Preparedness of recovery to the vulnerability of climate change in the coastal areas in Bangladesh

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ABSTRACT

Purpose of the Study: This research aims to identify the susceptibility of Bangladesh's coastal areas to natural disasters related to climate change and raise vigilance in the region.

Methodology: We have conducted a survey of farmers in eight coastal Unions to identify the impact of climate change and the ability to implement coping mechanisms and their family size and income level. Face-to-face interviews, in-depth case studies, and focus group discussions were carried out in the survey. We further summarized the effect and recent consequences of cyclones, the major disaster in the country that are followed by flooding.

Main Findings: The finding of the study reveals that the shelters are insufficient to accommodate the dense population and will be a crowded space under the influence of COVID-19, further raising the vulnerability of those affected by a disaster. The coping mechanisms implemented were the storage of rainwater and groundwater and empowering women to produce dairy products and sustain the household income. The experts' opinion to counteract the climate change was adaptation and mitigation. Since building resilience requires a fair budget and global support, we focused on adaption, considering three adaptive approaches: accommodation, protection, and retreat. Among those, considering the densely populated nature of Bangladesh, improving accommodation and protection were the feasible solution to be proposed. In conclusion, people's livelihood activities could be diversified by providing need-based training and motivations.

Research Implications: One-fourth of the total population lives in the coastal areas in Bangladesh, which frequently faces tropical cyclones, storm surges, coastal erosion, and sea-level rise that cost enormous loss to the crops, livestock, forestry, and human selves. The biodiversity of the Sundarban, one of the most vulnerable ecosystems, is also at risk of those natural disasters.

The novelty of the study: Climate change is posing major threats to Bangladesh's coast. This study's findings will help individuals recover from the effects of climate change and prepare for the future.

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1. INTRODUCTION

Bangladesh is a small deltaic country from the mighty Ganges-Brahmaputra-Meghna river flow with an external elevation. It is a highly densely populated poverty-prone country with a 711 km long coastline with a vast river system network (Minar et al., 2013). The coastline region's entire area is 47,211 square kilometers, accounting for 32% of its overall geographical area. Many people (35 million) reside in coastal areas in 6.85 million homes, accounting for over 28 percent of the country's total population (BBS, 2017). In terms of administrative districts, 19 of the country's 64 districts lay inside the coastline administrative district (Shamsuddoha and Chowdhury, 2007).

Coastal Regions	
Bagerhat	Jessore
Barguna	Jhalokati
Barisal	Khulna
Bhola	Lakshmipur
Chandpur	Narail
Chittagong	Noakhali
Cox's Bazar	Patuakhali
Feni	Pirojpur
Gopalganj	Satkhira
	Shariatpur
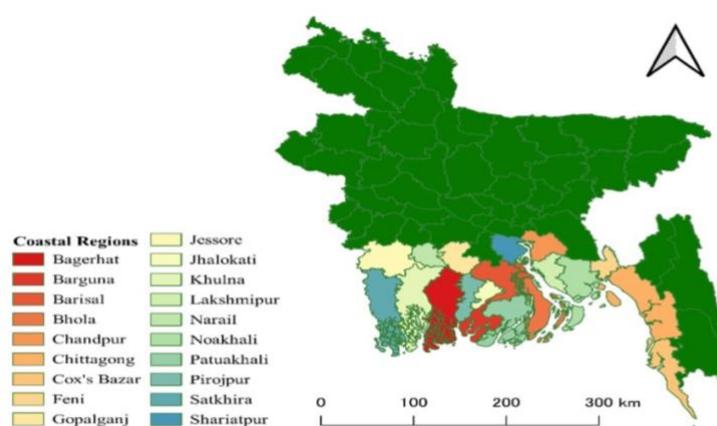
Figure 1: Coastal districts in Bangladesh

Climate change and global warming are interchangeable terms that refer to the increase of average surface temperature on the planet (Agrawala, Ota, Ahmed, Smith, & Van Aalst, 2003).

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Global warming is a frightening topic these days. Climate is changing dramatically in a variety of ways. The combustion of fossil fuels such as coal and oil, which emits different greenhouse (mainly carbon dioxide) gases into the atmosphere, is often regarded as the principal cause of climate change. Climate change is also being exacerbated by other human activities such as agriculture and deforestation, which contribute to the emission of greenhouse gases that cause climate change (Gazi, 2019). A modest increase in the earth's temperature as a result of climate change may have serious consequences for living organisms. Another serious consequence of climate change is melting the polar ice caps, which causes sea levels to increase. An increase in sea temperature causes more severe and frequent storms; occasionally, excessive rainfall causes horrible floods and other damages; and wildfire is another horrifying outcome of climate change that can harm environments, homes, and lives, ultimately resulting in fatalities and other damages (Reyer et al., 2017).

Bangladesh is more prone to various natural disasters in its geographical position. According to a World Bank report, 'Due to global warming, Bangladesh was enlisted among the most affected countries in South Asia. A 2'C rise in world average temperatures in the next decades (World Bank, 2013). This report also revealed that global warming and climate change led to many severe problems like rising sea levels, increased temperature resulting in more heat and more intense cyclones, a significant threat to food production, livelihood, infrastructure, and finally slowing down poverty reduction. The two terms' climate change and agriculture are interlinked to each other. Agriculture is affected by climate change in several ways, including the rise in temperature, heavy rainfall, heatwaves, pest community and outbreaks of different diseases, and changes in atmospheric carbon dioxide and ground-level concentrations and deteriorates the nutritional quality of different foods. Agriculture is already affected unevenly by climate change throughout the world. Climate change negatively affects crop production in low latitude countries, while its effects in northern latitudes are not well established. It increases the risk of food insecurity to some vulnerable groups of people, such as the poor and landless people (Bank, 1994). Agricultural production, the balance of an ecosystem, livestock production, and water body are constantly changing due to the impact of climate change (Figure 2).
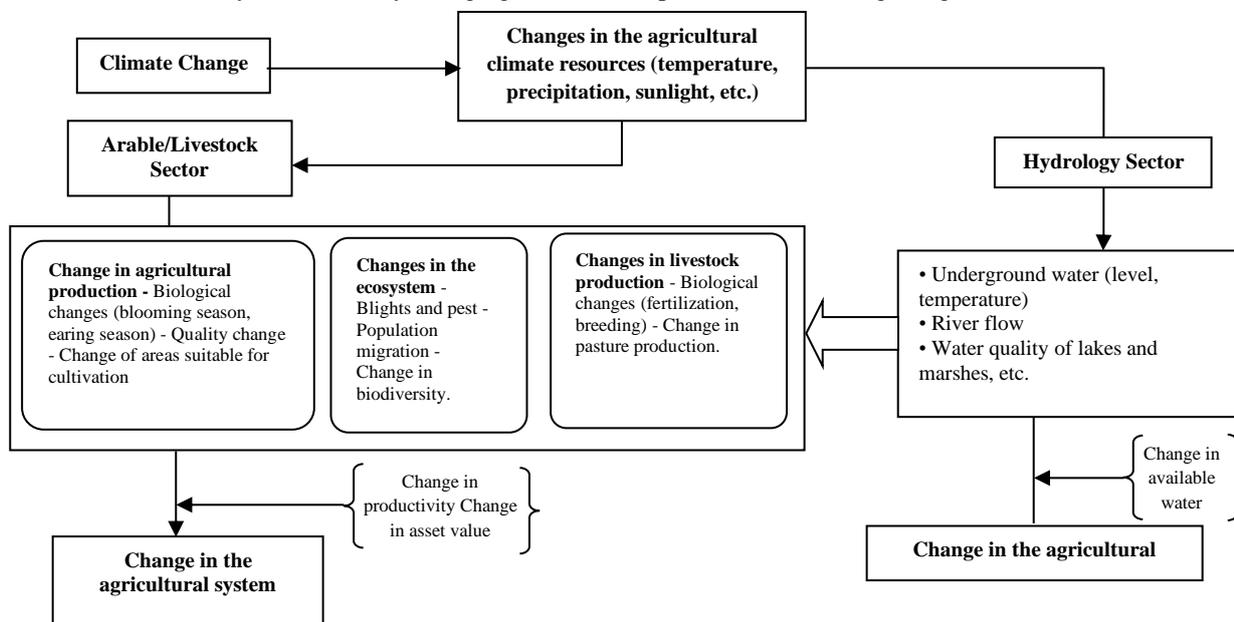

Figure 2: The flow of the climate change impact on the agricultural sector
Source: Kim, Chang-Gil and et al. (2009), p.96.
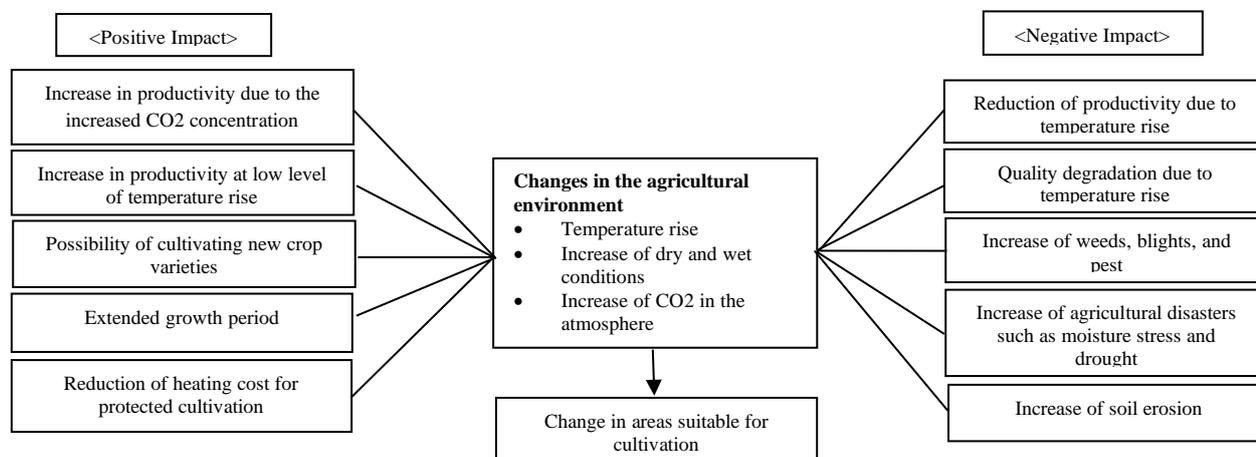

Figure 3: Potential impacts of global warming on the agricultural sector
Source: Kim, Chang-Gil and et al. (2009), p.38.

The effects of global climate change could be potentially serious over the next century. Climate change also seriously affects human health and safety. Most importantly, the densely populated, more impoverished communities living in the river basin and

low-lying coastal plains are vulnerable to dangerous natural hazards like storms, floods, and droughts. A report from the world's leading experts of the IPCC (2014) revealed that the rise in global temperature during past centuries is unlikely to have been caused entirely by natural effects, while global climate is mainly changed by the changes in both temperature and the geographic, seasonal and vertical pattern of temperature and by the impacts of human actions.

Some crucial reasons that made Bangladesh extremely vulnerable to climate change include geographical location, high population density, extreme poverty, and livelihood dependency on climate-sensitive factors like agriculture and fisheries (Rahman, 2008). The miserable impacts of these situations were falling more seriously on the women and girls of Bangladesh. Bangladesh has been more vulnerable to climate change due to its geographical feature, regional flow patterns, too much water flow in monsoon and too little in the dry season, etc. These impacts significantly affect different socio-economic realities, i.e., population density, poverty and per capita income, inequity and deprivation, and various developmental practices.

The gross impacts of climate variability on Bangladesh are very significant, and its consequences also significantly affect Bangladesh's hydrology (Huq and Ayers, 2008). The regional setting of this country makes itself more vulnerable to climate extremes. Further, it is very tough to adapt to climate change and climate variability due to various regional aspects of water management activity. The climate is changing so rapidly that this country's water resources and hydrology are highly responsive to current climate variability. Climate variability and trends have enormous influences on the environment and social development on which a growing human population relies (Mishra et al., 2010). Climate variability has two major dimensions in Bangladesh – temporal and spatial; both have significant effects.).

There are various elements of vulnerability associated with current climate variability. Among these effects, floods, droughts, and salinity ingress occurred more frequently with higher intensities. The country has to implement different adaptation measures to reduce the impact of climate change and variability. The effects of current climate variability in the southwest part of Bangladesh are of great concern, such as higher salinity, choking up of small rivers, waterlogging, embankment breaching and overtopping, cyclonic storm surges, riverbank erosion. The Bangladesh Water Development Board estimated that 1,200 km of riverbank had been actively eroded, and more than 500 km has been facing severe problems related to erosion. Despite some silt deposition, a net area of 8,700 hectares of land was being lost (Maria, 2006). Salinity intrusion in the agricultural cropland was a severe problem in the southwest region of Bangladesh.

On the other hand, the upper reaches faced fatal drought conditions. Bangladesh experiences a dry period for seven months, from November to May, when low rainfall. During this period, about 2.7 million hectares of land in Bangladesh are vulnerable to annual drought; and according to the Government of Bangladesh, there is about a 10% probability that 41-50% of the country experiences drought in a given year (Rahman, 2008). It was a great challenge to assure saline-free water for the southwest region of Bangladesh's population and ecosystem.

Bangladesh's coastal zone covers 47,201 km2, 32% of the country, and 19 districts. Around 35 million people, representing 29% of the population, live in the coastal zone directly or indirectly affected by different hazards like coastal floods/ tidal surges, salinity intrusion, riverbank erosion, tropical cyclones, etc. (Ahmad, 2019). Climate change brings significant coastal hazards. Bangladesh is most likely to suffer adverse impacts from anthropogenic climate changes. The rise of Sea-level up to one meter only would submerge a complete 18% of the total land area in Bangladesh. Around 30 million people living in Bangladesh's coastal areas could become Refugees because of Climate Change impacts (Minaret al., 2013). Bangladesh is especially vulnerable to tropical cyclones, with around 718,000 deaths from them in the past 50 years (Haque et al., 2012). Salinity intrusion rapidly increases day by day, already penetrating 100 km inside the country, which gradually deteriorates the existing scenario (Sobhan, 1994).

The resultant sea-water intrusion increases salinity in coastal drinking water with severe health consequences to surrounding populations (Daily Star, 2011). About 53% of the coastal areas are affected by salinity. Millions of people in northern Bangladesh are threatened by riverbank erosion and severe droughts (Daily Star, 2011). As most parts of this country are less than 10 meters above sea level and about 10% population lives below 1-meter elevation, there is a big chance of being highly vulnerable to high tides and storm surges. Moreover, the Bay of Bengal location is also the reason for severe cyclonic storms and tidal waves and hitting the coastline with severe impacts because of the shallow and conical shape of the Bay of Bengal (Denissen, 2012). Considering the above facts, this piece of research addresses those issues.

1.1. Identification of the problem

About one-fourth of the total population lives in the coastal areas in Bangladesh. Most of them are struggling with meeting their basic needs. Mostly they are the victim of natural disasters, viz. cyclone, tidal surge, and saline intrusion. These disasters make people's livelihood very vulnerable. Rising sea levels also posing a threat to them. Therefore, they should know how to cope with disasters, and the resilience mechanism should be apprehended.

1.2. Objectives of the research

The research's goal was to describe the socio-economic impact of climate change in coastal areas; explore how many areas were affected due to climate change in the coastal belt in Bangladesh; explore the vulnerability and coping mechanism of climate change in coastal regions of Bangladesh; find out the resilience mechanism, and seeking suggestions for the mitigation of climate change.

2. APPROACHES AND METHODOLOGIES

Data was collected through face-to-face interviews, in-depth case studies, and Focus Group Discussions (FGDs). In this regard, a semi-structured interview schedule was prepared and administered for collecting empirical data. Some farmers were consulted to extract in-depth information by considering case studies and FGDs. Multistage randomization was followed while the selection of samples. Some stakeholders include local leaders, local NGO workers, and local government officers, particularly those who deal with climate change and disaster management affairs. Recent newspaper articles, journal articles, books, etc.,

have also been checked to collect secondary information regarding this issue. Both qualitative and quantitative data were collected. The study was conducted in three purposively selected districts of coastal areas in Bangladesh. The selected districts are Patauakhali and Satkhira. The two districts were purposively selected as the study area (Reyer et al., 2017).
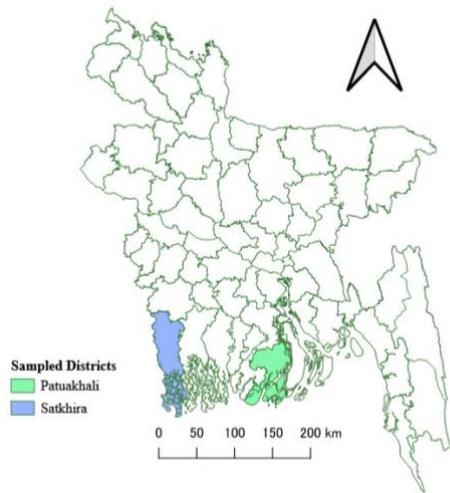
Figure 4: Study area (in districts)
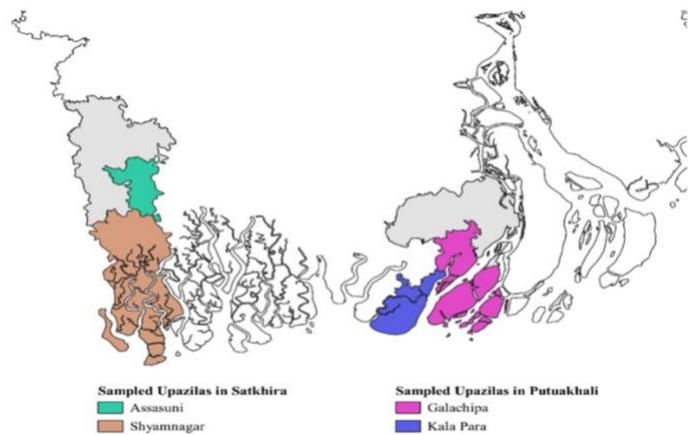
Figure 5: Study area (in Upazila level)
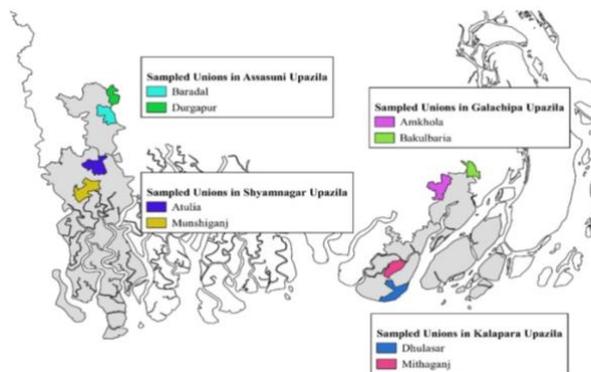
Figure 6: Study area (in union level)

All crop, livestock, and fish farmers of those districts have constituted the study population. Two Upazilas were selected from each district, and two unions were selected randomly (Table 1). Then, 20 farmers were selected from each union following the randomization procedure. Besides, two farmers were considered a reserved list from each union in case of farmers' absence in the sample list. Therefore, the total sample size was 160, and the reserve list was 16 (Table 1).

TABLE 1
List of the Population and Sample

Districts	Upazilas	Name of the Union	Population	Sample	Reserve list
Patuakhali	Kalapara	Dhulasar Union	20199	20	2
		MithaganjUnion	28964	20	2
	Galachipa	Amkhola Union	33132	20	2
		Bakulbari	32827	20	2
Satkhira	Assasuni	Durgapur	21682	20	2
		Baradal	31921	20	2
	Shyamnagar	Atulia	35152	20	2
		Munshiganj	37981	20	2
		Total		160	16

Source: Calculate by author.

The researcher was employed adequate care in selecting personal, economic, social, and psychological factors of the rural community; considering the availability of time and resources, reviewing relevant literature, and discussing relevant experts, the researcher selected the variables for the study. To describe the ordinary people's socio-economic and psychological characteristics in coastal areas: age, education, family size, farm size, annual income, training experience, cosmopolites, organizational participation, extension media contact, knowledge on climate change impact, and coping mechanism ability were considered. These variables were being measured using an appropriate scale, scores and categorized. Exploring how many areas were affected due to climate change in the coastal belt in Bangladesh was also discussed by consulting secondary sources and stakeholders. Some other variables were: the vulnerability, the resilience mechanism, and suggestions for the mitigation of climate change in Bangladesh's coastal areas.

An interview schedule was prepared carefully to collect relevant information, keeping the study's objectives in mind. The interview schedule contained both open and closed questions to obtain information regarding agricultural land availability. Appropriate scales were developed for computing data into suitable scores. The draft interview schedule was prepared in Bengali. It was pre-tested among farmers in the whole sample area before preparing the final version to collect the main study data. The pre-test helped identify faulty questions and statements in the draft schedule. Some case studies, as well as FGDs, were administered to collect qualitative data. Data were collected from December 17, 2019, to February 16, 2020. Collected data was analyzed and presented.

3. RESULTS &DISCUSSION

3.1. The socio-economic and psychological characteristics of the people of coastal areas:

To describe the ordinary people's socio-economic and psychological characteristics in coastal areas; age, education, family size, farm size, annual income, training experience, cosmopolites, organizational participation, extension media contact, knowledge on climate change impact, and coping mechanism ability were considered. Data in Table 2 indicates that about half the proportion (46.88 percent) fell into the middle-aged group. More than half the proportion (61.25 percent) of respondents have a primary level of education (Table 2). A significant proportion (47.5 percent) fell into the medium category. A large portion (58.75 percent) belongs to landless, marginal farmers. A more significant proportion (60.63 percent) of the respondents belongs to very low income to low-income categories (table 2). More than half the proportion (51.25%) had a medium level of knowledge on climate change impact, while 28.13 % had poor knowledge; however, 20.63% of respondents had a high level of knowledge on climate change impact (table 2). Regarding coping mechanism ability, 47.5% of respondents had medium coping mechanism ability, while 40% had a poor ability, but 12.5% had a high ability to cope with climate change (Table 2).

TABLE 2
Salient socio-demographic features of the respondents (N=160)

| Characteristics | Measuring units | Range | | Category | Respondents (N-160) | | Mean | Standard deviation |
		Expected	Observed		Number	Percent		
Age	Year	¦	20 to 81	Young (<35)	61	38	44.75	5.45
				Middle-aged (35-50)	75	46.88		
				Old (>50)	24	15		
Education	Years of schooling	¦	0 to 16	Illiterate	19	11.88	4.35	1.65
				Primary (1-5 yrs schooling)	98	61.25		
				Secondary (6 to 10 yrs)	38	23.75		
				Above secondary (>10)	05	3.13		
Family Size	Numbers	¦	2 to 10	Small family (2 to 3)	65	40.63	4.57	1.71
				Medium family (4 to 6)	76	47.5		
				Large family (>6)	19	11.88		
Farm size	Hectares	---z	0.07 to 5.0	Landless (<0.20 ha.)	38	23.75	0.38	0.17
				Marginal farmer (0.20 to 0.40 ha.)	56	35		
				Small farmer (0.40-1.01 ha.)	51	31.88		
				Medium (1.01-3.03 ha.)	10	6.25		
				Large (>3.04 ha.)	05	3.13		
Annual income	BDT. '000	¦	36 to 280	Very low income (<80)	45	28.13	112.75	7.48
				Low income (80-120)	52	32.5		
				Medium income (121 to 150)	38	23.75		
				High income (>150)	25	15.63		
Knowledge on Climate Change Impact	Score	5 to 25	6 to 23	Poor knowledge (≤10)	45	28.13	12.15	2.20
				Medium knowledge (11 to 20)	82	51.25		
				High knowledge (>20)	33	20.63		
Coping Mechanism Ability	Score	5 to 25	5 to 24	Poor ability (≤10)	64	40	11.85	2.05
				Medium ability (11 to 20)	76	47.5		
				High ability (>20)	20	12.5		

Source: Calculated by the author

3.2. Areas were affected due to climate change in the coastal belt in Bangladesh.

The Coastal zone in Bangladesh covers 20% of the total land areas, and 30 % of the cultivable land lies in this area and is mainly located in south-western areas. It comprises exceptionally diverse ecosystems such as the mangroves (the Sundarbans) forest, coral reefs, beaches, hills, and swamps. Bangladesh offers a range of goods and services to the people with its dynamic natural environments. It often faces storm surges, tropical cyclones, coastal erosion, and sea-level rise, which cost enormous loss to the crops, livestock, forestry, and human selves. The Sundarbans' most critical ecosystem also lose biodiversity due to the disasters.

A couple of years ago, cyclones Sidr in 2007 and Aila in 2009 hit Bangladesh. About 3,406 deaths were caused, and over 55,000 people sustained physical injuries due to the cyclone Sidr that hit Bangladesh on November 15, 2007. Heavy rain supplementary cyclones and tidal waves due to storm effects caused widespread casualties, physical destruction, damage of crops and livestock, and flooding in a total of thirty districts across the South Western coastal areas of Bangladesh. Cyclone Sidr affected nine coastal districts of Bangladesh. The most distressed districts were Patuakhali, Barguna, Bagerghat, Satkhira, and Pirojpur. About 15,000 people believed to be killed and damaging was calculated amounting to $1.7 billion (2007 USD) approximately due to Sidre. After Sidr, the Government of Bangladesh performed a quick preliminary appraisal of the damage. Their assessment found a prevalent waterborne disease outbreak, respiratory tract infection (RTI), and other related infections. People in the nine surveyed

areas were at risk of communicable diseases: dysentery, diarrhoea, pneumonia, and acute respiratory infection, and children aged five years or younger were vulnerable.

Cyclone Aila hit on May 25, 2009, in the southern coastline of Bangladesh. Aila was only one of its kind occurrence as a storm like this had not stricken the Sundarbans within the last thirty years. Khulna and Satkhira districts of Bangladesh underwent the heaviest damage along with, Pirojpur, Bagerhat, Patuakhali, Barisal Bhola, Noakhali, Lakshmipur, Feni, Cox's Bazar, and Chittagong. There had been an outbreak of diarrheal disease when cyclone Aila hit coastal areas of Khulna as a severe shortage of drinking water, and food worsened thousands of sufferings. The locals reported an approximate figure of 15 deaths in Paikgacha, Koyra, and Dacope in the District.

Super cyclone Amphan hit Bangladesh's southern coastal areas and West Bengal and Eastern India on May 21, 2020. It was a powerful and deadly tropical cyclone killed 128 people across India and Bangladesh. Thousands of trees were uprooted, roads were flooded, and the electricity supply in many areas was halted. It caused more than US$ 13.6 billion of damage. Causalities and damage in Bangladesh were lesser than in India because Sundarbans protect Bangladesh's landscape like a first-line defence. This cyclone was hit when the COVID-19 pandemic situation was in peak, and the lockdown was happening. It was challenging to evacuate people into the shelter center to maintain social distancing.

3.3. Exploring the vulnerability in coastal areas in Bangladesh

Since Bangladesh is a deltaic country, it is highly vulnerable to climate change. Some weak socio-economic indicators were considered, which are following:

- Population Density (sq. km), Literacy Rate (%), Male Female Ratio, Gender Gap in Literacy Rate, Percentage of Disable (%), Poverty, No. of Cyclone Shelter, No. of Flood Shelter, Irrigation by Pump (%), No. of Primary School, No. of fresh Water Source (ponds), Access to Transport facilities, No of Motor Vehicles, No. of Union Health Centre, No. of Cooperative Society, No. of Electrified Village, No. of Growth Centre, Length of the unmetalled road (km), Length of Embankment Road (km), Length of Railway and waterway (km), Production of Rice, Nationalize and Private Bank, Insurance Company, and Bank Loan.
- Data were collected by conducting some case studies as well as FGDs. Some vulnerable natural indicators were selected: salinity, riverside flood, storm surge, coastal elevation, rainfall, shoreline erosion, and shoreline accretion.
- Bangladesh is generally documented as one of the most climate-vulnerable countries on the planet. The frequency of natural disasters here is very high, which claims much life. Poor and marginal households are very vulnerable to the adverse impact of climate change. Disasters cause damage to the infrastructures and livelihood assets.
- Country's sufferings increase many folds due to these natural disasters. Climate change aggravates many of the existing issues those country faces which the coastal region suffers a lot. The rainfall water from upstream of the Ganges-Brahmaputra-Meghna system flows over Bangladesh, which frequently causes floods that damages crops, livestock, and infrastructures.
- Tropical cyclones and storm surge coupling with higher wind speed help cause severe damages in coastal areas. Higher river flows cause widespread flooding in rural and urban areas. Over-topping that was breaking embankment results in massive damage of lives and properties in urban and rural areas—riverbank erosion leading to the loss of homes and agricultural land the rivers. Increased sedimentation in riverbeds, leading to drainage congestion and water-logging in cropland delayed cropping season.
- Himalayan glaciers melting causes increased river flows in the year's warmer months. Subsequently, the glaciers have shrunk or disappeared, resulting in lower river flows and increased saline intrusion.
- In Bangladesh, mainly northern and western regions become drought due to lower and irregular rainfall. In coastal areas, saline water intrusion reduces the freshwater availability that damages the Sundarbans mangrove forest, a World Heritage site with rich biodiversity, and drainage congestion inside coastal polders, adversely affecting agriculture and warmer and more humid weather to increase the prevalence of the disease.
- Climate change has an enormous impact on the environment and natural resource systems; however, the livelihood of the people who live in coastal areas becomes the worst affected.

3.4. Finding out the resilience mechanism (how people cope with climate change)

The people in coastal areas of Bangladesh need alternative livelihood activities for coping with climate-induced disasters such as cyclones, floods, and storm surges. Several coping strategies are available in the reach of people. Food crises, health, housing, education for the children, etc., are chronic problems. They lend money when they cannot solve those problems. Even they receive loans and microcredit from several agencies and banks, which ultimately becomes a burden. They receive some food relief from the government and NGOs. They usually prepare mats and handicrafts, which they sell to earn some money. Affected people could not rear poultry and layers due to lack of dry spaces, but they rear livestock, such as buffalo. Also, earning from sweet water fish cultivation is considered as a source of income for them. Food crises were appeared to be a significant problem during the flood. In this case, women solve this problem to some extent by storing food. However, women face issues in cooking meals because of a lack of fuel, woods, and water.

Losing topsoil is a problem for crop growing. Crop farming is not possible in the farmland due to excessive saline water and rising temperature. However, some farmers adopt saline tolerant verities such as watermelon and cultivate betel leaves for their earnings. Cyclone shelters are not sufficient for taking refuge; some people find shelter houses far from their houses. Eventually, some people do not leave their house for sheltering fear of being stolen away from their livestock and belongings.

Many NGOs, micro-credit institutions, and cooperative organizations provide low interest to build and supply poultry and livestock and money. Many poor and ultra-poor people have been brought under social safety net programs. Also, people receive

training on increasing knowledge on climate change. The Pond Sand Filters (PSF) set up by the government to reduce salinity was found to be helpful for the local people.

The people learned to store rainwater as well as groundwater with the help of the government and NGOs. Moreover, harvesting rainwater was seen to be helpful for the affected people. They extract groundwater as well as surface water for agricultural activities. Women involve in earth-filling activities, planting vegetables in homesteads, and ail of the crop fields. They also raise poultry and milking cows to earn money for meeting family expenditures. They are also given priority for allocating Khas land for the female-headed household for solving the residential problem. Cottage industrial activities were found among the women as an alternative source of income. Some NGOs and GOs provide training and credit to perform activities related to the cottage industry. Women also prepare some dry foods such as cake, *Flattened and fried rice, puffed rice,* etc., to meet food scarcity during and pre calamity. It was found that credit agencies prefer women to provide credit supports as women are much more responsible than their male counterparts regarding payback. Cyclone shelter is not built to maintain social distance, proved during the AMPHAN hit when Bangladesh was locked down due to the COVID-19 pandemic. However, it was evident from the study that most people in coastal areas are trying to become more resilient to adapt to climate change.

3.5. Seeking suggestions for the mitigation of climate change (possible ways of mitigating climate change)

Stakeholders were gently asked to provide advice mitigating the problems that happened due to climate changes. The following suggestions were found after consulting respondents through case studies and FGDs. Experts opined that adaptation and mitigation are two choices to reduce the adverse impacts of climate changes in Bangladesh. It has a minimal capacity for mitigation since Bangladesh could not afford the cost. In this case, global supports are needed. Adaptation is a local initiative that can be possible by incorporating people who live in vulnerable areas. Bangladesh does not emit greenhouse gases; however, it is suffered from these consequences.

There are three adaptive approaches which are accommodation, protection, and retreat. The retreat is hardly possible for Bangladesh because it is the high densely populated country in the world. Bangladesh can reclaim land from the sea by establishing folders (Netherlands). Communities can be protected by building embankments that were overwhelming suggested by the local people. Green crops, animals, sweet water, fish culture plants, farmers' houses, etc., could be saved from saline water intrusion by storm surges during the cyclone. People's livelihood activities could be diversified by providing need-based training and motivations. Promoting women's empowerment through education and training discouraging early marriage is necessary. Polygamy among men should be reduced. Health care facilities and social security for poor people should be accelerated for the people's bottom class in coastal areas.

3.6. Finding out the resilience mechanism (how people cope with climate change:

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4. CONCLUSION

People live in extreme weather, and the climate change affected people can properly carry our agricultural activities, which is considered their livelihood activities. The unemployment rate of the people who live in coastal areas is much higher than mainstream people. Changing climatic conditions force them to migrate from their ancestral place. They face different issues such as food shortage, lack of Medicare facilities, and utility services in Bangladesh's coastal belt. It was found that people

adopt indigenous knowledge and coping mechanisms as the strategy of different alternative livelihood, such as planting trees, rearing poultry, farming vegetables, harvesting rainwater, using pond sand filters etc. Together, the government and NGOs have been rendering supports to coastal people to form a resilient culture through their adjustment strategies. The government encourages development partners to bring local people who need support under social safety net programs. The people have been providing - training on setting up cottage industry and salinity tolerant seed. However, the supports are not enough to better the challenges of the people living in coastal areas in Bangladesh.

5. RECOMMENDATIONS

Based on the above finding and conclusion, the following recommendation could be made:

The farmers and people are needed to increase capacity by providing proper training to deal with climate change's adverse effects on agriculture. Technical supports, extension services, helpful information, and inputs are required for the farmers. Physical as well as social infrastructures such as communication facilities, utility services, health care supports, and education facilities are necessary to be set up and strengthened. The government and other stakeholders should come forward to consider sustainable salinity tolerant agriculture programs in coastal areas in Bangladesh.

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