

# Challenges of Local Coping Capacities due to Climate Change in the Coastal Regions of Bangladesh

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## Abstract

Bangladesh is prone to a multitude of natural hazards and vulnerable to the adverse impacts of future change in climatic conditions. One of the most vulnerable aspects in climate change is the fragile coastal ecosystem in Bangladesh. Here, different ecosystems are highly exposed to cyclone, sea level rise, coastal flooding, flash flood, intense riverine floods, droughts and other climatic extremes. Traditionally, in Bangladesh, climatic variations have provided opportunities (resources) and imposed costs (hazards), depending on how society adapted to the environment. In the drive for modernization, evolving technologies and economic and social structures alter existing systems and make many sectors and groups in the ecosystems (especially Coastal Areas) more vulnerable to significant variations in climate and sea level. In this regard, indigenous knowledge and local coping capacities have become a key to survival of the people of the coastal areas (like Sundarbans Area) of Bangladesh. But in recent years, climate change has had a serious impact on the livelihood enterprises and coping capacities. The present paper has been prepared based on secondary sources to examine the often intriguing coping strategies of the coastal areas due to the adverse impacts of climate change. This paper hopes to contribute to our broader understanding of the challenges of the local coping strategies that communities have developed in their quest to stabilize increasingly fragile livelihood systems.

## Keywords

Climate Change, Coastal Environment, Indigenous Knowledge, Ecosystem Challenges

## 1. Introduction

The present paper deals with the challenges of local coping capacities due to climate change in the coastal regions<sup>1</sup> of Bangladesh. In Bangladesh, Indigenous knowledge is considered as a strategy of coping in vulnerable environmental situation due to natural hazards and disasters where climate change poses a continuous threat to the frontline people living in rural areas. This paper shows that how local coping strategies are being challenged by the constant threat of climate change, especially in the coastal ecosystem of Bangladesh. Because to adapt with the impacts of climate change, the vulnerable communities would definitely require their own efforts which are grounded in the system of implying indigenous knowledge in present time and also in future.

Bangladesh is one of the largest deltas in the world which is highly vulnerable to Natural Disasters because of its geographical location, flat and low-lying landscape, population density, poverty, illiteracy, lack of institutional setup etc. [1]. In other words, the physical, social as well as economic conditions of Bangladesh are very typical to any of the most vulnerable countries to Natural Disasters in the world [2]. In this regard, indigenous knowledge has become a key of disaster management for local communities. People who live in disaster prone zones of our country usually apply their inherited knowledge<sup>2</sup> to cope with various challenges [3]. These strategies have evolved from the system of implying indigenous knowledge. This knowledge is still the basic strength of local people to cope with the environmental challenges.

Bangladesh is widely recognized to be one of the most climate vulnerable countries in the world and climate change issues are being one of the major focuses of the government and other development agencies of Bangladesh [4]. Climate change impacts are already adding significant stress to our physical and environmental resources, our human ability and economic activities [5]. Impacts of observed changes are felt most in the different sectors, like: Water resources, Coastal resources, Agriculture, Health livelihoods, Food security, Habitat/settlement security. While the possible consequences of climate change are alarming, there are many ways for every individual to take part in preventing these consequences from reaching their most dangerous potential [6]. The coping responses of individuals living in rural vulnerable areas of the country (like: coastal zones) to climate change, confront them to depend on the subjectively perceived risk environment. So here it is important to know what rural people say about their own situation and how the local strategies are being challenged. It is important to have snapshots from the local communities about their perspectives to overcome these challenges of climate change.

<sup>1</sup>The coast of Bangladesh is a home to approximately 46 million people. It covers an area of 47,201 km<sup>2</sup> [7].

<sup>2</sup>Indigenous Knowledge is historically the root of all knowledge and is unique to the culture of Bangladesh. This knowledge is orally transmitted from generation to generation and has been the basis of wide range of activities for disaster management in the local communities of our region for many centuries.

## **Framing the Context with Objectives**

The purpose of the present paper is to present a detailed description of the challenges of local people with their endowed knowledge to adapt to the climate change vulnerability of the coastal regions of Bangladesh. The paper would explore the traditional risk management strategies of vulnerable communities with indigenous knowledge which are culturally unique and exclusive. The paper would tend to focus that how these traditional disaster management techniques are being challenged due to climate change. Here would be an overall assessment that why socio-cultural interventions through various researches are needed to focus the actual vulnerability of frontline people. The analysis would provide some essential recommendations for necessities of the preservation of local coping strategies, and it is expected that these recommendations can be of use for academia, government and other practitioners working in the field of policy making, climate change, & various social sciences.

## **2. Background**

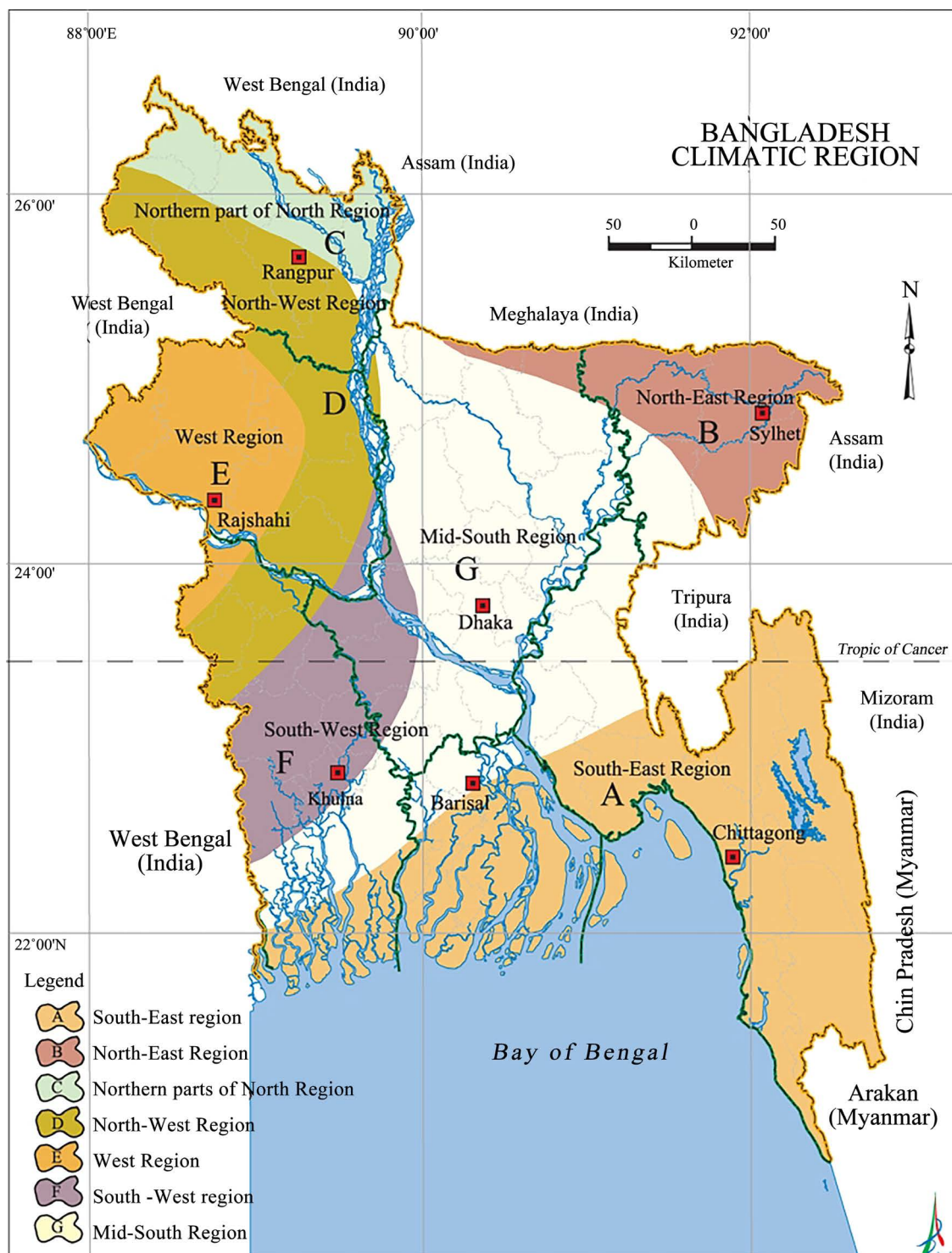
### **2.1. Ecological Features of the Country**

Bangladesh is bounded by India in the west, north and east, Myanmar in the south-east, and the Bay of Bengal in the south. Most of the country is low-lying land comprising mainly the floodplain delta of the three major rivers, the Ganges, the Brahmaputra and the Meghna, which originate outside Bangladesh and meet inside Bangladesh before discharging to the Bay of Bengal through a single outfall. Floodplains occupy 80% of the country. Bangladesh has a tropical monsoon climate. In general, the climate is characterized by high temperature, heavy rainfall, often excessive humidity during monsoon and marked inter and intra seasonal variation [8]. There are three distinct seasons in Bangladesh: a hot, humid summer from March to June; a cool, rainy monsoon season from June to October; and a cool, dry winter from October to March. In general, maximum summer temperatures range between 30°C and 40°C. April is the warmest month in most parts of the country. January is the coldest month, when the average temperature for most of the country is about 10°C and most parts of the country receive at least 2000 mm of rainfall per year. About 80 percent of Bangladesh's rain falls during the monsoon season [9].

The humidity remains high all year and reaches between 90% - 95% from June to September. Tropical cyclones emerge from the Bay of Bengal with high winds and tidal waves on the average of one major cyclone every 3 years. There are two cyclone seasons, one just before the monsoon (May to June) and one just after the monsoon (October to November). During the monsoon season in a normal year, about 30% of the country is under water. Some years, however, floods cover 70% of the country [10].

The varied ecological features of Bangladesh make up 30 agro-ecological zones with a high diversity index of genetic resources. There are three broad regions considered as the physiography of the country, they are: the floodplain

area, the Pleistocene terrace and the hilly regions in the Northeast and Southeast [3]. Considering the complex scenarios of all climatic conditions the whole country can be classified into seven climatic sub-regions in total (as shown in “Figure 1”).



**Figure 1.** Climatic regions of bangladesh [11].



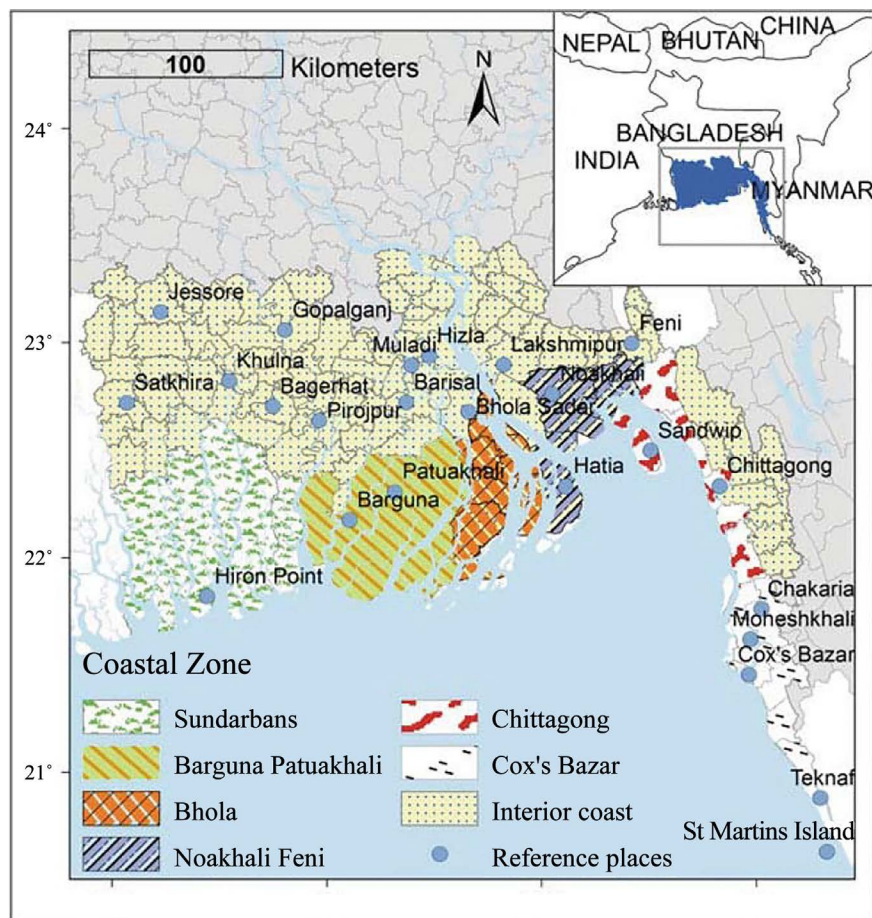
## 2.2. Coastal Ecological Zones of Bangladesh

The coastal zones of Bangladesh comprise the largest delta of the world. The coastal zones of Bangladesh consist of 19 districts comprising 147 *upazilas* [12]. The coastal zone contains the world's largest single chunk of mangrove forests; the Sundarbans. We can primarily divide the coast of the country into six zones (as shown in "Figure 2"):

- 1) Sundarbans coastal zone,
- 2) Barguna-Patuakhali coastal zone,
- 3) Bhola coastal zone,
- 4) Noakhali-Feni coastal zone,
- 5) Chittagong coastal zone and,
- 6) Cox's Bazar coastal zone.

## 2.3. Climatic Condition of the Coastal Zones of Bangladesh

The coast of Bangladesh is known as a zone of vulnerabilities as well as opportunities. It is prone to natural disasters like cyclone, storm surge and flood. The combination of natural and man-made hazards, such as erosion, high arsenic



**Figure 2.** The coast of bangladesh showing the six coastal zones [13].

content in ground water, water logging, earthquake, water and soil salinity, various forms of pollution, risks from climate change, etc., have adversely affected lives and livelihoods in the coastal zone and slowed down the pace of social and economic developments in this region [14].

### 2.3.1. Sundarbans Coastal Zone

Sunderbans, the largest mangrove forest in the world, is a very humid area, due to its proximity to the Bay of Bengal. Summers in Sunderbans start from March and continue until May. It is usually very hot during summers, when the mercury can soar up to 42 degrees C. On the other hand, winters in the area are very cool, when the temperature drops to around 9.2 degrees C. The maximum temperature during winters doesn't go beyond 30 degrees C. Sunderbans receives heavy rainfall, from mid-June to mid-September [15].

### 2.3.2. Barguna-Patuakhali Coastal Zone

Patuakhali a coastal district, a sub-division of Barisal district Region, is situated at the fringe of the Bay of Bengal. It is bounded on the north by Barisal district, on the east by Bhola district, on the south by the Bay of Bengal and on the west by Barguna. It lays between 21°48' and 22°36' north latitudes and between 90°08' and 90°41' east longitudes. The total area of the district is 3221.31 sq. km and 768.11 sq. km is under forest. Annual average temperature is (maximum 33.3°C, minimum 12.1°C) and rainfall is 2506 mm [16].

The maximum and minimum temperature of Barguna district varies from 33.3°C to 12.1°C. The annual average rainfall of the district is recorded as 2506 mm [17].

### 2.3.3. Bhola Coastal Zone

Bhola, the largest riverine delta island of the world became a sub-division in 1845 bearing the name of South Shahbazpur. The sub-division was renamed as Bhola in 1876. It was upgraded to a district in 1984. It lies between 21°54' and 22°52' north latitudes and between 90°34' and 91°01' east longitudes. The total area of the district is 3403.48 sq. km (1314.08 sq. miles) of which 1456.87 sq. km is under forest. Annual Average Temperature: Highest 32.7°C and lowest 11.6°C and annual rainfall 2360 mm [18].

### 2.3.4. Noakhali-Feni Coastal Zone

Noakhali has tropical climate and it has significant rainfall most months, with a short dry season. In Noakhali, the average annual temperature is 25.6°C and the average annual rain fall is about 3302 mm. With an average of 40.6°C, May is the warmest month. At 19.5°C on average, January is the coldest month of the year. The driest month is January with 8 mm of precipitation. In July, the rainfall reaches its peak, with an average of 671 mm [19].

Feni has a tropical climate. There is significant rainfall in most months of the year. The short dry season has little effect on the overall climate. The average

temperature in Feni is 25.6°C. The average annual rainfall is 2673 mm. The warmest month of the year is May, with an average temperature of 28.4°C. January has the lowest average temperature of the year. It is 19.5°C [20].

### **2.3.5. Chittagong Coastal Zone**

Chittagong is a district located in the south-eastern region of Bangladesh. It is a part of Chittagong Division. Chittagong is a metropolitan city and second largest city of Bangladesh and situated on the banks of the Karnaphuli River. The annual average temperature of this district varies from maximum 32.5°C to minimum 13.5°C. The average rainfall is 3378 mm [21].

### **2.3.6. Cox's Bazar Coastal Zone**

The climate of Cox's bazar is mostly similar to the rest of the country. It is further characterized by the location in the coastal area. The annual average temperature in Cox's Bazar remains at about a maximum of 34.8°C (94.6°F) and a minimum of 16.1°C (61.0°F). The average amount of rainfall remains at 3524 mm (138.7 in) [22].

## **2.4. Disaster Profile of the Coastal Zones of Bangladesh**

The Coastal Zone Policy considers three indicators for determining the landward boundaries of the coastal zone of Bangladesh, which are: influence of tidal waters, salinity intrusion and cyclones/storm surges [23].

The coastal zones Bangladesh experiences different types of Natural Disasters almost every year because of the Global Warming as well as Climate Change impacts, these are:

### **2.4.1. Cyclones and Storm Surges**

Tropical cyclones accompanied by storm surges are one of the major disasters of Bangladesh. The Bay of Bengal is called a breeding ground for tropical cyclones and Bangladesh is one of the worst victims in terms of fatalities and economic losses. The global distribution of cyclones shows that only 1% of all cyclones that form every year strike Bangladesh; but unfortunately the fatalities they cause account for 53% of the global total [24]. The phenomenon of re-curvature of tropical cyclones in the Bay of Bengal is the single most cause of the disproportional large impact of storm surges on the Bangladesh coast.

### **2.4.2. Tidal Floods**

Coincidence of heavy rainfall and flood tide occurred during monsoon urban area located in coastal part of our country faces flooding due to water logging. In Chittagong Division such type flood is a common phenomenon in every year monsoon [25].

### **2.4.3. Sea Level Rise and Salinity Intrusion**

Water and soil salinity are normal hazards in many parts of the coastal area. Impacts of climate change and sea-level rise should have real consequences on

the livelihoods of the coastal people as it would be affected by salinity intrusion [26].

## 2.5. Some Recent Adverse Impact of Climate Change

Although whole Bangladesh has been facing the adverse impacts of climate change, the people of coastal area are struggling more than any other parts of the country. Tropical cyclones, tidal floods and salinity intrusion are most common adverse impacts of climate change especially in the coastal areas of Bangladesh.

In recent years, Bangladesh was attacked by two severe devastating consecutive cyclones named Sidr and Aila. Cyclonic storm with Hurricane wind “SIDR” hit in Bangladesh on 15th November 2007. Maximum wind speed in kph was 223 and Surge height in meter was 6.02 m and total deaths were 3363. Cyclonic Storm “AILA” hit in Bangladesh on 25th May 2009. Maximum wind speed in kph was 92 and Surge height in meter was 2.5 m and total deaths were 190 [27]. Cyclone Sidr affected nine districts of Bangladesh. The most devastated districts were Bagerghat, Barguna, Patuakhali, and Pirojpur [28].

In cyclone “Aila” Satkhira and Khulna districts of Bangladesh suffered the heaviest damage along with Bagerhat, Pirojpur, Barisal, Patuakhali, Bhola, Lakshmipur, Noakhali, Feni, Chittagong, and Cox’s Bazar [29].

Some other mentionable cyclones hit in Bangladesh in recent years are as follows:

- **Cyclone Akash:** A cyclone storm named “Akash” hit the southern shore of Bangladesh on 14 May, 2007. As a result of the storm, three people were killed, four people were injured, and one person went missing. According to the media, 50 fishermen are still missing. A total of 1751 families were affected forced to take shelter in schools and highland areas. The number of houses that were fully destroyed was 205 and the number partially damaged was 845. Crops and shrimp cultivation were destroyed in some of the affected areas [30].
- **Cyclone Rashmi:** Cyclone Rashmi made landfall on the Bangladesh coast late on October 26 with wind speeds up to 85 km/hour, 15 people were killed and thousands of homes were also damaged [11].
- **Cyclone Bijli:** Cyclone Bijli attacked in Bangladesh on April 19, 2009. At least six people were killed as Cyclone Bijli struck overnight, said a food and disaster management ministry official on Saturday. At least 50 people were injured in the cyclone when trees and walls of their houses collapsed on them. Among the injured, at least 20 women and children were taken to hospitals in Cox’s Bazar. Over 600 houses and about 650 hectares of cropland were damaged by the tropical storm that made landfall overnight on the southeastern coast [31].
- **Cyclone Komen:** Cyclone Komen made landfall on 30 July 2015, weakening as it moved slightly towards the northeast. Cox’s Bazar, Chittagong, Bandarban, Noakhali, Feni and Bhola districts were significantly affected. At least



seven people (including two children) were reported to have lost their lives and 38 people were reported missing. The Government district level “D-form” data immediately after the disaster indicated many houses were flattened or under water, trees uprooted, and power supplies and communication systems disrupted in some places. Crops were damaged and shrimp projects flooded. Due to the impact of the cyclonic storm, heavy to very heavy rainfall triggered in southern Bangladesh widespread flooding. Consequently, the lives and livelihoods of the people of those areas were further worsened [32].

- **Cyclone Roanu:** Cyclone Roanu hit in Bangladesh on May 21, 2016. At least 24 people were killed and more than 139,000 families have been affected by the devastation wrought by Cyclone Roanu. Some 700,000 people have been affected as the tidal surge along with heavy rainfall damaged or destroyed around 80,000 homes and had major impacts on the livelihoods of local people by submerging rice fields and standing crops [33].
- **Cyclone Mora:** Severe Cyclonic Storm Mora made landfall in Bangladesh on May 30, 2017. According to the National Health Crisis Management Centre and Control Room of the Directorate General of Health Services (DGHS), reports the casualties to have at 6 lives lost, 136 injured, and Government report figured around 200,000 people displaced. Government sources have estimated that approximately 52,000 houses were damaged or destroyed, leaving 260,000 people in possible need of shelter. Cox’s Bazaar district was particularly heavily hit, with approximately 17,000 residences damaged [34].

### 3. Conceptual Framing

#### 3.1. Risk Perception of Frontline People

The perception of risk is a social process. The social perception of risk guides the vulnerable people to imply different indigenous knowledge as coping strategies. Vulnerable people live under stress, confront difficulties and make decisions that are perceived to reduce and control risks. Risks are perceived in terms of cause and effect. People survive environmental disasters through their attempt to cope and adapt. Local responses are accustomed and mediated by their respective perceptions of risk situations. So it is important to capture the local peoples’ understanding of risks as well as the options available to them. The procedure of decision making depends on the perception of risks which vary from area to area, and community to community [3].

#### 3.2. Indigenous Knowledge to Coping Strategy

Indigenous knowledge represents the experience gained over thousands of years of direct contact with their environment. Local people have developed enormous knowledge of their local environments over the centuries by directly interacting

with and experiencing the environment<sup>3</sup>. Coping responses are derived from the perception of risk and it is based on local or indigenous knowledge.

The application of indigenous knowledge in the situation of natural hazards/disasters or other threats is regarded as “coping strategy”. These strategies vary from community to community and depend on individual priority [3].

### 3.3. Ability to Cope

Coping strategies are related to resource and assets. The ability to generate coping therefore depends on the livelihood resources that local people have access or control over. Livelihood is the means of living and the ability to pursue different livelihood is dependent on tangible and intangible assets<sup>4</sup>. Here the linkage is essential to have a clear understanding of indigenous livelihood conditions which is related to coping strategies.

### 3.4. Adaptation to Climate Change

Adaptation is about coping and dealing with the consequences of climate change. Adaptation to climate change is an opportunity for social reform. Adaptation is an activity classified as adaptation related if it intends to reduce the vulnerability of human and natural systems regarding the impacts of climate change and climate related risks, by maintaining or increasing adaptive capacity [37].

## 4. Snapshots on Coping Strategies of Coastal People in Bangladesh during Natural Disasters (from Indigenous Perspectives)

Indigenous Knowledge related to coping in response to natural disasters has significant implications for disaster management issues in Bangladesh. It contributes to decisions on how the future would be different from present and what changes are necessary.

### 4.1. Coping in Cyclone & Storm Surge Prone Regions

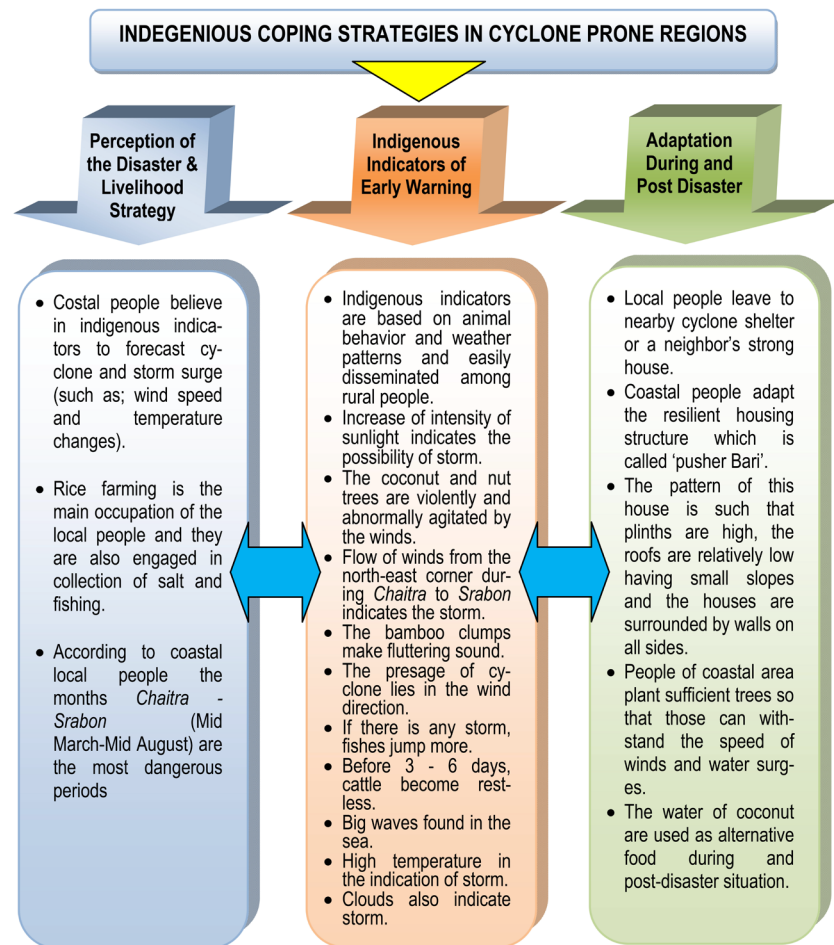
The present study finds three basic areas where the indigenous coping strategies acts through three aspects of life at the cyclone and storm surges regions of Bangladesh: 1) perception of the disaster and livelihood strategy, 2) indigenous indicators of early warning, and 3) adaptation during and post disaster situation. “Figure 3” explains in detail of these three aspects of indigenous coping strategies in cyclone prone regions of Bangladesh.

### 4.2. Coping in Tidal Flood Prone Regions

Tidal flood is not a new phenomenon to the people of coastal regions of Bangladesh.

<sup>3</sup>Indigenous Knowledge System Approach tends to reveal the knowledge which is build up through observation and hand-on-experience by people living in close contact with environment which in turn is transmitted orally from one generation to next [35].

<sup>4</sup>Generally five categories of assets are identified as contributing to livelihoods, such as: natural, physical, human, financial and social assets [36].



**Figure 3.** Indigenous coping strategies in cyclone prone regions of bangladesh (Source: Authors).

But the increasing trend of its frequency due to climate change is creating adverse effects to life of the communities in different districts. Sutradhar, Bala, Islam and Hasan (2015) [38] explores ingenious coping strategies of the communities of tidal flood prone areas as portrayed in “**Figure 4**”.

#### 4.3. Coping in Salinity Intrusion Prone Regions

As the post-disaster effect of cyclone and tidal flood, salinity intrusion pushes the toughest challenges to the coastal communities of Bangladesh against their survival in long term (“**Figure 5**” shows a typical scene of cyclone in a part of coastal Bangladesh and “**Figure 6**” shows the salinity intrusion situation in an affected area). In this regard Shafie, Haldar, Rashid, and Mita (2009) reveals the indigenous coping strategies in salinity prone areas through explaining the activities related to sourcing of food, water resource management and livelihood diversification based on their local perceptions [3]. “**Figure 7**” depicts the inner mechanism of indigenous coping strategies in salinity intrusion areas of Bangladesh in detail.

# INDEGENIOUS COPING STRATEGIES IN TIDAL FLOOD PRONE REGIONS

## Adaptation & Livelihood Strategies

- Farmers and stakeholders are practicing *Sorjan* system in saline tidal flooding areas through construction of embankment in Kolapara region.
- Shallow depth *Sorjans* are suitable for the year round cultivation of vegetables and monsoon rice, where the *Sorjans* with higher depths also allow rice-fish or rice-duck farming along with the year round vegetables cultivation on raised beds.
- This *Sorjan* system is very popular among the farmers in the coastal regions of Patuakhali and annual net return from investment in *Sorjan* system is very high.
- Crab fattening is increasingly accepted as livelihood practice for many families in the south-west coastal regions of Shatkhira, Bagerhat and Khulna. Such adaptation became favorable among coastal communities due to natural phenomenon like tidal inundation, water logging, saline water, availability of feed for crab, very profitable livelihood options, low investment and high demand in Dhaka market and abroad. A good number of farmers culture and fatten mud crab (*seylla scrrata*) in *ghers* of Chittagong region.

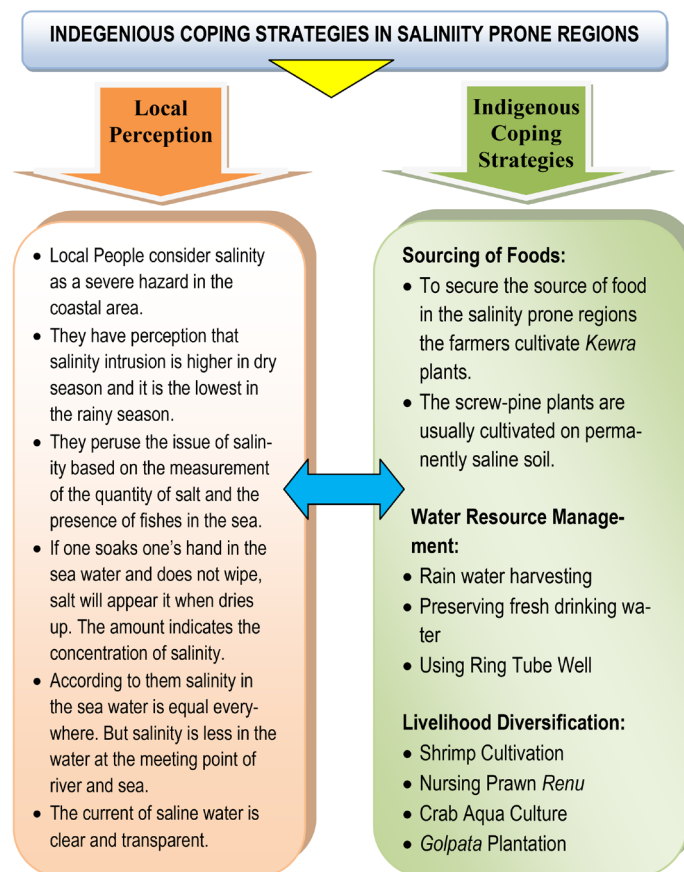
**Figure 4.** Indigenous coping strategies in tidal flood prone regions of bangladesh.



**Figure 5.** Cyclone in coastal area [39].



**Figure 6.** Salinity intrusion [40].



**Figure 7.** Indigenous coping strategies in salinity prone regions of bangladesh.

#### 4.4. Effectiveness of Local Strategies in Adverse Situation of Climate Change

The local people believe that their indigenous coping and adaptation strategies are very effective and useful to face the challenges of adverse situations. But all these coping and adaptation strategies are gradually improving with the help of some govt., non-govt. and international organizations. Some recent study found that the community people have been practicing different types of coping, adaptation and mitigation strategies and they acknowledge that these are effective for their survival.

A recent study conducted in a upazila named “Dumki” of Patuakhali district found that the community people are using some strategies such as floating garden, homestead gardening, crop diversification, rearing poultry, raising water pumps and using cyclone shelters to secure their livelihood. By using the method of floating gardens the community people get vital food after disaster they also can sale vegetable to nearest market for ensuring livelihood. Homestead gardening enhanced food and nutritional security, ensure women empowerment and make them resilience against climate change in the study area. Rearing poultry increases women empowerment and they can support their family income. 60%



community people in the study area are practicing this strategy. The community is cultivating different crops in their land to cope with climate change. To support food for growing population in this study area, farmer cultivated variety of crops in their fields. Although the people of study area are not fully conscious about raising water pumps and using cyclone centers, their awareness are gradually increasing day by day [41].

From another study it is found that to ensure/secure their livelihood local people diversified their works. It was found from community survey that after the two devastating cyclone Sidr and Aila about 35% peoples were involved in two occupation (agriculture, fishing), about 25% involved in three occupation (agriculture, fishing, small trading); about 10% involved in four occupation (agriculture labor, non-agricultural wage labor, fishing, motorcycle driving) and some involved in five or more works to earn money or to secure their livelihood [42].

Recently some govt., non-govt. and international organizations have started to develop the coping and adaptation strategies in the community of the disaster prone areas of Bangladesh. One mentionable example is “The Enhancing Resilience to Natural Disasters and the Effects of Climate Change program” started in 2011 as part of a joint initiative between the Government of Bangladesh and WFP. The package of interventions for participants includes community infrastructure work, training on disaster preparedness, capacity building, business development training and a cash grant to women for investment [43].

## 5. Challenges of Indigenous People of Coastal Areas in the Situation of Climate Change

Bangladesh is facing many of the impacts of climate in the form of severe flood, cyclone, sea level rise and salinity affecting the population, their livelihoods, natural systems, agriculture, water supply, health etc.

- The possible sea level rise will affect the country by inundating one third of the land areas in coastal belt dislocating millions of people from their homes, occupations and livelihoods.
- The climate change and the possible sea level rise are likely to inundate the wetlands, lowlands, accentuate coastal erosion, increase of frequent and severe floods, create drainage and irrigation problem. These devastating impacts would affect the vulnerable communities living in Bangladesh, especially in the coastal areas [44].
- The indigenous people living in the coastal areas would be critically affected in the possible climate change process.
- Southeastern and south central parts of coastal zone of the country would be most vulnerable due to sea level rise, salinity intrusion, cyclone and storm surges, where the indigenous adaptive capabilities of the vulnerable communities would be highly challenged.

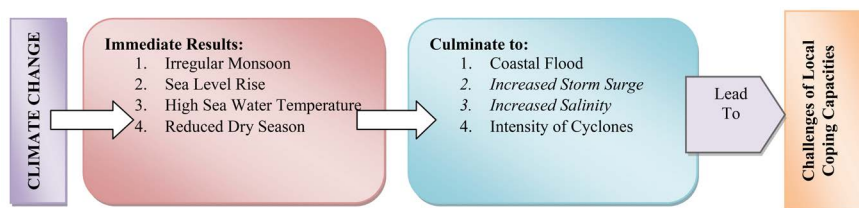
### Challenges of Indigenous People of Coastal Areas

- Extreme temperature and salinity intrusion would be responsible for the declining of crop yields in coastal areas.
- Rainfall changes have already been affecting the crop production of the country. So the indigenous coping strategies would be affected by the changed weather through climate change.
- Salinity intrusion in coastal land would affect the rice production of these areas, as well as the other livelihood strategies through the increased frequency of natural disasters.
- Due to the changed weather pattern the local people would face problem regarding their strategies of early warning about the storms, as we can see that the climate patterns are creating changes in the diversity of six seasons in Bangladesh.
- Increased salinity and scarcity of fresh water would create problems for the fisheries sectors (like: shrimp cultivation).
- Sea level rise would create significant number of climate refugees in the coastal areas of the country. Marine Resources, Biodiversity and Human Health of the local communities would suffer for the same.
- Indigenous coping strategies would be highly affected as the climate pattern is significantly changing its scenario, so the local resilient capacities would be endangered in near future.
- Climate change is likely to directly impact on the poor's livelihood in the coastal regions in many ways, such as the poor will face more food insecurity, water stress and health problems.
- Climate change would affect the common property such as mangrove forest which provides many poor the livelihood support in the coastal areas.

Climate change events would affect agriculture, food supply and water of the local people so badly and thus it would enhance chronic poverty. It would directly affect the poverty reduction strategies of the poor frontline people living in the coastal area. “**Figure 8**” shows the impacts of climate change on local coping capacities at a glance. “**Figure 9**”, “**Figure 10**”, “**Figure 11**” reflects some livelihood diversifications of coastal communities and “**Figure 12**” shows a picture of moving people to cyclone shelter during disaster situation.

### 6. How Socio-Cultural Interventions Can Highlight the Vulnerability of Frontline People through Various Researches?

Usually natural disasters become unavoidable for a community in the context of historically produced pattern of vulnerability evidenced in the location (such as coastal areas of Bangladesh), infrastructure, socio-political organizations and ideology of a society. Here the socio-cultural lens can highlight the emic perspectives of the vulnerable frontline people through the established theories, methodology and analytical stance.



**Figure 8.** Climate change impacts on local coping capacities.



**Figure 9.** Shrimp cultivation [45].



**Figure 10.** Duck rearing [46].



**Figure 11.** Homestead gardening [41].



**Figure 12.** Moving for cyclone shelters [47].

From the above discussion it is evident that human beings play major roles in the emergence and evolution of natural hazards and disasters. Finally climate change is impacting the people who are being vulnerable in the risk situations and we all are ultimately concerned about their vulnerability. So here the established socio-cultural interventions entail a comprehensive format which can be applied to reveal the vulnerability of local communities.

When hazards become activated, the degree to which they bring about a disaster in an indigenous community is an index of adaptation or maladaptation to the environment. Here, the role of disasters as mobilizing forces of cultural change is vastly understudied and the scope of socio-cultural intervention comes here. In local communities disasters usually unmask the society's structure and also instigate unity and the cohesion of social units as well as conflicts along the lines of opposition. It also reveals the linkage between local community and larger society. So, socio-cultural research regarding natural disasters and climate change can intertwine social sciences' platforms of assay so that the researches are returned to the fourfold essence of the disciplinary specialty [48].

- Socio-cultural researches can provide valuable socio-cultural information and perspectives that can contribute to disaster management and reconstruction.
- Socio-cultural intervention can provide more holistic perspectives of the vulnerability of frontline people through the established research methodology.
- A trained social researcher can contribute to the reorientation of the indigenously established disaster management models, making them more capable of integrating local resources.

## **7. Some Recommendations to Make the Local Strategies More Resilient in the Vulnerable Context of Climate Change**

- The policy makers, in making development program can follow the principle of self-help motto so that indigenous people may learn how to rely on themselves.

- Regarding the devastating climate change it is needed to find out alternative livelihood by local people themselves through the proper implication of indigenous knowledge to cope with changed conditions.
- Some livelihood strategies (like: duck rearing) should involve the women of the locality of coastal areas, so that they can contribute to their family income. In coastal region the poor can easily adopt the farming as livelihood in their minimum size of homestead.
- GO-NGOs may come forward to promote the cultivation of area specific crops as well as provide high yielding seeds and technology to the far reaching coastal areas.
- The rain water harvesting process should be disseminated nationally by GO-NGOs.
- GO-NGOs should come forward to take initiative for purifying the pond water by using different ingenious means.
- Supply of safe drinking water through ring tube wells should be taken as an initiative for awareness building in local communities of coastal areas.
- Shrimp cultivation and nursing the prawn rearing should get the attention from government as one of the best adaptive practice in regard to the growing salinity. This should get financial support from GO-NGOs.
- Government may come forward with the proactive programmes of crab cultivation.
- Salt cultivation in the coastal areas can be an important livelihood strategy under the affects of climate change.
- During cyclones and storm surges the loss of houses and properties can be mitigated by raising the strategies to built “Pusher Bari” in the coastal areas.
- More plants and tree plantation around the homestead should be replicable in the disaster prone areas of the country.
- GO-NGOs may come forward to disseminate these indigenous coping strategies among the frontline people of the vulnerable communities through various programs. Their traditional knowledge and coping strategies can be improved by their initiative can be effective to combat the challenges of climate change. Here the socio-cultural interventions through various research works can play an important role.

## 8. Conclusion

In conclusion, it can be said that Bangladesh is vulnerable to the adverse impacts of climate change. One of the most vulnerable aspects of climate change is the fragile coastal ecosystem in Bangladesh. In Bangladesh, climatic variations have provided opportunities (resources) and imposed costs (hazards), depending on how local people adapted to the environment. In this regard, implication of indigenous knowledge through local coping capacities has become a key to survival of the people of the coastal areas of Bangladesh. But in recent years, climate change has had a serious impact on the livelihood enterprises and indigenous



coping capacities. The present paper examined the intriguing coping strategies of the coastal areas due to the adverse impacts of climate change. This paper came up with some recommendations which may make local coping strategies more resilient in adverse impacts of climate change. Several good adaptation practices have been identified in this paper that can be tailored to the future changing climate in context of Bangladesh and can help in finding out future pathways on integration of best adaptation practices in ongoing as well as in future Climate Change Adaptation (CCA). The lessons learned so far could be replicated with modifications to be found from innovative research and applications in real field life.

### Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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