



## CLIMATE CHANGE: ADAPTATION AND PERCEPTION AT COASTAL REGIONS PERIPHERAL TO THE SUNDARBANS, BANGLADESH

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### Abstract:

This study demonstrates the adaptation and perception to the climate change by focusing the community's views and experience. This study suggests that majority (90%) of the coastal community proximity to the Sundarbans is experienced to adaption with changing environmental vulnerabilities but the major challenge they face is limitation of financial support. At the same time, most of the community (79%) has no knowledge about climate change but the rest have medium or little knowledge (21%). Results revealed that financial and insufficient livelihood support (76%), overlooking the needs of local communities are the key problem of climate change adaptation and perception. At the same time, most of the respondents are middle aged, less literate, and fishing is the primary occupation, while wood is the main source of their energy. Besides, geographical location, natural and anthropogenic challenges, lack of in-depth knowledge towards climate change adaptation and its vulnerabilities, and inadequate integration of policies and programs are hindering sustainable adaptation. The study suggests that information and knowledge must be improved within the community to find out and practice local scale adaptation options like livelihood diversification, diversify use of resource, community based co-management and financial support. Similarly, relevant training and awareness program could be effective to reduce the vulnerability of most innocent victims of the coastal area

**Keywords:** Co-management, financial support, livelihood, sustainable adaptation, vulnerable.

### Introduction:

Bangladesh is among the nations that are most at risk from climate change and coastal regions of Sundarbans which provides innumerable tangible and intangible benefits in this delta is the hot spot of climate change (Helal Siddiqui & Islam, 2021). The communities of this region are at severe risk in environmentally, socio-economically, culturally due to adverse impact of climate change (Selvaraju et al., 2006; NAPA, 2005). According to the most recent IPCC estimates from their Fourth Assessment Report, warming is predicted to occur over the next 20 years at a rate of 0.2° C each decade. The best predictions indicate that by 2100, the average global temperature will have increased by 1.8 to 4 ° C, while it may reach 6.4° C (Alley et al., 2008; Gregory et al., 2005; Islam et al., 2022). Within the next fifty years or so, it is possible that average global temperatures may rise by 1 to 3°C on current patterns, and if greenhouse gas emissions continue to soar, the Earth will continue to warm by several degrees more (IPCC, 2001; Adger et al., 2007).

The most pervasive and escalating issues in the modern world are climate change, ecosystem degradation, and a rise in natural disasters. This suggests that ecosystem function is under threat at a level that is having an increasingly detrimental effect on human well-being (UNEP, 2008). Bangladesh, where millions of people already suffer, is the only nation and people who are more familiar with this issue. Bangladesh has been considered as one of the nation's most susceptible to the effects of climate change (Siddique, N.A., 2001; Islam et al., 2022). This is a result of its particular geographic location, the dominance of the floodplain, the slow elevation from the sea, the high population density, the high levels of poverty, the inadequate infrastructure, the low level of social development, the lack of institutional capacity, and the extreme reliance on the resources and services of nature (FAO, 2007; Helal Siddiqui et al., 2021; Dey, et al., 2021). A major risk factor for risk aversion is the growing climate

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uncertainty, which poses an additional concern in Bangladesh's disaster-prone regions (Ahmed et al., 2022). Due to the effects of climate change, it is anticipated that the intensity and variability of climatic dangers would continuously grow in the near future (Ahmed, 2004; Sheikh et al., 2021; Islam, et al., 2021).

The majority of coastal settlements near the Sundarbans lack access to electricity and clean drinking water. The region's agricultural output is less than the state average. A low level of development and a high incidence of poverty in the area have been attributed to inadequate infrastructure, poor communication facilities, a lack of access to clean drinking water, health, education, and services (Islam, 2019; Dey et al., 2020). This enormous population depends on the Sundarbans either directly or indirectly for their livelihood (Abdul, 2014). The binding and cohering of soil by plant roots and vegetative matter, the dissipation of erosion pressures including wave and wind energy, and the trapping of sediments are all ways that mangrove plays a significant role in shore line stabilization (Helal Siddiqui & Islam, 2019; Dey, et al., 2021a). The mangroves serve as a natural barrier for the coastal human settlements, reducing the severity of cyclones and tidal surges (Ahmed et al., 2022). The protective effect of the Sundarbans was felt strongly following the super cyclone Sidr. It is generally believed that without the Sundarbans, the damage from cyclones Sidr and Aila would have been much worse (Islam et al., 2020; Helal Siddiqui & Islam, 2020).

The current study is carried out to capture the views of community peoples regarding ecosystem based adaptation so that their views can be recommended to incorporate in policy level. The results of this study may be used to identify possible areas where the community's capacity to adapt to rapidly changing climate variability could be accommodated. Again, the research findings would be supportive to increase the adaptive capability of vulnerable coastal community and to develop strategy for ecosystem based adaptation to climate change proximity to coastal Sundarbans. Furthermore, the findings would be beneficial for planners and policy makers and vulnerable coastal community. The study is carried out to better understand the climate change's effects on the coastal ecosystem as well as on the lifestyle of the local people. However, the objectives of the study are as follows-

1. To clarifies the adaptation and perception to climate change by focusing the respondents's views and experience.
2. To identify problems and provide insightful suggestions to some adaptation preferences for climate-sensitive coastal environments and its resources.

## Material and methods

### Selection of the Study Area

A World Heritage Site, the Sundarbans (21°39'- 22°30'N, 89°01'-89°52'E) is made up of three wildlife sanctuaries (Sundarbans West, East, and South) that are located on nearby deltaic islands. The Sundarbans, a region of 10,000 km<sup>2</sup> of land and water, is a section of the world's largest delta, which was created when the Ganges, Brahmaputra, and Meghna rivers converged in the Bengal Basin and left behind sediments (Reid et al., 2007; Siddique, N.A., 2001; Helal Siddiqui & Islam, 2020). The study area is located at Symnagor Upazilla of Satkhira district, Soronkhola Upazilla of Bagerhat district and Dhangmari Upazilla of Khulna district, and all of this sampling area located proximity to Sundarbans (Fig. 1). The communities of the area living at embankment are vulnerable to climate induced natural disaster like cyclone, flood, tidal surge, terrorism, tiger attack, river erosion, salinity intrusion by sea level rise and manmade activities (Siddique, N.A. 2001). People are usually collect rain water as drinking purpose and sometimes collect water from tube-wells which are near about 7/8 kilometer far away from their house. Children are frequently afflicted with water-borne illnesses such diarrhea, dysentery, skin conditions, etc. as a result of contamination and salinity (Islam, et al., 2021). People in the studied areas generally have poor socio-economic conditions, making it difficult for them to adapt to climate change and extreme weather (Islam et al., 2020). Therefore, the research region selection was significant in terms of sensitivity to find ecosystem-based adaption options for the study area's local population.

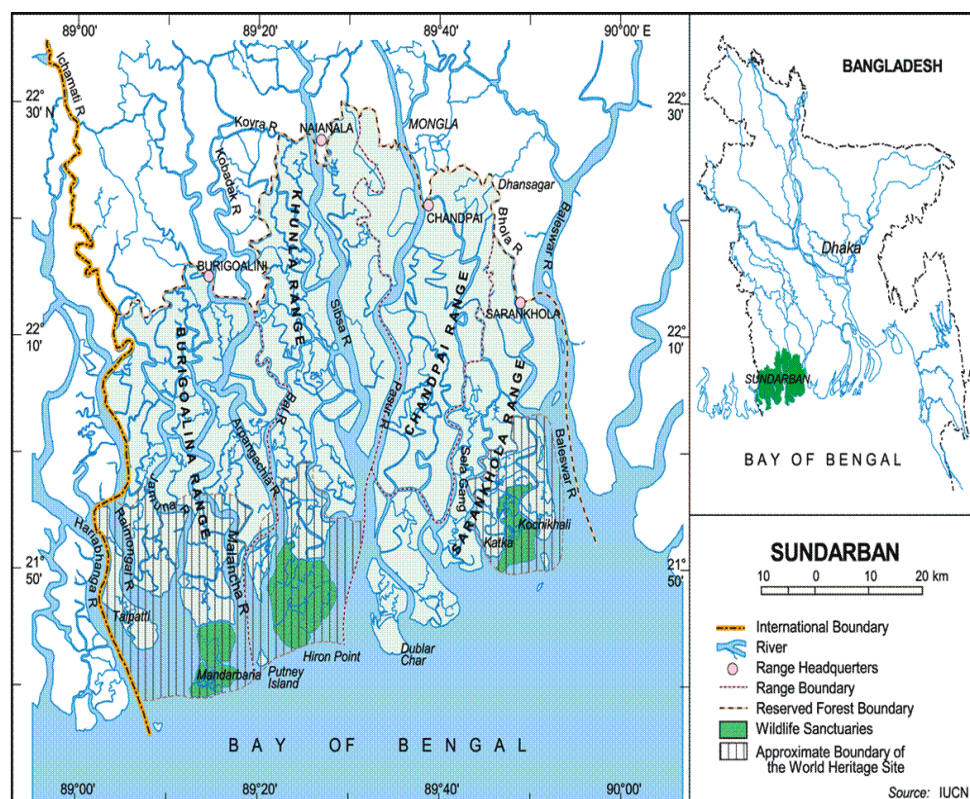


Figure 1. Map of the study area.

### Questionnaire preparation and survey

A questionnaire for the selected community was created taking into account the study's objectives. The study's primary data were obtained from a total of 120 sampling units using multistage purposive sampling techniques and a semi-structured questionnaire. Finally, from several government organizations (GOs) and online sources, secondary data and information were gathered.

### Data Analysis

The data was processed after it was collected from secondary and primary sources. After being sorted, the information and data were categorized, interpreted in accordance with the objectives, and analyzed with the use of MS Excel.

### Results

#### Effects of climate change on the research area's socio-economic condition

The socio-economic situation in the study area is under pressure due to the effects of climate change. Cyclone and tidal surge, tidal flood etc. natural disasters not only destroy infrastructure but also damage huge amount of production every year. Most of the climate vulnerable coastal communities were male (81%), middle aged (57%) with less family members (82.3%) and possess weak housing type in the study area. Again, their occupation, literacy level, and low income parsed out their miserable condition in the framework of climate variation adaptation and perception (Table 1).

#### Sources of energy of the respondents in the study area

Source of energy for cooking is another important indicator of the socioeconomic condition for the rural people. In the study area wood, cow dung, dried leaves are the main source of fuel energy. By ranking among the respondents, it was found that 100% respondents used wood as fuel energy for cooking and significant amount of them are

collected from the Sundarbans. In the study area, 65.4% people supported dried leaves as second option for fuel energy, while cow dung was also supported by 29% respondents as second option. Besides, 71 % people supported cow dung as third option while dried leaves were supported as third option by 35.5% people. From the ranking it is evident that, all people in the study area generally used wood for their cooking purpose. The distribution of source of energy for cooking is shown in figure 2.

Table 1. Demographic profile of the respondents in the study area.

Parameter	Categories	Percentage
Gender	Male	81
	Female	19
Age (Years)	<20	17
	20-45	57
	>40	26
Family members (In numbers)	2-6	82.3
	7-10	16.8
	>10	0.9
House type	Kacha	85.6
	Semi-pacca	12.0
	Pacca	2.4
Occupation	Agriculture	40
	Fishing	45
	Others	15
Income (BDT/Month)	<2000	35.6
	2000-6000	58.7
	>6000	5.7
Literacy level	Primary	48
	Above primary	35
	Illiterate	17

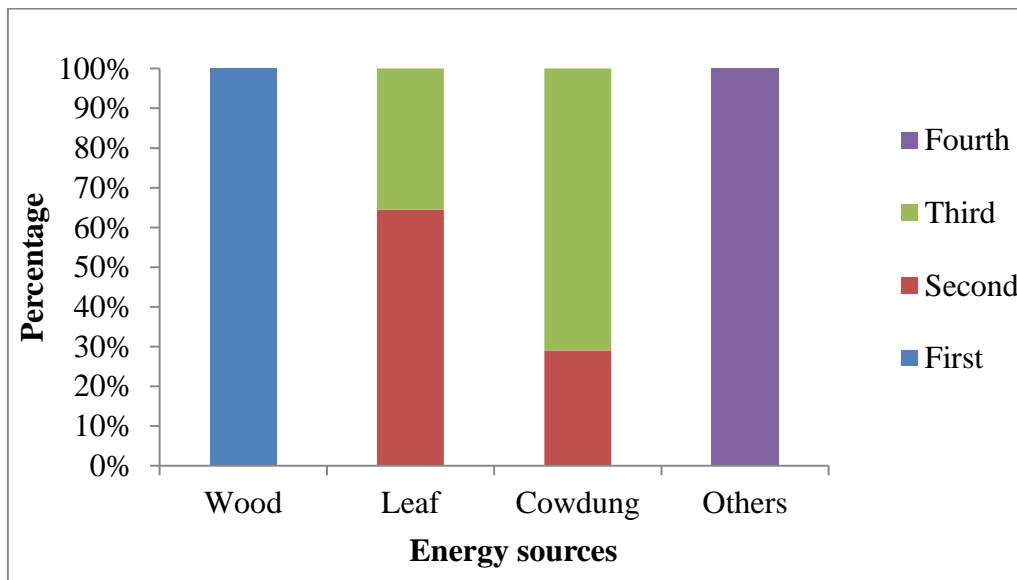


Figure 2. The distribution of fuel energy for cooking.

### Primary profession pattern of the respondents in the study area

Majority of the people in the study area mainly depends on natural resources for their livelihood. Land, water bodies, khas land, beels, forests, and livestock are the sources of their livelihood. The major ecosystem based activities in the study area are fishing and aquaculture, wood collection, honey collection. As the Sundarbans is situated near the study area, it is a major source of earning for the habitat. In the study area, 57.9% people are involved with fishing and aquaculture activities, 20.6% and 10.3% are involved in wood collection and honey collection respectively. Despite this, majority of the honey collector and wood collector mainly collect these resources from the Sundarbans. Only 11.2% are related with other activities including small-scale homestead agriculture, trading etc. The distribution of major ecosystem based activities is shown in figure 3.

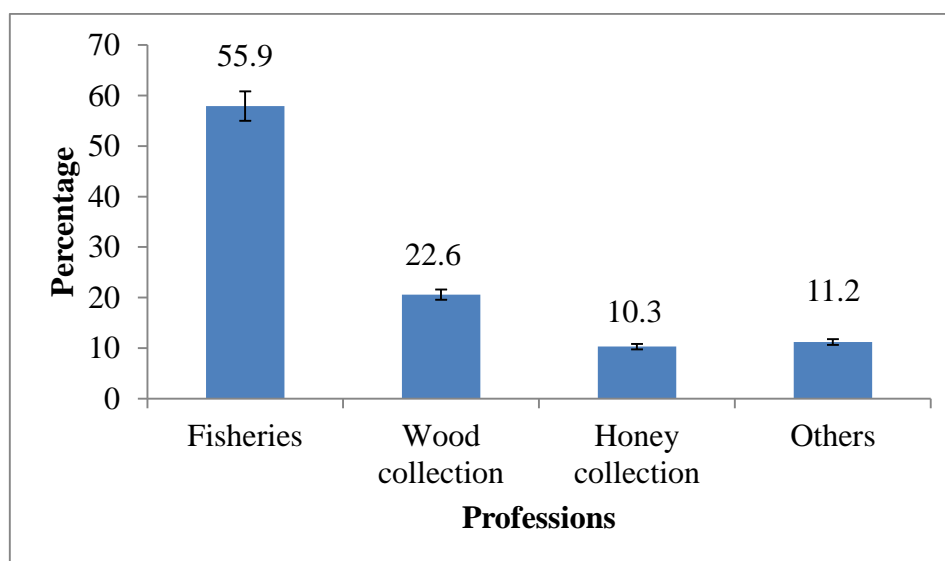


Figure 3. The distribution of major ecosystem based activities.

### Perception about climate change by the coastal community

The respondents were divided into three categories based on their level of understanding regarding climate change: those with no knowledge, those with low knowledge, and those with medium knowledge. The majority (79%) of respondents, according to data from the climate-vulnerable coastal community, had little knowledge of climate change. Only 14% people had low knowledge about climate change and only rest 7% people had medium knowledge about climate change and there was no sample found with high knowledge about climate (Figure 4). In the study area all the respondents believe that the concentration of cyclone flood salinity has increased in the contemporary years. Majority of the people disagreed about climate change but they stated that, frequent cyclone, flood are changing their locality. On the other hand, some individuals concur that climate change is a problem, but they are unaware of its causes. This contradictory comment indicates that, they have an extremely negative perception of climate change, making them more susceptible to its impacts.

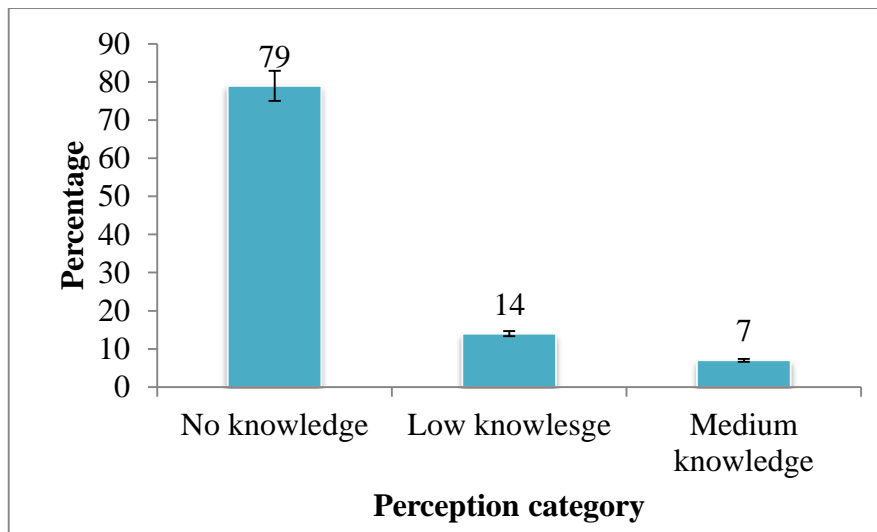


Figure 4. Perception of the respondents about climate change in the coastal area.

#### Problems faced by the respondents during working period

Most of the population in the study area face different types of problems during their working period. The Sundarbans region and the Bay of Bengal are where the fisherman must travel to fish. In the rainy season they have to catch fish in good and bad weather condition and they face different natural disasters. Wood collector and honey collector also has to go in the Sundarbans and they face different types of problems like disaster, tiger attack, shark attack, crocodile attack, disease etc. In this case, maximum people stated that, they face disaster during their activity and disease with insufficient food is also another severe concern issue. At the same time, a climbing number of people face different types of attack during their working period simultaneously. Coastal people are different types of problems and these are disasters, disease and insufficient food and animal attack. These problems reduce livelihood pattern which ultimately affects basic human needs and thus climate change adaptation and mitigation (Figure 5).

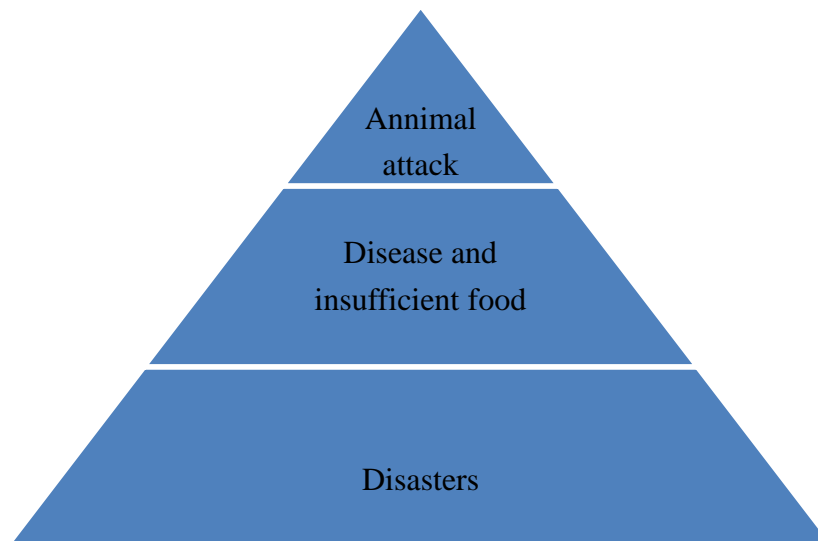


Figure 5. Problems faced by the respondents during working period in the coastal area.

### **Problems and necessity of support to the adaptation and perception of climate change in the coastal area of Sundarbans**

At the present situations most of the people need proper support to maintain their livelihood because they are affected by the recent Aila. Their fish Gher are in water logging condition, they lost their livestock resources and other property. They want different types of support to maintain their livelihood and to adapt with the changing condition. They want training, monetary, educational and technological support. In this regard, in the research area it was found that, maximum 76% people want monetary support. Similarly 5% people want educational support, 6% want instrumental support, 13% people want training and other supports for the adaptation and perception if climate change in the coastal regions of Sundarbans (Fig. 6). This study indicates that the coastal community proximity to the Sundarbans is experienced to adaption with changing environmental vulnerabilities but the major challenge they face is limitation of financial support.

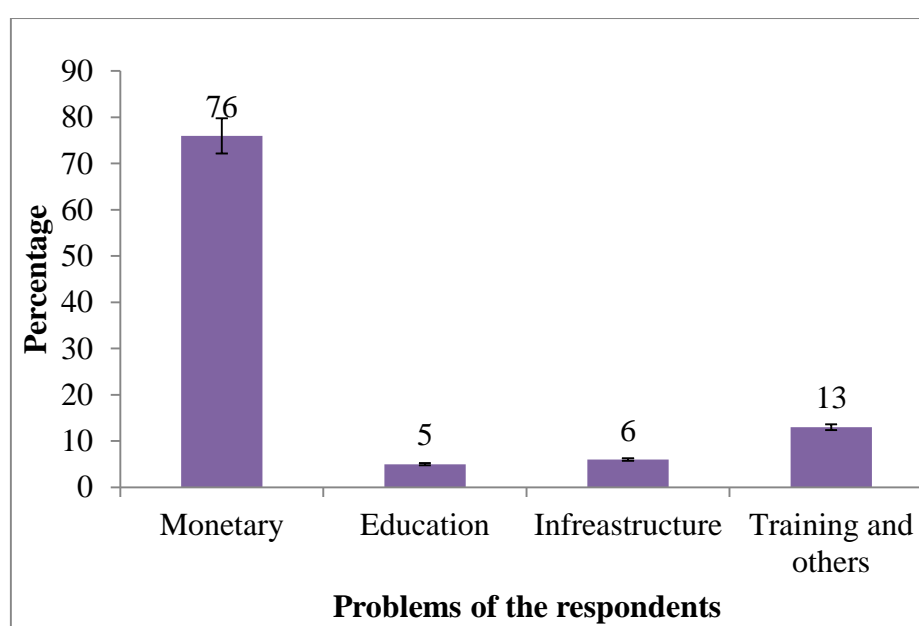


Figure 6. Problems faced by the respondents during working period in the coastal area.

### **Problems of climate change in coastal regions of Sundarbans**

Although for spontaneous adaptation to changing coastal environment, the coastal community required to adapt more fast in a planned way so that they can able to reduce their losses or even able to get benefit from fast changing environment. But in this case they have some barriers. In the study area the common barriers are the lack of awareness or perceptions at all level on global climate change impact. The barriers in adaptation strategies identified are summarized below-

- Due to climate change and sea level rise, impoverished households in the study area are ill-prepared to cope with rising calamities such saline intrusion, tidal surge, and water logging/drainage congestion.
- Most of the households whose livelihood exclusively depends on labor in coastal natural resources collection having very limited capacity to adapt.
- Low socio-economic condition of the households allows them in limited options to adapt with the changing environment.
- The community residents, local authorities, and civil society are not properly informed about the disastrous effects of climate change on the coastal region.
- The climate change issues and its consequences are not yet considered in the development plan of the locality. There is lack of integration in both development plan and implementation.

- Any kind of development activities in the study area generally considered short term benefits rather than long term effects.
- Lack of proper coordination in the utilization and uses of common natural resources within the community.
- Limited opportunity to diversify livelihoods in the locality due to limited access to facilities.
- Weak disaster management and early warning system within the community.

### Discussions

In the study area, majority of farmers are male and middle aged, and their literacy status is at primary level (Table 1) and this are revealed in another study by Uddin et al., (2017) conducted in the coastal region of Bangladesh. On the other hand, most of the houses in the study area are Kacca and majority of the respondents family members are of two to six in numbers (Table 1). The main reason of having such house could be the low income of the respondents as they are in the climate vulnerable areas. However, similar number of family members are observed regarding this climate vulnerability and adaptation in the coastal periphery of Bangladesh (Uddin et al., 2017). Regarding the income and occupation, on the contrary, most of the lower income respondents are massively depends on the fishing (Table 1 and Figure 3) because the study area is located adjacent to the Sundarbans, which could be responsible of such dependency on fishing occupation (Islam et al, 2020). Again, this occupation may not exist in the whole year in the study area and probably this the cause of reducing such income of that vulnerable coastal community and similar phenomenon are repeated in another study conducted by Lázár et al., (2015). Most of the respondents used wood as fuels followed by leaf, cowdung and so on (Figure 2) and this may be happened due to the availability of this resources from Mangrove forest and from the their farming facilities.

The probability of perception of climate change is greater for those who have higher educational attainment compared to less-educated or illiterate farmers. It is apparent that educated farmers have more knowledge, ability to understand and respond to expected changes, able to forecast future scenarios and have greater access to information and opportunities than others (Ndambiri et al., 2012; Amdu et al., 2013; Akanda & Howlader, 2015). So, education as an influencing factor of farmer's perception of climate change but in our study, most of the respondent's educational status is at primary level and they don't have enough knowledge (79%) regarding climate change adaptation (Figure 4). The reason could be behind this is their lack of available facilities such as education, trainings and so on, which are also revealed in this study (Figure 6).

In the study area, perception of climate change adaptation is low (Figure 4), which may make more climate vulnerable community in the coastal region. But, there may be a lot of reasons of having this condition such as proper education, training, and also lack of financial support, and all of these issues are repeated in this study (Figure 6). Again, similar findings are illustrated by Sanog et al., (2012) and Semenza et al., (2008), where they mentioned about potential explanation may be that all farmers have the potentiality but may be lack of proper education, training, poor communication exposures and fail to perceive more.

### Recommendations to enhance adaptation and perception of climate change in coastal regions of Sundarbans

Although it is not easy to give any concrete recommendation depending on such a small scale survey but based on the finding some recommendations are presented below.

- To boost local people's awareness and understanding about climate change, its impact on their way of life, and how to adapt to new climatic conditions, relevant training programs should be undertaken and informal educational facilities level should be raised. The various GOs and NGOs should be involved in the conduction of training programme.
- Information and knowledge for local adaptation must be improved within the community. Supporting the local population's efforts to improve their traditional knowledge systems and management techniques in response to shifting climatic conditions is vital for this reason.
- Necessary steps should be taken to develop effective early warning system, disaster management team weather forecasting practice within the community.

- At the present situation community based safe place for livestock and community based safe drinking water source should be established in the study area.
- As the people in the research area mainly depends on the local resource, training programme could be conducted among them to promote the diversify uses of resources that they collect to maintain their livelihood.
- Saline tolerant fish species can be cultured as fishing and aquaculture is the main occupation at the study area and mangrove afforestation is very much important at the study area to reduce climate change hazards.

### Conclusion

Climate change impacts are really high for Bangladesh and the southwest coastal area of Sundarbans is the most vulnerable part of the country. Besides, Bangladesh's coastal settlements can be best defined as being in a precarious state. It is necessary to find out local level ecosystem based adaptation options to save the coastal region, threatened by the upcoming event. The study suggests that information and knowledge must be improved within the community to find out and practice local scale adaptation options like livelihood diversification, diversify use of resource, community based co-management and financial support. Similarly, relevant training and awareness programme could be effective to reduce the vulnerability of most innocent victims of the coastal area. Respective authorities, in particular government and non-government groups, should develop legislative measures that take into account these determining elements in how farmers view climate change. The vulnerability that farmers experience due to the effects of climate change may be significantly reduced as a result.

### Conflict of Interest

The author declares no conflict of interest.

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