CC-SLR. Original five-point response (analogous to Likert scale) is

Variable and scale of measurement	Indicator/statement
Familiarity with weather/climate extreme signal	Respondent's familiarity with
Scale of measurement	Longer duration of summer in recent years than what was a decade or so ago
1 = cannot remember if heard about/felt or observed	Warmer summers in recent years than what was a decade or so ago
2 = heard from others	Shorter duration of winters in recent years than what was a decade or so ago
3 = felt/observed by own	Less cool winters in recent years than what was a decade or so ago
	Late start of winter than the normal timing
	More prevalence of untimely rain falls in recent years
	Increased frequency of stormy event in recent years
	Increased salinity in rivers and canals
	Increased incidence of encroachment on new areas during high/king tide
	Lower presence of migratory birds in recent winters than what was a decade or so ago
Perception about CC-SLR event	Respondent's perception about
Scale of measurement	Accelerated sea level rise
1 = there is doubt; no need to think at all	Rapid/more inward shift of coastline
2 = distant and uncertain; still we may start thinking if really happen	Permanent encroachment of new areas by saline water
3 = we must act from now no matter the extent of uncertainty	Increased frequency and magnitude of stormy even and surge
	Acute scarcity of salt free/sweet water for drinking
Tacit/intuitive knowledge about SLR impact	Respondent's ability to identify at least one potential (negative) impact of SLR associated with
Scale of measurement	Crop production/horticulture
1 = no/inaccurate response	Fisheries
2 = accurate response but only with the aid of surveyor	Livestock
3 = accurate response without any aid	Settlement/homestead
	Physical infrastructure
	Off-farm economic activity
	Public health
	Social mobility
	Other than the above
	Ability to identify positive impact of any kind

**Table I.** Indicators of respondent's "familiarity with weather/climate extreme signal", "perception about CC-SLR event", and "tacit/intuitive knowledge about SLR impact"

**Note:** In each cases to summarize the scale, values 1-3 were weighted as (1/3 = 0.33, 2/3 = 0.67 and 3/3 = 1, respectively)

recoded for this paper into a three-point scale by collapsing the terminal two responses in each side of the mid value (Table I). For each of the respondents, average "climate perception score" is computed to develop a "perception index" later of this paper (Table II).

3.2.3 *Indicator of “tacit/intuitive knowledge about the impacts of SLR”*. Translating climate impacts into non-specialist (lay people) public knowledge is essential to let people comprehend it and participate in/initiate appropriate adaptive responses (Delli Carpini and Keeter, 1996; Leal Filho, 2009). Since the respondents were not too familiar with the term “sea level rise”, the essence of SLR was communicated with them using practical means/example instead of using any abstract term. They were asked to identify ten possible impacts of SLR if farmlands next to their homesteads submerge – up to 30-40 cm (almost knee height) below saline water or if height of storm-surges increase a few meters than what they have experienced in the past. Following Steel *et al.* (2005) survey format was prepared enlisting major ten categories of impacts of SLR; mostly drawn from Smith (1997, p. 252), Houghton (2004), Choudhury *et al.* (2005), Wilbanks *et al.* (2007, pp. 216-18) and Tol *et al.* (2008, pp. 438-9). For each of the respondents average “tacit/intuitive (SLR impacts) knowledge score” is computed to develop an “impact knowledge index” later of this paper (Table II).

### 3.3 *Reliability of responses and formulation of indices for climate awareness*

Reliability (internal consistency) of responses for questions concerning three dimensions of climate awareness were tested which are fairly above acceptance limit of 0.70 measured by Cronbach alpha ( $\alpha$ ) (George and Mallery, 2006) (Table II). Respondent’s weighted mean score (index) for each of the three dimensions of climate awareness was separately computed using the formula  $\sum Wi/n$  ( $Wi$  = individual’s weighted score (either of 0.33, 0.67 and 1.0) for each question,  $n$  = number of question). These three climate awareness indices along with other variables selected from factor analysis have been used later in the multinomial logistic regression (MLR) model to predict the variances in the respondents’ preferences for choices of adaptation against three plausible scenarios of future SLR. From individual’s weighted mean score (index), by using the formula  $\sum Wif_i/\sum f_i$  (where  $Wi$  = individual’s weighted score for each question,  $f_i$  = frequency of that particular score) weighted average mean index for entire sample is prepared for each of the three dimensions of climate awareness for a comparison.

Respondents’ familiarities with weather/climate extreme signals are higher than their perceptions about events associated with CC-SLR and the impacts of SLR (Table II). On an average people are aware about all three dimensions of climate awareness. However, higher standard deviation (SD) in “familiarity index” implies that knowledge gap is higher among the respondents – meaning some people have had more familiarity with weather/climate extreme signals than many others.

Variable	Number of item/indicator	Cronbatch alpha ( $\alpha$ )	Mean index (out of 1)	SD
Familiarity with weather/climate extreme signal	10	0.82	0.85	0.14
Perception about CC-SLR event	5	0.71	0.75	0.10
Tacit/intuitive knowledge about SLR impact	10	0.75	0.74	0.11

**Table II.**  
Reliability of responses measuring three dimensions of climate awareness and descriptive statistics of indices of climate awareness

**4. Result and discussion**

*4.1 Sources of vulnerability that can cause mass displacement*

The respondents were asked to identify the key sources of future SLR vulnerability that might force the local people to evacuate their present localities given that “no additional measures” apart from their own would be taken. Multiple response analysis shows that the dominant cause of displacement would be loss of income from current sources (35.8 per cent), followed by permanent disruption in access to various services (e.g. local health care, market place and schooling) (35.1 per cent), loss of free/low cost access to potable drinking water (30.4 per cent) and loss of food security (26.4 per cent) (Table III). It is a bit strange, however, to see that more people may evacuate due to perceived lack of availability of potable water than lack of production and availability of food stuffs.

*4.2 Preference for various adaptation pathways against the future SLR*

Three story lines that tell likely scenarios of CC-SLR for the year 2020-2030, 2050-2075 and 2080-2100 were presented to the respondents and asked for their responses on preference for adaptation option (Table IV). They were asked what they or their descendents probably would do if farmlands next to their homesteads go – “almost ankle height (10-15 cm)”, “half-knee height (20-25 cm)” and “knee height (30-40 cm)” below saline water permanently by the year 2020-2030, 2050-2075 and 2080-2100, respectively? Altogether eight adaptation pathways were identified. These are: raising homestead and continue with same occupation anyway; raising homestead and continue agriculture with saline and flood tolerant varieties; raising homestead and use

**Table III.**  
Key sources of vulnerability associated with SLR that can cause mass displacement

Sources of vulnerability	Count <sup>a</sup>	Percentage of response <sup>a</sup>
a. Irrecoverable loss of income from current main source	53	35.8
b. Severe damage of essential services – local health care, market place, schooling, etc	52	35.1
c. Severe shortage of free/low cost potable water	45	30.4
d. Severe problem of food security (production/availability)	39	26.4
e. Incidence of evacuation of most relatives from the locality	19	12.8

**Note:** <sup>a</sup>Multiple responses (*n* = 148; total responses = 208)

**Table IV.**  
Preference for adaptation for three plausible scenarios of CC-SLR

Preference for adaptation ( <i>in situ</i> or evacuation) if farmland next to their homesteads permanently go below saline water of	10-15 cm (ankle height) by 2020-2030		20-25 cm (half of knee height) by 2050-2075		30-40 cm (almost knee height) by 2080-2100	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
a. <i>In situ</i> adaptation with same occupation	198	69.5	132	46.3	66	23.2
b. <i>In situ</i> adaptation with changed occupation	87	30.5	68	23.9	49	17.2
c. Evacuation/displacement	0 <sup>a</sup>	0.0	85	29.8	170	59.6
Total	285	100	285	100	285	100

**Note:** <sup>a</sup>Respondents do not considered 10-15 cm inundation as a problem and have rejected the last options as adaptation strategy for 10-15 cm rise of water

of saline affected land for aquaculture; commuting for non-farm occupation; evacuating and settle nearby safer localities; evacuating and take refuge nearby urban centres; evacuating the locality without predefined destination.

To make the preference for adaptation choices more distinct and meaningful similar adaptation pathways were consolidated and have been presented in three major distinct preference categories. These are *in situ* adaptation with same occupation, *in situ* adaptation with changed occupation, and evacuation/displacement (Table IV). In the immediate term (2020-2030), no evacuation is expected. However, almost 30 and 60 per cent respondents believe that they or their offspring might prefer evacuation for the medium term (2050-2075) and distant term (2080-2100) scenarios of SLR.

Currently almost 17 million people inhabit in the coastal low lying areas and by 2050, 130 million more people will be added in Bangladesh many of whom will be in that fragile coastal tract (GOB, 2008). How this huge number of people will be relocated if two-thirds of them eventually evacuate the coast-lying areas due to SLR is of very critical concern. This massive relocation could only be avoided with careful *in situ* adaptation planning for which there is clear need for information about the drivers of *in situ* adaptation. In the following section the driving force of *in situ* adaptation especially the role of climate awareness is quantitatively assessed.

#### 4.3 Factor analysis to identifying the factors/variables to be used in “adaptation preference” model

Initially, altogether 21 factors/variables which include various physical capitals/resources (identified by Blaikie *et al.* (1994), Smithers and Smith (1997), Kelly and Adger (2000) and Adger *et al.* (2003, 2005)), social capitals/resources (identified by Pelling and High (2005), Smit and Wandel (2006) and Fussel (2007)), information resources (identified by Phillips (2003) and Leal Filho (2009)) and psycho-social/behavioural elements (identified by Patt and Gwata (2002), Grothmann and Patt (2005) and Grothmann and Reusswig (2006)) were entered in principal component analysis (PCA) for identifying major components. Among them 13 factors/variables were dummy coded following Hardy and Bryman (2002) and the remaining eight variables are measured in their respective SI units. However, as the factor/variable “frequent adaptation against storm/surge (dummy)” is a constant it is excluded and finally 20 factors/variables were loaded in PCA.

In this PCA as the value of determinant of correlation matrix was found  $>0$  (i.e. 4.73E-05), the Kaiser-Meyer-Olkin value for sampling adequacy was 0.57, and the Bartlett’s test of sphericity was significant at  $p < 0.001$  the factor analysis is considered statistically valid (Field, 2005). Furthermore, a total of 20 variables for a sample size of 285 meet the requirement for factor analysis (i.e. 5:1 case/variable ration as recommended by Coakes and Steed (2001) as well. Finally, total eight components having Eigenvalue  $> 1$  were extracted using varimax rotation with Kaiser normalization to maximize intra-component variances as suggested by Tabachnick and Fidell (1996). These eight components have explained almost 72 per cent of the variances which is higher than the threshold recommended by Hair *et al.* (2006). Component-wise load factors (load factor  $< 0.200$  is not shown) of variables are presented in Table V.

The first component could be termed as “attachment with coastal environment”, which constitutes three variables that explains 13.89 per cent of the variances. The second component could be characterized as “wealth and social standing” which

**Table V.**  
Rotated factor loading  
matrix of  
components/variables  
having influence on  
preference for adaptation

Variable	1	2	3	4	5	6	7	8
Duration of living (yr)	0.95							
Age of respondent (yr)	0.83							
Changed settlement since birth (frequency)	-0.74							
Total farm land (ha)		0.89						
Total yearly income (BDT)		0.87						
Possession of television (dummy) <sup>a</sup>		0.76						
Education of respondent (yr of schooling)		0.57						
Habit of personal contact with official (dummy) <sup>a</sup>	-0.33		0.88					
Membership status of any entity (dummy) <sup>a</sup>	-0.20		0.87					
Use of newspaper for weather knowledge(dummy) <sup>a</sup>	-0.23	0.24	-0.22	0.70				
Adaptation with recurrent flood (dummy) <sup>a</sup>			0.22	0.57		0.38		0.28
Recurrent exposure to saline water (dummy) <sup>a</sup>				0.23	-0.80			
Recurrent exposure to rainfall (dummy) <sup>a</sup>				0.26	0.69			
Peer/community as source of knowledge (dummy) <sup>a</sup>					0.45	0.25		
Distance from the coast (km)						0.85		
Household size (number)						-0.59		
Adaptation with recurrent dry spell (dummy) <sup>a</sup>							0.85	
If agriculture and allied livelihood (dummy) <sup>a</sup>							0.53	0.20
If respondent is male (dummy) <sup>a</sup>								0.68
Regular access to radio (dummy) <sup>a</sup>								0.66
Variance(%)	13.89	13.51	-0.21	7.89	7.70	7.47	-0.31	5.61
Cumulative variance (%)	13.89	27.40	36.97	44.86	52.56	60.04	66.46	72.07

**Notes:** <sup>a</sup>Variable with dummy coding follows simple logic of applicability or non-applicability; if the response is yes it is coded with 1 otherwise 0 (for details see Hardy and Bryman (2004, pp. 24-5, 210-1))

constitutes four variables that explains 13.51 per cent of the variances. The third component related with “social networking” constitutes two variables and explains 9.57 per cent of the variances. The fourth component has two variables characterized with “access to print media for flood information” and explains 7.89 per cent of the variances. Likewise, the fifth component is “coping and adaptation with recurrent hazard” which includes three variables and explains 7.70 per cent of the variances. The sixth component has two variables characterized with “spatial and demographic causes of exposure to climatic hazard” and explains 7.47 per cent of the variances. The seventh component is related to “exposure potential of dry spell due to types of occupation” which includes includes variables and explains 6.42 per cent of the variances. The last component is characterized as “gender difference in electronic media use for climate information” which constitutes two variables that explains 5.61 per cent of the variances. While PCA identified the components and factors having influence on respondents’ adaptation choices, however, it does not quantified the extent of influence of each relevant variable/factor on respondents’ adaptation preferences; a MLR model was used later to identify the extent of such influence.

#### 4.4 Model parameterization and selection of variables for use in MLR model

After reclassification of adaptation pathways, the dependent variable “respondent’s adaptation choice” has left three options. There are “*in situ* adaptation with same occupation”, “*in situ* adaptation with changed occupation” and “evacuation/displacement” (Table IV). It does not reflect any precise ordering hence MLR analysis is preferred over ordered logistic regression (Field, 2005). In the MLR model, in addition to three climate awareness indices such as: “familiarity index”, “perception index”, and “knowledge index”, all the 20 variables drawn from the PCA (Table V) were planned to use as independent/predictor variables. However, bivariate correlation analysis has identified strong colinearity between “total yearly income (Bangladeshi Taka (BDT))” and “total farmland (ha)” ( $r = 0.91$ ), “duration of living (yr)” and “age of respondent (yr)” ( $r = 0.81$ ) and “membership status of any entity (dummy)” and “personal contact with official (dummy)” ( $r = 0.73$ ) (Table VI). Following Hair *et al.* (2006) the variable “total yearly income (BDT)”, “duration of living (yr)” and “membership status of any entity (dummy)” have been excluded from the model because of their strong colinearity ( $r > 0.70$ ). Thus, total PCA variable turned out to be 17.

Furthermore, in order to correctly fit with the MLR model, all the 12 dummies (independent variables) from these 17 variables were separately cross-tabulated with the dependent variable “respondent’s adaptation choice” to eliminate dummy variables (binary coded) having any empty cell or 0 frequency. Thus, after dropping “possession of television (dummy)” and “habit of reading newspaper (dummy)” the total explanatory variables became 18 (including three climate awareness indices). Finally, these 18 variables were entered into the MLR model. Here, the reference category is “evacuation”, which was compared with the other two choices, i.e. “*in situ* adaptation with same occupation” (Table VII), and “*in situ* adaptation with changed occupation” (Table VIII). As no incidence of evacuation was observed for immediate scenario (2020-2030), the MLR model was used for only medium (2050-2075) and distant term (2080-2100) scenarios of CC-SLR. After running the MLR model factors that significantly explain the variations in respondents’ preferences for *in situ* adaptation (with same occupation or with changed occupation) over evacuation were identified.



7	0.007	0.076	-0.017	-0.066	0.078	-0.081	-0.037	-0.110	-0.107	0.073
8	-0.130*	-0.221**	-0.048	-0.088	-0.173**	0.729**	0.142*	0.027	-0.021	-0.179**
9	0.909**	-0.083	0.487**	0.342**	0.036	-0.156**	0.096	0.160**	-0.168**	0.007
10	-0.301**	0.153**	-0.184**	-0.341**	0.051	-0.167**	-0.240**	-0.147*	0.288**	0.054
11	1	-0.072	0.485**	0.367**	0.073	-0.132*	0.158**	0.170**	-0.215**	-0.009
12	-0.072	1	-0.135*	-0.171**	0.095	-0.120*	-0.116	0.004	-0.102	0.058
13	0.485**	-0.135*	1	-0.020	0.013	-0.052	0.079	0.059	-0.081	-0.110
14	0.367**	-0.171**	-0.020	1	0.077	-0.096	0.146*	0.109	-0.032	-0.127*
15	0.073	0.095	0.013	0.077	1	-0.125*	0.065	0.071	0.083	-0.126*
16	-0.132*	-0.120*	-0.052	-0.096	-0.125*	1	0.097	0.126*	-0.021	-0.104
17	0.158**	-0.116	0.079	0.146*	0.065	0.097	1	0.156**	-0.013	-0.365**
18	0.170**	0.004	0.059	0.109	0.071	0.126*	0.156**	1	0.063	0.234**
19	-0.215**	-0.102	-0.081	-0.032	0.033	-0.021	-0.013	0.063	1	0.070
20	-0.009	0.058	-0.110	-0.127*	-0.126*	-0.104	-0.365**	0.234**	0.070	1

**Notes:** Correlation is significance at: \*0.05 and \*\*0.01 levels (two-tailed); description of variables: 1, distance from the coast (km); 2, age of respondent (yr); 3, if respondent is male (dummy); 4, education of respondent (yr of schooling); 5, duration of living in present place (yr); 6, changed settlement since birth (frequency); 7, household size (number); 8, membership status of any entity (dummy); 9, total farmland (ha); 10, if agriculture and allied livelihood (dummy); 11, total yearly income (BDT); 12, regular access to radio (dummy); 13, possession of television (dummy); 14, use of newspaper for weather knowledge(dummy); 15, peer/community as source of knowledge (dummy); 16, habit of personal contact with official (dummy); 17, recurrent exposure to rainfall (dummy); 18, adaptation with recurrent flood (dummy); 19, adaptation with recurrent dry spell (dummy); 20, recurrent exposure to saline water (dummy)

Table VI.

**Table VII.**  
MLR for factors likely to influence the people's choice of adaptation with same evacuation or evacuation as strategy against SLR

<i>In situ</i> adaptation with same occupation relative to evacuation	Scenario: 2050-2075: if farmlands next to homestead permanently go 20-25 cm (half knee height) below saline water			Scenario: 2080-2100: if farmlands next to homestead permanently go 30-40 cm (almost knee height) below saline water		
	B: Coefficient	Exp(B): odds ratio	Wald $\chi^2$	B: Coefficient	Exp(B): odds ratio	Wald $\chi^2$
Intercept	-2.19		0.75	-5.617		2.82
Distance from the coast (km)	-0.03	0.97	0.60	-0.06	0.94	0.90
Education of respondent (yr of schooling)	-0.09	0.91	1.54	-0.19	0.82 *	4.08
Household size (number)	-0.003	0.99	0.00	0.25	1.29	1.25
Total farm land (ha)	-0.12	0.89	1.89	0.09	1.09	0.79
If respondent is male (dummy)	-0.16	0.85	0.23	-0.41	0.66	0.86
If agriculture and allied livelihood (dummy)	1.06	2.88 *	5.65	1.34	3.84 *	5.86
Regular access to radio (dummy)	1.13	3.10 **	10.44	1.50	4.47 **	8.95
Peer/community as source of knowledge (dummy)	0.70	2.01	3.07	0.10	1.10	0.03
Recurrent exposure to rainfall (dummy)	1.48	4.40 ***	12.83	1.44	4.22 **	7.58
Adaptation with recurrent flood (dummy)	-0.21	0.81	0.21	-1.49	0.23 ***	7.68
Adaptation with recurrent dry spell (dummy)	-0.63	0.53	2.73	-2.78	0.06 ***	18.81
Recurrent exposure to saline water (dummy)	-0.46	0.63	1.65	-0.69	0.50	2.09
Age of respondent (yr)	0.007	1.01	0.12	-0.005	0.99	0.04
Changed settlement since birth (frequency)	-0.14	0.87	0.13	0.63	1.88	2.04
Climate familiarity Index (in 100)	-0.04	0.96	3.60	-0.05	0.95 *	4.35
Climate-SLR perception index (in 100)	0.05	1.05 *	4.99	0.09	1.10 **	8.99
Intuitive knowledge about SLR impact index (in 100)	0.006	1.01	0.14	0.01	1.01	0.48
Habit of personal contact with official (dummy)	-0.14	0.87	0.12	0.78	2.17	2.30
Likelihood ratio $\chi^2$		183.38 ***			202.08 ***	
Pseudo (Nagelkerke) $R^2$		0.54			0.60	
<i>n</i>		285			285	

**Notes:** Significance at: \*  $p \leq 0.05$ , \*\*  $p \leq 0.01$ , and \*\*\*  $p \leq 0.001$ ; the reference category is: evacuation (coefficient with minus sign indicates preference for evacuation)

<i>In situ</i> adaptation with changed occupation relative to evacuation	Scenario: 2050-2075: if farmlands next to homestead permanently go 20-25 cm (half knee height) below saline water		Scenario: 2080-2100: if farmlands next to homestead permanently go 30-40 cm (almost knee height) below saline water	
	B: Coefficient	Exp(B): odds ratio	B: Coefficient	Exp(B): odds ratio
Intercept	-3.557		2.471	
Distance from the coast (km)	-0.03	0.97	1.05	0.56
Education of respondent (yr of schooling)	0.08	1.09	0.34	0.13
Household size (number)	-0.20	0.82	0.78	0.75
Total farm land (ha)	-0.30	0.74	0.86	0.96
If respondent is male (dummy)	0.20	1.23	3.13	0.05
If agriculture and allied livelihood (dummy)	2.04	7.68***	0.23	0.70
Regular access to radio (dummy)	2.22	9.18***	8.42	2.75
Peer/community as source of knowledge (dummy)	-0.33	0.72	19.46	6.24
Recurrent exposure to rainfall (dummy)	-0.19	0.83	0.43	1.16
Adaptation with recurrent flood (dummy)	-0.32	0.73	0.16	1.50
Adaptation with recurrent dry spell (dummy)	-0.30	0.74	-0.44	0.70
Recurrent exposure to saline water (dummy)	1.98	7.23**	0.41	2.53
Age of respondent (yr)	-0.01	0.99	11.01	7.60
Changed settlement since birth (frequency)	-0.54	0.58	-0.02	0.75
Climate familiarity index (in 100)	-0.03	0.97	0.64	0.27
Climate-SLR perception index (in 100)	0.02	1.02	1.18	3.08
Intuitive knowledge about SLR impact index (in 100)	0.03	1.03	-0.04	0.99
Habit of personal contact with official (dummy)	-1.53	0.22*	-0.004	0.02
Likelihood ratio $\chi^2$		183.38***	2.05	0.08
Pseudo (Nagelkerke) $R^2$		0.54	-1.04	2.83
<i>n</i>		285	202.08***	

**Notes:** Significance at: \*  $p \leq 0.05$ , \*\*  $p \leq 0.01$ , and \*\*\*  $p \leq 0.001$ ; the reference category is: evacuation (coefficient with minus sign indicates preference for evacuation)

**Table VIII.**  
MLR for factors likely to influence the people's choice of adaptation with changed occupation or evacuation as strategy against SLR

#### 4.5 Interpretation of output of MLR model

4.5.1 *In situ adaptation with same occupation vs evacuation.* For the SLR scenario of 2050-2075 (20-25 cm inundation) occupational engagement, use of radio as source of weather/climate information, exposure to rainfall, perception about CC-SLR appeared as the most significant predictors of intension for evacuation or *in situ* adaptation with same occupation (LR  $\chi^2 = 183.38$ , pseudo  $R^2 = 0.54$ ,  $p < 0.001$ ). Similarly, for the SLR scenario of 2080-2100 (30-40 cm inundation) in addition to the above cited four factors an additional four factors such as educational attainment, exposure to recurrent flood, dry spell, and climate familiarity, emerged as the most significant predictors of respondents' preferences (LR  $\chi^2 = 202.08$ , pseudo  $R^2 = 0.60$ ,  $p < 0.001$ ) (Table VII). However, for neither of the scenarios of SLR some common socio-demographic, economic and cultural factors such as age, sex, social network and size of farmland holding have any significant influence on the respondents' preferences for adaptation or evacuation.

It is a bit surprising that contrary to general expectation even knowledge differences about SLR's impacts do not have significant influence on the respondents' preference for adaptive response. Similarly, contrary to expectation, no significant differences were observed in adaptation preferences for respondents living on the coast (within 5 km) and off the coast (within 10-15 away from the coast (Table VII). The reason could be attributed to the fact that everyone cares much about cyclone and surges for which almost no differences in impacts are usually felt for even 50 km inward from the coast because the whole coastal tract is nearly flat.

People engaged in agriculture and allied occupations are more likely than others to prefer *in situ* adaptation over evacuation for both the scenarios of SLR. This occupational category prefers *in situ* adaptation primarily because this is the only skill that each individual possesses. They believe any evacuation may force them into a more challenging situation while struggling for their future security of livelihood. However, there is greater prospect for relocating people currently engaged in non-agricultural professions. Failure to relocate this category of people may leave millions of souls eventually as climate refugees.

People having regular access to radio as sources of climate/weather information are more likely than those who do not have such access to prefer *in situ* adaptation over evacuation for both the scenarios of SLR. It is probably because weather information and warning disseminated via radio were credible enough to the listeners to take precaution to avoid or minimize loss in the event of climate related natural disasters. This finding supports the findings of other studies where the role of radio, especially community radio to disseminate the warning information before the onset of natural disasters are highly hailed (Steel *et al.*, 2005; Kurita *et al.*, 2006; Perry, 2007; Collins and Kapucu, 2008; Cretikos *et al.*, 2008). This finding is substantive for policy makers because by increasing credible radio programmes on weather, climate and SLR it might be possible to build awareness for *in situ* adaptation among the people who have been living in the coastal regions for years.

People having experience of recurrent exposure to intense and prolong rainfall are more likely than those who do not have such experience to prefer *in situ* adaptation over

evacuation for both the scenarios of SLR. The key reason could be the fact that this group of people believe that their indigenous coping and adaptation strategies, which they have developed over years, would be adequate to face the future challenge as well. It is hard to say whether they are overestimating their ability, which is often the case. In psychology this syndrome is termed as “illusion of control” (Wortman, 1976). However, any overestimation of current coping capacity may lead some people of this category to prefer evacuation eventually when they face actual situations of vulnerability in the future.

Respondents having better/accurate perception about CC-SLR are more likely than others who do not have such perceptions to prefer *in situ* adaptation with same occupation over evacuation. This finding confirms with other studies which conclude that people having accurate/better perception about a problem are more rational while devising ways to counteract with the problem (Grothmann and Patt, 2005; Grothmann and Reusswig, 2006; Blennow and Persson, 2009). It implies that there is greater need for building accurate perception about the dynamics of CC-SLR among the coastal inhabitants to encourage *in situ* adaptation. Appropriate information about the CC-SLR may help them leave out any misconception that they might have derived from rumour concerning possible lose of settlement altogether due to accelerated SLR. This finding confirms with the theory of climate communication (Leal Filho, 2009; Nerlich *et al.*, 2010) and is substantive for policy makers while designing programme components for raising climate awareness.

Even if most respondents do not care much about 20-25 cm inundation by 2050-2075, many of them are serious about the possible inundation of 30-40 cm by 2080-2100. For example, respondents with higher educational attainment than low achievers believe they or their descendents are more likely to prefer evacuation over *in situ* adaptation for the distant scenario (2080-2100) of SLR (Table VII). It implies that substantial relocation of educated people is and needs to be handled with careful planning. This finding may be unexpected for a land-scarce country like Bangladesh, but it is not unusual. This finding confirms very fundamentals of modern migration where it is theorized that educated people can more afford the risk of displacement than less/uneducated one. Here, future SLR might act as a push factor to force better educated groups to move out from the naturally vulnerable coastal tracts. Since, a growing body of migration literature confirms that educated people quit their place of origin for their developmental needs, it is very usual that they will evacuate the fragile coast for their survival needs as well, and resettle elsewhere.

Respondents having more experience of recurrent exposures to flood and seasonal dry spells are more likely than those who have less exposure of such kind to prefer evacuation over *in situ* adaptation with same occupation. Apparently, the finding is contrary to the general belief that people with more experience of coping are more likely to continue to better cope in future as well, and thus prefer adaptation over evacuation. However, in reality this may not be the case because of the limit of coping capacity, i.e. these people are already in their upper end of coping threshold. Any additional exposure may lead mass displacement due to their fear that the future recurrent hazard must exceed their coping ranges which confirms with the findings of Blaikie *et al.* (1994). Teversky and Kahneman (2008) and Crocker (1981) typified this fear as “availability heuristic” and is much like the way people with higher climate familiarity are more likely to prefer evacuation over *in situ* adaptation (Table VII).

The above finding does not confirm earlier findings, for example, Weber (1997) and Semenza *et al.* (2008). This contrasting finding is unusual but not altogether unexpected. Higher evacuation intention with increased familiarity of climatic events may be attributed to the possibility that such familiarity about CC-SLR might have frightened the respondents and created panic about the possible impacts of SLR rather than making them aware about these. This finding has to be evaluated very carefully with further exploratory research because it signifies that if peoples are partially aware about the possible rises of sea level such awareness may even be counter productive- resulting in mass displacement. As a remedy, while designing awareness raising programme about CC-SLR, programme components must be put in a way that these will not create panic among the coastal people. Rather these should build awareness through altering wrong notions and experiences, and encouraging them to adapt with the possible effects of CC-SLR. Finally, it should be noted as well that some people having more familiarity with climate change/weather extreme still may prefer evacuation over *in situ* adaptation if those people are more cautious about their life and livelihood, and always bear risk aversion attitude.

4.5.2 *In situ adaptation with changed occupation vs evacuation.* For the SLR scenario of 2050-2075 (20-25 cm inundation) people engaged in agriculture and allied occupations are 7.68 times more likely than people of non-agricultural occupations to prefer *in situ* adaptation with changed occupation over evacuation. However, for the SLR scenario of 2080-2100 (30-40 cm inundation) occupational engagement does not have any significant influence on peoples' preferences. Similarly for the SLR scenario of 2050-2075 (20-25 cm inundation) people who use radio as source of climate/weather information are 9.18 times more likely than who does not use radio to prefer *in situ* adaptation over evacuation. However, for the SLR scenario of 2080-2100 (30-40 cm inundation), preference for *in situ* adaptation with changed occupation over evacuation of the regular listener of radio is only 3.15 times higher than who does not listen regularly (Table VIII).

The above finding gives two clear messages. First, with the increased amount of SLR people will be more likely to prefer evacuation over *in situ* adaptation in general. Second, beyond certain level of SLR adaptation may not work – meaning adaptation has a limit. This finite nature of adaptive capacity confirms with the findings of Adger and Barnett (2009), Adger *et al.* (2009) and Barnett and Adger (2010) where they have given clear indication that after a certain levels people cannot adapt any more, thus the effort for innovative mitigation measures must continue.

However, for both the scenarios of SLR people who have the experiences of recurrent exposure to salinity are more likely than those who do not have such experiences to prefer *in situ* adaptation with changed occupation over evacuation. It is a stark contrast against the general belief that with increased salinity the tendency for evacuation will increase. But in reality people may prefer changed occupation over evacuation. It is primarily because over the years many people have adapted with salinity by investing in brackish water shrimp production. They believe, in the event of gradual SLR they would be able to harness the positive benefit out of it. Because, as of now, they have to spend quite a lot of money to bring saline water from the rivers/canals to their shrimp “gheers” (farms), however, for gradual SLR they may not need to spend additional money for it. This finding is also substantive; it indicates that the more the number of people in the coastal areas engaged in brackish water aquaculture the more their chances to follow *in situ* adaptation. Despite this general finding it is equally true that over times their preferences

for evacuation may increase because for 20-25 cm inundation (by 2050-2075), preference for *in situ* adaptation over evacuation is 7.23 times higher but for the 30-40 cm inundation (by 2080-2100), preference for *in situ* adaptation over evacuation is only 4.88 times higher. Here, again the question of limit to adaptation comes (Adger and Barnett, 2009; Adger *et al.*, 2009; Barnett and Adger, 2010).

## 5. Conclusion and recommendations

Accurate estimation of the extent of possible impacts of CC-SLR along Bangladesh coast is yet to be confirmed. Nonetheless, peoples in the coastal areas need to be prepared for anticipatory adaptation to avoid mass displacement. Because, Bangladesh may not be able to afford the cost of relocation of millions of families in the mainland which is already highly densely populated (GOB, 2008). For coastal communities to adapt against CC-SLR there is need for full understanding about the various dynamics of climatic events and SLR. This study examined the local people's relative levels of familiarity with, perception about, and intuitive knowledge about possible impacts of CC-SLR. Further, it examined how different dimensions of climate awareness such as familiarity, perception, knowledge about CC-SLR and various socio-demographic, economic, adaptive behavioural and climate information related factors influence the coastal people's preference for *in situ* adaptation over evacuation given the plausible scenarios of future SLR.

The finding has confirmed that while educational attainment, occupational engagement, use of radio for climate information, past exposure against intense rainfall, flood, salinity intrusion, climate familiarity and perception about CC-SLR have significant influences on the peoples' likely preference for adaptation choice, many common socio-demographic, economic, cultural factors such as age, sex, social network and farmland holdings do not have any significant influence. A most striking feature is that distance of settlement from the coast does not significantly influence the coastal inhabitants in this regard. Two dimensions of climate awareness such as familiarity with climatic events and perception about CC-SLR have significant influences on peoples' choice of adaptation strategies. However, no difference is observed in terms of adaptation preference among respondents having higher intuitive knowledge and lower intuitive knowledge about the impacts of SLR.

The above findings have very strong policy implications. These can be summarized as follows:

- First, initiative must be taken to explore ways to retain educated and non-agricultural professional group to avoid mass out-migration. Significant out-migration of better educated people may instigate others to evacuate as well. It is primarily because in the socio-cultural context of rural Bangladesh the educated people, especially if they are elder as well, are highly regarded and others often follow them.
- Second, since the people who use radio as a source of climate/weather information prefer *in situ* adaptation over evacuation, policy makers may put more attention to the establishment of community radio and patronise the radio operating agencies for more information and awareness campaign related to adaptation with CC-SLR. This initiative may prove very effective because coastal people, a significant portion of whom have been engaged in offshore and marine fishing for generations, still consider weather information and warning disseminated through radio as credible and make plans accordingly to avoid/minimize damages from inevitable natural disasters.

- Third, some people who have adapted against salinity intrusion in the past by heavily investing in brackish water aquaculture are very likely to continue this activity as long as it is feasible for them. Policy makers could explore the ways and means to support this group without undermining the livelihood struggle of other occupational groups especially rice growers.
- Fourth, campaigns targeting coastal people may be initiated to build positive perception and increase awareness about *in situ* adaptation against the impacts of CC-SLR. It is primarily because people with better/accurate perception about CC-SLR have shown their intention for *in situ* adaptation. Since transfer of (climate) knowledge is intergenerational, future generations will also benefit from current awareness campaigns (Gronhoj and Thogersen, 2009).

Further, it is equally important to keep in mind that people with more climate familiarity have shown their intention for evacuation which is a stark contrast with the general expectation. Policy makers and researchers alike must concentrate more on this. A concluding remark in this regard is that such familiarity probably has frightened them about the impact of CC-SLR rather than making them aware about these natural processes. Carefully designed intervention needs to be initiated without further delay to let them acquire authentic knowledge about the adaptation against CC-SLR from credible institutions. This may help them leave out any wrong conception and encourage them to think about *in situ* adaptation. However, the need for further exploratory research to see with deeper insight why this group of people are willing to evacuate contrary to general expectation of *in situ* adaptation is not ruled out. In this regard, the key research question for future research could be: whether the intention for evacuation of people having more familiarity with climate change/weather extreme is due to their past bad experiences from natural calamities.

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