



Climate Change Impact on Sustainable Development in Rural Areas of Bangladesh

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ABSTRACT

Extreme climatic events such as floods, cyclones and river bank erosion, drought and salinity intrusion cause adverse socio-economic consequences for the affected people and, therefore, are a major concern for national sustainable development in Bangladesh. Reviewing the available research in relation to climate change and sustainable development, the study found that since 1954, 7 events were severe where more than 30% of land area was inundated. On the other hand, over the last 50 years, 15 severe cyclones have hit in the coastal areas of Bangladesh. Besides, Bangladesh experiences major droughts once in 5 years. Cumulatively, the direct annual costs from natural disasters to the national economy have been estimated at 0.5 percent to 1 percent of GDP. This study also found that, the damages from a single typical severe cyclone with a return period of 10 years is expected to rise nearly five-fold to over \$9 billion by 2050. Addressing the additional risks due to climate change will require additional investments of \$2,426 million and annual maintenance costs of \$50 million by 2050. However, to address these horrible situations, Bangladesh has formulated different policies, act and strategic plans along with introduction of 'green development'. Finally this study suggest that for sustainable development in Bangladesh in a changing climate, a collaborative approach with public, private, international development agencies are urgently needed.

Kew words: *Climate change, sustainable development, rural areas, adaptation, economic loss, impacts*

INTRODUCTION

Climate change is a problem that is continuously affecting people and the environment. Historically, Bangladesh is one of the most susceptible countries of the world to bear the burden of the negative impact of climate change. The coastal areas are worst affected and the coastal population are the sufferers. Climate change refers to any significant change in measures of climate (such as temperature, precipitation, wind, sea level, and natural phenomena), lasting for an extended period of time (decades or longer) that negatively affects the terrestrial and aquatic ecosystems (all living things: plants, animals and organisms, interacting with each other, and also with their non-living environments: weather, earth, sun, soil, climate, and atmosphere). Greater energy efficiency and new technologies hold promise for reducing greenhouse gases (such as Carbon dioxide- CO₂, Methane- CH₄, Nitrous oxide- N₂O, water vapor, while others are synthetic. Those that are man-made include the chlorofluorocarbons-CFCs, Hydro-fluorocarbons-HFCs, Per-fluorocarbons-PFCs, Sulphur- hexafluoride- SF₆) and solving this global challenge. Greenhouse gases and certain synthetic chemicals, trap some of the Earth's generated energy, thus retaining heat in the atmosphere. Efforts are being made for reducing, reusing and recycling solid waste to decrease the amount of heat-trapping greenhouse gases released.

Bangladesh is now widely recognised to be one of the countries which are most vulnerable to climate change. Natural hazards that come from increased rainfall, rising sea levels, and tropical cyclones are expected to increase as climate changes, each seriously affecting agriculture, water and food security, human health and shelter. It is believed that in the coming decades the rising sea level alone will create more than 20 million climate refugees. Bangladeshi water is contaminated with arsenic frequently because of the high arsenic contents in the soil. Up to 77 million people are exposed to toxic arsenic from drinking water.

Bangladesh is prone to floods, tornados and cyclones. Also, there is evidence that earthquakes pose a threat to the country. Evidence shows that tectonics have caused rivers to shift course suddenly and dramatically. It has been shown that rainy-season flooding in Bangladesh, on the world's largest river delta, can push the underlying crust down by as much as 6 centimetres, and possibly perturb faults.

The extreme variations in the meteorological phenomena, pose a threat to the coastal zones. The observable weather events are primarily: Earth's atmosphere: temperature, air pressure, water vapor, mass flow, floods/flash floods, cloud burst, heavy precipitation; tropical cyclones and their associated storm surges; severe convective storms - thunderstorms, hailstorms, tornadoes, lightening, dust storms, sand storms; heat/cold wave; land-slides; and river/sea erosion. The spatial and temporal scales of these hazards vary widely from short-lived, violent phenomena of limited extent (e.g. severe thunderstorms), through large systems (e.g. tropical cyclones). These events can subject large regions to disastrous weather phenomena like strong winds, heavy flood-producing rains, storm surges and coastal flooding, freezing rain and extreme hot or cold temperature conditions for periods of several days. With this wide variety of the scales of weather phenomena, the requirements of meteorological and hydrological forecasting for effective early warning of these hazards also vary spanning over a very broad spectrum. These can range from very short range forecasts of less than one hour in the case of severe thunderstorms and flash floods; through short and medium range forecasts of - from a few hours to days for tropical cyclones, heavy rains, extreme temperatures and high winds. According to the 3rd assessment report of IPCC, South Asia is the most vulnerable region of the world to climate change impact (Mc Cathie, et.al-2001). Bangladesh ranks high in respect of vulnerability due to its topography and other factors such as hydro-geological and socio-economic factors mentioned below:

1. Its Geographical location in South Asia
2. The Ganga-Brahmaputra-Meghna Catchments area includes a great diversity of Physical environment
3. Its flat deltaic topography with very low elevation
4. Its extreme climate variability droughts; cyclones; and the monsoon season, when much of the country is routinely inundated

Bangladesh is called the land of six seasons. It has a temperate climate because of its physical location. Though the climate of Bangladesh is mainly sub-tropical monsoon, i.e. warm and humid; Bangla calendar year is traditionally divided into six seasons:

1. Grisma (Summer): (Baishakh and Jyaistha): mid-April to mid-June
2. Barsha (Rainy): (Ashar and Shraban): mid-June to mid-August
3. Sharat (Autumn): (Bhadra and Ashwin): mid-August to mid-October
4. Hemanto (Late Autumn): (Kartik and Agrahayan): mid-October to mid-December
5. Sheet (Winter): (Paus and Magh): mid-December to mid-February
6. Bashonto (Spring): (Phalgun and Chaitra): mid-February to mid-April

Actually, Bangladesh has three distinct seasons: the pre-monsoon hot season from March through May, rainy monsoon season which lasts from June through October, and a cool dry winter season from November through February. However, March may also be considered as the spring season, and the period from mid-October through mid-November may be called the autumn.

For practical purpose, however, three seasons are distinguishable: summer, rainy, and winter. The pre-monsoon hot season is characterised by high temperature and occurrence of thunderstorms. April is the hottest month in the country when the mean temperature ranges from 27°C in the east and south to 31°C in the west-central part of the country. After April, increasing cloud-cover dampens temperature. Wind direction is variable in this season, especially during its early part rain-fall accounts for 10 to 25 percent of the annual total, which is caused by thunderstorms. Southerly or south-westerly winds, very high humidity, and heavy rainfall and long consecutive days of rainfall characterise the rainy season, which coincides with summer monsoon. Rainfall of this season accounts for 70 to 85 percent of the annual total. This is caused by the tropical depression that enters the country from the Bay of Bengal. Low temperatures, cool air blowing from the west or northwest, clear sky, and meagre rainfall characterise the cool dry season. Average temperature in January varies from 17°C in the northwest and north-eastern parts of the country to 20°C-21°C in the coastal areas. Minimum temperature in the extreme northwest in late December and early January reaches 3°C to 4°C. The seasons of Bangladesh regulate its economy, communication, trade and commerce, art and culture and, in fact, the entire lifestyle of the people. In the recent past Bangladesh has experienced increased frequency in climate change and increased intensity of natural disasters. These disasters continue to have adverse effect on the society in terms of human casualties, economic and social losses, disruption of livelihoods, and degradation to environment also affecting health and sanitation and availability drinking water.

OBJECTIVES OF THE STUDY

The overall objective of the research is to suggest to the vulnerable population of the coastal districts - successful strategies for coping with different climate induced disasters through lesson learnt documentation and analyzing

national and International actions for achieving sustainable development. However the specific objectives of the study are as follows:

1. To identify adaptation and mitigation strategies used by the coastal population of Bangladesh.
2. To understand climatic hazards faced by the coastal population of Bangladesh.
3. To analyze vulnerability of the areas.

METHODOLOGY OF THE STUDY

The following methodology was used for the study:

Study Design: The study was survey type.

Study Area: The study has been conducted at Samnagar Upazila of Satkhira District, Pathorghata Upazila of Barguna District and Cox's Bazar Sadar Upazila and Moheshkhali Upazila of Cox's Bazar District.

Sampling Method: Random sampling method has been used for the study.

Tools for Data Collection: Questionnaire has been used for data collection.

Sources of Data: Data have been collected from the field by face to face interview with the respondents.

Sample Size: 100 respondents have been interviewed for the study. The respondents were elected representatives of the local areas. 7 Chairman, 23 Councilor, 66 Members, 2 Mayors, and 2 Secretary were interviewed for the study.

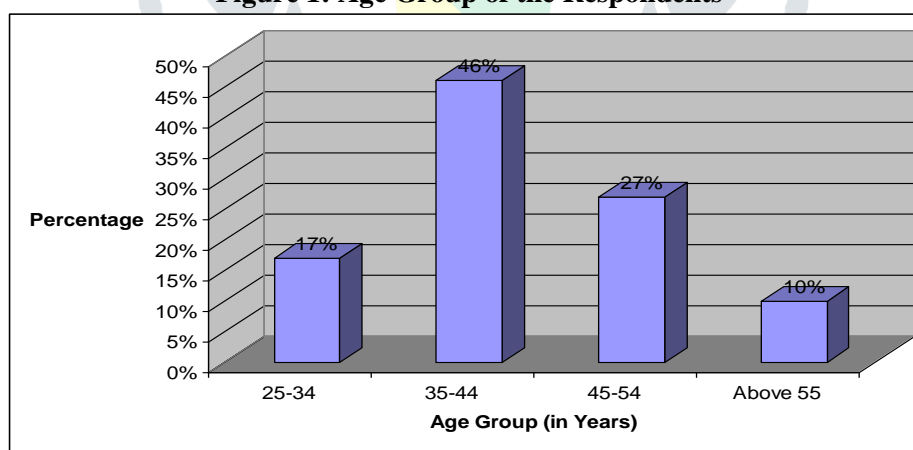
Data Analysis: The collected data were tabulated and analyzed by using Computer Program Microsoft Excel.

RESULTS AND DISCUSSION

Table 1: Age Group of the Respondents

Sl. No.	Age Group	Percentage
1	25-35	17%
2	35-44	46%
3	45-54	27%
4	Above 55	10%
Total		100%

Figure 1: Age Group of the Respondents

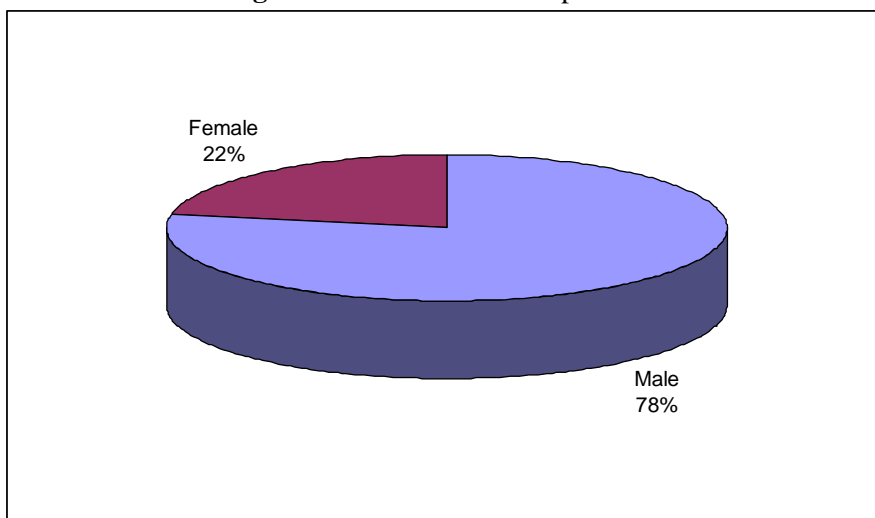


Age groups of the respondents are described in the above graph. From the graph it was found that age group 35-44 is 46 % which is the maximum and age group above 55 is 10 % which is the minimum. Age group 25-34, 45-54 years is 17% and 27 % respectively. The selection of the participants was done randomly. It indicates that most of the elected representatives are from 35-44 age groups. On the other hand, there are very little number of participants is elected from this above 55 age group.

Table 2: Gender of the Respondents

Sl. No.	Gender	Percentage
1	Male	78%
2	Female	22%
Total		100%

Figure 2: Gender of the Respondents

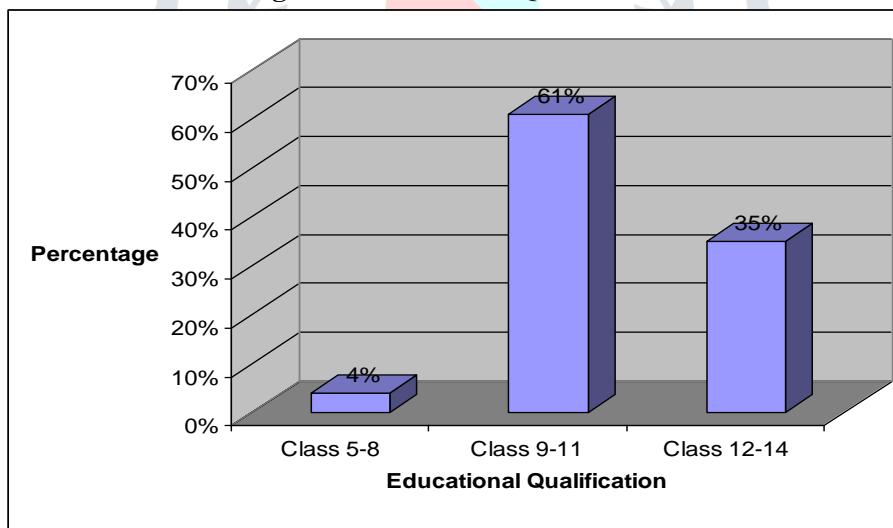


Gender of the respondents is described above. From the graph it was found that out of 100 respondents, 78% respondents were male and 22% respondents were female.

Table 3: Educational Qualification

Sl. No.	Education	Percentage
1	Class 5~8	4.0%
2	Class 9~11	61%
3	Class 12~14	35%
Total		100%

Figure 3: Educational Qualification

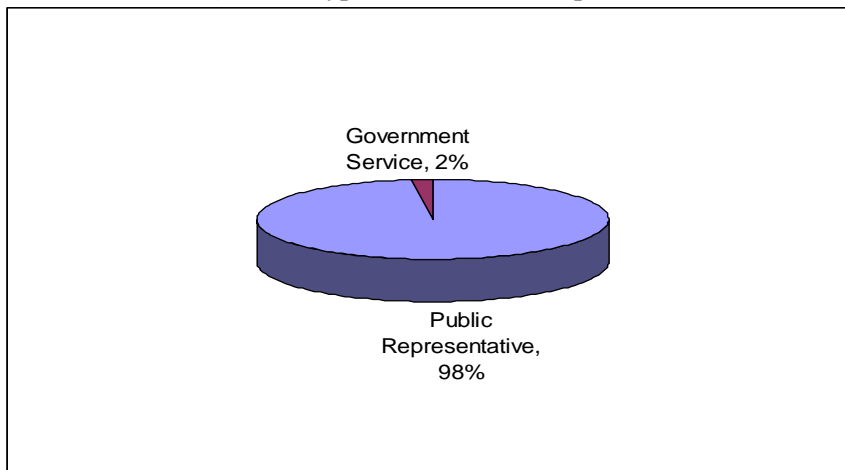


Educational qualifications of respondents are described above. From the graph it was found that out of 100 respondents, 61 % respondents completed class 9~11 which is the maximum and 4.0% completed class 5~8 which is the minimum and 35% respondents completed class 12~14.

Table 4: Type of Job of the Respondents

Sl. No.	Type of Job	Percentage
1	Government	2.0%
2	Public Representatives	98%
Total		100%

Figure 4: Type of Job of the Respondents

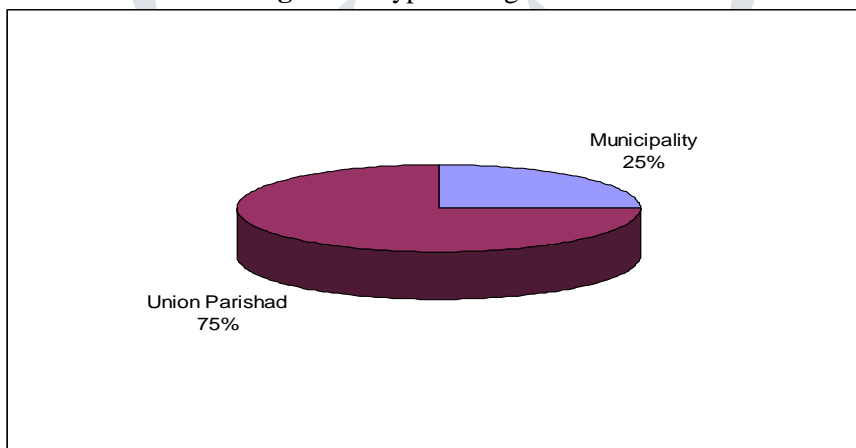


Job category of the respondents is described above. From the graph it was found that out of 100 respondents 98% respondents are Public Representative and 2.0% respondents are Government Service holder.

Table 5: Type of Organization

Sl. No.	Type of Organization	Percentage
1	Union Parishad	75%
2	Municipality	25%
Total		100%

Figure 5: Type of Organization

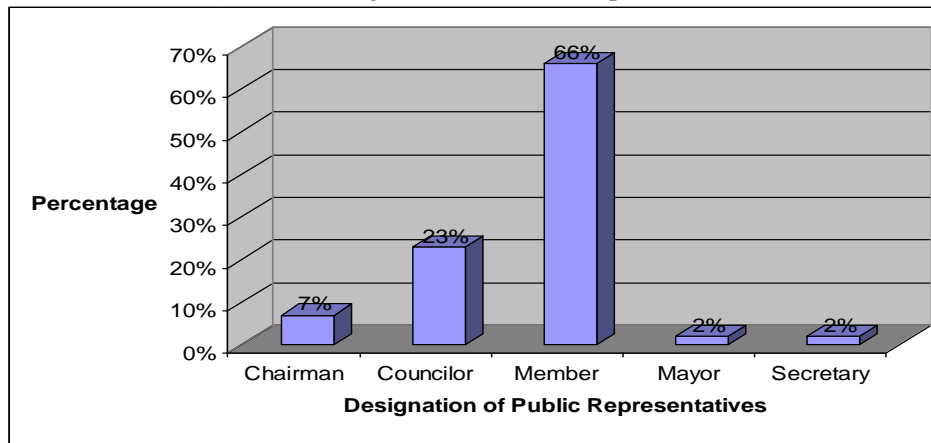


Category of the Organization is described above. From the graph it was found that out of 100 respondents, 75% respondents engaged in Union Parishad and 25% respondents are engaged in Municipality.

Table 6: Designation of Public Representatives

Sl. No.	Designation	Percentage
1	Chairman	7.0%
2	Councilor	23%
3	Member	66%
4	Mayor	2.0%
5	Secretary	2.0%
Total		100%

Figure 6: Designation of Public Representatives

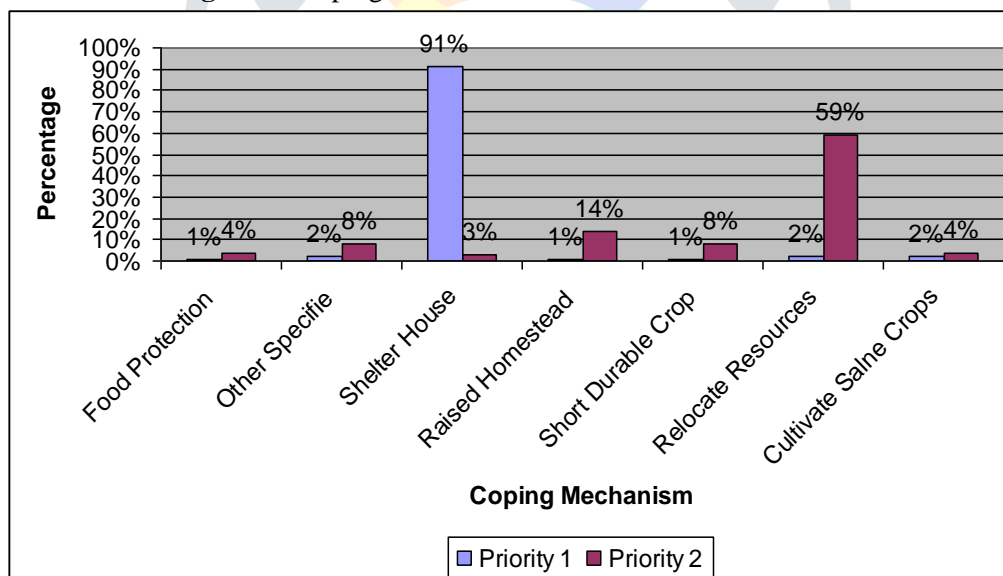


Designation of the Public Representatives is described above. From the graph it was found that out of 100 respondents, 66% was Member of Union Parishad which is the maximum and 2.0% are Mayor of Municipality and Secretary of Union Parishad. Other representatives are Chairman of Union Parishad, Councilor of Municipality are 7.0% and 23% respectively.

Table 7: Coping Mechanism of Climate Induced Hazard

Category	Priority 1	Priority 2
Food Protection	1.0%	4.0%
Other Specifie	2.0%	8.0%
Shelter House	91%	3.0%
Raised Homestead	1.0%	14%
Short Durable Crop	1.0%	8.0%
Relocate Resources	2.0%	59%
Cultivate Salne Crops	2.0%	4.0%

Figure 7: Coping Mechanism of Climate Induced Hazard

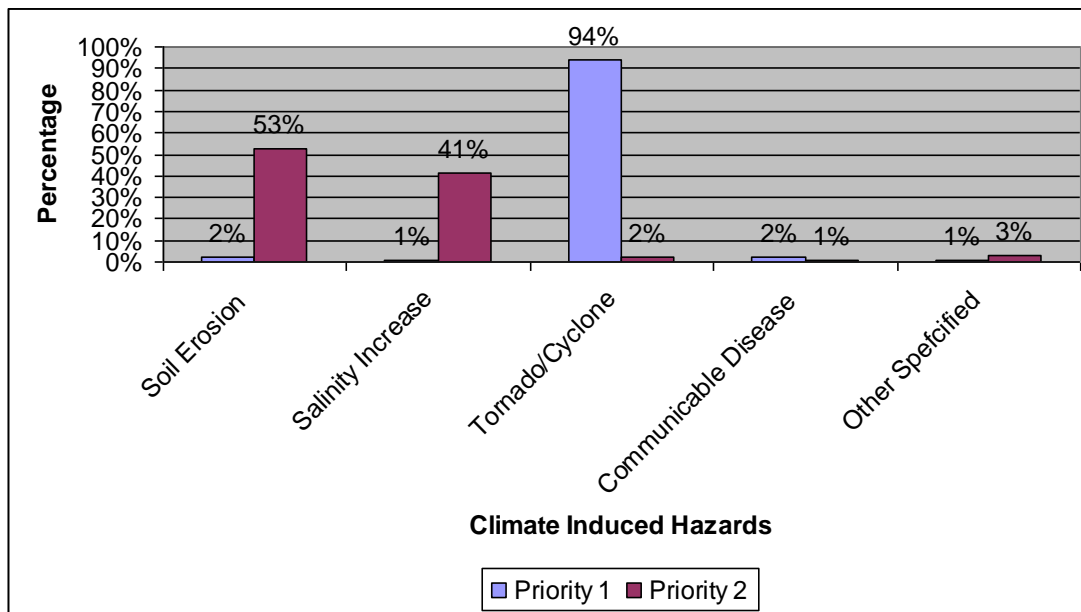


Coping mechanism of the disaster prone areas are described above. Here opinions of the respondents are categorized into Priority 1 and Priority 2. From the graph it was found that in case of priority 1, out of 100 respondents, 91% respondents were agreed that Shelter House is the most effective coping mechanism against natural disaster and other coping mechanisms are Food Protection, Other Specific adaptation measure like take shelter in embankment/dam during disaster period, Raised Homestead, Short Durable Crop, Relocate Resources and Cultivable Saline Crops are 1.0%, 2.0%, 1.0%, 1.0%, 2.0% and 2.0% respectively. In case of Priority 2, out of 100 respondents, maximum 52% respondents agreed that Relocate Resources is the most effective coping mechanism against natural disaster and other coping mechanisms are Food Protection, Other Specific, Raised Homestead, Short Durable Crop, Relocate Resources and Cultivable Saline Crops are 4.0%, 7.0%, 8.0%, 17%, 8.0%, and 4.0% respectively.

Table 8: Climate Induced Hazards

Hazards	Priority 1	Priority 2
Soil Erosion	2.0%	53%
Salinity Increase	1.0%	41%
Tornado/Cyclone	94%	2.0%
Communicable Disease	2.0%	1.0%
Other Specified	1.0%	3.0%

Figure 8: Climate Induced Hazards

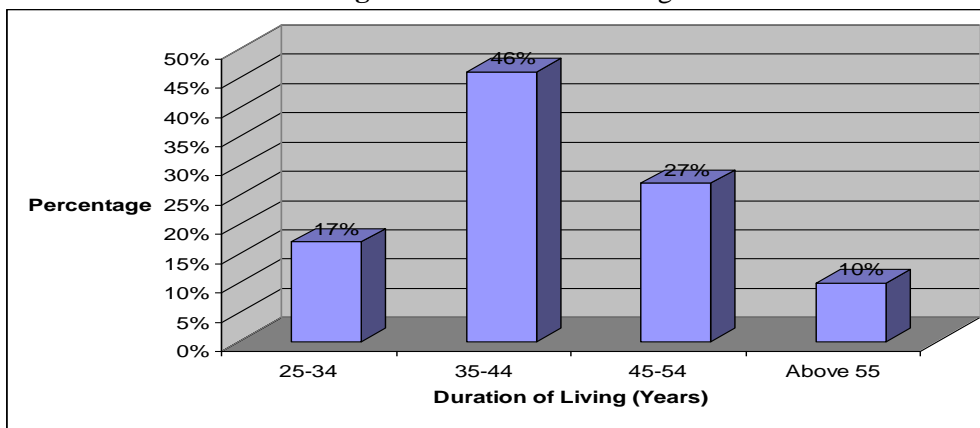


Climate Induced Hazards are described above. Here opinions of the respondents are categorized into Priority 1 and Priority 2. From the graph it was that in case of priority 1, it was found that out of 100 respondents, maximum 94 % respondents agreed that Tornado/Cyclone is the main climate induced hazards, and other climate induced hazards are Soil Erosion, Salinity Increase, Communicable Disease and Other Specified hazards are 2%, 1%, 2%, and 1% respectively. In case of Priority 2, it was found that out of 100 respondents, maximum 53% respondents agreed that Soil Erosion is the main climate induced natural hazards and other climate induced natural hazards are Salinity Increase, Tornado/Cyclone, Communicable Disease and other Specified hazards are 41%, 2%, 1% and 3% respectively.

Table 9: Duration of Living

Sl. No.	Duration	Percentage
1	25-35	17%
2	35-44	46%
3	45-54	27%
4	Above 55	10%
Total		100%

Figure 9: Duration of Living

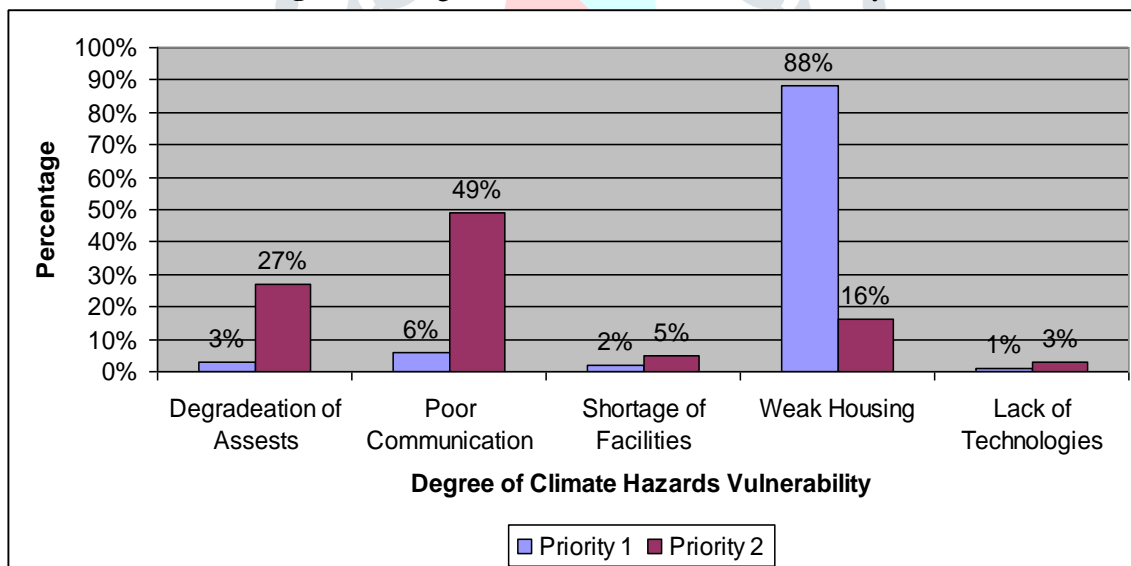


Duration of living of the respondents is described in the above graph. From the graph it was found that duration of living 35-44 years is 46 % which is the maximum and duration of living above 55 years is 10 % which is the minimum. Duration of living 25-34, 45-54 years is 17% and 27 % respectively. The selection of the participants was done randomly.

Table 10: Degree of Climate Hazards Vulnerability

Degree	Priority 1	Priority 2
Degradation of Assets	3.0%	27%
Poor Communication	6.0%	49%
Shortage of Facilities	2.0%	5.0%
Weak Housing	88%	16%
Lack of Technologies	1.0%	3.0%

Figure 10: Degree of Climate Hazards Vulnerability



Degree of Climate Hazards Vulnerability is described above. Here opinions of the respondents are categorized into Priority 1 and Priority 2. From the graph it was that in case of priority 1, out of 100 respondents, 88% respondents agreed that Weak Housing is the effect of natural disaster which is the maximum and lack of technologies is 1% which is the minimum effect of natural hazards. Other effects of natural hazards are Degradation of Assets, Poor Communication, Shortage of Facilities, Weak Housing and Lack of Technologies is 3%, 6%, 2% respectively. In case of priority 2 out of 100 respondents, 49% respondents agreed that Poor Communication is the effect of natural disaster which is the maximum and Shortage of Facilities is 1% which is the minimum effect of natural hazards. Other effects of natural hazards are Degradation of Assets, Weak Housing and lacks of Technologies are 30%, 6% and 4% respectively.

SUMMARY AND RECOMMENDATION

A study was conducted to identify the adaptation and mitigation strategies of climate induced hazards in the coastal areas and understand the climate hazards and degree of vulnerability caused by these disasters in coastal zone in Bangladesh. Adaptation to climate change is a complex topic that presents a number of challenges. This involves a process of sustainable and permanent adjustment in response to new and changing environmental circumstances. So adaptation cannot be treated as a stand-alone issue and should be premised on the following factors.

1. Vulnerability and adaptation assessments should be developed for prioritizing adaptation policies and measures. Adaptation has to be mainstreamed in investment planning both in public and private sector. Governments therefore need to devise policies, incentives, and regulation to public and private initiative toward strengthening adaptation.
2. Capacity needs to be built for both short-term and long-term adaptation planning. Innovative risk sharing mechanisms (insurance) are needed to respond to emerging challenges including biodiversity loss and land degradation.
3. Adaptation, rather than being concentrated in one sector, should essentially be dispersed across all socio-economic sectors including water, health, agriculture, and infrastructure, each of which presents in own challenges, and will involve stakeholders in different if overlapping groups. Adaptation measures are likely to be less capital intensive and more amenable to small scale interventions.
4. More Shelter Centers should be built to give shelter during the natural hazards.
5. Living house should be built in such a way so that the houses can resist the tidal surge and cyclones.
6. Governmental institutions (ministries, governmental organizations and agencies), private entries and NGOs should consider integrating climate change in their planning and budgeting at all levels of decision making and coordinate their actions among themselves.
7. Vulnerability and adaptation assessments should be developed for prioritizing adaptation policies and measures. Adaptation has to be mainstreamed in investment planning both in public and private sector. Governments therefore need to devise policies, incentives, and regulation to public and private initiative toward strengthening adaptation.
8. Capacity needs to be built for both short-term and long-term adaptation planning. Innovative risk sharing mechanisms (insurance) are needed to respond to emerging challenges including biodiversity loss and land degradation.
9. Adaptation, rather than being concentrated in one sector, should essentially be dispersed across all socio-economic sectors including water, health, agriculture, and infrastructure, each of which presents in own challenges, and will involve stakeholders in different if overlapping groups. Adaptation measures are likely to be less capital intensive and more amenable to small scale interventions.

Still many climate change impacts timing and exact magnitude are uncertain. Hence, the strategy and Action Plan will require periodical revision. The following enhancements should be considered by Government of Bangladesh to their policies and programs.

1. Adopt meaningful, achievable climate change targets.
2. Pursue strong, binding emissions targets in international negotiations.
3. Ensure commitment of developing countries fair share to climate change adaptation for Bangladesh.
4. Education, training and public awareness.
5. Seeking more support for climate change mitigation and adaptation research: The Government of Bangladesh should look for increased funding support to research into innovative technologies including renewable energy, understanding climate change dynamics, carbon capture and sequestration, energy efficiency, crop varieties, and other adaptation and mitigation innovations.
6. Encourage environmental solutions in other counties.
7. Collaborate with our neighbors who are victim of climate change.

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