Enhancing Climate Resilience in the Most Climate Affected Communities by Adapting Locally Suitable Technologies through Actions Research

A Research Report

Of

Social Research project (Climate Resilience through Action Research)

Conducted

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Acronyms

CC	Climate change
GO	Government Organization
NGO	Non-Governmental Organization
LDC	Least Developed Countries
CVF	Climate Vulnerable Forum
SLR	Sea Level Rise
IPCC	Intergovernmental Panel on Climate Change
UNFCCC	Framework Convention on Climate Change
UNISDR	International Strategy for Disaster Reduction
UN	United Nation
UK	United Kingdom
FGD	Focus Group Discussion
GPS	Global Positioning System
KII	Key Informant Interview
BBS	Bangladesh Bureau of Statistics
SSC	Secondary School Certificate
BDT	Bangladesh taka
ADB	Asian Development Bank
GCA	Gross-Cropped Area
HYV	High Yield Variety
BRRI	Bangladesh Rice Research Institute
FAO	Food and Agriculture Organization
DMS	Disaster Management Service
CDMP	Comprehensive Disaster Management Programme
GBV	Gender-Based Violence

Executive Summary

Natural disasters make Bangladesh more vulnerable, particularly in the southern part of the coastal belt in Bangladesh. The aim of the study is to explore locally suitable adaptive technologies and alternative livelihood options for the disaster affected and vulnerable communities of the coastal belt in Bangladesh. In-depth semi-structured interviews technique were used to conduct study with both primary (household surveys, FGD and KII) and secondary data. The locations of the study were Sonakata, Barabagi and Nishanbaria union of Taltoli upazila in Barguna district and Nilgonj and Dhankhali union of Kalapara upazila in Patuakhali district.

The study found that people in study area have different livelihood pattern, among them 40% farmer, 30% fisherman, 20% livestock and 10% wage labour were vulnerable due to the natural hazard. The income decreased in the agriculture sector almost 25%, fisheries sector 15%, livestock 5% and day labor 11%. The study also revealed that the natural hazards destroyed their crops and livestock as well as reduce their production rate. The people change their livelihood option and seek for alternate livelihood opportunity such as farmer, fishermen, day labour and small trader. Even they try to cope with the impact of climate change by adjusting with meal; selling agricultural products, household productive assets, small animals, trees, jewellery, tin sheets of their house, farmlands; taking relief from loan.

The Study found that the most adverse effect of climate change is occurred among children such as inadequete nutrition facilities, death risk, injuries, skin disease and other disease like cholera typhoid. The study reveals that adolescents suffered numerous issues. The following issues are increased child labor, child marriage and sexual exploitation, trafficking, school dropout (56%), drowning, injuries, begging , and orphan hood. In terms of violence of women and most of the perpetrators were husband (55%), own family member (12.23%), followed by known person (13%), neighbours (12%), lovers (2.15%), house master and mistress (2.62%), in laws and others (3%).

In terms of the potential climate adaptive and locally suitable technologies for sustainable livelihood, the farmers in communities have adopted different kinds of indigenous coping strategies to protect their crops from the impacts of flooding. Study find out that farmers of this

area to ensure food or production of crop practice floating bed for cultivating different types of vegetables. They made bed with water hyacinth, algae or plant residues and use bamboo for foundation. The floating garden are extremely suitable for growing several vegetables and fruits. It is more commonly used for growing tomato, pumpkin, cucumber, okra, bitter gourd, snake gourd, brinjal, spinach, red spinach etc. Farmers also cultivate vegetables on tin roof top of their house to avoid effects of floodwater and water logging impacts on vegetables. They also plant vegetables on net that place over the pond. They also have taken the initiative to cultivate kewra, which can be grown well in saline soil. It is now considered a cash crop for its fruit, and its wood can be used to make furniture or as fuel. They also cultivate vegetables on their homestead in plastic bag or bottle which they can move or lifted up to avoid salinity intrusion into the soil. Hence, they have adopted some coping strategies such as shrimp cultivation and rice cultivation for generations using their own methods and community wisdom, reed cultivation and mat weaving, cultivation of prawn renu, crab aquaculture, and golpata (a tree variety), and salt cultivation. In terms of salinity, they cultivate saline tolerant varients, cultivate kewra or golpata and remove upper soil of land. In cases of waterlogging they use floating bed, tin roof. People meet the crisis of drinking by harvesting rainwater, preserving fresh drinking water, conserving pond water. In terms of indigenous practice people build machan and petaton (31%), temple shaped house (19%) and courtyard on a raised platform (7%). The result shows that to avoid natural hazards people climed up trees, stayed in house ceiling, use plastic container or banana rafts, and force to temporary migration.

Chapter 1
Introduction

1.1 Background of the study

The climate is changing and weather patterns are becoming extreme and unpredictable so climate change is a major global concern in present days (IPCC, 2007). Bangladesh is widely recognized as one of the most climate vulnerable countries in the world because of its disadvantageous geographic location; flat and low-lying topography; high population density; high levels of poverty; and reliance of many livelihoods (Harmeling, 2010). It experiences frequent natural disasters that cause loss of life, damage to infrastructures and economic assets, and adversely impact on lives and livelihoods, especially of poor and marginal households. The coastal area, about 32 % of the country's total area, is aggravated by climate change and its impact. Many of the anticipated adverse effects of climate change, will aggravate the existing stresses that already impede development in Bangladesh (Dasgupta *et al*., 2018).

As per the recent delineation, the coastal zone of Bangladesh consists of 19 districts comprising 147 sub-districts covering an area of 47,201 km^2 (Islam, 2004). Among them Patuakhali and Barguna are most vulnerable coastal districts of Bangladesh which faces adverse climatic events every year like cyclone, tidal surges, flood, heavy rainfall, river erosion, salinity intrusion etc. The majority of the people living in these areas are connected to either agriculture or fishing or both, which are highly dependent on the usual functioning of natural events. A climatic event appeared as a stress to livelihood sustainability when it happened in an untimely manner (e.g., flooding during resource harvesting periods) and directly affected the production process (e.g., agriculture and fisheries). Unfortunately, over the last several decades these livelihoods have gradually decreased pushing farmers and fishermen to look for alternative livelihoods (Shamsuddoha and Chowdhury, 2007). A major reason for this is changing environmental stress caused by both climate change and human-interventions.

Extreme weather events have also been associated with increases in aggressive behaviour and domestic violence. Exposure to extreme heat may lead to increased use of alcohol to cope with stress, increases in hospital and emergency room admissions for people with mental health or psychiatric conditions, and an increase in suicide (Huq *et al*., 2020). Some people are more vulnerable to the potential impacts of climate change, including children, the elderly, the chronically ill, people with cognitive or mobility impairments, pregnant and postpartum

women, and people with mental illness. Children are more impacted by disasters than adults and are more likely to have continued trauma-related symptoms after a disaster. Disruptions in routine, separation from caregivers as a result of evacuations or displacement, and parental stress after a disaster all contribute to children's distress (Hossain et al., 2020). Uncomfortable climatic condition effects their mental health and education progress. The health effects of these disruptions include increased respiratory and cardiovascular disease, injuries and premature deaths related to extreme weather events, changes in the prevalence and geographical distribution of food- and water-borne illnesses and other infectious diseases, and threats to mental health. If climate change weakens educational attainment, it may have a compounding impact on underdevelopment that would over time amplify the immediate forces of climate change*." As the effects of climate change increase, children in the tropics will face new barriers to learning",* (IPCC, 2001).

Efforts to mitigate the impacts of hazards and climate change tend to focus on infrastructure development such as building high sea walls, or on high-tech solutions such as sophisticated early warning systems based on scientific data and modeling. Although these technical and scientific solutions save lives when hazards strike, they need to be complemented by actions to address the risks surrounding the hazard and the underlying components of vulnerability – the interrelated human, social and cultural factors that influence risk – which can contribute to turning a hazard into a disaster. An important factor that can increase the resilience of communities is their local knowledge, which, in combination with outside knowledge, has helped communities manage crises – be it natural hazards, economic problems, or political conflicts (Shaw *et al*., 2014)

The climate resilience of communities facing disasters can increase when new and old techniques and knowledge are combined. Furthermore, it is now generally recognized that integrating indigenous knowledge with scientific knowledge can lead to successful disaster preparedness strategies and climate change adaptation strategies. In combination with the latest technology and scientific assessment, local and indigenous knowledge can give communities and decision-makers a very good knowledge base to enable them to make decisions about the environmental issues they face (Morzaria-Luna *et al*., 2014).

The study has been carried out to find out adverse effect of climate change on the people's life and livelihoods especially on children, women and adolescents' life in Patuakhali and Barguna

district. The study also tried to explore locally suitable adaptive technologies and alternative livelihood options for the disaster affected and vulnerable communities of the area.

1.2 Problem Statement

The biophysical and socio-economic condition of the Southern Part especially Patuakhali and Barguna district is extremely vulnerable and almost every year this region is being affected by natural disasters and climatic stress like cyclone, flood, water logging, salinity intrusion, storm surge, river bank erosion etc. People in this area lose their lives, health, and education advancement every year due to cyclones. Due to its geographical location, topography, high population density, poverty and lower adaptive competence it is considered to be highly vulnerable to natural disasters in the world (Khan *et al.*, 2011). It has been also observed that cyclone with storm surge, damage human settlement, homestead, infrastructures, productive land and natural resources, which decrease the livelihood assets of the poor and marginal community. This area has fresh water scarcity due to salinity intrusion, so the community people largely depended on rain water, GOs and NGOs supply water scheme.

The people of the project location having direct negative impact of the climate change by erratic rainfall, increased number of severe floods, increased frequency of cyclone, salinity intrusion and riverbank and river erosion. These series of events resulted no more crops without chemical fertilizer and poising pesticide in the coastal belt. Destruction of crop varieties and reduction of agricultural production causes short term migration which affects the livelihoods of coastal people. Most of agri-farmers are migrating from their agriculture to non-firm IGAs (Income Generating Activities). Moreover, aquaculture and fishing are being hampered greatly due to flash flood, tidal surge, and frequent depression in Bay. Area migration is a measure impact of climate changes for coastal people. Most of the climate vulnerable and victim peoples migrating from their own place to Dhaka and other districts for searching new IGAs (Ahmed *et al*., 2019). After a natural disaster, women are more likely to become victims of domestic and sexual violence which impacts women`s and children health. It has been observed that due to adverse effect of climate change the menstrual period of the adolescent girls is happening earlier (within 11 to 12 years of age) before the normal period. Reproductive health and basic rights are negatively impacted by climate change for women and adolescent girls as in the society, women are more susceptible among the vulnerable groups due to gender inequality. High rate of sickness and mortality of women rather than men for impact of CC issues due to lack of proper education and dignity in the family members (Anderson, 2012; Davidson, 2008).

The majority of the inhabitants in the chosen area are impoverished, and they are unaware of the effects of climate change on their health and education. They have no idea how to adapt to climate change in order to avoid or lessen climatic hazards, or how to make their health and education more disaster-resistant. They do not have adequate catastrophe preparedness in their families and communities. Additionally, the disaster management system in this area is inadequate.

Considering the above facts this proposed research conducted to acquire an in-depth study on climate adaptive technologies for alternative livelihood which is feasible and sustainable for coastal belt. The research findings will support community people to select the best options for climate change adaptions that will contribute to reduce the risks in their livelihood.

1.3 General Objective

The overall purpose of the study was to explore locally suitable adaptive technologies and alternative livelihood options for the disaster affected and vulnerable communities of the coastal belt in Bangladesh.

1.4 Specific Objectives

1. To find out adverse effect of climate change on the people's livelihoods in Patuakhali and Barguna district.
2. To find out the most adverse effect of climate change on children, women and adolescents in relationship to rights in Patuakhali and Barguna district.
3. To find out the potential climate adaptive and locally suitable technologies for sustainable livelihood for the people in Patuakhali and Barguna district.

1.5 Research Questions

A. To what extents are the people's livelihood adversely affected due to climate change?
B. How do and what extent women, adolescents and children are affected by the climate change?
C. Which groups and what are their areas mostly affected due to climate change and to what extent?
D. What are the best practices by the local communities to cope up with the adverse situation on livelihood and other rights aspects?

E. What lessons we learnt regarding adverse effect of climate change and locally adaptable and suitable technology?
F. How the good practices for climate adaptive technologies can be replicated by others?

1.6 Limitations of the Study

Some limitations have been encountered during the study period to complete this research work. Those are given below:

- Data from the entire study area was difficult to obtain in a short span of time.
- Insufficient financial support also causes great harm while conducting the research.
- Level of knowledge of the responders is also a barrier of the study.
- The study area is rural riverside area. So, transportation and communication are a greater problem to conduct the research.
- Very limited literature and secondary data on the local level losses and damages were available.

Chapter 2

Literature Review

IPCC (2001) Intergovernmental Panel on Climate Change, Geneva in a report entitled Climate Change 2001: Impacts, Adaptation, Vulnerability reveals, Climate change has caused substantial damages, and increasingly irreversible losses, in terrestrial, freshwater and coastal and open ocean marine ecosystems. The extent and magnitude of climate change impacts are larger than estimated in previous assessments. Widespread deterioration of ecosystem structure and function, resilience and natural adaptive capacity, as well as shifts in seasonal timing have occurred due to climate change, with adverse socioeconomic consequences. Approximately half of the species assessed globally have shifted pole wards or, on land, also to higher elevations. Hundreds of local losses of species have been driven by increases in the magnitude of heat extremes, as well as mass mortality events on land and in the ocean and loss of kelp forests. Some losses are already irreversible, such as the first species extinctions driven by climate change. Other impacts are approaching irreversibility such as the impacts of hydrological changes resulting from the retreat of glaciers, or the changes in some mountain and Arctic ecosystems driven by permafrost thaw. (Hans-O. Pörtner (Germany), Debra C. Roberts (South Africa), Helen Adams (United Kingdom), Carolina Adler (Switzerland/Chile/Australia), Paulina Aldunce (Chile), Elham Ali (Egypt), Rawshan Ara Begum (Malaysia/Australia/Bangladesh), Richard Betts (Ahmed et al., 2019).

Bangladesh Strategies and Role Based on Paris Agreement, 2012 In Cop21, Bangladesh had a team led by the Minister of Environment and Forests which included a team of parliamentarians. A team of senior government officials and experts worked hard and closely under the leadership of the Secretary, Environment and Forests. Dr. Q. K. Ahmed was the coordinator of the expert group for the negotiators. There was also a large presence of scientists, think tanks, civil society organizations, NGOs, private sector and media from Bangladesh in Paris. Government of Bangladesh had a country booth and the civil society networks had their own booth. Both these areas became useful meeting places as well as areas of rapid exchange of ideas, information and documents. The Bangladesh delegates worked well together focusing on issues of their concerns and interacted well within G77, LDC, and the Climate Vulnerable Forum (CVF) groups. Besides, both the Government and civil societies were well engaged in several side events and many bilateral meetings and negotiations. The Bangladesh civil society groups presented side events on Bangladesh grassroots people's perceptions and expectations

from Paris, loss and damage research, migration issues, health services to vulnerable groups, arranging press conferences as well as interacting with the Climate Action Network (CAN) and its regional groups and contributed to “ECO”, the conference journal. Government of Bangladesh also organized well attended press conferences and explained their positions on issues and approaches.

To take leadership role in a post-Paris Agreement world Bangladesh could and should take a number of activities that will build capacity, prepare for significant fund mobilization and move rapidly forward to the sustainable development pathway with reduction of climate risks. There is a need for an exercise regarding what individual agencies of the government, research community, civil society and private sector can do. But we can always start with a few key activities. Let us remember that Bangladesh has very little obligation. Bangladesh must choose the path which meets its development aspirations as well as the need for climate impact reduction and/or contribute to low carbon growth pathways. A set of actions that can be immediately activated as a priority is given below. These are only a set of examples that can be initiated urgently on a priority basis. These include activities on both adaptation and mitigation. (Nurul, 2013)

Durgadas Mukhopadhyay, in a study on, Cultural values, indigenous knowledge for climate change adaptations in developing countries reveals 30% of animal and plant species will be vulnerable to extinction if global temperature rose by 1.5 to 2.5 degrees Celsius. It says the world’s have-nots would be worst hit by climate change, predicting greenhouse gases would change rainfall patterns, intensify tropical storms, accelerate the melting of Arctic ice and mountain glaciers and amplify the risk of drought, flooding and water stress. As with disaster risk management, policies and measures concerned with climate change represent a risk management approach. Both disaster prevention measures and climate adaptation measures aim to address underlying vulnerabilities, which would otherwise put the natural and human systems at risk Indigenous knowledge is knowledge unique to a given culture or society, acquired through accumulation of years of experiences of local people passed on from generation to generation. Any adjustment (economic, ecological or social), whether passive, reactive or anticipatory is used as a means to ameliorate the anticipated adverse consequences associated with climate change. Indigenous knowledge is a precious national resource that can facilitate. the process of disaster prevention, preparedness and response in cost-effective participatory and sustainable ways. (Mukhopadhyay, 2009)

A recent study on climate change conducted by Dr. Mahbuba Nasreen in the article entitled 'Climate Change and Food Security' (Nasreen et al., 2008), pointed out 'Growing scarcities of water, land and fuel are likely to put increasing pressure on food prices, even without climate change. Additional pressures on these resources due to climate change, the introduction of mitigation practices that have the potential to create land use competition, and the attribution of market value to environmental services to mitigate climate change, also have the potential to cause significant changes in relative prices for different food items and an overall increase in the cost of an average food basket for the consumer'. Achieving food security and reducing poverty in Bangladesh has been a major challenge for both governments and development agencies due to vulnerability of Bangladesh agriculture. Currently, much more people in the rural Bangladesh are considered food insecure due to recurrent different events like flood, storm, river bank erosion, salinity intrusion, and drought. This unfortunate situation is the result of many factors, some of which are:

The poor nature of soils due to intensive cultivation and cropping (most soils are now low in organic matter content, low in carbon and poor in different micro-nutrients);

The rapid population growth, which has led to continuous cropping, expansion of agriculture to marginal areas and overgrazing;

The low use of technologies such as improved varieties, fertilizers, mechanization and irrigation that have stimulated agricultural development; and

The absence of adequate technologies and policies that take into account the specific needs of the small-scale farmers.

This study can immensely make able to correlate the climate change and food security, but the geographical heterogeneities that the main victims of coastal regions are somehow excluded to discuss. (Wali and Hassan, 2016)

Another important study on the article entitled 'Impact of sea level rise on coastal zone of Bangladesh' made by Golam Sarower pointed out sea level rise has various impacts on Bangladesh, a coastal country facing 710 km long coast to the Bay of Bengal. It already has affected Bangladesh by land erosion, salinity intrusion and loss in biodiversity. Its potential threats are coming even strongly in the future. Sea level rise will cause river bank erosion, salinity intrusion, flood, damage to infrastructures, crop failure, fisheries destruction, loss of biodiversity, etc. along this coast. A one-meter sea level rise (SLR) will affect the country's

vast coastal area and flood plain zone. It will affect Millennium Development goals, causing environmental refugees. Most vulnerable sectors to one metre sea level rise are coastal resources, water resources, agriculture and the ecosystem of Bangladesh. (Wallman, 2005)

2.1 Conceptualization of Some Terminologies

The following sections will discuss definitions of main relevant concepts to the study.

2.1.1 Climate Change

Climate change is a change in the statistical distribution of weather patterns when that change lasts for an extended period of time (i.e., decades to millions of years). Climate change may refer to a change in average weather conditions, or in the time variation of weather within the context of longer-term average conditions. Climate change is caused by factors such as biotic processes, variations in solar radiation received by Earth, plate tectonics, and volcanic eruptions. Certain human activities have been identified as primary causes of ongoing climate change, often referred to as global warming.

The United Nations Framework Convention on Climate Change (UNFCCC) defines it as a change of climate that is attributed directly or indirectly to human activity, altering the composition of the global atmosphere.

IPCC refers to the climate change as the change caused by all activities whether arising from human or natural causes, and also linked it to time and variability in climate characteristics.

Climate change refers to significant changes in global temperature, precipitation, wind patterns and other measures of climate that occur over several decades or longer. Climate change is a change in the statistical distribution of weather patterns when that change lasts for an extended period of time (i.e., decades to millions of years). Climate change may refer to a change in average weather conditions, or in the time variation of weather within the context of longer-term average conditions.

2.1.2 Adaptation

Adaptation refers to the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. As such, reducing coastal vulnerability to natural hazards and climate change is

a form of adaptation. The main goals of climate change adaptation are to reduce vulnerability and build resilience to the impacts brought by climate change (IPCC, 2007).

Adaptation to climate change has the potential to substantially reduce many of the adverse impacts and enhance beneficial impacts, though neither without cost nor without leaving residual damage.

Leary (2008) argued adaptation to be a process, which includes learning about risk, evaluating response options, creating the conditions that enhance adaption, mobilizing resources, implementing adaptation, and reviewing choices with new learning.

Adapt or adaptation is a synonym for to make more suitable or fit to some purpose by altering or modifying (Hurd et al., 1999). Adaptation in the context of climate change developed its own definitions over time. Adaptation is "adjustments in ecological-social-economic systems in response to actual or expected climatic stimuli, their effects or impacts". Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation (Haddad, 2005).

Adaptability refers to the degree to which adjustments are possible in practices, processes, or structures of systems to projected or actual changes of climate. Adaptation can be spontaneous or planned and can be carried out in response to or in anticipation of change in condition (Watson et al, 1996).

2.1.3 Climate Change Adaptation

Climate Change Adaptation is defined by the United Nations Framework Convention on Climate Change (UNFCCC) as "Adjustments in natural or human systems in response to actual or expected climatic stimuli or their effects that moderate harm and exploit beneficial opportunities. This can include: (a) adapting development to gradual changes in average temperature, sea level and precipitation; and (b) reducing and managing the risks associated with more frequent, severe and unpredictable extreme weather events" (UNISDR, 2010).

The IPCC describes it as adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

The UN Development Program calls it a process by which strategies to moderate, cope with and take advantage of the consequences of climatic events are enhanced, developed, and implemented.

The UK Climate Impacts Program defines it as the process or outcome of a process that leads to a reduction in harm or risk of harm, or realization of benefits associated with climate variability and climate change.

2.1.3 Concept of Successful Adaptation

There is a lack of consensus about what constitutes successful adaptation, starting at the global level and having rippling effects downwards. Ultimately, successful adaptation will be seen on multi-decadal timeframes based on the achievement of development objectives sensitive to a changing climate. However, the assessment of such long-term achievements would require monitoring and evaluation to extend over periods much longer than with those associated with project and programmed lifetimes. However, it seems prudent to claim that evaluations of adaptation at all scales should include elements of effectiveness, flexibility, efficiency, equality and sustainability. Table 1 presents the main determining factors of successful adaptation.

Table 1: Factors in Determining the Success of Climate Change Adaptation (Source: Bene, 2011)

Measure	Description
Effectiveness: Achieving objectives	An effective adaptation intervention will achieve its stated objectives.
Flexibility: How far can we adapt?	The large uncertainty around climate change means that it is likely we will either do too much, or too little, adaptation.
Efficiency: Cost effectiveness	Efficiency or cost-effectiveness is typically used to compare the costs of alternative ways of producing the same or similar results, i.e., to assess the least-cost path to reaching a given target.
Equity: Inequality dimensions to adaptation	Adaptation aims to reduce vulnerability to climate change shocks and stresses. However, vulnerability also depends on socio-economic factors, which implies that any given adaptation

	may reduce vulnerability inconsistently across groups. Adaptation can
	Reinforce existing inequalities, or it could be designed in such a way as to protect especially vulnerable groups.
Sustainability: The wider implications of adaptation	Sustainability of an adaptation is concerned with looking beyond the immediate sphere of the intervention's impact.

2.1.4 Adaptation Measures Proposed by IPCC

Various adaptation measures proposed by IPCC in its fourth assessment report are as following Table 2. It will be useful to compare these measures with currently practiced techniques in the selected study areas.

Table 2: Adaptation Measures Proposed by IPCC (Source: Adger, 1999a; Adger, 1999b)

Sector	**Adaptation Measures Proposed by IPCC**
Water	Expanded rainwater harvesting. Water storage and conservation techniques. Water re-use and Desalination. Water-use and irrigation efficiency.
Agriculture	Adjustment of planting dates and crop variety; crop relocation. Improved land management, e.g., erosion control and soil protection through tree planting.
Human Health	Heat-health action plans. Emergency medical services. Improved climate-sensitive disease surveillance and control. Safe water and improved sanitation.

Chapter 3
Methodology

3.1 Study Area

The locations of the study area in south central coastal belt of Bangladesh. The selected areas were Sonakata, Barabagi and Nishanbaria union of Taltoli upazila in Barguna district and Nilgonj and Dhankhali union of Kalapara upazila in Patuakhali district. In the selected union's households' questionnaire survey were conducted. Based on this survey result, Livelihood Vulnerability Indices were determined. At the same time, the impact and coping methods of local people to various natural hazards were also analysed. Focus Group Discussion (FGD) conducted from gender perspective in three areas namely Nilgonj of Kalapara upazila, Nishanbaria and Barabagi of Taltoli upazila.

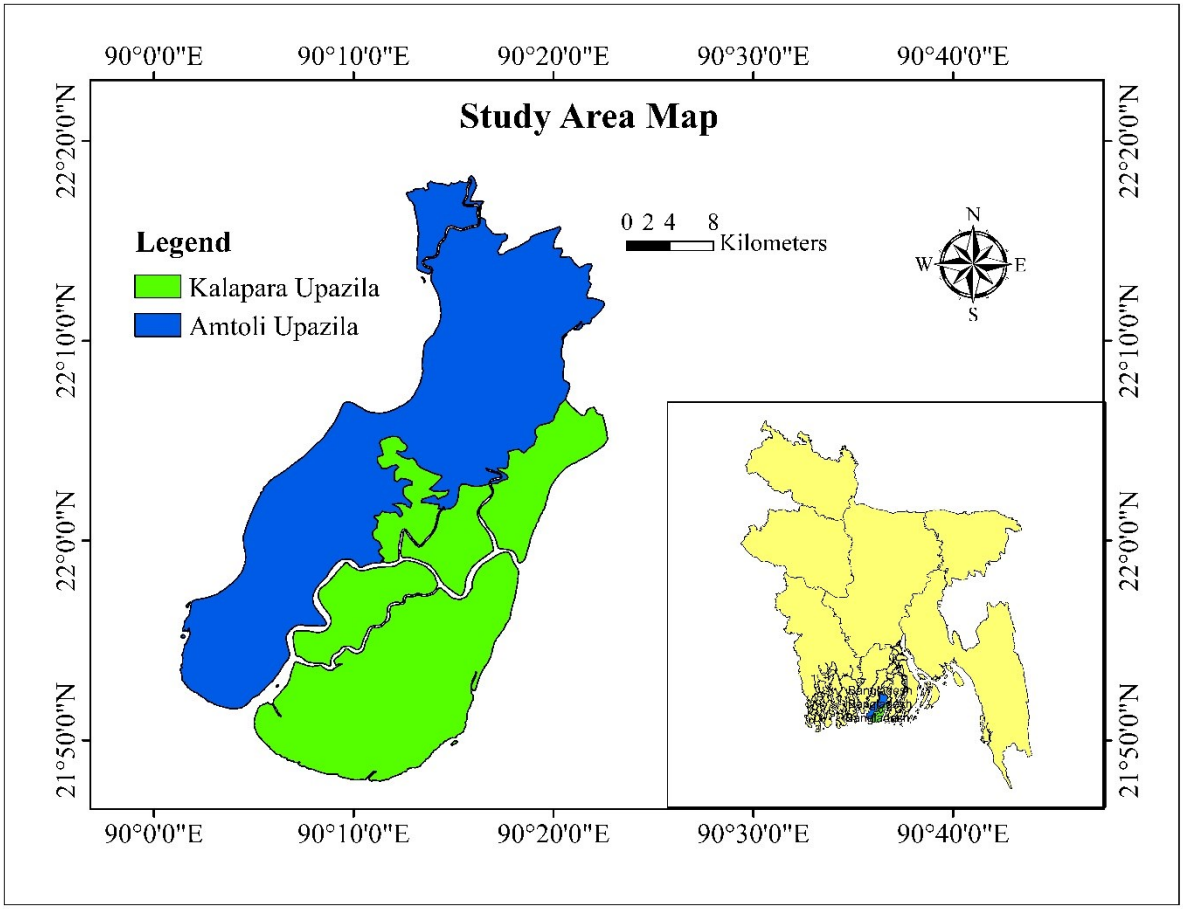

Figure 1: Map of the Study (Taltali Upazila, Kalapara Upazila)

3.2 Materials

To assess the present condition of the study area and to fulfil the research objectives following materials were used from different organizational sources.

These were:

- Calculator, MS office i.e., MS word, Excel etc. for report writing and analysis
- Arc GIS 10.8 for generating study area map
- Mobile for capturing pictures during data collection time
- Pen drive, pen and paper during data collection at the field

3.3 Data Collection Method

In this report, mainly two data collection methods were used. The list of the data collection methods is given below:

- Primary Data Collection Method
- Secondary Data Collection Method

3.3.1 Collection of Primary Data

3.3.1.1 Household Questionnaire Survey

Local household men and women were interviewed during survey. For survey purpose, a structured questionnaire was formed. A total number of 400 household survey was conducted

Questionnaire preparation and finalization process were:

- **Pre-testing of Questionnaire**

Considering the objective of the study, at first a sample questionnaire was prepared on basis of information gotten from reconnaissance survey, and literature review. Then a few numbers of questionnaire were tested in the field to see that whether they are fit collecting all the necessary data. Some of the questionnaires had some deficiencies which was needed to be updated.

- **Preparation of Final Questionnaire**

After further modification of the remaining questionnaires, finally a single questionnaire was formed which was able to collect all the qualitative and quantitative data.

- **Sampling Procedure and Sample Size Determination**

Population size was used for sampling unit and simple random sampling procedure was used to collect data. The sample size for data collection from the study area was obtained from the following equation (Kothari, 2006)

$$n = \frac{z^2 pqN}{e^2(N-1) + z^2 pq}$$

Where,

n= Sample Size

z= The Value of the Standard Variant at a Given Confidence Level

p= Sample Proportion

q= 1-p

e= Acceptance Error

N= Population Size

When,

p= 5% of the population, i.e., 0.05, q= 0.95

z= 1.96 [for 95% confidence level the value of z is 1.96]

e= 0.05[Since the estimate should be within 5% of the true value]

Now,

$$n = \frac{z^2 pqN}{e^2(N-1) + z^2 pq}$$

$$= \frac{(1.96)2 * 0.5 * 0.5 * 97685}{(0.05)2 * (97685 - 1) + (1.96)2 * 0.5 * 0.5}$$

$$= \mathbf{382.65}$$

The determine sample size from the total population was 383; for conservative measure sample size was 400

3.3.1.2 Focus Group Discussion

FGD or Focus Group Discussion is an effective method of collecting data by a participatory approach. Like other participatory methods, a key characteristic of FGD is the interaction between participants. Then during the main data collection period, 15 FGDs were conducted to gather the data on their perception and opinion to fulfil the quest. The participants of the FGD was 10 to 12 people. Several groups were chosen for each session. The groups are like housewives and wage workers group. Each FGD session had duration of about half an hour. FGD plays a vital role to show the real picture of the study area.

3.3.1.3 Key Informants Interview (KII)

As local people lack various in-depth knowledge and information, it is necessary to conduct a few 'Key Informant Interview'. Key informants help us with different in-depth information of their corresponding area. 20 Key informants were chosen from the indirectly involved group of the study area. The key informants are UNO, Chairman, Upazila Agriculture Officer, ward councillors, political leader and higher officials from coastguard, officials from divisional civil surgeon office, local elite persons, and NGO representative of the respective to two Upazila.

3.3.2 Collection of Secondary Data

Like primary data, secondary data are also very important in a research work. It helps to gather knowledge and information in the relevant research topic. Thus, secondary data made the research works more informative and well-furnished. Some secondary data were collected as follows:

- BBS report
- City corporation data
- Journals and article
- Academic research works
- Government annual report
- NGOs annual report
- Internet

3.4 Data Analysis:

The collected data were processed due to some biased and ambitious information. After collecting data, analysis was performed. For analysing data different tools were used. Such as:

- **Microsoft Excel**: Most of the bars, pie charts created by the use of Microsoft excel.
- **Microsoft Word**: Microsoft Word is also used for the data editing and writing the whole report.
- **ArcGIS 10**: Using ArcGIS 10 software study area map has been prepared.

3.5 Methodology

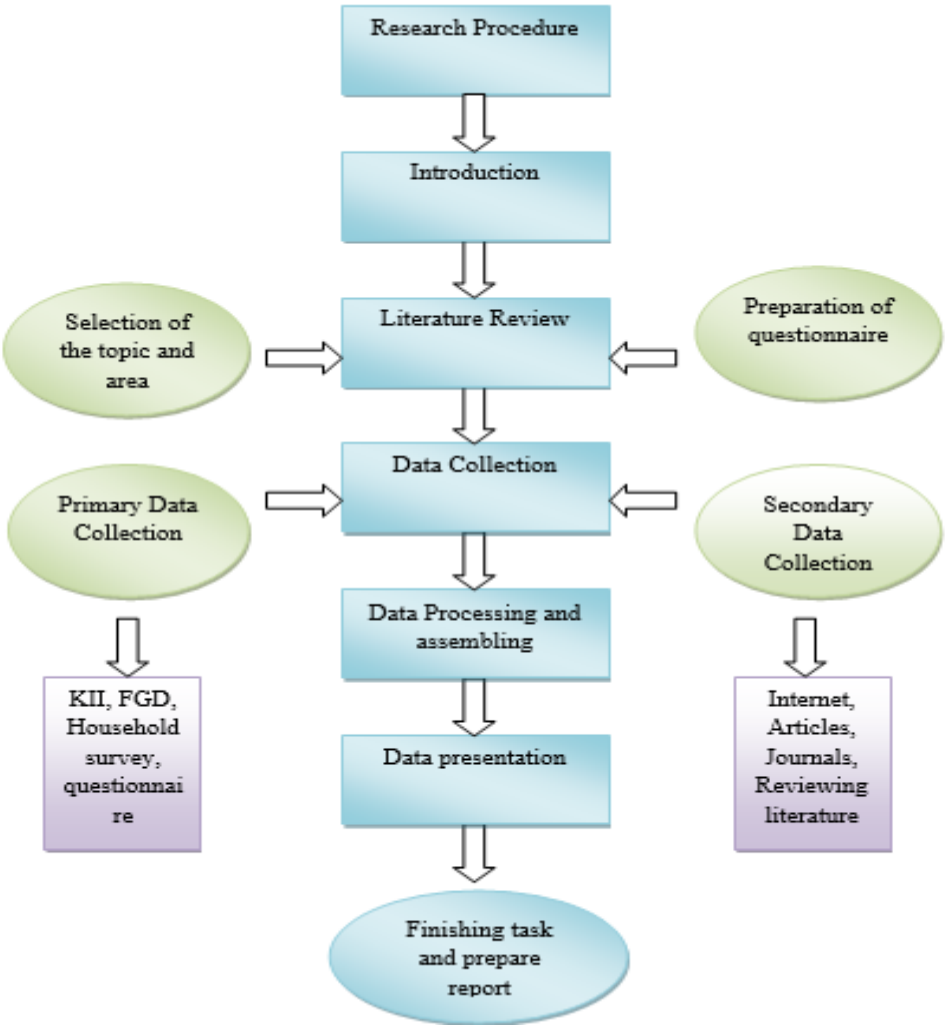

Figure 2: Methodological flowchart of the research

Chapter 4
Results and Discussion

4.1 Demographic and Socio-economic Condition

Assessment of respondent's demographic and socio-economic conditions is a very important step to find out adverse effect of climate change on the people's livelihoods, the most adverse effect of climate change on children, women and adolescents and the potential climate adaptive and locally suitable technologies for sustainable livelihood for the people in Patuakhali and Barguna district.

Demographic and Socio-economic Condition

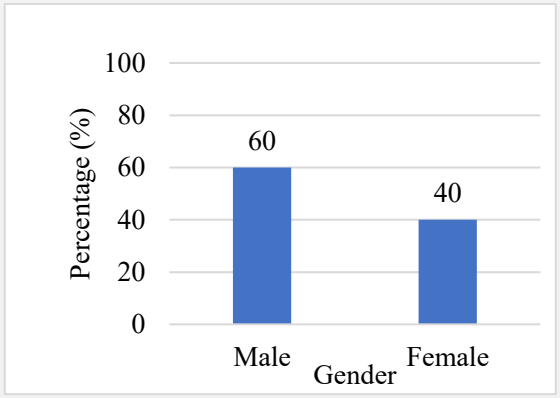

Figure 3: Gender Distribution

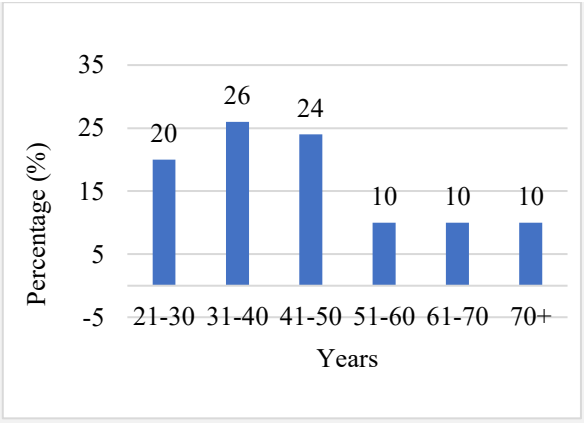

Figure 4: Age Distribution

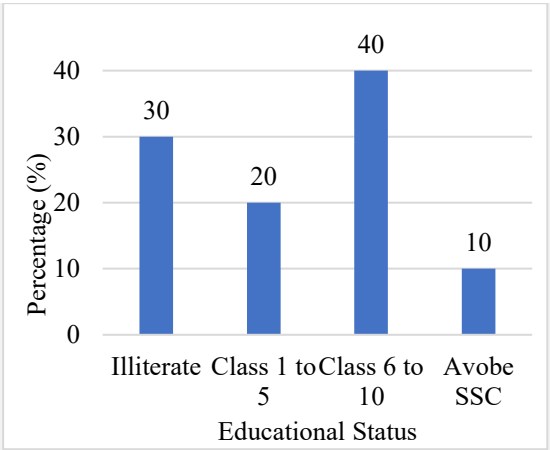

Figure 5: Educational Status

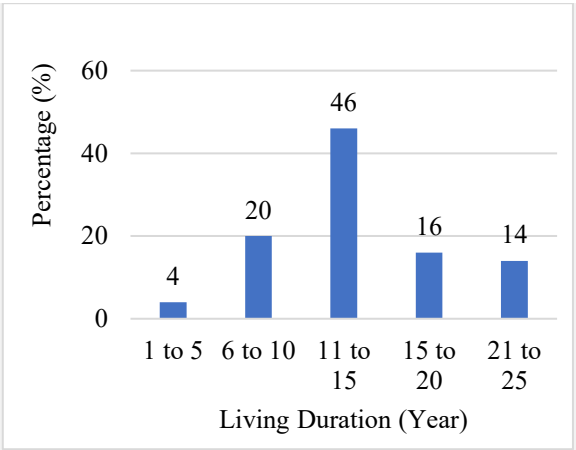

Figure 6: Living Duration

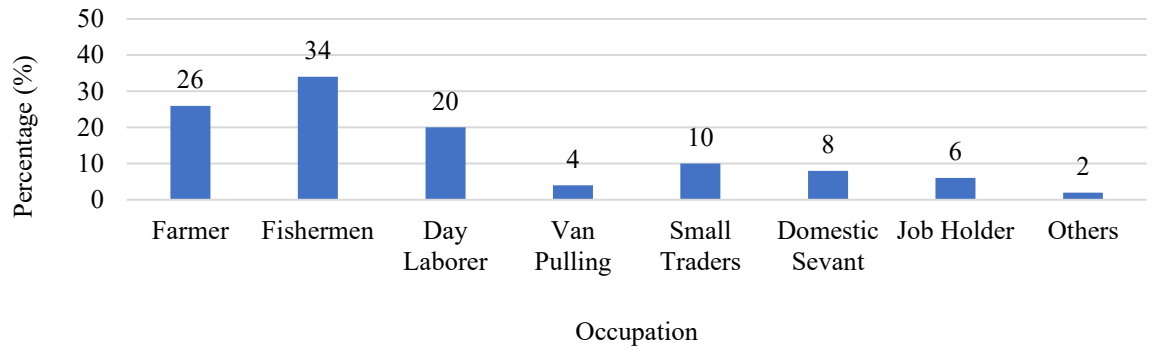

Figure 7: Occupational Status

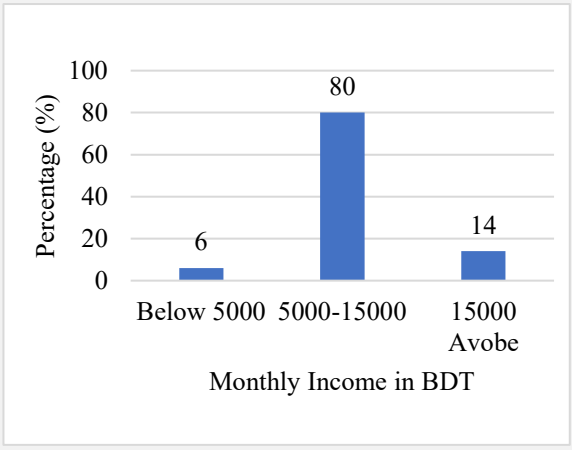

Figure 8: Monthly Income Scenario of Households

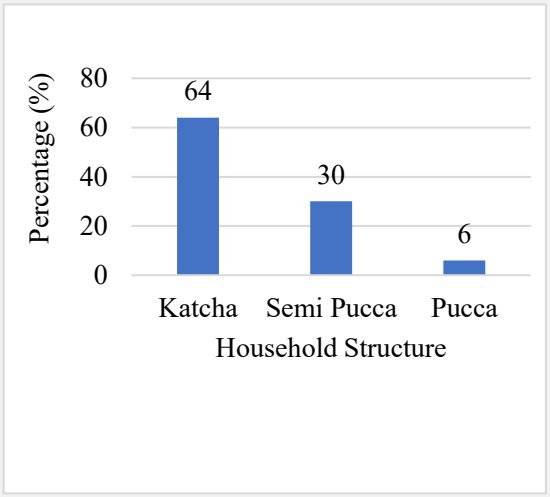

Figure 9: Household Structure Condition

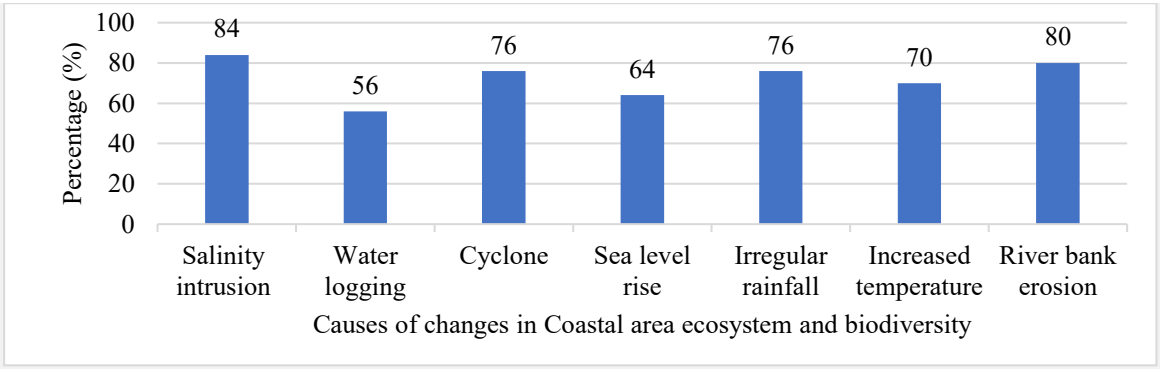

Figure 10: Causes of changes in coastal area ecosystem and biodiversity due to CC

4.1.1 Gender Distribution

The gender distribution for this research is presented in Figure 3. It is clear that among the respondent 242 of them were male (60%) and female participation were 168 (40%). Necessary data were collected from both male and female because the perceptions of male and female aren't the same in the participation of community-based work. According to BBS (2015), male and female ratio of Taltoli upazila and Kalapara Upazila union is almost 50:50 but during face-to-face survey in this research, this ratio is 60:40 and this difference was occurred due to lack interest of the female members to a questionnaire survey.

4.1.2 Age Distribution

The necessary information was collected from different aged people. Different age grouped people have different thinking about any topic raise in the community. Respondent's age ranged from 20 to 70+ years in this study. Figure 4 Shown that the data were collected from age group 21-30 years (20%). 26% were in the age group 21-40 years, 24% were in the age group 41-50 years, 10% were in the age group 51-60 years, 61-70 years and 70+ each. while, a study in Taltoli upazila (Siddeqa et al., 2018) found age group of people 15-30 years (31.84%), 31-45 years (25.13%), 46 years or above (19.96%). The statistics also recorded by BBS (2015) database where people from 15 to 59 years age range is 56.87% and people with more than 60 years is 9.34%.

4.1.3 Educational Status

Information has been collected from different level of educational qualification. Educational status was categorized into 4 levels. Distribution of educational status is shown in Figure 5.
Most of the respondents have educational qualification of secondary level (40%), respondents have primary level of educational qualification were 20%. respondents have qualification above SSC is 20% and 30% respondents were illiterate (Figure 6). All these data indicate that the literacy rate of the study areas is average. The literacy rate of Kalapara Upazila according to BBS (2015) is 65% and Taltoli district is 57.6% (BBS, 2011). But Siddeqa et al., (2018) record the educational status of the respondents in Taltoli area is very poor (30.72% were illiterate).

4.1.4 Duration of Living

Living duration has an influence on findings. There people from different duration of living were interviewed to get the best result. Distribution of respondents living duration in this area is presented in Figure 8. From Figure 6, it is clear that most of the respondents (46%) interviewed were living there from 11 to 15years. About 4% were living there from 1 to 5 years, 20% were living there from 6-10 years, 16% were living there from 21 to 30 years, 13% were living there from 41 to 50 years, and 12% were living there from 15 to 20 years. And 14% were living for 21-25 years.

4.1.5 Occupational Status

From Figure 7, it is clear that about 26% respondents were farmer. 34% of respondents were engaged in fish capture. Besides 20% of respondents engaged in daily labor work. 4% respondents were van puller, small trade was 10%. The domestic servants were 8%. People working in government organization and non-government organization were respectively 6% and 2% According to (BBS, 2015) most of the people in the coastal Bangladesh are engaged in agriculture, fishing, and forestry.

4.1.6 Monthly Income Scenario of Household

Respondents from different income level also have influence perception effect of climate change. Monthly income scenario of respondents is shown in Figure 8. From Figure 9, it is found that the majority of people having monthly income range from 5000-15000 BDT (80%). 14% of respondents have monthly household income range below 5000 BDT, 6% have monthly household income range above 1500 BDT. The monthly income of the two study areas are well. People have a handsome monthly income as monthly income of maximum people is higher than Growth National Income of Bangladesh which is 1,190 BDT per year (99.12 USD per month) (World Bank, 2016) and average national household monthly income is 188.63 USD (BBS, 2016).

4.1.7 Household Structure Condition

Household structure condition of the study area is shown in Figure 9. Household structure condition of the study area is not so well. Majority of the household (64%) was katcha, 30% was semi-pucca and only 6% was pucca (Figure 10). According to BBS (2015) report in

Barguna district, the majority of the house was kutcha (89.59%). The pucca structures were 1.96%, and semi-pucca was only 17.29%.

4.1.8 Causes of Changes Due to Climate Change

Figure 10 shows Respondents agree adverse effect of climate change happened due to different climatic factor, 84% respondents said that salinity intrusion, 56% people agreed that water logging, while 76% people perceived that cyclone, other 64% said sea level rise is responsible for changing climate change. Irregular rainfall, increased temperature and river bank erosion are also responsible for changing in ecosystem and biodiversity said by the 76%, 70% and 80% respectively.

4.2 Adverse Effect of Climate Change on the People's Livelihoods in Patuakhali and Barguna District

4.2.1 Vulnerability of Study Area

The geographical location, low and almost flat topography, very high population density, etc. have made Kalapara and Taltali are the most vulnerable to be affected by the impact of cyclone. The funnel-shaped northern portion of the Bay of Bengal causes tidal bores when cyclones make landfall and thousands of people living in the coastal areas are affected especially in this region. As a result, in any types of moderate cyclone, the devastating impact expands more than this range. Bank erosion, saline water intrusion, and inundation in large scale are common matters in every cyclone disaster.

4.2.2 Vulnerability of Livelihood

The majority households depend on the climate-sensitive sector of agriculture, fisheries and wage labour activities as the main source of livelihood. According to field survey 40% farmer, 30% fisherman, 20% livestock and 10% wage labor are vulnerable due to the cyclone (shown in figure 11). A male respondents said,

"Waterlogging caused me to lose my crops and fishes; following a significant loss, I also lost the animals I was rearing due to a cyclone"--- Newaz

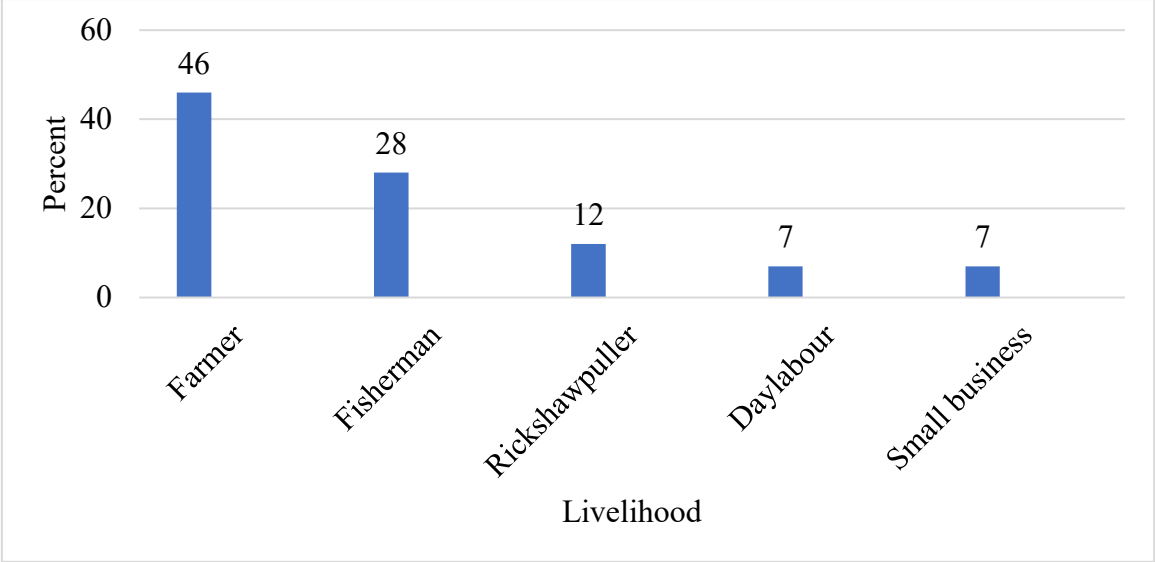

Figure 11: Vulnerability of Livelihood in study area.

4.2.3 Climate Change Impact in Income Scenario

According to the responders the most income decreases in the agriculture sector almost 25%, fisheries sector faces loss about 15%, livestock and day labour faces respectively 5% and 11% differences in livelihood sector (shown in figure 12).

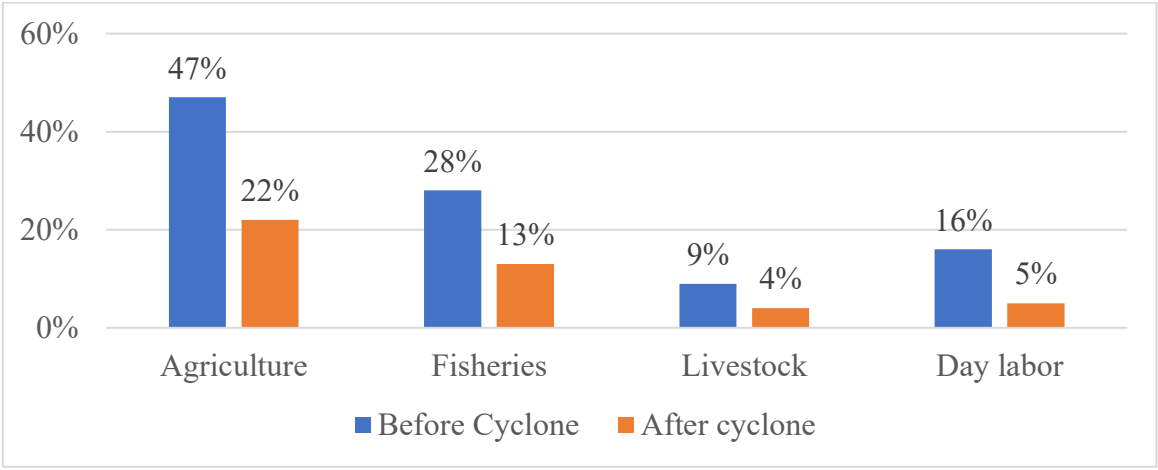

Figure 12: Income differences due to climate change

4.2.4 Impact on Agriculture Due to Climate Change

Types of crops that cultivated in the study area:

In Kalapara and taltoli Upazila there are wide varieties of crops. Respondents engaging in agricultural activities cultivated the following crops:

Table 3: Types of crops that cultivated in the study area

	Crops	Involving farmers to cultivate the crops (%).
Rice	Aus.	75 %
	Amon	75 %
	Boro	45 %
	Chilies	40 %
	Potato	30 %
	Sweet potato	10 %
	Water melon	30 %
	Wheat	25 %
	Pulses	30 %
	Oil seeds	20 %

Damage Intensity of Crops

Approximately 55% of farmers claimed that the calamity had destroyed all of their crops. According to the figure 13, 35% of farmers were only able to save a small percentage of their crops, while only 9% were able to save the majority of their harvests. Aman cultivation was also severely impacted by the cyclone. Farmers' major dominant crops in the research area in the future, causing significant losses in agricultural crop production. Farmers could have harvested their crops without damage and loss if the cyclone had arrived with modest intensity and speed, and they could have planted another crop on their land. So, the circumstance due to cyclone would not be worse like that.

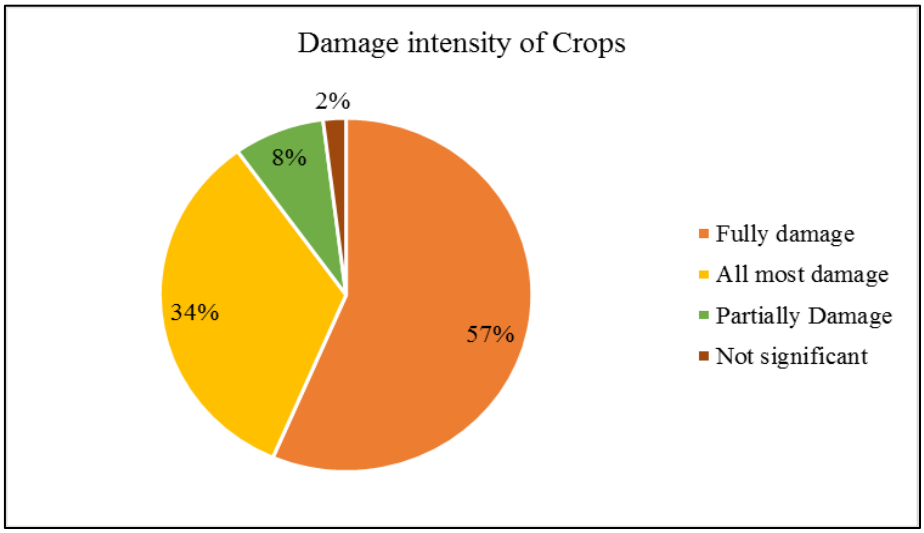

Figure 13: Damage intensity of Crops

4.2.5 Impact on Fisheries Sector

The effects of the cyclone also affect the fisheries sector, which has serious consequences for the fishing community due to their economic, dietary, and social reliance on the sector. The fisherman who raises fish in their own pond and has flood water come into the pond during a storm, flashing all of the fish out. As a result, his and his family's economic source is completely destroyed. However, the state of fish culture is not acceptable since saline water frequently enters the pond and kills the existing fish. The storm surge that accompanied the cyclone washed away all of the fish in the pond. Because the pond's bank is not raised, water can simply enter it. According to the findings of the field survey, residents are unable to protect their ponds from external nets or other local commodities. Cyclones have a significant impact on fish culture as a result of these factors.

Loss of fish

In the study area the people related to fisheries sector describes that they face more the loss of fish cultivation comparing to salinity, epidemics. So, cyclone impact on fisheries sector is significant. The losses of fish due to different adverse situation are is illustrated in figure 14.

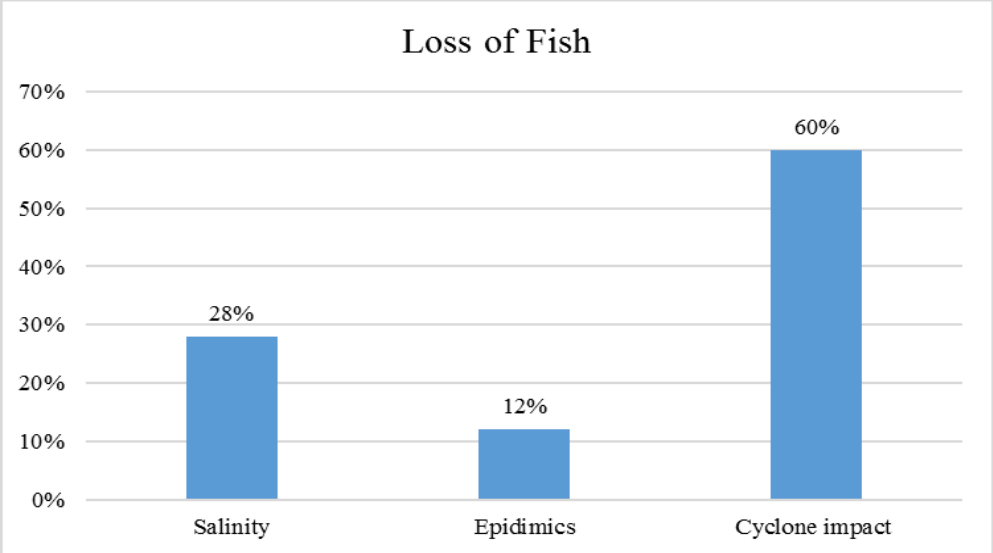

Figure 14: Loss of fish

Damage of fisheries equipment

Cyclone causes a huge amount of economic loss by destructing the fishing equipment. As per the respondents some of the product get fully damaged, some are partially damaged and the new product is costly (shown in figure 15).

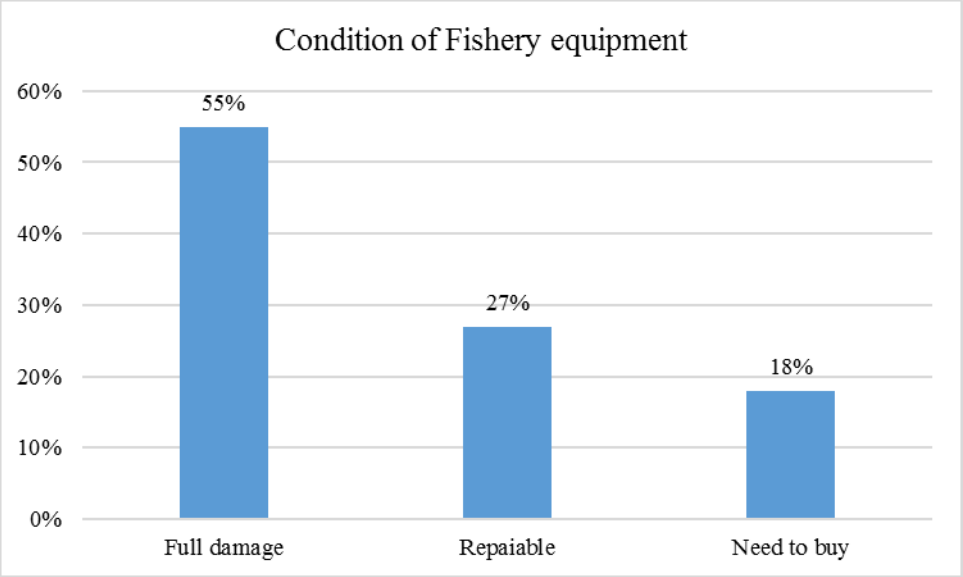

Figure 15: Condition of Fishery equipment

4.2.6 Impact on Livestock Sector Due to Climate Change

Different types of livestock rearing

Below figure no 16 represents different type's livestock that reared by the respondents of the study area. Results show that highest 25 percent of the respondent's rear cow then duck are 19 percent and lowest 12 percent rear buffalo and then goat 8 percent. Most of the respondent said that goats are more vulnerable to uncomfortable climatic condition as cyclone, flood, salinity, storm surge etc.

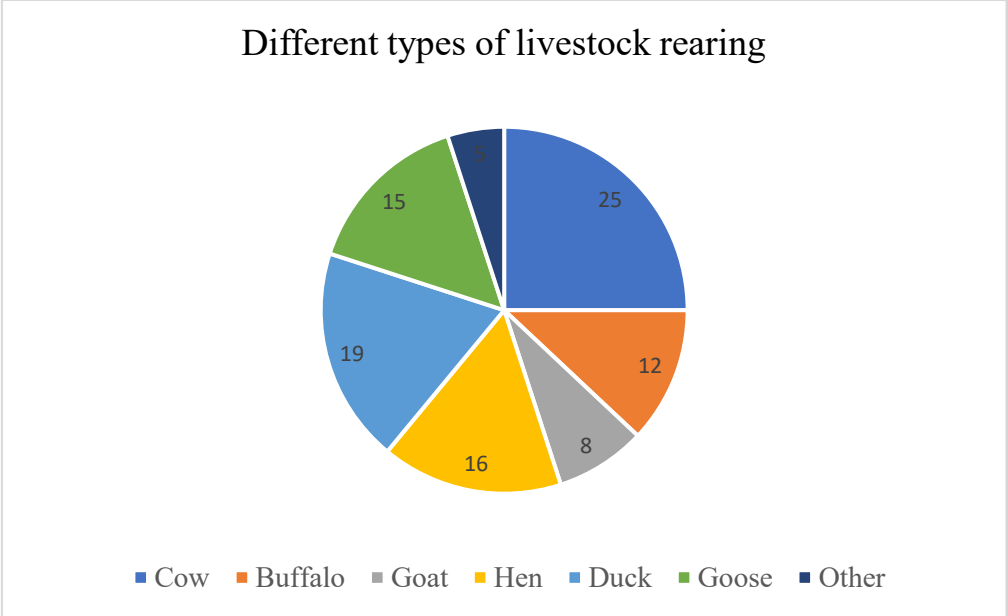

Figure 16: Different types of livestock rearing

Impact on livestock sector

- **Death of Livestock**

When a cyclone impacts the livestock are more vulnerable. The livestock rear sometimes cannot afford to take their livestock with them to the cyclone shelter. The reason behind this the distance of the shelter, the communication road and the number of livestock. According to responders about 35% loss their cow, 24% loss their goat, about 10% loss their hen-duck (shown in figure 17).

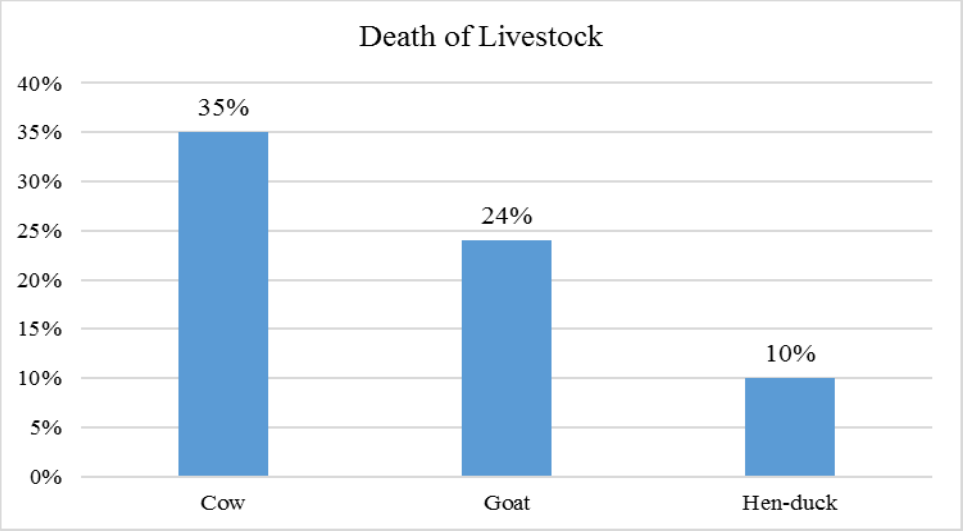

Figure 17: Death of Livestock

- **Reduce production rate**

As the cyclone impact the production rate has a drastically effect. The availability of grazing land and the proper food is not available cause of tidal flooding, lower income source and bad communication system. As well as in the tidal water the production of milk is also reduced. As well as it also has an impact in goat meet, hen-duck meet and the egg production from them (shown in figure 18). A respondents said,

When I was 25 years old, I had five cows that could each generate roughly 5 litters of milk. I'm 42 years old right now, and I have 14 cows that can only produce 2.5-3 litters of milk each. --- Ajgor farmer

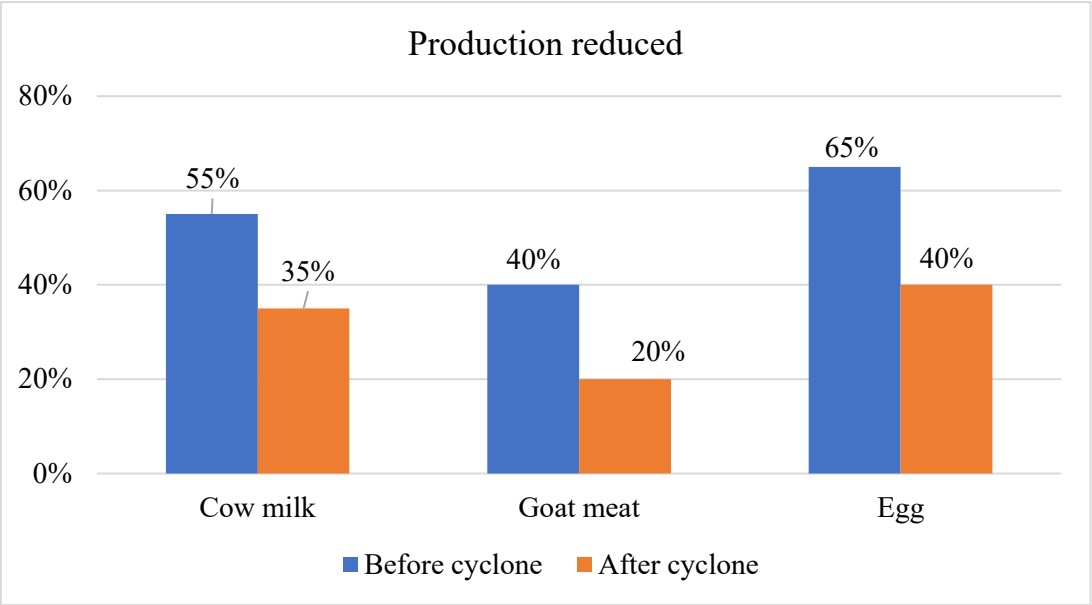

Figure 18: Reduce production rate

4.2.7 Impact on Day labourer

The day labourer faces more vulnerability as a result of cyclone impact. Day labourer are work done where they are hired and paid for one day at a time. When cyclone almost 80% of them are become jobless in that period. (Shown in figure 19).

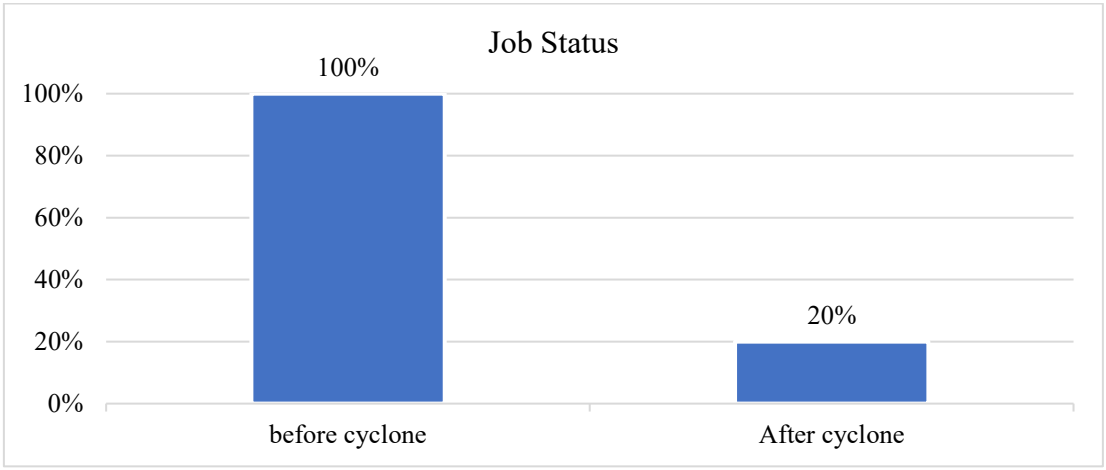

Figure 19: Job status of day labourer

4.2.8 Alternate Livelihood Options Due to Climate Change

Data indicated that before disaster 38% of the respondents were involved in farming activities but after affecting by disaster it decreased and then only 24% of the respondents were involved in farming activities. It also revealed that disaster decrease the percent of day labors and increased the percent of unemployed in the study area. After disaster 16% of the respondents

were day labor while it was 28% before the disaster and 22% respondents were unemployed and migrated after the disaster. Before disaster 30% respondents were related with fishing activities but after natural hazard it increased and the percent of 36% because after disaster increased the level of water agricultural land submersed all crops are damaged. In case the fishing activities increased after disaster. It is clear that natural hazards decreases the employment status of the affected people. Due to disaster occupation pattern changes and after natural hazards most people loss their agricultural land and become landless and homeless. So unemployment arise day by day in the study area.

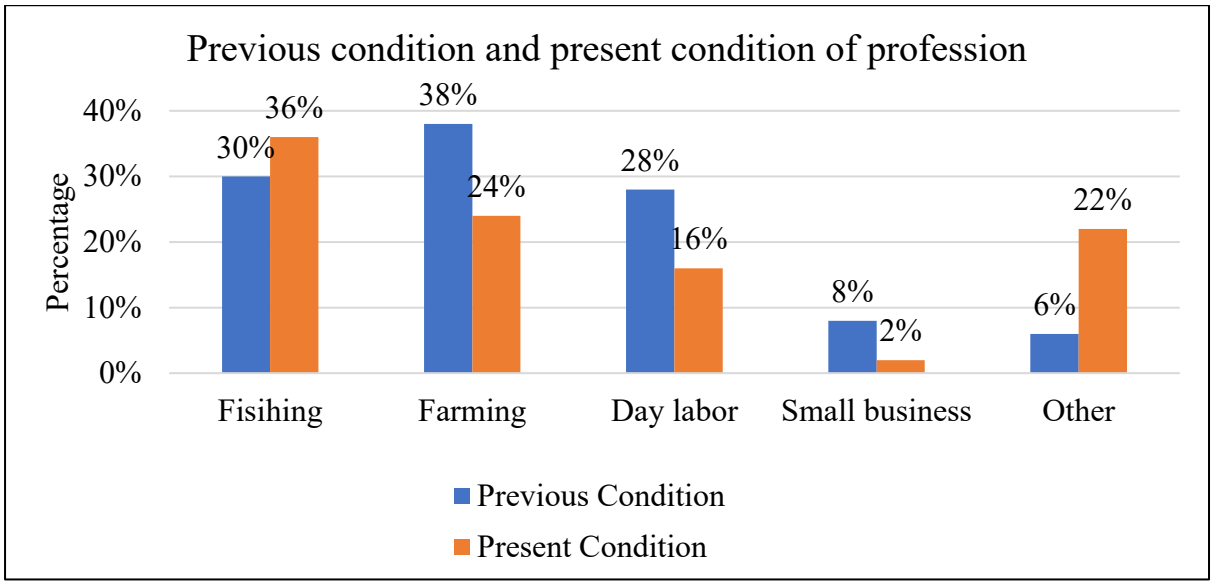

Figure 20: Previous condition and present condition of profession before disaster

From the FGD it is found that to ensure/secure their livelihood local people diversified their works. Most of the people now increase their works, they do two, three or more works to earn money. Now farmer also catch fish in their off season or do both agriculture and fishing. Fisherman also involve with agriculture and small treading. Labor workers drive motorcycle, carrying van in dry season.

Agricultural adaptation strategies to climate change impacts

Modify the Threats to Crop Production:

This appears to be the mostly practiced option in the study area. Adequate precautionary measures might possibly modify the threats. Many such measures are technology-oriented and may require early investment for research and extension. Development of drought and/or salinity tolerant varieties, switching to alternate cropping patterns with respect to altered agro

ecological zones etc. could modify the threat to a significant extent. In my study area people using BRRI-47, Uri-Dhan, BRRI-67 salt tolerance rice varieties for cultivating their agriculture field.

Change Land Use:

Climatic activities make sometimes very much inadequate for cropping different crop. That time they are shifting to Shrimp farming, fish farming and making coconut palm garden in their agriculture lang.

Mixed cropping

People cultivating cereals (maize, sorghum), legumes (beans) are together. The advantages of mixing crops with varying attributes are in terms of maturity period (e.g., maize and beans), drought tolerance (maize and sorghum), input requirements (cereals and legumes) and end users of the product.

Using indigenous technique

People are using cow dung, compost fertilizer, water hyacinths etc. for cultivating the land. People raise some crops, such as Dioscorea spp (Geco alu), Curcuma longa (Holud) and cocoyam (Gati) in their empty space under the tree they planting to protect their house from different disaster.

Different types of fish farming

Figure 21 represents different type's fish that cultivated by the respondents of the study area. Result show that highest 27 percent pangas then 22 percent tilapia and lowest 6 percent nilotica fish are cultivated in the study area.

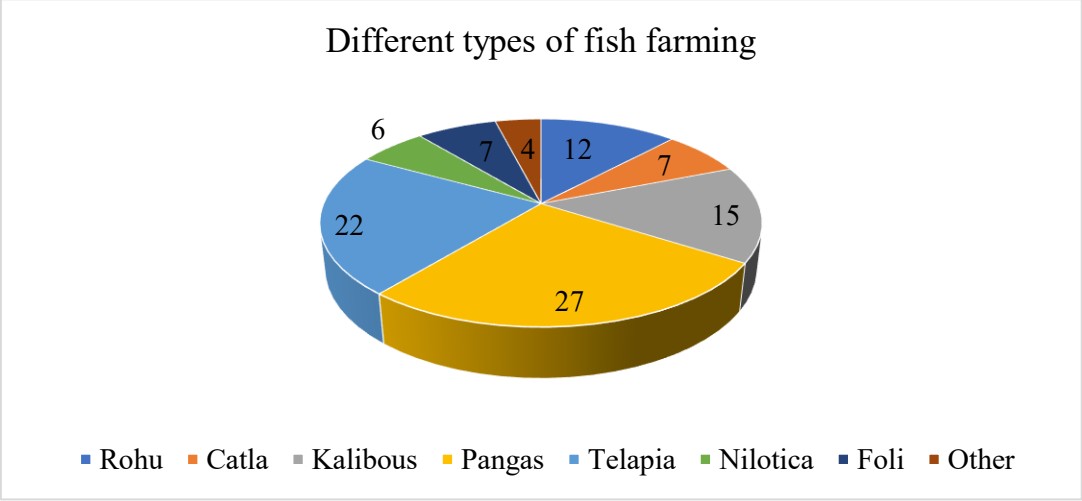

Figure 21: Different types of fish farming

4.3.9 Different Practices to Cope Up the Impacts of Climate Change

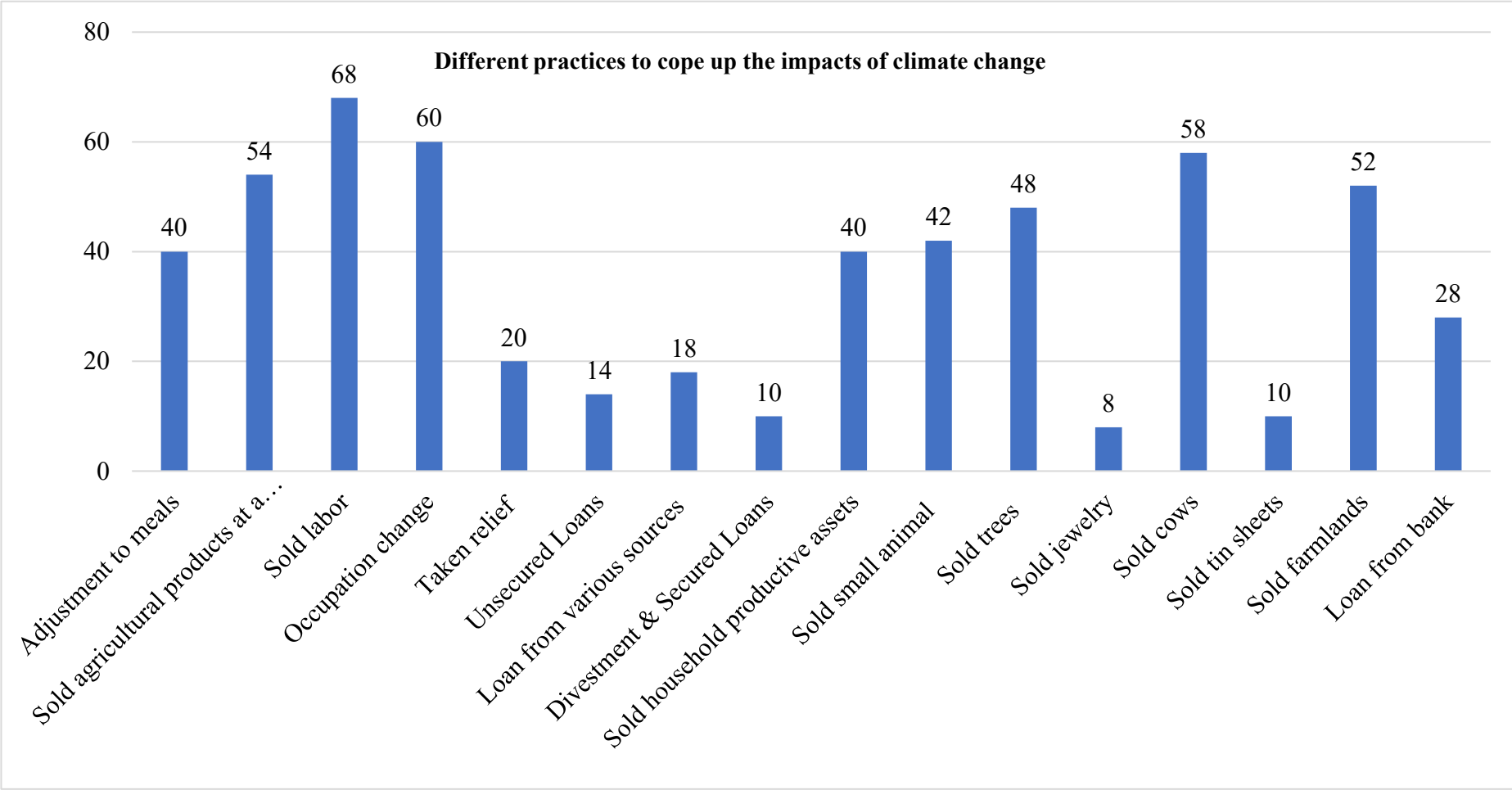

Figure 22: Different practices to cope up the impacts of climate change

For the best practices to cope with the impact of climate change On-farm livelihood, 40% respondents said that they have adjusted with meal, 54% respondents said they sold their agricultural products at a lower price, 60% respondents changed their occupation, 20% respondents taken relief from loan, 14% respondents took unsecured loan, 18% respondents took loan from various sources while only 14% respondents took secured loan. On the other hand 40% respondents sold their household productive assets, 42% respondents sold small animals, 48% respondents sold trees, only 8% sold jewellery, 58% respondents sold their domestic animal cow, 10% respondents sold tin sheets of their house, 52 % people sold farmlands and 28% respondents took loan from the bank to cope up the impact of climate change (shown in figure 22)..

4.3.10 Steps Taken By Government on Farming Sectors

With a view to developing the agriculture sector, the Government has taken a number of steps. Most of the respondents (78%) said that government has taken expansion of small irrigation facilities at their place. 24% respondents said that government has taken initiatives to conducted training and workshop program. 68% people said that they received high yielding variety from government. On the other hand, 48% respondents said that they received financial support from government while 28% took soft loan from government in order to secure their livelihood.

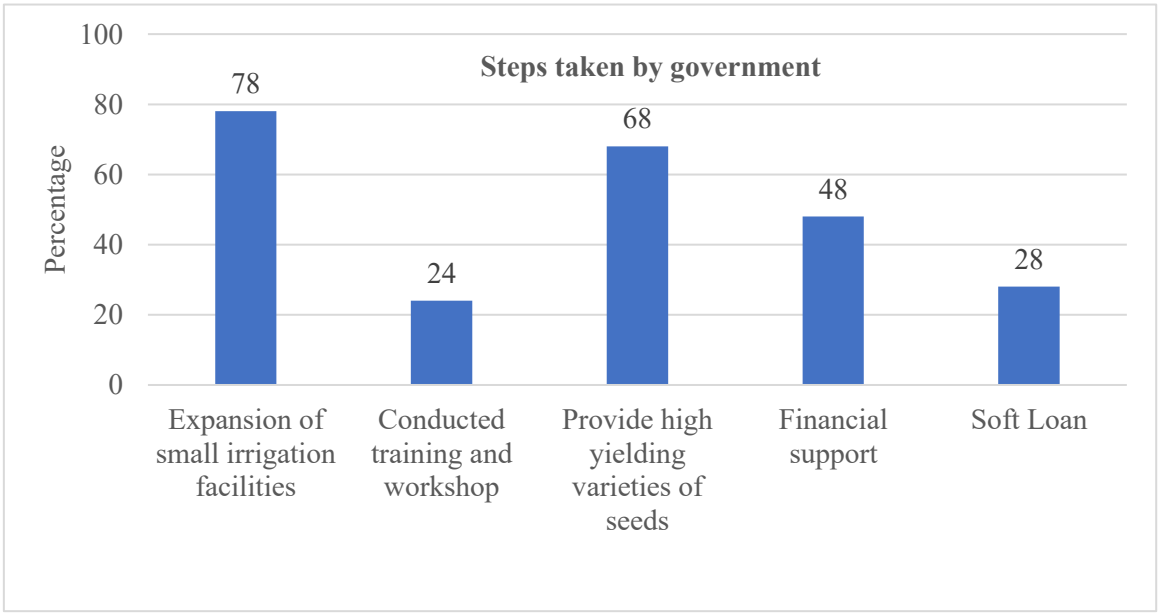

Figure 23: Steps taken by government on farming sectors

4.3 The Most Adverse Effect of Climate Change on Children, Women and Adolescents in Relationship to Rights in Patuakhali and Barguna District

4.3.1 Adverse Effect of Climate Change on Children

The adverse effect of climate change on children according to respondents are shown in figure 24. 45% Respondents agreed that climate change decreased nutrition facilities, 28% of the respondents agreed that death toll had increased due to natural calamities. 55% said that common injuries are occurred among respondents. While 27% had faced problem with screen disease and other disease like cholera typhoid were faced either them or their family member, said by 32% respondents.

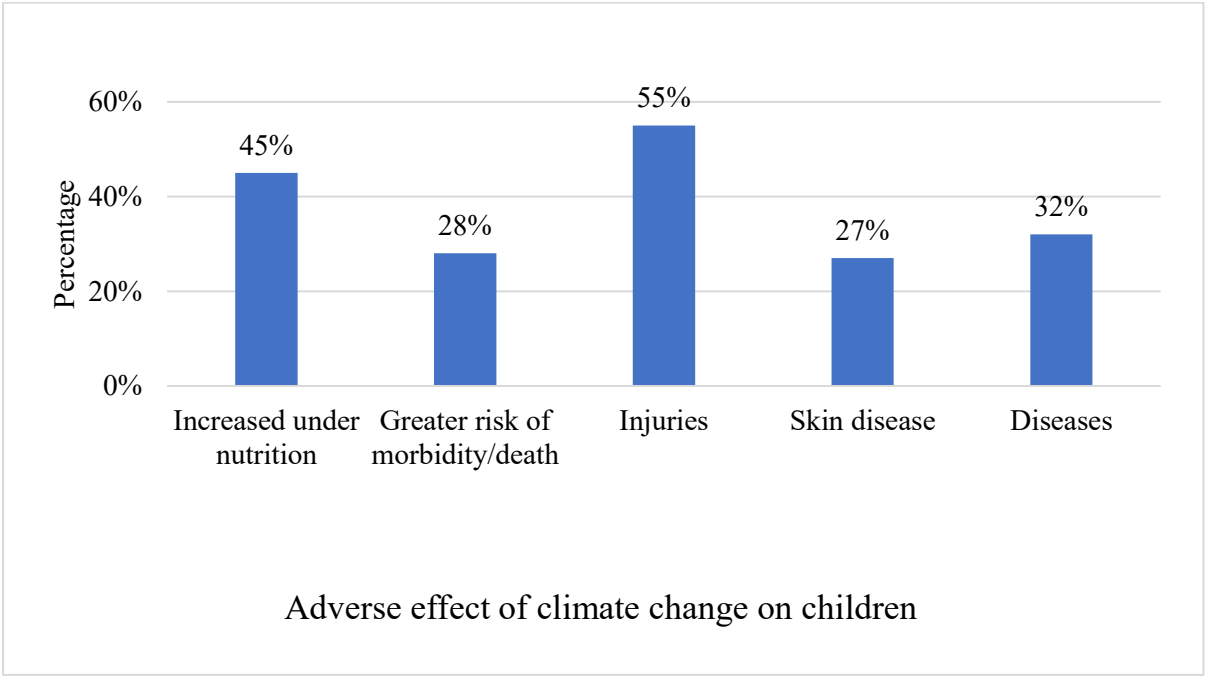

Figure 24: Adverse effect of climate change on children

4.3.2 Adverse Effect of Climate Change on Adolescent

The adverse effect of climate change on adolescent are shown in figure 25. According to the most of the respondents (54%) perception adolescents suffered in inadequate sanitation, 42% said Child labor were increased, 20% said about child marriage and 12% about Sexual exploitation. Respondents also mentioned about trafficking (8%), Decreased school attendance (72%), increased school dropout (56%), Drowning (25%), Injuries (41%), Begging (15%), and Orphan hood (5%). A respondents said,

My older son was in class seven at the time of the recent cyclone, but he never returned because of the dire circumstances in our household. ----Rabeya

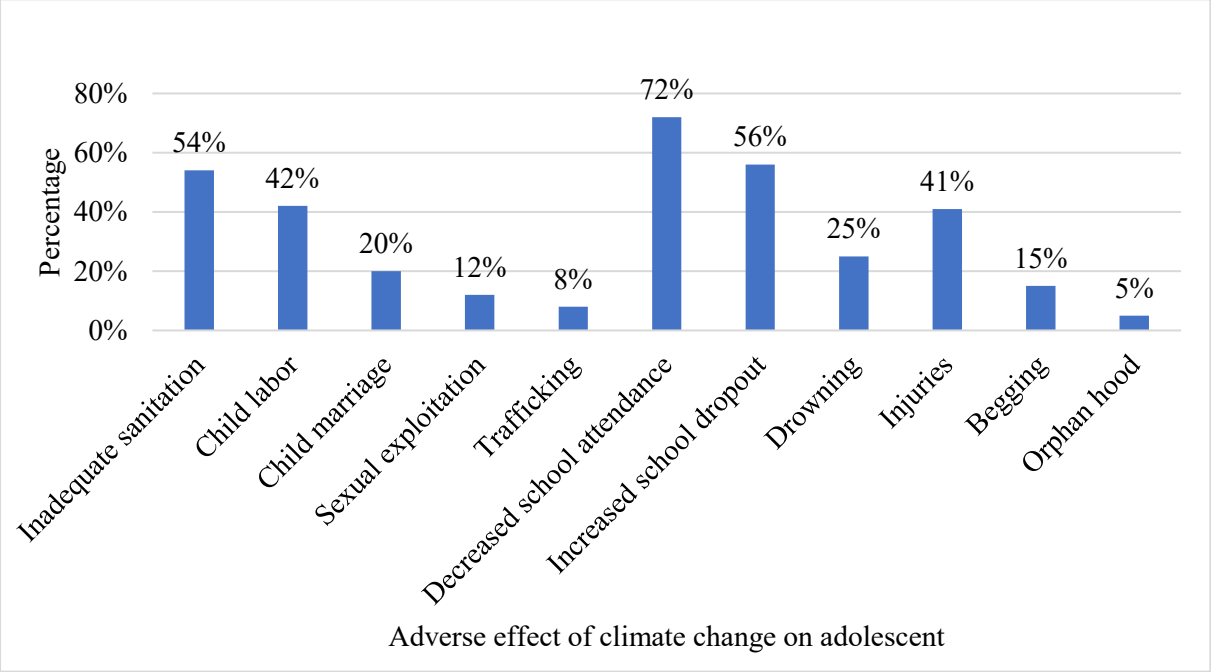

Figure 25: Adverse effect of climate change on adolescent

4.3.3 Adverse Effect of Climate Change on Women

4.3.3.1 Types of Violence for Particular Climate Change Induced Disaster

There are numerous reports and unreported domestic violence cases in my study area, including physical, verbal, financial, psychological, and sexual abuse. Domestic violence also includes dowry-related violence, marital rape or violence, harassment, and humiliation. Violence types of particular disasters:

Table 4: Violence for Particular Disaster

Disaster	Violence
Cyclone	Physical, Economical, Mental torture and Sexual harassment
Tidal flood	Physical torture
Hail storm	Physical torture
Thunder storm	
Drought in dry season	Economical and Physical torture

Disaster	Violence
Salinity	Economical and Physical torture

4.3.3.2 Violence Rate of the Study Area

Violence can be physical, verbal, financial, psychological, and sexual abuse. Domestic violence also includes dowry-related violence, child marriage, marital rape or violence, harassment, and humiliation. Rapes and sexual assaults occur even during the disasters, both inside homes and outside. Married women are physically and mentally tortured by husbands, husband's families and their own family members. The rate of different violence of my study area are given below:

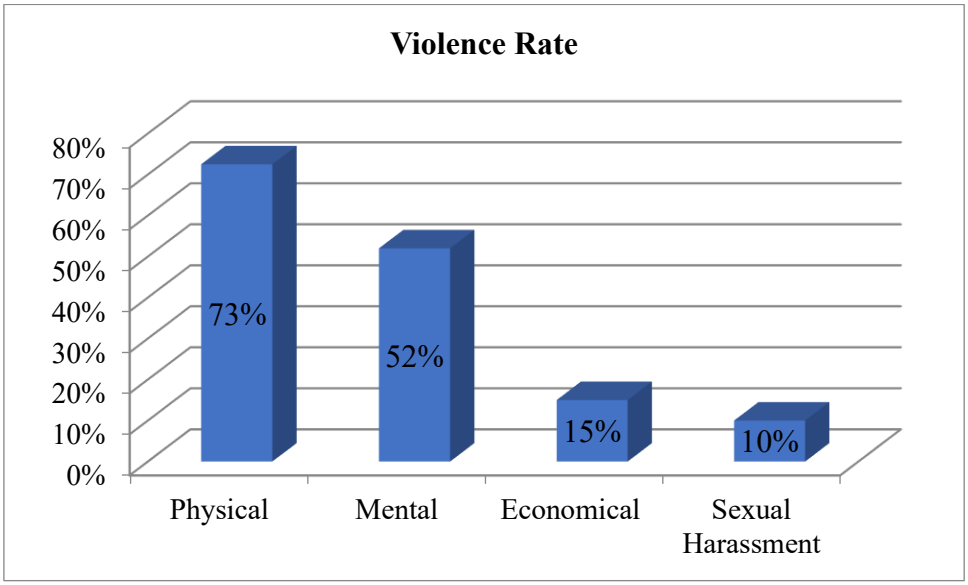

Figure 26: Violence Rate of Kalapara

By this chart we can see that the physical torture rate is 50%, mental torture is 20%, economical torture 15%, sexual harassment is 10%, others is 5%. The rate of the physical violence victim is high than other violence in Kalapara.

4.3.3.3 Who is the Perpetrator

From the findings of the research, most of the perpetrators were husband (55%) , own family member (12.23%), followed by known person (13%), neighbors (12%), lovers (2.15%), house master and mistress (2.62%), in – laws and others (3%).

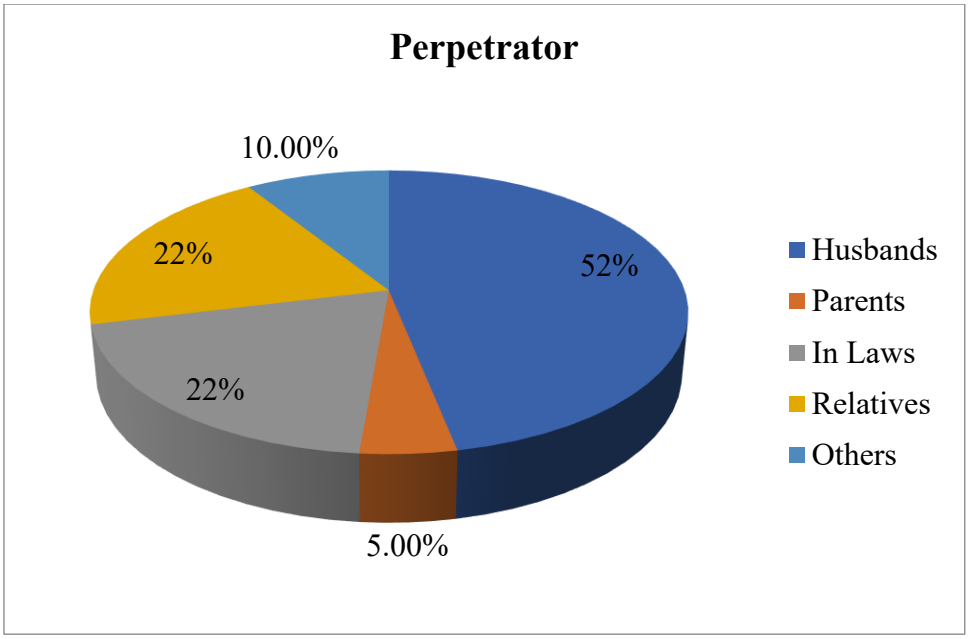

Figure 27: Perpetrator of the Violence

4.3.3.4 Violence at Workplace

Most of the women of Kalapara and taltoli are unaware of the violence. They often face violence at the workplace. Economical torture is the main violence at the workplace. They don't get paid at time because of the weak positions of the women. They often face sexual harassment at the workplace by colleagues or boss. Women become the victims of eve-teasing, psychological torture, economical and physical violence.

4.3.3.5 Effects of the Violence

Effects of the climate change induced gender-based violence in Kalapara, Amtali are given below:

Table 5: Effects of the Violence

Impact on women's health	Economic and social impact	Impact on women's family and dependents	impact of violence on society
Physical: • injury, • disability, • Chronic health problems	• Rejection, ostracism and social stigma at community level;	**Direct effects:** • divorce, or broken families; • jeopardized family's	• burden on health and judicial systems • hindrance to economic

Impact on women's health	Economic and social impact	Impact on women's family and dependents	impact of violence on society
(irritable bowel syndrome, gastrointestinal disorders, various chronic pain syndromes, hypertension, etc.), • death **Psychological** Effects can be both direct/ indirect • Direct: anxiety, fear, mistrust of others, inability to concentrate, loneliness, post-traumatic stress disorder, depression, suicide, etc. • Indirect: psychosomatic illnesses, withdrawal, alcohol or drug use.	• Reduced ability to participate in social and economic activities; • Acute fear of future violence, which extends beyond the individual survivors to other members in community; • Damage to women's confidence resulting in fear of venturing into public spaces • Job loss due to absenteeism as a result of violence; • Negative impact on women's income generating power	economic and emotional development • babies born with health disorders as a result of violence experienced by the mother during pregnancy (i.e. premature birth or low birth weight); • increased likelihood of violence against children growing up in households where there is domestic violence; **Indirect effects:** • Compromised ability of survivor to care for her children (e.g. child malnutrition and neglect due to constraining effect of violence on women's livelihood strategies and	stability and growth through women's lost productivity • Hindrance to women's participation in the development processes and lessening of their contribution to social and economic development. • constrained ability of women to respond to rapid social, political, or economic change. • breakdown of trust in social relationships • weakened support networks on which people's survival strategies depend.

Impact on women's health	Economic and social impact	Impact on women's family and dependents	impact of violence on society
		their bargaining position in marriage)	

4.3.3.6 Causes and Mitigation Measures of Violence

Some causes and mitigation measures of climate change induced gender based violence in Kalapara, patuakhali:

Table 6: Causes and Mitigation Measures of Violence

Causes	Mitigation Measures
• Climate change • Poverty • Gender discrimination • Lack of women empowerment • Early marriage • Dowry • Illiteracy • Unemployment • Extramarital relation of husband, suspicious attitude, • Gambling, • Low status of women.	• Educate people about climate change and its impacts. • Reduce the vulnerability of the climatic disasters • Building resiliency against the disasters • Educate people on the root causes of violence. • Interrupt discriminatory language • Report photos and messages that exploit women and girls • Interrupt abuse. • Stop sexual harassment. • Stop victim blaming • Call gender-based violence what it is – violence, not "bullying."

4.4 The Potential Climate Adaptive and Locally Suitable Technologies for Sustainable Livelihood for the People in Patuakhali and Barguna District

4.4.1 Local and Indigenous Knowledge Related to Hydro-Meteorological Hazards

Coastal and small island communities have long histories of observing changes in the environment and have amassed a wealth of knowledge and practices closely related to these

changes. A key insight from the action research across the different sites was the ability of local people to closely observe and monitor changes in their environment (seas, clouds, animals, plants, and insects) and celestial bodies (the moon, sun, and stars) to predict hydro-meteorological hazards (Hiwasaki et al, 2014).

To predict heavy rainfall or strong winds, communities carefully observe clouds, waves, winds, sun, and the stars. For clouds, changes in texture (thin or thick), color (white, dark, yellow or red), location (over mountains or the sea), and movement (to/from the coast), including speed (fast) and direction (vertical or horizontal) are observed; for waves, changes in color (white), direction, and height (high). The direction (usually east or west) and temperature (cold or warm) of winds, the position (high or low) and size (large or small) of the sun, and visibility (many or absent) (Shaw et al, 2014)

Behavior of animals, insects, and plants also predict hazards. Birds, usually migratory, are important indicators of changing seasons and their duration, as well as heavy rains, storms, or droughts. Various animals are used to predict hazards: the fast movement of sea snakes, and hermit crabs going inland or climbing up trees all forewarn storms or typhoons. These observations are also considered indicators of other hazards such as landslides and flooding, since they often take place after heavy rainfall and strong winds (Hiwasaki et al, 2014).

4.4.2 Indigenous Coping Strategies for Cyclone and Induced Storm Surge

This study shows that people in community have developed their own coping strategies which are distinct in character as compared to other regions of the country. Based on a specific situation, the adoption of a particular set of strategies depends on people's cultural and socio-economic background, physical location, the characteristics of the cyclone and induced storm surge and the level of the individual's vulnerability and ability to absorb shock. This study has considered the sequence of coping measures well in advance of the hazard event, immediately before the hazard event, and post event. The following section provides a brief description of coping strategies adopted by different households in response to cyclones and induced storm surges in the study area.

4.4.2.1 Coping strategies before the cyclone and induced surge event

In this stage people commonly adopt some impact minimizing strategies and preparedness measures based on their past experiences of cyclone and surge events. Impact minimizing

strategies refer to activities that minimize loss and facilitate recovery. The present study finds that unique design and construction method of houses:

- Building Machan and Pataton
- Temple shaped house
- Courtyard on a raised platform

and other measures to save household items, foods and goods are some common strategies that households adopt to minimize impact of the disaster and to protect it from normal tides, and avoiding the use of housing materials susceptible to surge water. This includes a preference for corrugated iron sheets, bamboo, thatch and wood etc. One quarter of the total respondents prefer semi-flat roofed houses with separable tin sheets.

Additionally, temple-shaped houses are found mostly in villages. This has more than one roof with less space in the upper floor and is usually square in shape. This is where people keep their valuables and take shelter as well during cyclones. Plantations of coconut, betel nut and banana trees around the house are also very common. In Figure that people adopted indigenous practices before cyclone and induced storm surge event.

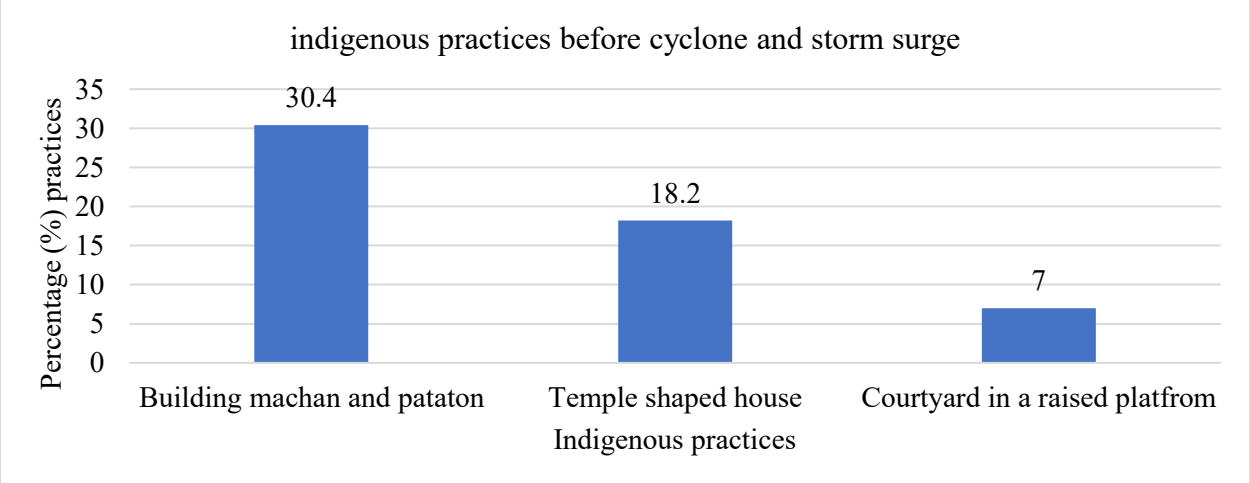

Figure 28: Indigenous practices before cyclone and storm surge

People prepare a Machan inside the house (51%), temple shape house (30%) and (18%) prepare courtyard in a raised platform to save household utensils, furniture, foods, goods, seeds and other assets in all study area. For poultry and livestock they made elevated or higher house to keep them safe especially for hen and duck.

Figure 29: Machan and Temple shape house

4.4.2.2 Coping strategies during the cyclone and induced surge event

In disaster-prone localities, coping measures immediately before the hazard event start with the saving of human lives. This study finds that a majority of the household members (36.4%) do not take shelter in traditional cyclone shelters, but prefer to stay in the ceilings or on top of the thatched roof of their own houses (48%), or seek refuge in neighbor's houses (14.3%). Two cyclone shelters are available in study area. Thus, in an emergency people climbed up trees and stayed in their house ceilings until the threat was over. A few people made use of plastic containers or banana rafts to save their lives from the fast flow of surge water. In the worst cases, those who did not have any alternatives, took shelter on the embankments, cyclone shelter, raised roads or other elevated places after the cyclone.

Besides that, they have some assets like poultry or livestock. During cyclone or immediate before cyclone if they cannot keep them on higher or safer place they release them so that hen, duck, cow, goat can survive by themselves.

People adopted indigenous practices during cyclone and storm surge event in below:

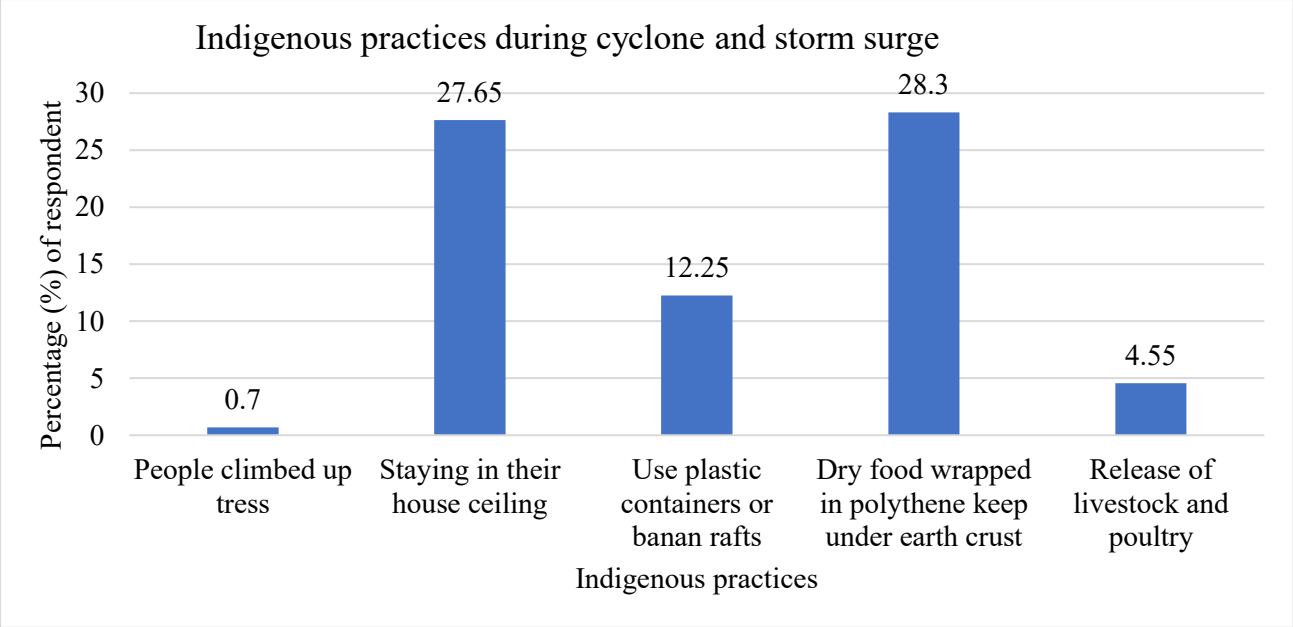

Figure 30: Indigenous practices during cyclone and storm surge

4.4.2.3 Coping strategies: post cyclone and induced surge event

These include measures such as consumption smoothing, relying on inexpensive foods (flattened rice, fried rice, gur etc.), collection of wild foods, temporary migration, begging, selling of unproductive and productive assets, and assisting each other within the community, etc.

Disposal of assets is also a common coping strategy for rural households exposed to shocks in order to meet consumption requirements or acquire the means to purchase food, the study reveals that about people in villages respectively had sold assets during the post-disaster period. Main disposable items were big trees, jewellery, household utensils, paddies, chickens, cattle, fish, tin sheets, fishing and agricultural equipment, and leasing out or mortgaging of farmland, etc. However, selling of cattle and chickens was most common in the study area.

In Figure 31 shown that, people or community adopted indigenous practices for post cyclone and storm surge event.

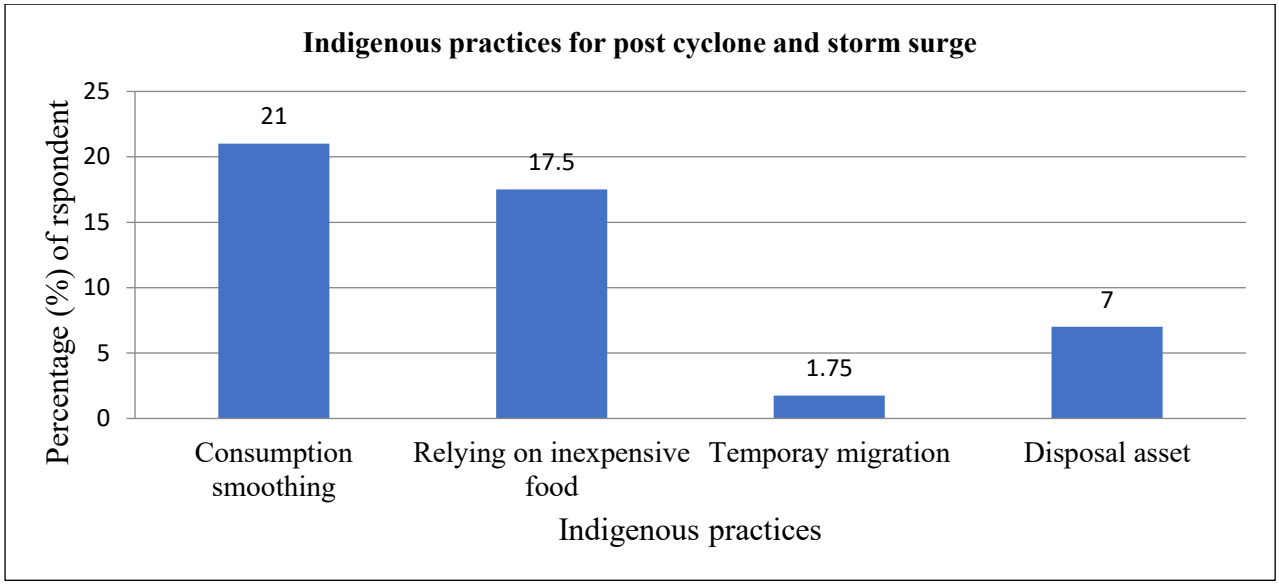

Figure 31: Indigenous practices for post cyclone and storm surge

4.4.3 Indigenous Coping Strategies for Salinity Intrusion

Salinity is one of the major problems in Bangladesh's southern region. It is exacerbated by climate change and rising sea levels. One direct consequence of sea-level rise is intrusion of salinity with tides through rivers and estuaries. Intrusion would be more acute in the dry season, especially when freshwater flows from rivers would diminish Communities of people practice different coping strategies to mitigate the impacts of increased salinity.

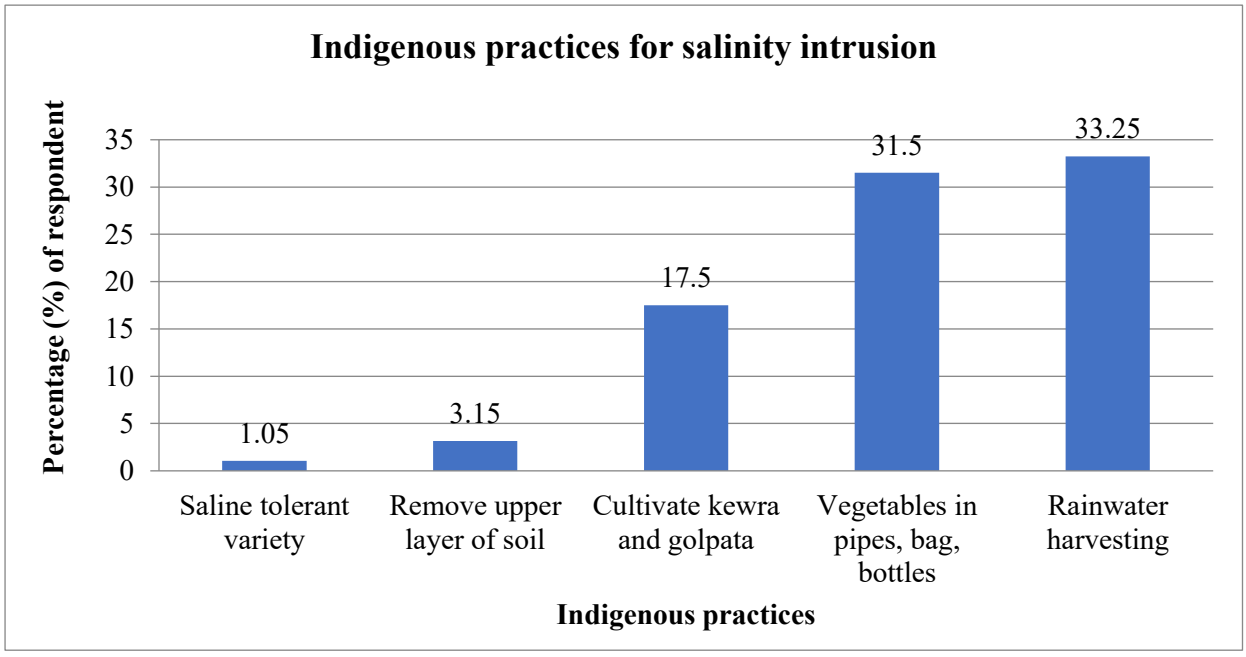

Figure 32: Indigenous practices for salinity intrusion

4.4.4 Coping Strategies for flood security

To ensure food security, the farmers in this area cultivate local saline-tolerant varieties of rice that are especially suited to the current circumstances of this area. They remove upper layer of soil crust that affected by salinity. Furthermore, they have taken the initiative to cultivate kewra, which can be grown well in saline soil. It is now considered a cash crop for its fruit, and its wood can be used to make furniture or as fuel. They also cultivate vegetables on their homestead in plastic bag or bottle which they can move or lifted up to avoid salinity intrusion into the soil.

Hence, they have adopted some coping strategies such as shrimp cultivation and rice cultivation for generations using their own methods and community wisdom, reed cultivation and mat weaving, cultivation of prawn renu, crab aquaculture, and golpata (a tree variety), and salt cultivation.

4.4.5 Coping Strategies for Safe Drinking Water

To meet the crisis of drinking water, the communities practice strategies such as

- Harvesting rainwater,
- Preserving fresh drinking water
- Conserving pond water

These practices ensure the availability of fresh drinking water of the study areas, although all of these practices are not very safe or dependable

4.4.6 Indigenous Coping Strategies for Flooding and Water Logging

The coping strategies were considered in this context to be the approaches people employ to deal successfully with a crisis. The adoption of a particular set of strategies depended on people's socio-economic circumstances and the characteristics of the flood. The study findings suggest that a household's response to a flood does not involve the adoption of all strategies but rather the sequential implementation of preventative and mitigative initiatives.

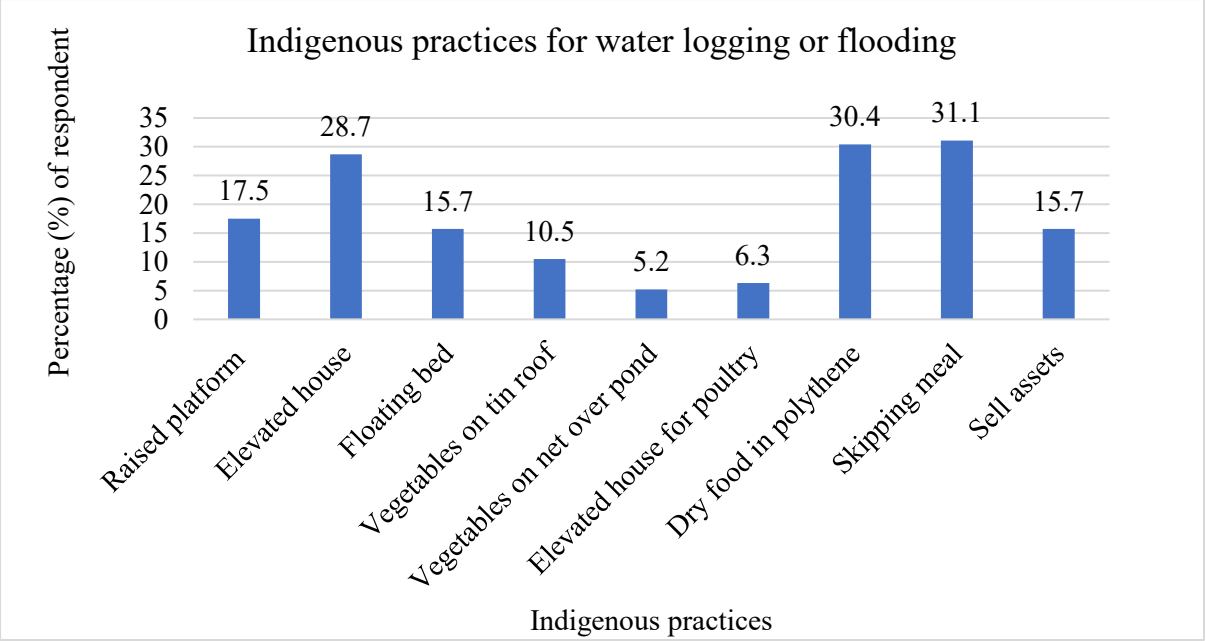

Figure 33: Indigenous practices for water logging or flooding

4.4.7 Strategies to Save Human Lives and Household Item

Flood-affected localities, coping starts with efforts to save people's lives, such as raising a homestead before a flood. Given previous experience of flooding, communities tend to elevate their bed using bricks or stones. Some use raised platforms outside their houses as shelter and others seek for safety in relatively higher ground. Besides attempting to save human lives, communities also try to rescue their assets such as furniture and kitchen utensils. Initially they keep their kitchen utensils on mud shelves built in the kitchen or outside. Such shelves are built at a height of about a meter or two from the ground so that kitchen utensils are not washed away when floodwaters rises and water logging.

4.4.8 Techniques to Save Shelter

Techniques to protect shelter depend on the risk posed by flood and erosion. Some studies conducted in flood prone areas such as Bangladesh emphasis how villagers built their dwelling units on raised land or on earthen platforms so that water cannot reach the plinth level in a low magnitude flood. People said that they had raised primarily the floor of their bedrooms due to changing heights of floodwaters each year.

4.4.9 Strategies to Protect Crops

The farmers in communities have adopted different kinds of indigenous coping strategies to protect their crops from the impacts of flooding. From the survey, find out that farmers of this area to ensure food or production of crop practice floating bed for cultivating different types of vegetables. They made bed with water hyacinth, algae or plant residues and use bamboo for foundation. The floating garden are extremely suitable for growing several vegetables and fruits. It is more commonly used for growing tomato, pumpkin, cucumber, okra, bitter gourd, snake gourd, brinjal, spinach, red spinach etc.

Figure 34: Floating Bed for Vegetables

Farmers also cultivate vegetables on tin roof top of their house to avoid effects of floodwater and water logging impacts on vegetables. They also plant vegetables on net that place over the pond.

Figure 35: Vegetables on net over the pond

4.4.10 Strategies to Protect Poultry and Livestock

Poultry and livestock are important assets for households with low incomes in study areas. During the initial stage of a flood or water logging, households keep their poultry and livestock on slightly higher parts of their homestead. When this becomes unsafe, they move them to safer places on higher ground, or they sell the poultry and livestock to outsiders.

4.4.11 Coping Strategies to Conserve Food and Water

The storage of food and water is a big challenge for victims of a flood. People prefer and use polythene bags to stockpile dry food, grain and seed. Seventy-five per cent of the total households in community prefer plastic containers to transport water as they are easy to seal and carry. In most houses, the storing place is higher than the normal floor; such places remain safe until there is high flood- water. However, when floodwater increases, community usually relocate to higher ground with their containers of food and water.

4.4.12 Adaptations to Food Insecurity

Scarcity of food during and after a flood water logging is a common phenomenon in flood affected areas. When faced with such an insufficient food supply, the household head is primarily responsible for feeding the family members. He or she adopts different measures to cope with such a situation, including reducing the number of meals per day and relying on inexpensive food stuffs such as vegetable leaves and wild fruits. The study confirms that in community, skipping a meal is a coping strategy and that there are variations in dependency on inexpensive food. By contrast, respondents said that they had reduced their number of meals because of wet firewood during and immediately after the flood. Consequently, they prepared two light meals per day.

Households in community employ many other coping methods during a flood. Among households exposed to shocks, for example, borrowing money after a flood and disposing of assets are considered very important initiatives. The study found that the most common assets sold in community to overcome difficult periods and manage crisis are cattle, goats, chicken and duck. Women of the community sometimes engaged themselves for katha stitching for extra income.

Chapter 5
Conclusion and Recommendation

5.1 Conclusion

Now a day's climate change becomes one of the major concerns for most of the countries across the globe. Bangladesh is one of the most climate vulnerable countries in the world and will become even more as a result of climate change. For Bangladesh they are most critical as large part of the population is chronically exposed and vulnerable to a range of natural hazards especially southern part of Bangladesh.

The study found that people of the study area have different livelihood pattern. Their livelihood includes farmer, fisherman, day labour, shopkeeper, rickshaw puller, small business, large business, household worker and so one. Findings shows that 40% farmer, 30% fisherman, 20% livestock and 10% wage labor are vulnerable due to the cyclone. The income decreases in the agriculture sector almost 25%, fisheries sector faces loss about 15%, livestock and day labor faces respectively 5% and 11% differences in livelihood sector.

Livestock was significantly affected in this area due to cyclone. In terms of damage intensity of crops approximately 55% of farmers claimed that the calamity had destroyed all of their crops, 35% of farmers were only able to save a small percentage of their crops, while only 9% were able to save the majority of their harvests. Aman cultivation was also severely impacted by the cyclone. The effects of the cyclone in fisheries sector are loss of fish, damage of fisheries equipment and in livestock sector cow (20%), goat (30%) and hen-duck rear (50%) were died.

The most adverse effect of climate change is occurred among children, women and adolescents. In terms of violence of women and most of the perpetrators were husband (55%), own family member (12.23%), followed by known person (13%), neighbours (12%), lovers (2.15%), house master and mistress (2.62%), in laws and others (3%).

The potential climate adaptive and locally suitable technologies for sustainable livelihood for the people in Patuakhali and Barguna district are identified. Study find out that farmers of this area to ensure food or production of crop practice floating bed for cultivating different types of vegetables. They made bed with water hyacinth, algae or plant residues and use bamboo for foundation. The floating garden are extremely suitable for growing several vegetables and fruits. It is more commonly used for growing tomato, pumpkin, cucumber, okra, bitter gourd, snake gourd, brinjal, spinach, red spinach etc. Farmers also cultivate vegetables on tin roof top

of their house to avoid effects of floodwater and water logging impacts on vegetables. They also plant vegetables on net that place over the pond.

They also have taken the initiative to cultivate kewra, which can be grown well in saline soil. It is now considered a cash crop for its fruit, and its wood can be used to make furniture or as fuel. They also cultivate vegetables on their homestead in plastic bag or bottle which they can move or lifted up to avoid salinity intrusion into the soil.

Hence, they have adopted some coping strategies such as shrimp cultivation and rice cultivation for generations using their own methods and community wisdom, reed cultivation and mat weaving, cultivation of prawn renu, crab aquaculture, and golpata (a tree variety), and salt cultivation. In terms of salinity, they cultivate saline tolerant varients, cultivate kewra or golpata and remove upper soil of land. In cases of waterlogging they use floating bed, tin roof.

People meet the crisis of drinking by harvesting rainwater, preserving fresh drinking water, conserving pond water. In terms of indigenous practice people build machan and petaton (31%), temple shaped house (19%) and courtyard on a raised platform (7%). The result shows that to avoid natural hazards people climed up trees, stayed in house ceiling, use plastic container or banana rafts, and force to temporary migration.

For the best practices to cope with the impact of climate change, 40% respondents said that they have adjusted with meal, 54% respondents said they sold their agricultural products at a lower price, 60% respondents changed their occupation, 20% respondents taken relief from loan, 14% respondents took unsecured loan, 18% respondents took loan from various sources while only 14% respondents took secured loan. On the other hand 40% respondents sold their household productive assets, 42% respondents sold small animals, 48% respondents sold trees, only 8% sold jewellery, 58% respondents sold their domestic animal cow, 10% respondents sold tin sheets of their house, 52 % people sold farmlands and 28% respondents took loan from the bank to cope up the impact of climate change.

5.2 Recommendations

The following recommendations are suggested:

1. Alternate livelihoods must be introduced which will not be affected due to climate change.
2. Engaging farmer with HYV crops an train them properly.
3. The affected areas due to the climate change must be identified for further planning.
4. Proper structural measures like as cyclone shelter, polder, embankment etc. must be constructed.
5. Proper steps for relief and rehabilitation for the displaces should be taken.
6. Minimum amount of khasland should be allotted to them for shelter if possible.
7. The rights and security of the victims should be ensured.
8. Capacity building of the Climate Change and Food Security relevant ministries, departments, institutions and so on.
9. Ensure proper education facilities for children and adolescents.
10. Stopping sexual harassment, Bulling and other violance by developing action plan and enforcing law.
11. Awareness programs among the people have to be introduced in the affected areas.
12. Promoting indigenous knowledge based adaptive technologies.
13. Adjustment of agricultural system with changing climate through change of planting time of crops, introduction of saline resilient varieties of crops, introduction of floating bed cropping in flood monsoon etc. Also storing the rain water during the rainy season in canal and cultivate Boro paddy during dry season.
14. Develop an umbrella program of social safety nets.
15. Need to give assistance for climate vulnerable community.
16. Need to develop a fund-raising program for climate vulnerable community.
17. Need to give soft loan and insurance facilities for sustain their livelihood.
18. Comprehensive disaster management policy should be made nationally.

References

Adger, W. N.: 1999a, 'Exploring income inequality in rural, coastal Vietnam'.

Adger, W. N.: 1999b, 'Social vulnerability to climate change and extremes in coastal Vietnam'.

Ahmed, M.N.Q., Haq, A. and Md, S., 2019. Indigenous people's perceptions about climate change, forest resource management, and coping strategies: a comparative study in Bangladesh. *Environment, Development and Sustainability*, *21*(2), pp.679-708.

Anderson, A., 2012. Climate change education for mitigation and adaptation. *Journal of Education for Sustainable Development*, *6*(2), pp.191-206.

BBS. 2011 Preliminary Report on Household Income and Expenditure Survey. Statistics & Informatics Division (Sid). Ministry of Planning Government of The People's Republic of Bangladesh Dhaka, Bangladesh

BBS. 2015 *Bangladesh Bureau of Statistics.* Statistics and Informatics Division (SID). Ministry of Planning. Government of People's Republic of Bangladesh.

Béné, C., 2011. Social protection and climate change. *IDS Bulletin*, *42*(6), pp.67-70.

Dasgupta, S., et al. 2018. "Climate change, salinization and high-yield rice production in coastal Bangladesh." Agricultural and Resource Economics Review **47**(1): 66-89.

Davidson, S. 2008. Davidson, S., 2008. A Review of the IFRC-led Shelter Coordination Group Bangladesh Cyclone Sidr Response 2007-2008. *Bangladesh Red Crescent Society, Dhaka* Development Studies 35, June.

Haddad, B.M., 2005. Ranking the adaptive capacity of nations to climate change when socio political goals are explicit. *Global environmental change*, *15*(2), pp.165-176.

Harmeling S., 2010. Global Climate Risk Index 2010: Who is the Most Vulnerable? Weather-related Loss Events since 1990 and How Copenhagen Needs to Responds. Germanwatch, Bonn.

Hiwasaki, L., Luna, E. and Shaw, R., 2014. Process for integrating local and indigenous knowledge with science for hydro-meteorological disaster risk reduction and climate

change adaptation in coastal and small island communities. *International journal of disaster risk reduction*, *10*, pp.15-27.

Hossain, M.S., Arshad, M., Qian, L., Kächele, H., Khan, I., Islam, M.D.I. and Mahboob, M.G., 2020. Climate change impacts on farmland value in Bangladesh. *Ecological indicators*, *112*, p.106181

Huq, M., Shoeb, A.Z.M., Hossain, M.A., Fahad, S., Kamruzzaman, M.M., Javed, A., Saleem, N., Adnan, K.M., Sarker, S.A., Ali, M.Y. and Sarven, M., 2020. Measuring vulnerability to environmental hazards: qualitative to quantitative. In *Environment, climate, plant and vegetation growth* (pp. 421-452). Springer, Cham.

Hurd, B., Leary, N., Jones, R. and Smith, J., 1999. Relative regional vulnerability of water resources to climate change 1. *JAWRA Journal of the American Water Resources Association*, *35*(6), pp.1399-1409.

IPCC 2007. Climate change the physical science basis. In *Agu fall meeting abstracts* (Vol. 2007, pp. U43D-01).

IPCC, 2001. Climate Change 2001: Impacts, Adaptation, and Vulnerability. Contribution of Working Group Ii to the Third Assessment Report. Cambridge University Press, Cambridge, Uk. 102

IPCC, 2007. Climate Change 2007: Impacts, Adaptation and Vulnerability Contributing of Working Group II to the Fourth Assessment Report (Ch. 9).

IPCC. 2007 Climate Change 2007: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report. Cambridge, UK: Cambridge University Press.

Islam, M. R., 2004. Where the Land Meets the Sea: A Profile of Coastal Zone of Bangladesh, the University Press Ltd., Dhaka, p. 4-5.

Kelman, I. and Gaillard, J.C., 2010. Embedding climate change adaptation within disaster risk reduction. In *Climate change adaptation and disaster risk reduction: Issues and challenges*. Emerald Group Publishing Limited.

Khan, A.E., Ireson, A., Kovats, S., Mojumder, S.K., Khusru, A., Rahman, A. and Vineis, P., 2011. Drinking water salinity and maternal health in coastal Bangladesh: implications of climate change. *Environmental health perspectives*, *119*(9), pp.1328-1332.

Kothari, A., 2006. Community conserved areas: towards ecological and livelihood security. *Parks*, *16*(1), pp.3-13.

Leary, N. ed., 2008. *Climate change and vulnerability* (p. 82). London: Earthscan.

Morzaria-Luna, H.N., Turk-Boyer, P. and Moreno-Baez, M., 2014. Social indicators of vulnerability for fishing communities in the Northern Gulf of California, Mexico: implications for climate change. *Marine Policy*, *45*, pp.182-193.

Mukhopadhyay, D. 2009. 'Cultural values, indigenous knowledge for climate change adaptations in developing countries', *IOP Conference Series: Earth and Environmental Science*, 6(57), p. 572006. doi: 10.1088/1755-1307/6/7/572006.

Mullon, C., Fréon, P. and Cury, P., 2005. The dynamics of collapse in world fisheries. *Fish and fisheries*, *6*(2), pp.111-120.

Nasrin, A.B., Ma, A.N., Choo, Y.M., Mohamad, S., Rohaya, M.H., Azali, A. and Zainal, Z., 2008. Oil palm biomass as potential substitution raw materials for commercial biomass briquettes production. *American Journal of Applied Sciences*, *5*(3), pp.179-183.

Nurul, mas'ud waqiah (2013) 'NDC Bangladesh', *Bangladesh*, 53(9), pp. 1689–1699.

Parvin, G.A., Ali, M., Fujita, K., Abedin, M., Habiba, U. and Shaw, R., 2017. Land use change in southwestern coastal Bangladesh: Consequence to food and water supply. In *Land use management in disaster risk reduction* (pp. 381-401). Springer, Tokyo.

Rahman, H.Z. and Matin, I., 2020. Livelihoods, coping, and support during COVID-19 crisis. *Dhaka, BRAC Institute of Governance and Development*.

Shamsuddoha, M. and Chowdhury, R.K., 2007. Climate change impact and disaster vulnerabilities in the coastal areas of Bangladesh. *COAST Trust, Dhaka*, pp.40-48.

Shaw, R., 2012. Overview of community-based disaster risk reduction. In *Community-based disaster risk reduction*. Emerald Group Publishing Limited.

Shaw, R., 2012. Overview of community-based disaster risk reduction. In *Community-based disaster risk reduction*. Emerald Group Publishing Limited.

Wali, A. and Hassan, R. 2016. 'Sectoral inputs towards the formulation of Seventh Five Year Plan (2016 – 2021) CLIMATE CHANGE AND DISASTER MANAGEMENT Ahsan Uddin Ahmed , Saleemul Haq , Mahbuba Nasreen and', (January 2015).

Wallman, P. (2005) 'Impacts of Sea Level Rise on the Coastal Zone of Bangladesh Lund University International Masters Programme in Environmental Science'.

Watson, R.T., Zinyowera, M.C. and Moss, R.H., 1996. *Climate change 1995. Impacts, adaptations and mitigation of climate change: scientific-technical analyses*.

Annex

Annex 1: Household Survey Questionnaire

Household Survey Questionnaire 2021

Enhancing Climate Resilience in the Most Climate Affected Communities by Adapting Locally Suitable Technologies through Actions Research

Objectives of the Research

1. To find out adverse effect of climate change on the people's livelihoods in Patuakhali and Barguna district.
2. To find out the most adverse effect of climate change on children, women and adolescents in relationship to rights in Patuakhali and Barguna district.
3. To find out the potential climate adaptive and locally suitable technologies for sustainable livelihood for the people in Patuakhali and Barguna district.

[N.B.: All the information being collected under this module only for the research purpose.]

Questionnaire No: .... Date: ……

A. Identification of the Respondent

Name of the Respondent:
District: Barguna **Upazila:** **Union:** **Village:** **Mobile No:**
Gender: ☐ Male ☐ Female
Educational Status:
☐ Illiterate ☐ Can read and write ☐ Primary school ☐Secondary school ☐ College

☐ Graduate ☐ Postgraduate ☐ others
Age:
☐ 20-30yrs ☐ 31-40yrs ☐ 41-50yrs ☐ 51-60yrs ☐ 61-70yrs ☐ 71-80yrs
☐ above 80 years
Occupation:
☐Unemployed ☐ Farmer ☐ Day Laborer ☐ Fisherman ☐ Rickshaw/Van puller ☐ House helper/maid
☐ Handicraft ☐ Beggar ☐ Driver ☐ Student ☐ Housewife
☐ Teacher ☐ Govt. officials ☐ Small traders Businessman ☐ NGO job holder ☐ Fish cultivation ☐ Others (Please Mention) _____

How long have you been living here?
☐ 1-10 years ☐ 11-20 years ☐ 21-30 years ☐ 31-40 years ☐ 41-50 years ☐ 51-60 years ☐ 61-70 years
☐ 8= 71-80 years
Monthly income of the household .....Taka.
Structure condition of the house
☐ Jhupri ☐Katcha ☐ Semi-Pucca ☐ Pucca

B. Adverse Effect of Climate Change on the People's Livelihoods in Patuakhali and Barguna District

1. Which livelihood are vulnerable due to climate change?
☐ Farmer ☐ Fisherman ☐ Rickshaw puller ☐ Day labour ☐ Small business

2. How climate change impact in your income?

3. What types of crops do you cultivate?

☐ Aus. ☐ Amon ☐ Boro ☐ Chilies ☐ Potato ☐ Sweet potato
☐ Water melon ☐ Wheat ☐ Pulses ☐ Oil seeds ☐ Other (Please mention)

4. How climate change impact on agriculture sector?

5. How natural calamities damage your crops?

☐ Fully Damage ☐ All most Damage ☐ Partially Damage ☐ Not significant

6. How natural calamities impact on fisheries sector?

☐ Loss of fish ☐ Damage of fisheries equipment ☐ Other (Please mention)

7. What types of livestock are you rearing?

☐ Cow ☐ Buffalo ☐ Goat ☐ Hen ☐ Duck ☐ Goose ☐ Other (Please mention)

8. How natural calamities impact on livestock sector?

☐ Death of Livestock ☐ Reduce production rate

9. How natural calamities impact on labor sector?

10. What are the possible alternate option due to climate change?

11. What are the adaptation strategies do you follow due to climate change?

12. How do you cope with the livelihood impacts of climate change?

☐ Adjustment to meals ☐ Sold agricultural products at a lower price ☐ Sold labor
☐ Occupation change ☐ Taken relief ☐ Unsecured Loans ☐ Loan from various sources
☐ Divestment & Secured Loans ☐ Sold household productive assets ☐ Sold small animal
☐ Sold trees ☐ Sold jewelry ☐ Sold cows
☐ Sold tin sheets ☐ Sold farmlands ☐ Loan from bank ☐ Other (Please mention)

13. What are the steps taken by government for farming sector?

☐ Expansion of small irrigation facilities ☐ Conducted training and workshop ☐ Provide high yielding varieties of seeds ☐ Financial support ☐ Soft Loan ☐ Other initiatives

C. The Most Adverse Effect of Climate Change on Children, Women and Adolescents in Relationship to Rights in Patuakhali and Barguna District

14. How climate change effect the children?

☐ Increased under nutrition ☐ Greater risk of morbidity/death ☐ Injuries ☐ Skin disease
☐ Diseases ☐ Other (Please mention)

15. How climate change effect the adolescent?

☐ Inadequate sanitation ☐ Child labor ☐ Child marriage ☐ Sexual exploitation
☐ Trafficking ☐ Decreased school attendance ☐ Increased school dropout ☐ Drowning
☐ Injuries````☐ Begging ☐ Orphan hood ☐ Other (Please mention)

16. How climate change effect the Women?

_____

17. What types of violence women do face during natural calamities?

_____

18. Who are the perpetrator of women violence?

_____

19. Please mention the effects of the violence.

Impact on women's health	Economic and social impact	Impact on women's family and dependents	impact of violence on society

20. Can you mention the causes and possible measures of violence?

_____

D. The Potential Climate Adaptive and Locally Suitable Technologies for Sustainable Livelihood for the People in Patuakhali and Barguna District

21. What are the local indigenous knowledge do you practice for hydro meteorological hazards?

_____

22. What are the local coping strategy do you practice before/during/after cyclone?

Coping strategies before the cyclone	Coping strategies during the cyclone	Coping strategies after the cyclone

23. What are the local coping strategy do you practice for salinity intrusion?

_____

24. What are the local coping strategy do you practice for flooding and water logging?

_____

25. What are the local coping strategy do you practice to protect crops, fish and livestock?

_____

26. What are the local coping strategy do you practice for safe drinking water?

_____

27. What are the local coping strategy do you practice for food security?

Thanks for Your Cordial Cooperation

…… ……

Signature of the Interviewer (With Date) Signature of the Interviewee

(With Date)

Annex 2: Focus Group Discussion Checklist

Focus Group Discussion

Enhancing Climate Resilience in the Most Climate Affected Communities by Adapting Locally Suitable Technologies through Actions Research

Objectives of the Research

1. To find out adverse effect of climate change on the people's livelihoods in Patuakhali and Barguna district.
2. To find out the most adverse effect of climate change on children, women and adolescents in relationship to rights in Patuakhali and Barguna district.
3. To find out the potential climate adaptive and locally suitable technologies for sustainable livelihood for the people in Patuakhali and Barguna district.

[N.B.: All the information being collected under this module only for the research purpose.]

Set Ground Rules:

- One person speaking at a time and no sub-group discussions
- Allow others to speak
- Respect the right of others to express views that are not your own
- Speak clearly and respect confidentiality of other group members
- The discussion will cover the following topics. Please feel free to express your opinions.

Interview Information

Name of Community	
Number of people attending	1) Men ____ Person 2) Women ____ Person 3) Total _____ Person
Types of FGD	☐ Affected Community People ☐ Community Representatives
Time of Meeting	
Date	

1. In your opinion which livelihood are vulnerable due to climate change?
2. How climate change impact in income in your community?
3. What types of crops usually cultivate in your area?
4. How climate change impact on agriculture, livestock and other sector?
5. What are the possible alternate option for livelihood due to climate change?
6. How do you cope with the livelihood impacts of climate change?
7. How climate change effect the children, adolescent and women?
8. What are the coping strategy do you practice before/during/after cyclone?
9. What are the local coping strategy do you practice for salinity intrusion, flooding and water logging?
10. What are the local coping strategy do you practice to protect crops, fish and livestock?
11. What are the local coping strategy do you practice for safe drinking water and food security?

Is there anything else you would like to add?

Thanks for Your Cordial Cooperation

Annex 3: Key Informant Interview (KII) Questionnaire

Enhancing Climate Resilience in the Most Climate Affected Communities by Adapting Locally Suitable Technologies through Actions Research

Objectives of the Research

4. To find out adverse effect of climate change on the people's livelihoods in Patuakhali and Barguna district.
5. To find out the most adverse effect of climate change on children, women and adolescents in relationship to rights in Patuakhali and Barguna district.
6. To find out the potential climate adaptive and locally suitable technologies for sustainable livelihood for the people in Patuakhali and Barguna district.

[N.B.: All the information being collected under this module only for the research purpose.]

Questionnaire No: .... **Time ……** **Date: ……**

Name of the Respondent:
Institution_____ **Designation**_____ **Age**_____ **Gender:** ☐ Male ☐ Female

District: Barguna **Upazila:** **Union:** **Village:** **Mobile No:**

1. In your opinion which livelihood are vulnerable due to climate change?
2. How climate change impact in income in your community?
3. What types of crops usually cultivate in your area?
4. How climate change impact on agriculture, livestock and other sector?
5. What are the possible alternate option for livelihood due to climate change?
6. How climate change effect the children, adolescent and women?
7. What are the coping strategy do you practice before/during/after cyclone?
8. What are the local coping strategy do you practice for salinity intrusion, flooding and water logging?
9. What are the local coping strategy do you practice to protect crops, fish and livestock?
10. What are the local coping strategy do you practice for safe drinking water and food security?

Thanks for Your Cordial Cooperation

Annex 4: Photograph