CLIMATE CHANGE HAZARDS AND COPING MEASURES OF THE COASTAL COMMUNITY IN SHYAMNAGAR UPAZILA OF SATKHIRA DISTRICT

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Fisheries and Marine Resource Technology Discipline

Khulna University

Khulna, Bangladesh

April, 2014

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A Thesis

By

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Examination Roll No.: MS-130618

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The thesis submitted to the Fisheries and Marine Resource Technology Discipline in partial fulfillment of the requirements for the degree of

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In

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Khulna

April, 2014

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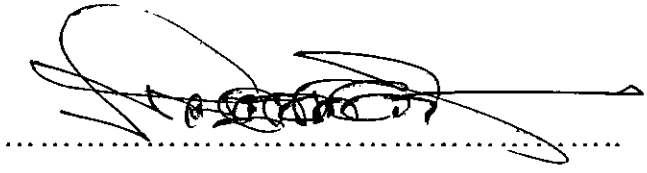
Approved as to the style and content

By



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CLIMATE CHANGE HAZARDS AND COPING MEASURES OF THE COASTAL COMMUNITY IN SHYAMNAGAR UPAZILA OF SATKHIRA DISTRICT

The results presented in the thesis with the above mentioned title are entirely of the candidate's own investigations and no part of the results has been accepted for any degree nor is it being concurrently submitted for any degree.

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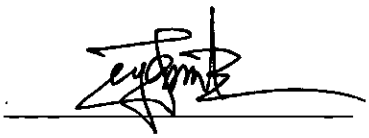

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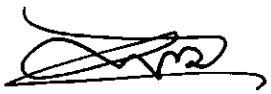

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DEDICATED TO

MY BELOVBED GRANDMOTHER

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ABSTRACT

The study has been conducted to five unions named Burigoalini, Gabura, Munshiganj, Ramjannagar and Koikhali of Shymnagar upazila under Satkhira district the most vulnerable coastal region of Bangladesh to identify global climate change hazard and copying measured of the disaster of the coastal community. In the recent past an amplified number of fatalities happened and the greater impact also happened to the coastal people. The aim of the study is to assess the climate change hazards on the coastal community and copping measure of the coastal people by applying both the quantitative and qualitative methods. The quantitative study followed the purposive sampling technique. The total sample size of this study is 100 and a survey was conducted with the help of structured interview questionnaire .For qualitative part, the study conducted 5 Focus Group Discussions (FGDs) with the male and female respondents from July to December, 2013. The result of the study depicts that climate change induced natural disasters have severely affected coastal people's life and livelihoods. People change their occupation due to climate change. From 100 respondent's maximum 28 % change their occupation from agricultural farmer to brick worker, day labor, carpenter, fish farmer, fishermen, motorcycle driver and petty businessman. The study examines the impact of climate change on agricultural productivities, fisheries, livestock and structural challenges that the coastal people face. Maximum 19 % respondents said crop affected by disease due to cyclone. The study also indicates that due to climate change they suffer from various kinds of diseases such as diarrhea, cholera, fever, skin disease. Maximum 30 respondent's family member suffered from diarrhea. The study also explores the adaptation measures taken by the local people. They take some coping measure like alternative occupation, producing adaptive species, migrating towards town, participation of women in work. From 100 off 35% were adapted by alternative occupation, respondents17 numbers were adapted by producing adaptive species, 30% migrated towards town, 21% women participated in works. This research work can help the vulnerable coastal people to develop their consciousness about the negative effect of climate change. In the same way the policy makers, concerned people as well as government know about the vulnerable situations of that particular people and take decision about the welfare activities and help them by training some strategies of coping mechanism for sustainable livelihoods of that particular people.

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LIST OF ABBREVIATION

ABBREVIATION	ELABORATION
FMRT	Fisheries And Marine Resources Technology Discipline
et al.	Et alli; Latin word meaning "and others"
PP	Page
ADB	Asian Development Bank
AR4	Fourth Assessment Report
DOE	Department of Environment
BRAC	Bangladesh Rural Advancement Committee
EMDAT	Centre for Research on the Epidemiology of Disasters
FAO	The Food and Agriculture Organization
GDP	Gross Domestic Product
IPCC	Intergovernmental Panel on Climate Change
UNDP	United Nations Development Program

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CHAPTER 1

INTRODUCTION

1.1. Background of the study

Climate change is defined as any change in global temperatures and precipitation over a period of time due to natural variability or as a result of human activity. It is the mother of all environmental changes (Glantz 2010). Geographical location, mean sea level, land characteristics, and many other factors are contributing to the rising trend of vulnerability. During the last few decades, the country became highly vulnerable to almost all types of climate hazards i.e. floods, cyclones, droughts, river erosion, tidal surges, tornadoes, salinity intrusion, waterlogging, high arsenic content of ground water etc. Global warming and climate change are unequivocal, are agreed by all scientists around the world. Experts and officials from across the world collectively endorsed the latest findings of the Inter-Governmental Panel on Climate Change (IPCC) through its fourth Assessment Report (AR4) that the average temperature might increase up to about 5.5 degree Celsius with respect to current mean values by 2100 in Asia (Cruz *et al.* 2007). The UNDP has identified Bangladesh to be the most vulnerable country in terms of cyclone and the 6th most vulnerable country in terms of floods (Siddique 2010). The intensity of vulnerability is further enhanced by climate change. A number of major studies in the past investigated the causes of vulnerability of Bangladesh due to climate change. (Huq *et al.*, 1998, Warrick and Ahmed 1996, ADB 1994). All of these devastating disasters have immense effect of the life and livelihoods of coastal people, as they lost their occupations, crop cultivation, tree plantations, fish cultivation and other usual activities that makes their life vulnerable and enforced them to lead a very miserable life. Moreover the merciless disaster washed away their housing structure and other infrastructures that enforced this coastal people to live on road sides or embankment or migrate elsewhere which also affect severely on their livelihoods. As elsewhere in the world the number of occurrences of disastrous events over the past decade or so has indeed increased dramatically in the low-lying delta, which not only has negated her development stride but also her relentless efforts to improve quality of lives of millions of her poverty stricken citizens. Historically the country has been subject to a variety of water-related hazards, mostly in the forms of flood, cyclone, storms surge, river bank erosion, drought and salinity intrusion (Ahmed and Mirza 2000., Karim *et al.*, 1990). A

large number of recent analyses suggest that such hydrological hazardous events are likely to be aggravated due to climate change. (Reazuddin *et al.*, 1997, Huq *et al.*, 1996).Ever since the global concerns have been raised about the adverse impact of climate change, the global community has already recognized Bangladesh as one of the most vulnerable country. The reasons are obvious. It is highly vulnerable, even under no-climate change, due to many factors including its disadvantageous location, flat and low-lying topography, high population density, rampant poverty, chronic inefficiency regarding institutional aspects and poor state of economic development. The magnitude of vulnerability would just increase manifold due to the impacts induced by climate change. Recent studies suggest that all such factors would exacerbate the advertiser for the poor people of Bangladesh under climate change scenarios (BCAS 1994, Huq *et al.*, 1996, Warrick and Ahmed, 1996). In Bangladesh about 42% of the people live below poverty line and 85 % live in rural areas (WDI 2001, 2002) and about half of Bangladesh is located a few meters above sea level and about a third is flooded in the rainy season. The country has been hit often by natural disasters. In 1976-2001 drought affected 25 Million people, floods affected 270 millions of people and rain and wind storms affected 41 million people (EM-DAT data base, 2009). Bangladesh scientists also believe that because of sea level rise coastal Bangladesh has already experienced severe impacts especially in terms of coastal inundation and erosion, saline intrusion, deforestation, loss of biodiversity and agriculture, and large scale migration (DOE 2007). About 830,000 million hectors of arable land is affected by varying degrees of soil salinity (Karim *et al.*, 1990). During the period 1973-1987 about 2.18 million tons of rice was damaged due drought and 2.38 million tons due to floods (Paul, 1995). Drought affects annually about 2.32 million hectors and 1.2 million hectors of cropped land during the Kharif (summer) November to June and Robi (winter) (July to October) seasons respectively, while soil salinity, water logging and acidification affect 3.05 million hectares, 0.7 million hectors and 0.6 million hectors of crops land respectively (BARC 2000) in the country. From 1970 to 2009, the total numbers of major cyclones striking Bangladesh was 26, where the numbers of occurrences increased significantly since 1990. It should also be noted that higher numbers of affected people have been recorded after 1990. In 2007 the country was ravaged by cyclone Sidr, which displace 650,000 people and killed 3447 (official record). In the year 2009 two cyclones hit (Cyclone Bijli, April 2009 and Aila, May, 2009). About 2, 00000 people were displaced by cyclone Bijli (Akter T. 2009) All of these devastating disasters have immense effect of the life and livelihoods of coastal people, as they lost their occupations, crop cultivation, tree plantations, fish cultivation and other usual activities that makes their life vulnerable and enforced them

to lead a very miserable life. Moreover the merciless disaster washed away their housing structure and other infrastructures that enforced this coastal people to live on road sides or embankment or migrate elsewhere which also affect severely on their livelihood. Therefore, in response to climate change it is necessary to develop and implement suitable adaptation options. There are some initiatives through the NGOS and GOs input to build adaptation capacity of the climate prone coastal community. The Climate Change Adaptation Knowledge Platform for Bangladesh has been developed to respond to demand for effective mechanisms for sharing information on climate change adaptation and developing adaptive capacities for Bangladesh, which are the most vulnerable to the effects of climate change. The Adaptation Knowledge Platform will facilitate climate change adaptation at local, national and regional levels to strengthen adaptive capacity of country in the region -- while working with existing and emerging networks and initiatives. Through its work the Adaptation Knowledge Platform is working towards building bridges between current knowledge on adaptation to climate change and the governments, agencies and communities that need this knowledge to inform their responses to the challenges that climate change presents to them. The study is to understand ongoing adaptation approaches against climate change impacts and to suggest possible future adaptation options. The main purpose of the study assessing climate change hazards, identifying ongoing adaptation measures and Suggesting possible future options to adapt with the changing climate using locally available resources.

1.2. Objective of the study

The study has been conducted to know the following objectives:

- To identify climate change hazards in the study area and ongoing adaptation measures and their response to cope with climate change impacts by the coastal community.

CHAPTER 2

LITERATURE REVIEW

The review of the literature provides the background and context for the research problem. It should establish the need for the research and indicates knowledgeable about the area. A large numbers of studies have been conducted over the decades on impact, adaptation, and vulnerability to climate change.

Rashid *et al.* (1989) in their paper "Greenhouse Effect of the Agriculture Sectors in the Coastal Area of Bangladesh" reveals that the effect of greenhouse on the agriculture sector (crops livestock, fisheries, and forestry). They said that climate change create conflicts if temperatures are increasing in areas that are already hot, it will have a direct effect on the scarce resources required to sustain life: water, food, crops and livestock will die, crops will decline and there will not be enough food.

Hossain and Monowar (1998) in their paper "The Greenhouse Effect and the Coastal Area of Bangladesh: Its People and Economy" intends to deal mainly the consequence of sea level rise in relation to the coastal area of Bangladesh, one of the most vulnerable areas in the world. The paper revel that the probable global warming will affect the agricultural land of the coastal areas, and the fish farm will be disrupted of that particular area due to flooding or tidal surge. The paper further depicts that the mangrove forest may be fall in great threat as salinity intrusion in the forest will disrupt the ecological balance of the areas.

Ahmed *et al.* (1994) have presented a document named "The Implications of Climate Change for Bangladesh: A Synthesis" depict that there are firm scientific evidence to show the concentration of greenhouse gas such as carbon dioxide, methane and nitrous oxide, in the Earth's atmospheres have been steadily increasing. The document claimed that climate change and sea level rise could possibly have profound effects on Bangladesh her water, agriculture, forestry, fisheries and livestock resources.

IPCC (2001) has presented a report, that asserted that climate change have a wide range of impacts on human health in Asia. Global warming will alter the occurrence of vector borne diseases, such as malaria and dengue fever.

Karim and Nehal (2002) have conducted a study about "Options for Cyclone Protection: Bangladesh Context", present that Bangladesh is one of the most natural disaster prone country over the last 30 years. The paper refers some devastating natural disasters such as cyclone of 1991 and 1996 and floods of 1987, 1988, and 1998 that severely affected the people of Bangladesh. The strength of this paper is that it reviews the options on structural and non-structural measure for reduction of vulnerability of the affected people in Bangladesh.

UNDP *et al.* (2002) in the paper "Climate Change: What is in Store for Our Sunny Long Beaches" assert that climate related disasters have adversely affected the economy, public health, food security, agriculture, water resources and bio-diversity in Bangladesh. The report also predicts that two situations are likely to worsen if human beings continue to pump Greenhouse Gases (GHGs) like carbon dioxide into the atmosphere.

Ahmed *et al.* (2005) in their study "Vulnerability of Forest Ecosystem of Bangladesh to Climate Change" predict that the impact of climate change will increase moisture stress in winter months enhance & prolong floods in monsoon, produce higher salinity in the coastal areas & have possible higher incidences of tropical cyclones & storms surges affecting the coastal areas.

Agarwal (2003) in his study "Development and Climate Change in Bangladesh: Focus on Coastal Flooding and the Sundarbans" reveals that coastal zone of Bangladesh face great threat due to sea level rise. The study also claims that the mangrove forest of Bangladesh is also now in great threat of sea level rise.

Cruz *et al.* (2007) have presented a paper named "Asia Climate 2007: Impact, Adaptation and Vulnerability" reveal that the region of Asia is highly subject to various natural hazards such as the 2004 Indian ocean tsunami, the 2005 Pakistan earthquake and the 2006 landslides in the Philippine.

DOE (2007) has conducted a study titled "Impacts Assessment of Climate Change & Sea Level Rise on Monsoon Flooding" covering seven districts of Bangladesh name Sirajganj Gaibangha, Pabna. Faridpur, Sunamgaj, Barisal, Satkhira. The aim of the study is to assess the impacts of flooding during the monsoon due to climate change. From the study it is found that about 61% of the districts get inundated in an average flood in 2005.

DOE (2007) in its article "Climate Change and Bangladesh" has revealed the effect of climate change on Bangladesh and some adaptive measure to reduce the losses. From the study it is found that because of sea level rise coastal Bangladesh has already experienced severe impact especially in terms of coastal inundation and erosion, saline intrusion, deforestation, loss of biodiversity, agriculture and large scale migration.

Ahmed and Ahsanuddin (2008) provide a paper titled "Effective Strategies for Adapting to Climate Change: Lessons from RVCC Project" in order to reduce the vulnerability of the rural poor of climate change and climate variability. This paper identified alternative livelihood options that are sustainable under climate change.

Pender and James (2008) in his article "What Is Climate Change? And How It Will Affect Bangladesh" indicates that human beings are the cause of creating greenhouse gas that causes global warming. The article also asserts that the effect of global warming is very severe in different sectors of life. The report indicates that the effect may be on agriculture, biodiversity, human health, environment as well as all sectors of life. The report further suggests some recommendations for mitigating this problem.

FAO (2008) in its article "Climate Change and Food Security: A Framework Document" indicates that climate change impacts on food production and other agricultural activities. The document also takes the view that impacts on the food production will affect food supply at the global and local level.

Roy *et al.* (2009) have conducted a study "Climate Change Disaster & Rural Poverty: Care for Coastal Bangladesh". From the study it is found that due to flood caused by tropical cyclone, sidr (2007) and Aila (2009) average income has dropped about 44% and debt increase 40% in the affected households. Majority (95%) of the farmers loss of about 23%

incomes during 2008-09 with respect to 2005, 2006. Because of decrease of agricultural income many 72% of the farmers have adapted additional occupations like day labor, rickshaw puller etc. The study also showed that still about 86% of the farmers mentioned that they are earning at least 10% less now-a-days overall of that they used to earn from only doing agriculture.

Akter and Tahera (2009) has conducted a study "Climate Change and Flow of Environmental Displacement in Bangladesh" depicts environmental displacement with the premise of increased frequency of natural disasters and adverse impacts of climate change. The research findings reveal that about 30% of the population (47 million) is displaced on average, from different natural calamities like floods, cyclones and droughts.

Howard et *al.* (2009) in their article "Securing 2020 Vision for 2030: Climate Change and Ensuring Resilience in the Water and Sanitation Services" assert about drinking water and sanitation services for human health, but their technology and management system are potentially vulnerable to climate change.

Leslie (2009) presents a article named "Advancing the Climate Change Agenda" depicts that climate change has negative impacts on social, economic, environment and other sectors of the world. The article assesses the estimated costs associated with climate change impacts for agriculture is GDP loss 220.5 million us dollars in 2007 and estimated 74.4 million dollars per annum up to 2080 at 2007 prices.

Choudhury (2010) in his writing "Save Bangladesh, Saves Humanity" reveals that it is true that global temperature is rising because of carbon dioxide emissions. There is increase in floods and cyclones and the glaciers are melting.

Siddique *et al.* (2010) have conducted a group of case studies titled "Climate Change & Community Adaptation" in different parts of Bangladesh. In this study they state that Bangladesh faces six key climate change related challenges: cyclones, floods, drought, riverbank and coastal erosion, erratic rainfall and saline intrusion into coastal farmland. It is pointed out that climate change is not causing anything new in Bangladesh, but the frequency and intensity of events is increasing.

Braunch (2010) has conducted a study "Climate Change Impacts: Securitization of Water, Food, Health, Energy and Mitigation" reveals the impact of climate change on various sectors in the environments such as human health, agriculture, biodiversity, flora and fauna, forestry, food security etc. The report further presents a chart that reveals the acute impacts of drought in some part of the world.

WB report on "Climate Change: Bangladesh Facing the Challenge" reveals that in Bangladesh climate change may affect many sectors, including water resources, agriculture, food security, ecosystems and biodiversity, human health and coastal zones.

CHAPTER 3

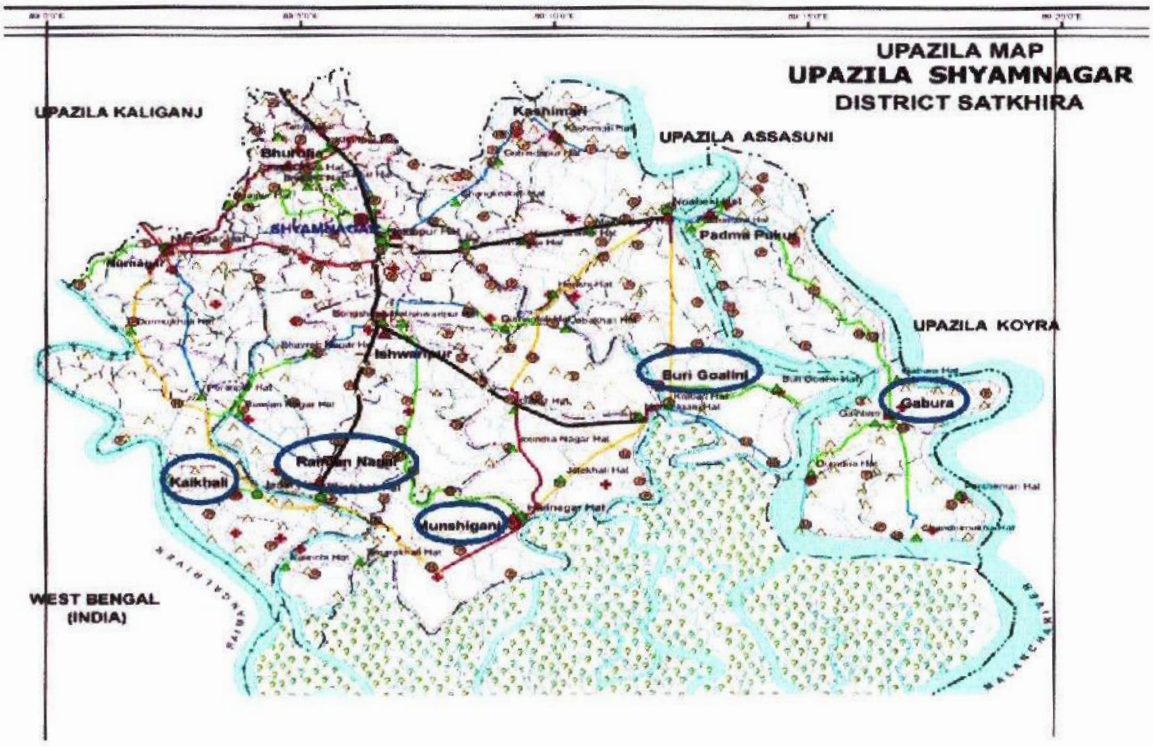
MATERIALS AND METHODS

3.1. Methodology

The study followed the triangulation method, i.e., the combination of quantitative and qualitative method. The quantitative analysis is an analysis of numerically coded data especially ordinal, interval and ratio data, often involving computation of statistical measures. Therefore qualitative tool (FGD) had been adopted to get the vivid and comprehensive picture of climate change in a holistic manner.

3.2 Study area

This study was conducted in five unions named Burigoalini, Gabura, Munshiganj, Ramjannagar and Koikhali stand Shyamnagar upazila, out of 12 unions of Shymnagar upazila those unions were selected randomly.



Map of the study area

3.3 Study period

The study was conducted from July - December 2013.

3.4 Target community

Vulnerable coastal community mainly emphasis to male and each female (age 20->80)

3.5 Sampling Size

The sample size of the study was 100. These 100 samples consist of male and female respondents of the selected areas. In the study male and female were given equal importance, because both of them are victim of climate change. The study conducted in male (72.0%) and female (28.0 %). The age structures of the respondents were 20-30 years (9.0%), 31-50 years (47.0%), 51-80 years (36%), >80 years (8.0%). Most of the respondents are muslim (76.0%) and hindu (24.0%). About 5 Focus Group Discussion (FGDs) were conducted in the particular areas.

3.6 Sampling procedure

The questionnaire was employed to the field and respondents were interacted through rapport building and were convinced for voluntarily providing the information. For this reasons different strategies was followed for 'ice breaking' and make close link with them. In doing this contact was made to the local leaders and young men to help convincing the people to collect data 20 questionnaire had been used each union. For 100 questionnaire survey 10 times field was conducted. Secondary information regarding climate change impacts over the last few years and adaptation measures that are being practiced will be collected from different GOs and NGOs, universities and research organizations.

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3.7 Study instruments

In the study scheduled interview of survey method had been taken. This method is probably the best method in social research as it easy to collect empirical data with limited time and money. However this method is useful to collect authentic data from lower educated people like the respondents of the study by asking scheduled questions and writing them from the respondents. So in the study interview scheduled survey method had been used.

3.8 Pre-test

In the research the pre-test was done from the respondents who were not part of study population. Five respondents were interviewed following the draft questionnaire from the affected area who became the victims of climate change induced disaster.

.3.9 Data processing and analysis

After finishing the data collection each of the questionnaires has been edited on regular basis. There were 37 questions in the questionnaire which have been coded after coming home from the setting site. Quantitative data was processed by using SPSS windows program (version 20.0) and Microsoft Excel 2010. Qualitative data have been gathered by Focus Group Discussions (FGDs), are analyzed manually and represent in descriptive mode.

CHAPTER 4

RESULTS

4.1 Quantitative method

4.1.1 Natural disaster seen by respondents last 30 years

Natural disaster is a common phenomenon in Bangladesh. Almost every year Bangladesh suffers highly by different kinds of disasters like cyclones, flood, drought, river erosion, salinity intrusion, earth quake etc. Natural disaster is the key factor of climate changed.

Table 4.1 Name of the natural disaster seen by respondents last 30 years

Disaster Name	No. of respondents	%
Cyclone	49	32.0
Flood	44	29.0
Drought	3	2.0
River erosion	4	3.0
Salinity intrusion	48	32.0
Earth quake	3	2.0

The 4.1 table showed that cyclone seen by 32% respondents, flood seen by 29% respondents, drought seen by 2% respondents, river erosion seen by 3% respondents, salinity intrusion seen by 32% respondents, earth quake seen by 3% respondents.

4.1.2 Status of changing occupation

People livelihood depends on their Occupation. Before natural disaster occupation was satisfactory. They have multiple sources of occupations and they have not become unemployment at that time. They earn much money to support their family and lead a very sustainable life. But after climate change their occupation was changed.

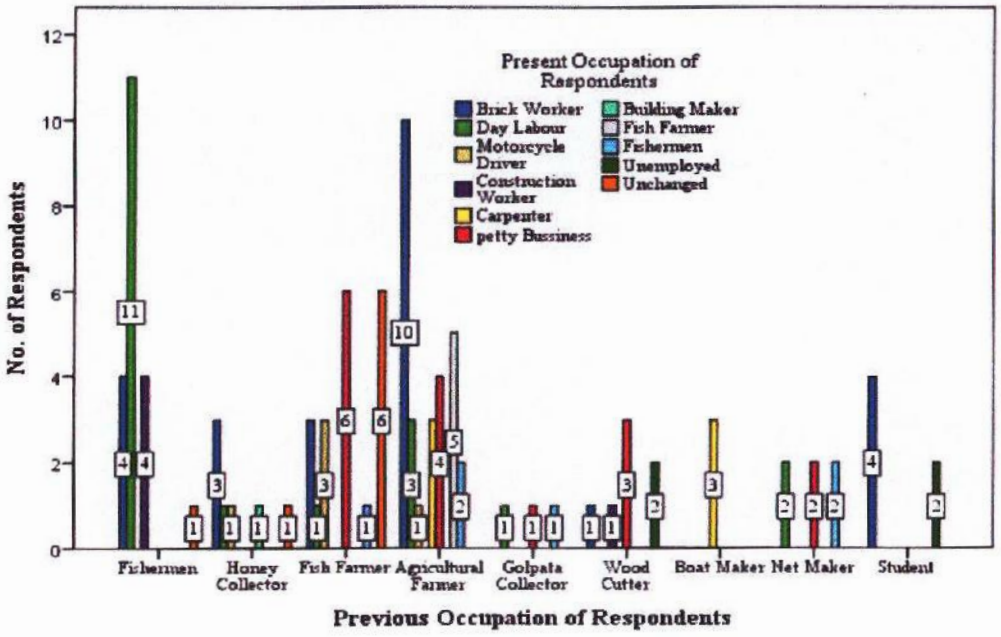

Fig. 4.1 Status of changing occupation

The 4.1 figure showed 19% fisherman changed their occupation where maximum 11% changed their occupation to day labor from fisherman, 1% did not change his occupation. 6% honey collector changed their occupation where maximum 3% changed their occupation to brick worker from honey collector, 1% did not change his occupation. 14% fish farmer changed their occupation where maximum 6% of them changed their occupation to petty businessman from fish farmer, 6% did not change his occupation. 28% agricultural farmer changed their occupation where maximum 10 of them changed their occupation to brick worker from agricultural farmer. 3% golpata collector changed their occupation where 1% converted to day labor, petty business man, fisherman from golpata collector respectively. 7% wood cutter changed their occupation where maximum 3 numbers converted to carpenter from boat maker. 6% net maker changed their occupation where maximum 2% changed their occupation day labor, petty business man, fisherman from net maker respectively. 6% student changed their occupation where maximum 4% changed their occupation where maximum 3 % converted to brick worker.

4.1.3 Year basis occupation change

The occupation changes depend on year. After natural disaster most of the respondents changed their occupation because natural disaster damages their working sources.

4.1.3.1 Occupation changing status (1980-1990)

The 4.2 figure showed that 2 agricultural farmers changed their occupation, The changing occupations were 1 day labor and 1 fish Farmer.1 golpata collector became day labor, 2 wood cutters changes his occupation became unemployed and 2 net maker changed their occupation became 2 patty business men.

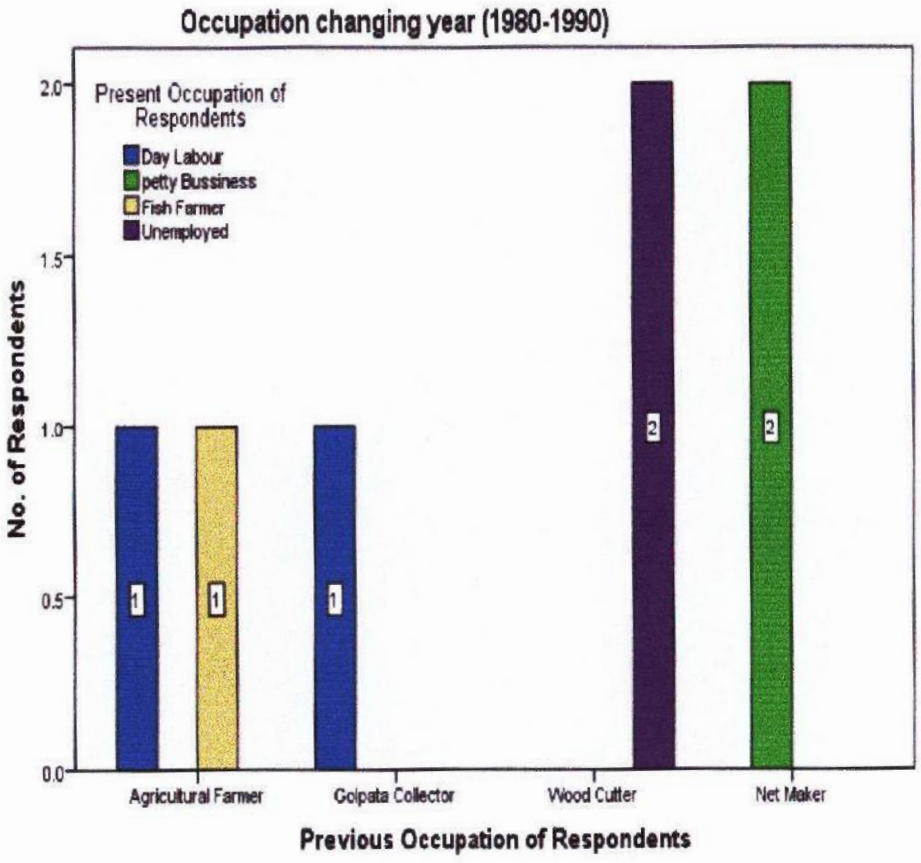

Fig. 4.2 Occupation changing status (1980-1990)

4.1.3.2 Occupation changing status (1991-2000)

The figure 4.3 showed 5 fishermen changed their occupation where maximum 3 numbers changed their occupation to brick worker from fisherman. 2 honey collectors changed their occupation to brick worker from honey collector, 4 fish farmer changed their occupation to petty businessman from fish farmer. 15 agricultural farmers changed their occupation where maximum 6 of them changed their occupation to brick worker from agricultural farmer.1 golpata collector changed their occupation converted to petty business man. 2 wood cutter changed their occupation where 1 number converted to carpenter and 1 number convert to construction worker from wood cutter respectively. 2 boat makers changed their occupation convert to fisherman. 2 net makers changed their occupation converted to day labor.

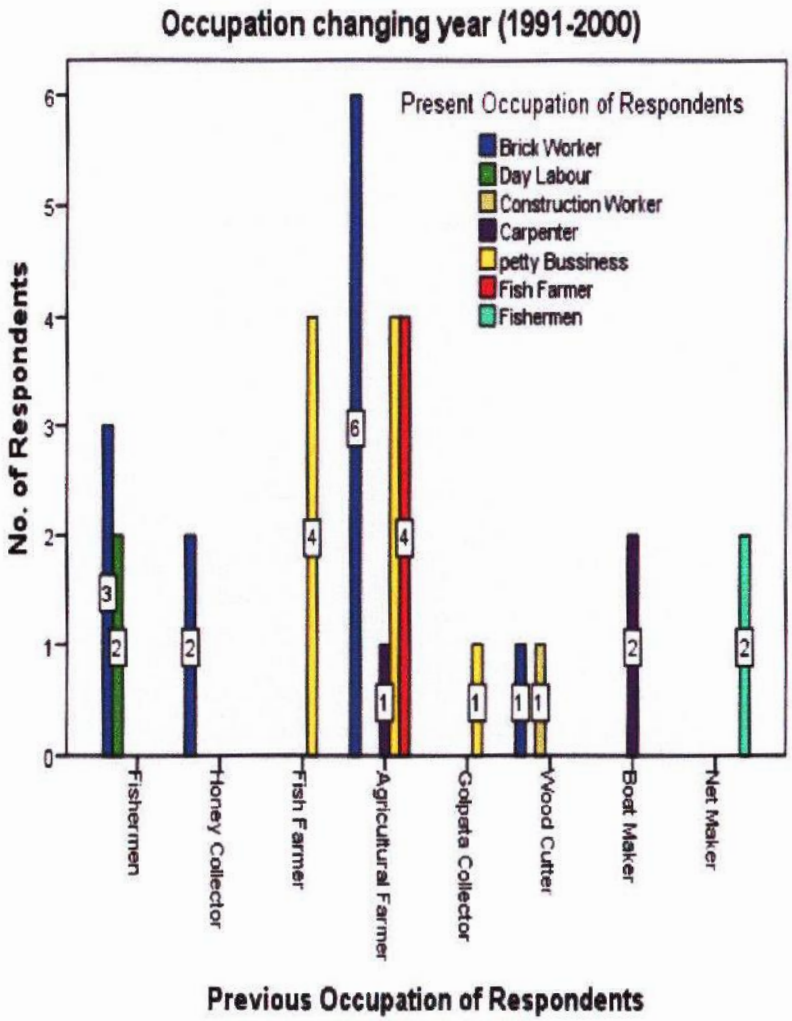

Fig. 4.3 Occupation changing status (1991-2000)

4.1.3.3 Occupation changing status (2001-2010)

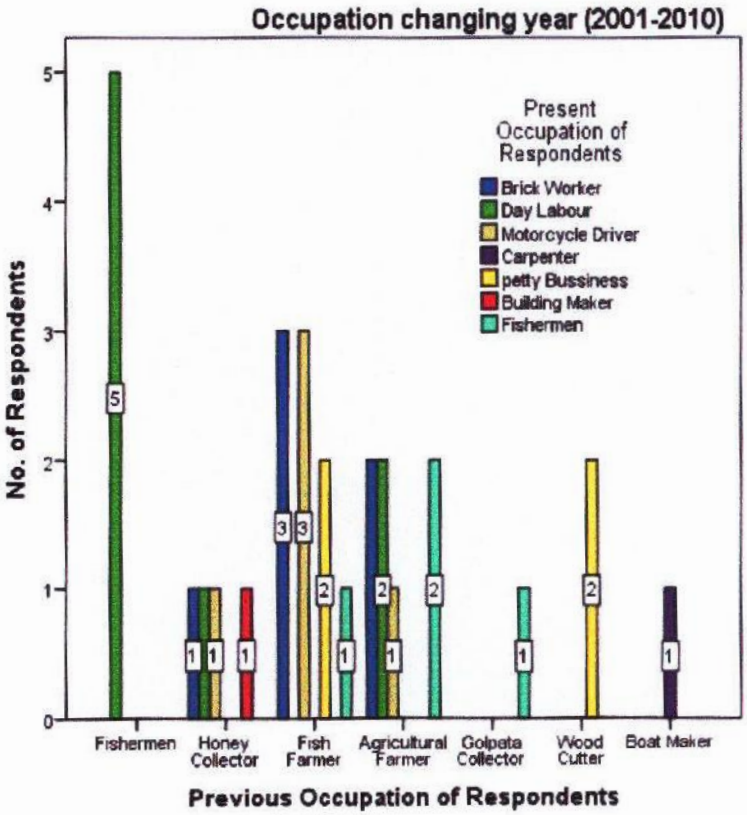

Fig. 4.4 Occupation changing status (2001-2010)

The figure 4.4 showed 5 fishermen changed their occupation to day labor from fisherman, 4 honey collectors changed their occupation where 1number changed their occupation to brick worker, day labor, motorcycle driver, building maker from honey collector respectively. 9 fish farmer changed their occupation where maximum 3 numbers changed their occupation to brick worker, petty businessman from fish farmer respectively. 7 agricultural farmers changed their occupation where maximum 2 numbers changed their occupation to brick worker, day labor, fisherman from agricultural farmer respectively. 1 golpata collertor changed their occupation to fisherman. 2 wood cutters changed their occupation to carpenter from boat maker. 1 boat maker changed their occupation to carpenter.

4.1.3.4 Occupation changing status (2011-recent)

The figure 4.5 showed 9 fishermen changed their occupation where maximum 4 numbers changed their occupation to day labor, construction worker from fisherman respectively. 1 fish farmer changed their occupation to day labor. 4 agricultural farmers changed their occupation where maximum 2 numbers changed their occupation to brick worker, carpenter from agricultural farmer. 1 wood Cutter changed their occupation to petty businessman. 2 net makers changed their occupation to day labor. 6 students changed their occupation where maximum 4 numbers converted to brick worker.

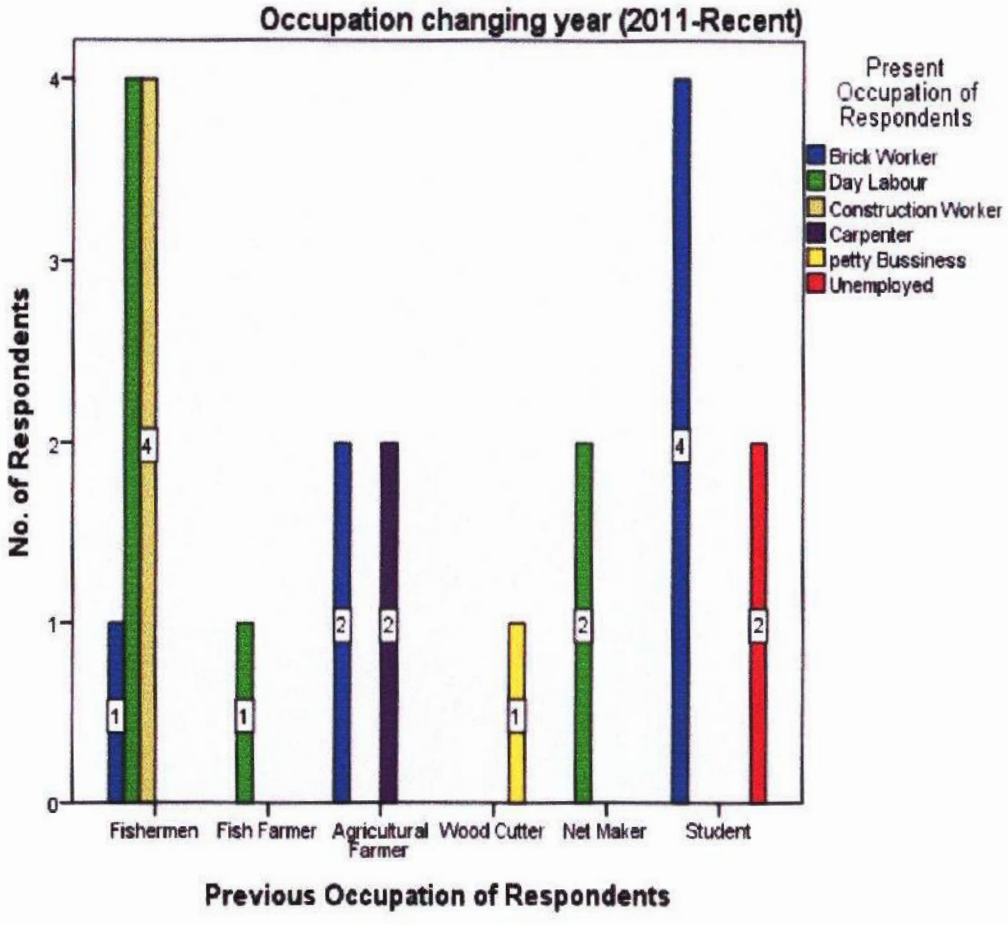

Fig. 4.5 Occupation changing status (2011-recent)

4.1.4. Monthly income

The socio-economic condition of a man is understood by his income. The income mostly depends on their occupation. Monthly income expressed in taka.

Table 4.4 Status of monthly income

Income(Tk.) /month	No. of respondent	%
<3000	35	35.0
3001-5000	40	40.0
5001-7000	11	11.0
7001-9000	14	14.0
Total	100	100.0

The table 4.4 showed that 35.0% respondents earned less than 3000 taka, 40.0% respondents earned 3001-5000, 11.0% respondents earned 5001-7000 taka, and 14.0% respondents earned 7001-9000 taka.

4.1.5 Media of disaster forecasting

To know something media is best. The best media can easily transfer news. The people were known disaster forecasting by radio- television, mike, NGO, Go, newspaper, relatives etc.

Table 4.5 Media of disaster forecasting

Media	No. of respondent	%
Radio-Television	33	33.0
Mike	12	12.0
NGO	28	28.0
GO	4	4.0
Newspaper	22	22.0
Relatives	1	1.0
Total	100	100.0

The table 4.5 showed 33.0% respondents known disaster forecasting by radio-television, 12.0% respondents by mike, 28.0% by NGO, 4.0% respondents by GO, 22.0% respondents by newspaper and 1.0 % by their relatives.

4.1.6 Preparation for disaster

There is no available secure place, so during natural disaster they face numerous problems, especially women, child, disables and elderly people. For escaping natural disaster people do some pre-climatic activities.

Table 4.6 Preparation for disaster

Activities	No. of respondent	%
Cyclone shelter	27	27.0
keep dry food	45	45.0
Keep livestock in high place	14	13.3
Take with valuable things	14	14.0
Total	100	100.0

The table 4.6 showed that 27.0% respondents go to cyclone shelter, 45.0% respondents keep dry food, 13.3% respondents keep livestock in high place, and 14.0% respondents take with valuable things to prepare for knowing signal of disaster.

4.1.7 Severe disaster

The disaster causes much damage which disaster called dangerous disaster. According to respondents opinion cyclone and flood was severe disaster.

Table 4.7 Name of the severe disaster

Disaster name	No. of respondent	%
Cyclone	74	74.0
Flood	26	26.0
Total	100	100.0

The table 4.7 showed that cyclone & flood was very severe natural disaster.74.0% respondents said cyclone and 26.0% respondents said flood was very severe.

4.1.8 Approximate year of disaster occurrence

The disaster occurred in any time. Disaster occurring time are kept in mind his approximate year. 40.0% respondent said natural disaster occurred within 1-5 years, 6.0% respondent said natural disaster occurred within 6-10 years, 13.0% respondent said natural disaster occurred within 11-15 years, 13.0% respondent said natural disaster occurred within 16-20 years, 28.0% respondent said natural disaster occurred within 21-25 years showed in Table 4.8.

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Table 4.8 Approximate year of disaster occurrence

Year	No. of respondent	%
1-5 year	40	40.0
6-10 year	6	6.0
11-15 year	13	13.0
16-20 year	13	13.0
21-25 year	28	28.0
Total	100	100.0

4.1.9 Definite year of disaster occurrence

The occurrence time disaster is definite. According to respondents natural disaster were occurred in 1988, 1996,1998,2007,2009. 26.0% respondents said natural disaster occurred in 1988 year, 15.0% respondents said natural disaster occurred in 1996 year, 11.0% respondents said natural disaster occurred in 1998 year, 6.0% respondents said natural disaster occurred in 2007 year, 42.0% respondents said natural disaster occurred in 2009 year showed in table 4.9.

Table 4.9 Definite year of disaster occurrence

Year	No. of respondent	%
1988	26	26.0
1996	15	15.0
1998	11	11.0
2007	6	6.0
2009	42	42.0
Total	100	100.0

4.1.10. Types of damages

Natural disaster damage house, crop, fish and causes death of man and animal.52.0 % respondents said natural disaster damage their house and domestic animals were died, 20.0% respondents said natural disaster damage their crop, 28.0% respondents said natural disaster damage their fish farm showed in Table 4.10.

Table 4.10 Types of damages

Damage	No. of respondent	%
House damage & domestic animal died	52	52.0
crop damage	20	20.0
Fisheries damage	28	28.0
Total	100	100.0

4.1.11 Damages of houses

The total respondents were 100 among them 9 respondents said partial damage and 65 respondents said full damage of house caused by cyclone, 17 respondents said partial damage and 9 respondents said full damage of houses caused by flood showed in table 4.11.

Table 4.11 Damages of houses

Severe disaster	Condition of house damage		Total
	Partial damage	Full damage	
Cyclone	9	65	74
Flood	17	9	26
Total	26	74	100

4.1.12 Man mortality

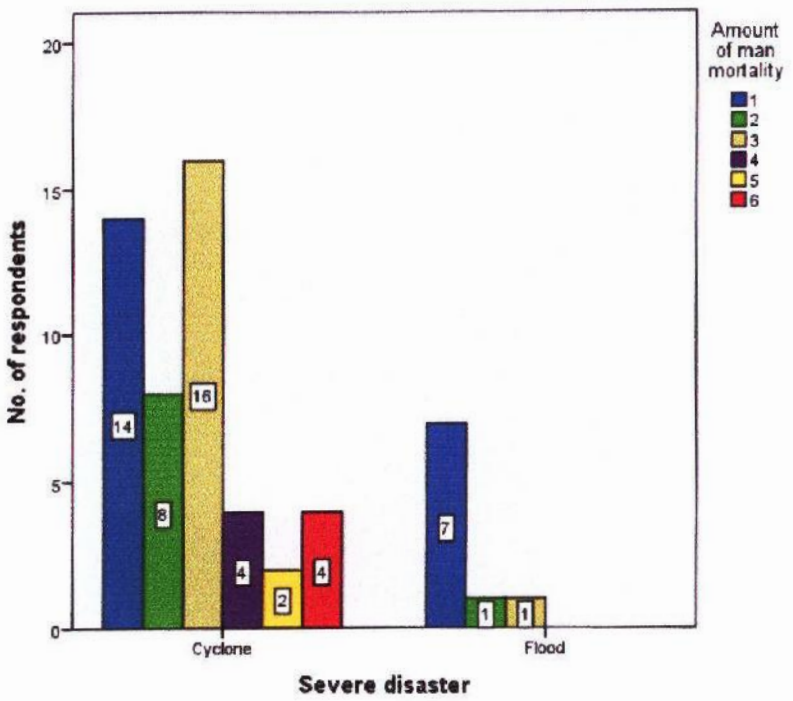

Fig. 4.6 Man mortality due to severe disaster

The figure 4.6 showed that the total respondents were 100, among them maximum 16 respondents said that 3 family member died by cyclone. Similarly maximum 7 respondents said that 1 family member died by flood.

4.1.13 Mortality of domestic animal

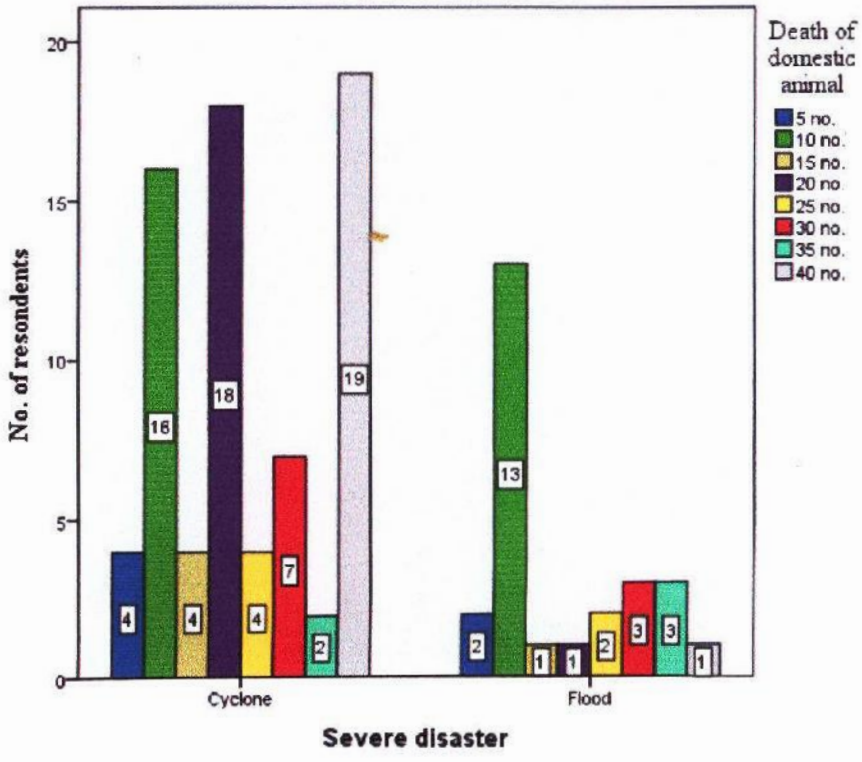

Fig. 4.7 Death of domestic animal due to severe disaster

The figure 4.7 showed that the total respondents were 100, among them maximum 19 respondents said that 40 domestic animal died by cyclone. Maximum 13 respondents said that 10 domestic animal died by flood.

4.1.14 Damage of crop

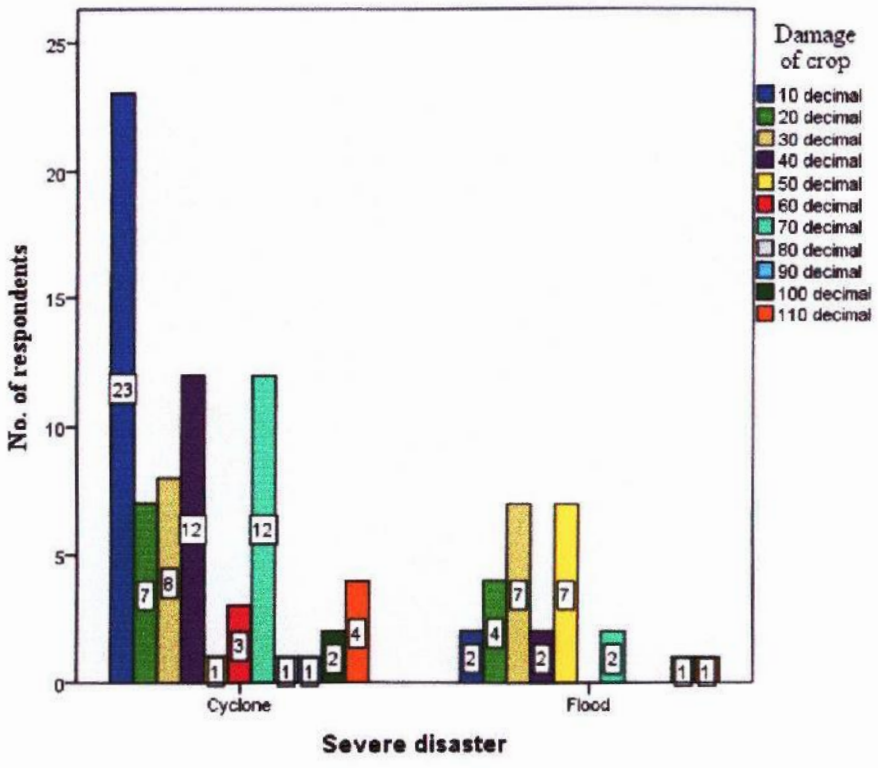

Fig. 4.8 Damage of crop due to severe disaster

The figure 4.8 showed that the total respondents were 100, among them maximum 23 respondents said that 10 decimal crop lands were damaged by cyclone. 7 respondents said that 30 & 50 decimal crop lands were damaged by flood.

4.1.15 Damage of fish farm

The figure 4.9 showed that the total respondents were 100 among them maximum 27 respondents said those 10 decimal fish farms were damaged by cyclone. Maximum 7 respondents said those 20 decimal fish farms were damaged by flood.

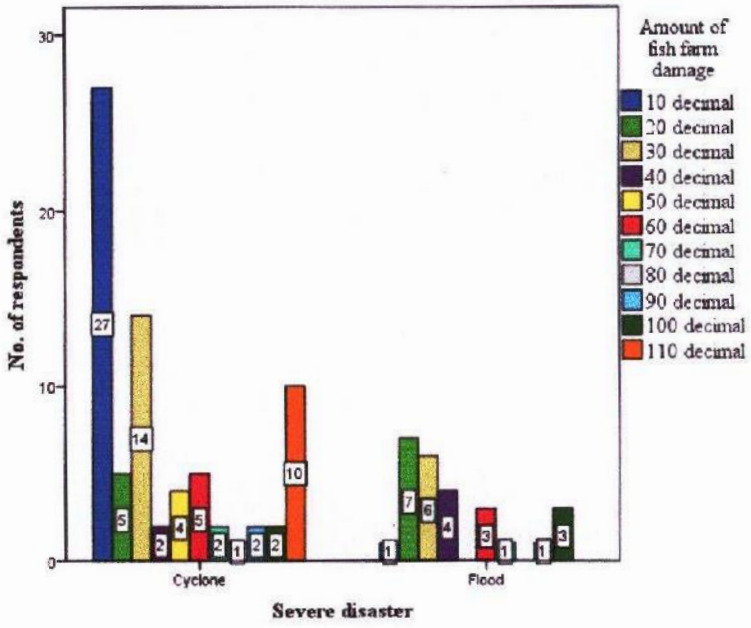

Fig. 4.9 Damage of fish farm due to severe disaster

4.1.16 Disease suffered by respondents family member

The figure 4.10 showed that Maximum 30 respondent's family member suffered from diarrhea due to cyclone. Maximum 10 respondents' family member suffered from diarrhea due to flood.

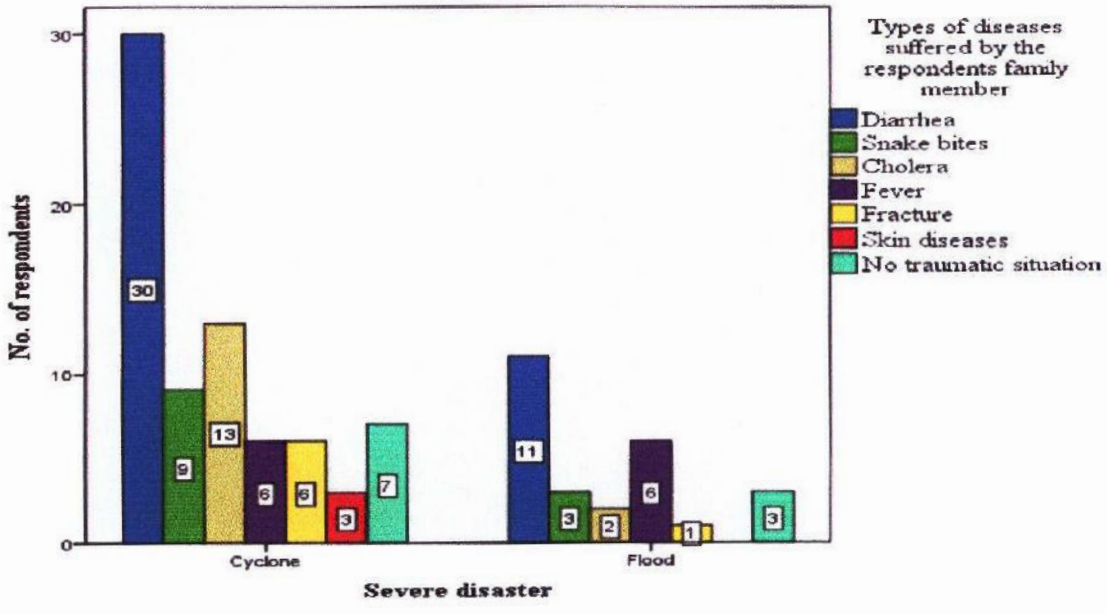

Fig. 4.10 Disease suffered by respondent's family member due to severe disaster

4.1.17 Condition of resources before climate change

Before climate changed the fish, crab, shrimp, paddy, fruits, live stocks were plenty. 35.0% respondent said plenty of fish crab and shrimp before climate change, 30% respondent said plenty of paddy & fruits before climate change, 35.0% respondent said plenty of livestock before climate change showed in table 4.17

Table 4.17 Condition of resources before climate change

Resources	No. of respondent	%
Plenty of fish, crab & shrimp	35	35.0
Plenty of paddy & fruits	30	30.0
Plenty of live stock	35	35.0
Total	100	100.0

4.1.18 Condition of resources after climate change

Due to climate changed natural resource were scared. 22.0% respondent said scarcity of fish crab and shrimp after climate change, 27.0% respondent said scarcity of paddy & fruits after climate change, 51.0% respondent said scarcity plenty of livestock after climate change showed in table 4.18.

Table 4.18 Condition of resources after climate change

Resources	No. of respondent	%
Scarcity of fish, crab & shrimp	22	22.0
scarcity of paddy & fruit	74	27.0
scarcity of livestock	51	51.0
Total	100	100.0

4.1.19 Status of income

The economic condition of man is known by their income. 11.0% respondents said income was increasing, 78.0% respondents said income was decreased and 11.0 % respondents said income remain unchanged showed in table 4.19.

Table 4.19 Status of income

Parameter	No. of respondent	%
Increase	11	11.0
Decrease	78	78.0
Unchanged	11	11.0
Total	100	100.0

4.1.20 Change of land use pattern

Land is the vital factor for all kind of production. So appropriate land use can changed the economy of a country.

Table 4.20 Change of land use pattern

Parameter	No. of respondent	%
Road construction	31	31.0
House made	44	44.0
Gher	25	25.0
Total	100	100.0

The table 4.20 showed that 31.0% respondents said that land was used as road construction, 44.0 % respondents said that land was used as house made, 25.0 % respondents said that land was used as gher.

4.1.21 Social forestation

After natural disaster people try to plant various types' plant like fruit & wooden tree.

Table 4.21 Types of social forestation

Types of forestation	No. of respondent	%
Fruit tree	39	39.0
wooden tree	61	61.0
Total	100	100.0

The table 4.21 showed that fruit tree was planted by 39.0 % respondents and wooden tree was planted by 61.0% respondent after climate change. They also try to cultivate many fruit trees like mango, guava, jack fruits etc. and some wooden tree like babla, shisu, segun, kaora, goran, bain, eukaliptus etc also planted.

4.1.22 Status of water body

Due to climate change the water current is reduced, causes scarcity of fish, deposition of silt on river bank.

Table 4.22 Status of water body

Parameter	No. of respondent	%
Reduce current	26	26.0
Scarcity of fish	38	38.0
Silt	36	36.0
Total	100	100.0

The table 4.22 showed that 26.0% said reduce current, 38.0% said scarcity of fish and 36.0% said that silt accumulation in water body.

4.1.23 Effect of climate change in agriculture

The crop production was damaged by the frequent natural disaster. So they faced challenge of agricultural productivity in the present situation.

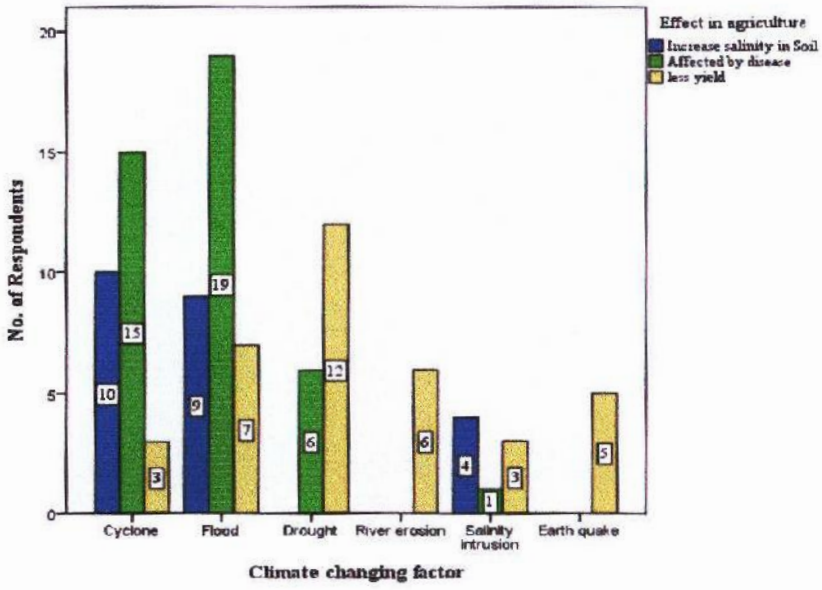

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Fig 4.11 Effect of climate change in agriculture

The figure 4.11 showed that the total respondents were 100 among them, Maximum 16 respondents said crop affected by disease due to cyclone, Maximum 19 respondents said crop affected by disease due to flood. Maximum 12 respondents said less production of crop due to drought. 6 respondents said less of crop due to drought. 6 respondents said less crop production due to river erosion, Maximum 4 respondent said crop affected by disease due to salinity intrusion. 5 respondents said less crop production due to earth quake.

4.1.24 Effect of climate change in fisheries

Fish farm was damaged by the frequent natural disaster. So they faced challenge of fish production in the present situation.

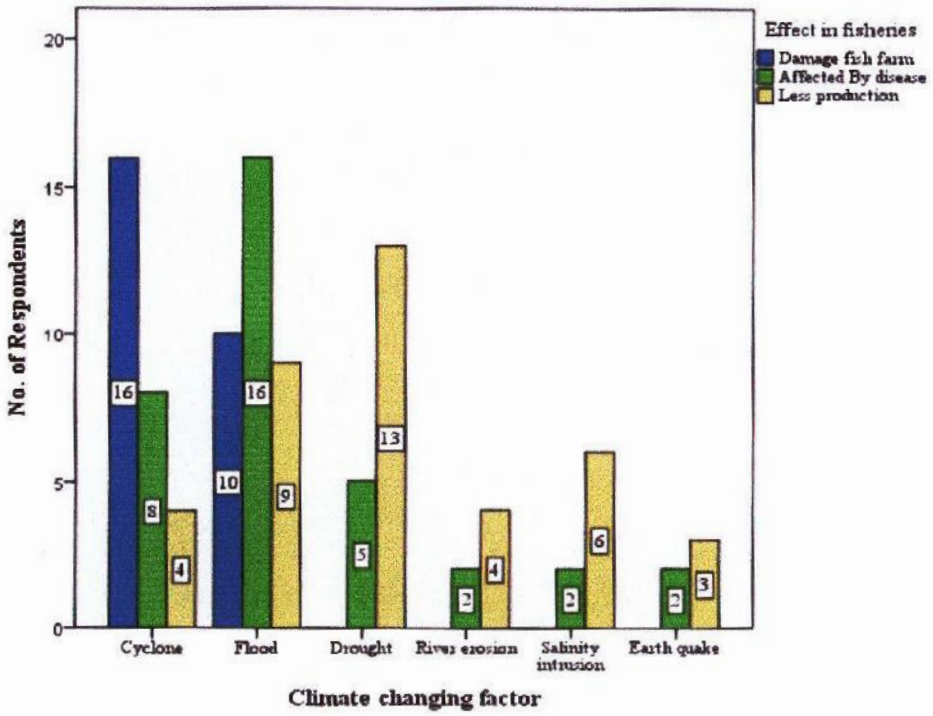

Fig.4.12 Effect of climate change in fisheries

The figure 4.12 showed that the total respondents were 100 among them, Maximum 16 respondents said damage fish farm due to cyclone, Maximum 16 respondents said Fish affected by disease due to flood. Maximum 13 respondents said less production of fish due to drought. Maximum 4 respondents said less production of fish due to river erosion. 6 respondents said less fish production due to salinity intrusion. Maximum 5 respondents said less fish production due to earth quake.

4.1.25 Effect of climate change in livestock

The livestock washed away or damaged during natural disaster. As a result the livestock is decreased day by day.

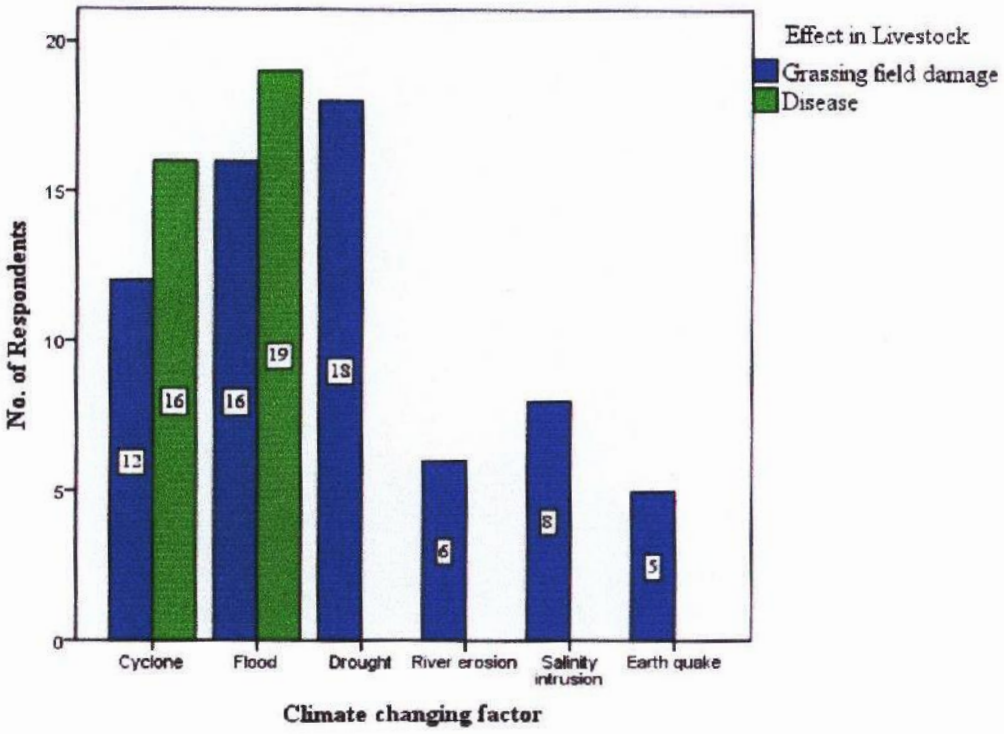

Fig. 4.13 Effect of climate change in livestock

The figure 4.13 showed that the total respondents were 100 among them maximum 16 respondents said grassing field damage due to cyclone. Maximum 19 respondents said livestock affected by disease due to flood. Maximum 18 respondents said livestock affected by disease due to drought. Maximum 6 respondents said grassing field damage due to river erosion. 8 respondents said grassing field damage due to salinity intrusion. Maximum 5 respondents said grassing field damage due to earth quake.

4.1.26 Damage due to salinity intrusion

Due to salinity intrusion damaged of cultivated land, fresh water fish, water source.

Table 4.26 Damage due to salinity intrusion

Parameter	No. of respondent	%
Damage of cultivated land	33	33.0
Damage of freshwater fish	35	35.0
Damage of water source	32	32.0
Total	100	100.0

The table 4.26 showed that 33.0% respondent said cultivated land was damaged, 35.0% respondents said freshwater fish damage and 32.0% respondents said water source damage as salinity intrusion.

4.1.27 Source of drinking water before climate change

The sources of drinking water before the climate change, 74.0% respondents drink pond water, 26.0% drink rain water showed in table 4.27.

Table 4.27 Source of drinking water before climate change

Source of water	No. of respondent	%
Pond water	74	74.0
Rain water	26	26.0
Total	100	100.0

4.1.28 Source of drinking water after climate change

The sources of drinking water after the climate change, 20.0% respondents drink pond water, 40.0% drink pond sand filter water, 14.0% drink tube well water and 26.0% drink rain water. After the cyclone Aila pond water turn into saline water as a result they faces a great problem for drinking water showed in table 4.28.

Table 4.28 Source of drinking water after climate change

Water source	No. of respondent	%
Pond water	20	20.0
Pond sand filter	40	40.0
Tube well water	14	14.0
Rain water	26	26.0
Total	100	100.0

4.1.29 Coping measure of the coastal community

In disaster management, coping means the trends and techniques where people gain their expected results by using their property. It is very much related with capacity. Strategies can be defined as a set of activities or mechanism by which people try to survive in disasters, recover their situation and develop their conditions after disaster.

4.1.29.1 Adaptation of local people

Adaptation to climate is the process through which people reduce the adverse effects of climate on their health and well-being, and take advantage of opportunities that their climate environment provides.

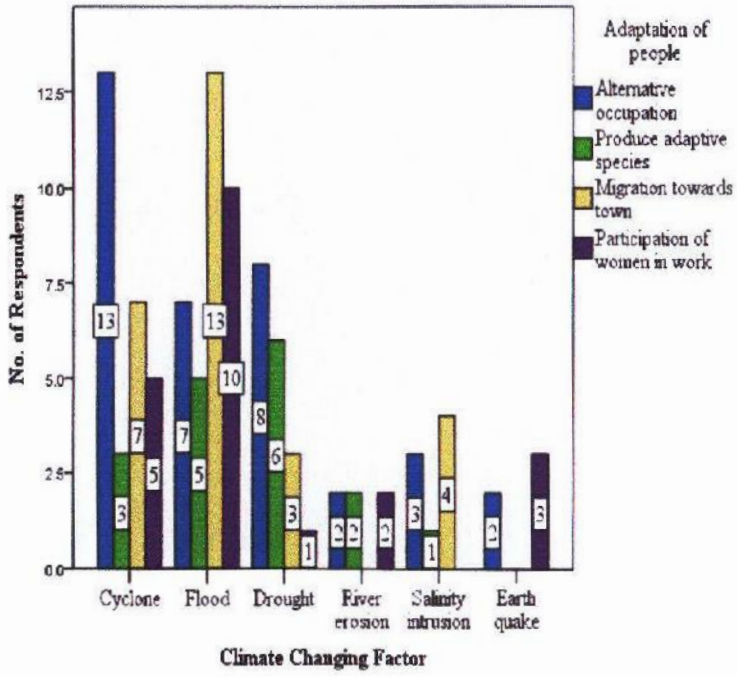

Fig.4.14 Adaptation of local people against climate change

The figure 4.14 showed that the total respondents were 100. 28 Respondents adapted against cyclone among them maximum 13 respondents adopted by taking alternative occupation, 35 respondents adapted against flood among them maximum 13 respondents adopted migrating towards town, 18 respondents adapted against drought among them maximum 8 respondents by taking alternative occupation. 6 respondents adapted against river erosion among them maximum 2, 2, 2 respondents adopted by taking alternative occupation, Producing adaptive species, participation of women in work respectively. 8 Respondents adapted against Salinity intrusion among them maximum 4 respondents adopted migrating towards town. 5 Respondents adapted against Earth quake among them maximum 3 respondents adopted participation of women in work. From 100 respondents 35 numbers were adapted by alternative occupation, respondents17 numbers were adapted by producing adaptive species, 30 numbers migrated towards town 21 numbers women participated in works.

4.1.29.2 Adaptation by GO and NGOs

For climatic adaptation GO & NGOs play a vital role. They help various ways of disaster affected people.

4.1.29.2.1 Institutional help

70.0% respondents were helped by different institutions and 30.0% said that no help by institutions showed in table 4.30.

Table 4.30 Institutional help

Help	No. of respondent	%
Yes	70	70.0
No	30	30.0
Total	100	100.0

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4.1.29.2.2 Types of organization

The table 4.31 showed that Govt. help is said by 48.6% respondents and NGOs help is said by 51.4 % respondents.

Table 4.31 Types of organization

Organization	No. of respondent	%
GO	34	48.6
NGOs	36	51.4

4.1.29.2.3 Types of Institutional help

38.6% respondents got economical help, 41.4% respondents got relief and 30.0% respondents got training showed in table 4.32.

Table 4.32 Types of help

Types of help	No. of respondent	%
Economical	20	38.6
Relief	29	41.4
Training	21	30.0
Total	70	100.0

4.2. Qualitative method

4.2.1 Focus Group Discussion (FGD)

FGD in Gabura	FGD in Burigoalini	FGD in Koikhali	FGD in Munshigang	FGD in Ramjannagor
Income condition and occupation were satisfactory before natural disaster	Income condition and occupation were satisfactory before natural disaster	Income condition and occupation were satisfactory before natural disaster	Income condition and occupation were satisfactory before natural disaster	Income condition and occupation were satisfactory before natural disaster
After natural disaster they have become unemployment	After natural disaster they have become unemployment	After natural disaster they have become unemployment	After natural disaster they have become unemployment	After natural disaster they have become unemployment
The scarcity of pure drinking water	The scarcity of pure drinking water	The scarcity of pure drinking water	The scarcity of pure drinking water	The scarcity of pure drinking water

They have homestead land but have no constructed house	They have homestead land but have no constructed house	They have homestead land but have no constructed house	They have homestead land but have no constructed house	They have homestead land but have no constructed house
They had faced strong challenges of agricultural productivity	They have faced strong challenges of agricultural productivity	They have faced strong challenges of agricultural productivity	They have faced strong challenges of agricultural productivity	They have faced strong challenges of agricultural productivity
They had livestock before natural disaster but now they had no livestock	They had livestock before natural disaster but now they had no livestock	They had livestock before natural disaster but now they had no livestock	They had livestock before natural disaster but now they had no livestock	They had livestock before natural disaster but now they had no livestock
They had gher (shrimp farm) but natural disaster washed away all the prawn and other fish from the gher.	They had gher (shrimp farm) but natural disaster washed away all the prawn and other fish from the gher.	They had gher (shrimp farm) but natural disaster washed away all the prawn and other fish from the gher.	They had gher (shrimp farm) but natural disaster washed away all the prawn and other fish from the gher.	They had gher (shrimp farm) but natural disaster washed away all the prawn and other fish from the gher.
Their house was made of wood with goal pata roof.	Their house was made of wood with goal pata roof.	Their house was made of wood with goal pata roof.	Their house was made of wood with goal pata roof.	Their house was made of wood with goal pata roof.
There were not sufficient cyclone centers or secure places in their locality	There were not sufficient cyclone centers or secure places in their locality	There were not sufficient cyclone centers or secure places in their locality	There were not sufficient cyclone centers or secure places in their locality	There were not sufficient cyclone centers or secure places in their locality

No early warning system to aware the people about the natural disaster	No early warning system to aware the people about the natural disaster	No early warning system to aware the people about the natural disaster	No early warning system to aware the people about the natural disaster	No early warning system to aware the people about the natural disaster
Severe food security occurred	Severe food security occurred			
Suffered from diseases due to natural disaster	suffering from diseases due to natural disaster	suffering from diseases due to natural disaster		
There are no medical centers, hospital in the locality	There are no medical centers, hospital in the locality	There are no medical centers, hospital in the locality	There are no medical centers, hospital in the locality	There are no medical centers, hospital in the locality
Response to climate change	Response to climate change	Response to climate change	Response to climate change	Response to climate change

CHAPTER 5

DISCUSSION

5.1. Nature of disaster

The major focus of this study was to identify climate change hazards in the study area and ongoing adaptation measures and their response to cope with climate change impacts. During the last few decades, the country became highly vulnerable to almost all types of climate hazards i.e. floods, cyclones, droughts, river erosion, salinity intrusion, earth quake etc. cyclone and salinity intrusion was seen by maximum 32% respondents and flood was seen by 29% respondents. Siddique *et al.* (2010) state that Bangladesh faces six key climate change related challenges: cyclones, floods, drought, riverbank and coastal erosion, erratic rainfall and saline intrusion into coastal farmland. It is pointed out that climate change is not causing anything new in Bangladesh, but the frequency and intensity of events is increasing.

5.2 Condition of income

It is unfortunate but true that most of the people of the selected area can't afford their daily foods properly as 35.0% respondents said their family income less than 3000 taka, 40.0% respondent's family income within 3001-5000, 11.0% respondent's family income within 5001-7000 taka, and 14.0% respondent's family income within 7001-9000 taka. But some month their income decrease. So many of them have to eat less or starve, especially in disaster periods. Most of the respondents said that before aila and sidr their income were well but these devastating disasters have destroyed their working sources and decrease their income. 78.0% respondents said income was decreased. The present research findings were more or less similar to the findings of Roy *et al.*, (2009). Roy *et al.* (2009) was found that due to flood caused by tropical cyclone, sidr (2007) and aila (2009) average income has dropped about 44% and debt increase 40% in the affected households.

5.3 Severe disaster and their effect on housing condition, man mortality, death of domestic animal, agricultural, fisheries and people disease

Cyclone & flood was very danger natural disaster.74.0% respondents said cyclone and 26.0% respondents said flood was very dangerous. The most devastating natural disasters affecting Bangladesh in recent history are the cyclones of 1988, 1991, 1997, 1998, 2007, 2009. Maximum 42.0% respondents said natural disaster occurred in 2009 year. Almost all of them had own houses but many of that destroyed in the disasters. Maximum 65 respondents said full damage of house caused by cyclone. Maximum 16 respondents said that 3 family member died due to climate changed. People had livestock before natural disaster but now they had no livestock as most of the livestock washed away or damaged during natural disaster. Maximum 19 respondents said that 40 domestic animal died by cyclone. Severe disaster destroyed the Crop productivity. Maximum 23 respondents said that 10 decimal crop lands were damaged by cyclone. 7 respondents said that 30 & 50 decimal crop lands were damaged by flood. Fish farm was damaged by the dangerous natural disaster. Maximum 27 respondents said those 10 decimal fish farms were damaged by cyclone. Maximum 7 respondents said those 20 decimal fish farms were damaged by flood. People suffered from various diseases like diarrhea, cholera, fever, skin diseases etc. due to climate changed. There were no medical centers, hospital in the locality 30 respondent's family member suffered from diarrhea due to climate changed. The present research findings were more or less similar to the findings of Karim and Nehal (2002). Karim and Nehal (2002) present that Bangladesh is one of the most natural disaster prone country over the last 30 years. The paper refers some devastating natural disasters such as cyclone of 1991 and 1996 and floods of 1987, 1988, and 1998 that severely affected the people of Bangladesh.

5.4 Condition of resources before and after climate change

Before climate changed the fish, crab, shrimp, paddy, fruits, live stocks were plenty. 35.0% respondent said plenty of fish crab & shrimp before climate change, 30% respondent said plenty of paddy & fruits before climate change, 35.0% respondent said plenty of livestock before climate change. But due to climate changed those resource were scared. 22.0% respondent said scarcity of fish crab & shrimp after climate change, 27.0% respondent said scarcity of paddy & fruits after climate change, 51.0 % respondent said scarcity of livestock after climate change. UNDP *et al.* (2002) assert that climate related disasters have adversely

affected the economy, public health, food security, agriculture, water resources and bio-diversity in Bangladesh.

5.5 Effect of climate change in agricultural, fisheries and livestock

Respondents had faced strong challenges of agricultural productivity in the caused that agricultural land is inundated by salinity water and excessive heat and drought damage this agricultural productivity to a great extent. Otherwise this crops production was damaged by the frequent natural disaster. So they faced challenge of agricultural productivity in the present situation maximum 16 respondents said Crop affected by disease due to cyclone, maximum 19 respondents said crop affected by disease due to flood. Maximum 12 respondents said less production of crop due to drought. 6 respondents said less of crop due to drought. 6 respondents said less crop production due to river erosion, maximum 4 respondent said crop affected by disease due to salinity intrusion. 5 respondents said less crop production due to earth quake.

Fish farm was damaged by the frequent natural disaster. So they faced challenge of fish production in the present situation maximum 16 respondents said damage fish farm due to cyclone, maximum 16 respondents said fish affected by disease due to flood. Maximum 13 respondents said less production of fish due to drought. Maximum 4 respondents said less production of fish due to river erosion. 6 respondents said less fish production due to salinity intrusion. Maximum 5 respondents said less fish production due to earth quake.

The livestock washed away or damaged during natural disaster. As a result the livestock is decreased day by day. The total respondents were 100 among them maximum 16 respondents said grassing field damage due to cyclone. Maximum 19 respondents said livestock affected by disease due to flood. Maximum 18 respondents said livestock affected by disease due to drought. Maximum 6 respondents said grassing field damage due to river erosion. 8 respondents said grassing field damage due to salinity intrusion. Maximum 5 respondents said grassing field damage due to earth quake. The present situation of environments is not favorable for cultivating livestock as there are severe scarcity of fodder or animals food. Some of them said that they grow paddy few years ago, so they provide rice husk as animal food to their cattle but now they can't do that because they can't produce paddy in their field. Ahmed *et al.* (1994) claimed that climate change and sea level rise could possibly have profound effects on Bangladesh her water, agriculture, forestry, fisheries and livestock resources.

5.6 Adaptation of local people against Climate change

It is visible that from 100 respondents 35 numbers were adapted by alternative occupation like brick worker, industrial worker, grosser, rickshaw puller, day labor, fish farmer etc. as well as some depend on few particular seasonal works. From 100 respondents17 numbers were adapted by producing adaptive species. In case of agriculture, in past BR-3, BR-4, BR-5,BR-7, kalvuriy, bresail, dulavock, progoti etc. rice cultivated but now s They were trying to introduce saline tolerable crops in their locality named BR-28, BR-29 ,BR-36, BR-45, BR-47, BR-50, BR-55, BR-58, BR-59, BR-60, BR-61, Brehibred-2, Brehibred-3. There were found various kinds of fish such as ken fish, vetki. prawn, paira, chacckle, verimurlac, chapra, vangle, peso, khaira, vola, laubor,slip, kaskill,totuki etc but climate change it amount has decreased and some of the species has extinct forever. There noticed a major change in fish farming. Most of the species of Fresh water fish like rui, katla, mrigal, kalibaush, shol, taki, rui, catla, koi, boal, veda, punti, mrigal, darkina, were not found in the local area. The native species are lost day by day. Now shrimp, tilapia, koral, thai koi, pangus were trying cultivated. For climatic adaptation people migrated towards town for searching new job like brick worker, construction worker, garments worker etc. In some family women are engaged in work to increase their family income. From 100 respondents 30 numbers migrated towards town. For climatic adaptation women have participated in various works like day labor, brick worker, garments worker etc. From 100 respondents 21 numbers women participated in works. Roy *et al.* (2009) showed that decrease of agricultural income many 72% of the farmers have adapted additional occupations like day labor, rickshaw puller etc. Akter and Tahera (2009) reveal that about 30% of the population (47 million) is displaced on average, from different natural calamities like floods, cyclones and droughts.

CHAPTER 6

RECOMMENDATIONS AND CONCLUSION

6.1 Recommendations

Adaptation and minimization of climate change are already urgent priority for Bangladesh as being one of the poorest and most vulnerable countries. Reducing the risks posed by climate change to people's lives and livelihoods and to national development processes. Bangladeshi people as well as the study area people can reduce vulnerability and bring sustainable livelihoods of the coastal community if sustainable development and other goals address integrate climate risks. For decreased climate change hazards following recommendation should be flowed.

1. Reduction of climate change hazards through coastal afforestation with community participation.

2. Providing drinking water to coastal communities to combat enhanced salinity due to sea level rise.

3. Capacity building for integrating climate change in planning, designing of infrastructure, conflict management and land water zoning for water management institutions.

4. Climate change and adaptation information dissemination to vulnerable community for emergency preparedness measures and awareness raising on enhanced climatic disasters.

5. Construction of cyclone shelter, and information and assistance center to cope with enhanced recurrent floods in major floodplains.

6. Mainstreaming adaptation to climate change into policies and programs in different sectors (focusing on disaster management, water, agriculture, health and industry).

7. Inclusion of climate change issues in curriculum at secondary and tertiary educational institution.

8. Enhancing resilience of urban infrastructure and industries to impacts of climate change.

9. Development of eco-specific adaptive knowledge (including indigenous knowledge) on adaptation to climate variability to enhance adaptive capacity for future climate change.

10. Promotion of research on drought, flood and saline tolerant varieties of crops to facilitate adaptation in future.

11. Promoting adaptation to coastal crop agriculture to combat increased salinity.

12. Reduction of climate change hazards establishing small handicraft industry.

13. Promoting adaptation to coastal fisheries through culture of salt tolerant fish, Crustaceans, Mollusks, Seaweeds, Perl culture etc.

6.2 Conclusion

Bangladesh is considered one of the most vulnerable countries to climate change in the world. The devastating natural disasters due to climate change affect massively to the lives and livelihoods of the coastal community. Different type of hazards destroy human lives, houses, roads & other infrastructures domestic animals, crops and trees, fish farms, fishing tools and others livelihoods items & resources. Multi Adaptive measurements like to introduce saline adaptive rice variety, culture salt tolerance fish, crustaceans, mollusks, coastal afforestation and create different kinds of occupation.

CHAPTER 7

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APPENDIX-1

FMTR Discipline

Khulna University

Khulna-9208, Bangladesh

INTERVIEW SHCEDULE

CLIMATE CHANGE HAZARDS AND COPING MEASURES OF THE COASTAL COMMUNITY IN SHYAMNAGAR UPAZILA OF SATKHIRA DISTRICT

1. Name: .....

2. Sex: Male ☐ Female ☐

3. Age: 20-30 years ☐ 30-50 years ☐ 50-80 years ☐

80-Up ☐

4. Religion: Muslim ☐ Hindu ☐ Baddish ☐ Kristin ☐

Others.....

5. Present occupation

Brick worker ☐ Day labor ☐ Motorcycle driver ☐

Construction worker ☐ Carpenter ☐ Petty business ☐

Building maker ☐ Fish farmer ☐ Fishermen ☐

6. Previous occupation

Fishermen ☐ Honey collector ☐ Fish farmer ☐

Agricultural farmer ☐ Golpata collector ☐ Wood cutter ☐

Boat maker ☐ Net maker ☐ Student ☐

7. Which natural disaster seen by respondents last 30 years?

Cyclone ☐ Flood ☐ Drought ☐ River erosion ☐

Salinity intrusion ☐ Earth quake ☐

8. When occupation was changed?

1980-90 ☐ 1990-2000 ☐ 2001-2010 ☐ 2011-Recent ☐

9. Income (monthly gross family income)

>3000 ☐ 3001-5000 ☐ 5001-7000 ☐ 7001-above ☐

10. What type's media are used for dis aster forecasting?

Radio-television ☐ Mike ☐ GO ☐ NGO ☐

Newspaper ☐ Relatives ☐

11. What are the pre-natural climatic activities of the Respondents?

Cyclone shelter ☐ Keep dry food ☐ Keep livestock in high place ☐

Take with valuable things ☐

12. Which is the Dangerous disaster?

Cyclone ☐ Flood ☐

13. In which year Dangerous disaster are occurred?

1-5 year ☐ 6-10 year ☐ 11-15 year ☐ 16-20 year ☐

21-25 year ☐

14. Which is definite year of Disaster occurrence?

1988 ☐ 1996 ☐ 1998 ☐ 2007 ☐ 2009 ☐

15. What types of damages are occurred?

House damage & domestic animal died ☐ Crop damage ☐

Fisheries damage ☐

16. What was the Housing condition after disaster?

Partial damage ☐ Full damage ☐

17. How many family members are died?

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐

18. How many domestic animals are died?

5 no. ☐ 10 no. ☐ 15 no. ☐ 20 no. ☐ 25 no. ☐

30 no. ☐ 35 no. ☐ 40 no. ☐

19. How much damage of crop?

10 dec. ☐ 20 dec. ☐ 30 dec. ☐ 40 dec. ☐ 50 dec. ☐

60 dec. ☐ 70 dec. ☐ 80 dec. ☐ 90 dec. ☐ 100 dec. ☐ 110 dec. ☐

20. How much damage of fish farm?

10 dec. ☐ 20 dec. ☐ 30 dec. ☐ 40 dec. ☐ 50 dec. ☐

60 dec. ☐ 70 dec. ☐ 80 dec. ☐ 90 dec. ☐ 100 dec. ☐ 110 dec ☐

21. What types Disease are occurred?

Diarrhea ☐ Snake bites ☐ Cholera ☐ Fever ☐

Fracture ☐ Skin diseases ☐ No traumatic situation ☐

22. What is Condition of resources before climate change?

Plenty of fish, crab & shrimp ☐ Plenty of paddy & fruits ☐

Plenty of live stock ☐

23. What is Condition of resources after climate change?

Scarcity of fish, crab & shrimp ☐ scarcity of paddy & fruit ☐

Scarcity of livestock ☐

24. What is the condition of monthly income?

Increase ☐ Decrease ☐ Unchanged ☐

25. What types Changes are occurred of land use pattern after climate change?

Road construction ☐ House made ☐ Gher ☐

KHULNA UNIVERSITY Central Library KHULNA

26. What types of pant do you plant?

Fruit tree ☐ wooden tree ☐

27. What is the condition of water body after climate change?

Reduce current ☐ Scarcity of fish ☐ Silt ☐

28. What is the effect of climate change in agriculture?

Increase salinity in Soil ☐ Affected by disease ☐ Less yield ☐

29. What is the effect of climate change in fisheries?

Damage fish farm ☐ Affected by disease ☐ Less production ☐

30. What is the effect of climate change in livestock?

Grassing field damage ☐ Disease ☐

31. What are the Damages caused due to salinity?

Damage of cultivated land ☐ Damage of fresh water source ☐

32. Which Source of drinking water is used before climate change?

Pond water ☐ Rain water ☐

33. Which Source of drinking water is used after climate change?

Pond water ☐ Pond sand filter ☐ Tube well water ☐

Rain water ☐

34. How People adopt after Climate changed?

Alternative occupation ☐ Produce adaptive species ☐

Migration towards town ☐ Participation of women in work ☐

35. Have you found any Institutional help?

Yes ☐ No ☐

36. Form which organization you got help?

GO ☐ NGOs ☐

37. What Types of help you found?

Economical ☐ Relief ☐ Training

APPENDIX 2

SUPPLEMENTARY TABLES

Table 4.2 Status of changing Occupation

Previous Occupation	Present Occupation											
	Brick worker	**Day labor**	**Motorcycle driver**	**Construction worker**	**Carpenter**	**Petty business**	**Building maker**	**Fish farmer**	**Fishermen**	**Unemployed**	**Unchanged**	**Total**
Fishermen	4	11	0	4	0	0	0	0	0	0	1	20
Honey collector	3	1	1	0	0	0	1	0	0	0	1	7
Fish farmer	3	1	3	0	0	6	0	0	1	0	6	20
Agricultural farmer	10	3	1	0	3	4	0	5	2	0	0	28
Golpata collector	0	1	0	0	0	1	0	0	1	0	0	3
Wood cutter	1	0	0	1	0	3	0	0	0	2	0	7
Boat maker	0	0	0	0	3	0	0	0	0	0	0	3
Net maker	0	2	0	0	0	2	0	0	2	0	0	6
Student	4	0	0	0	0	0	0	0	0	2	0	6
Total	25	19	5	5	6	16	1	5	6	4	8	100

Table 4.3 Year basis occupation change

Changing year	Previous occupation	Changing Occupation										Total
		Brick worker	Day labor	Motorcycle driver	Construction worker	Carpenter	Petty business	Building	Fish farmer	Fishermen	Unemployed	
1980-1990	Agricultural farmer		1				0		1		0	2
	Golpata collector		1				0		0		0	1
	Wood cutter		0				0		0		2	2
	Net maker		0				2		0		0	2
	Total		2				2		1		2	7
1991-2000	Fishermen	3	2		0	0	0		0	0		5
	Honey collector	2	0		0	0	0		0	0		2
	Fish farmer	0	0		0	0	4		0	0		4
	Agricultural farmer	6	0		0	1	4		4	0		15
	Golpata Collector	0	0		0	0	1		0	0		1
	Wood cutter	1	0		1	0	0		0	0		2
	Boat maker	0	0		0	2	0		0	0		2
	Net maker	0	0		0	0	0		0	2		2
	Total	12	2		1	3	9		4	2		33
2001-2010	Fishermen	0	5	0		0	0	0		0		5
	Honey collector	1	1	1		0	0	1		0		4
	Fish farmer	3	0	3		0	2	0		1		9
	Agricultural farmer	2	2	1		0	0	0		2		7
	Golpata collector	0	0	0		0	0	0		1		1
	Wood cutter	0	0	0		0	2	0		0		2
	Boat maker	0	0	0		1	0	0		0		1
	Total	6	8	5		1	4	1		4		29
2011-recent	Fishermen	1	4		4	0	0				0	9
	Fish farmer	0	1		0	0	0				0	1
	Agricultural farmer	2	0		0	2	0				0	4
	Wood cutter	0	0		0	0	1				0	1
	Net maker	0	2		0	0	0				0	2
	Student	4	0		0	0	0				2	6
	Total	7	7		4	2	1				2	23

Table 4.12 Man mortality

Severe disaster	Amount of man mortality						Total
	1 no's	2 no's	3 no's	4 no's	5 no's	6 no's	
Cyclone	14	8	16	4	2	4	48
Flood	7	1	1	0	0	0	9
Total	21	9	17	4	2	4	57

Table 4.13 Mortality of domestic animal

Severe disaster	Death of domestic animal								Total
	5 no.	10 no.	15 no.	20 no.	25 no.	30 no.	35 no.	40 no.	
Cyclone	4	16	4	18	4	7	2	19	74
Flood	2	13	1	1	2	3	3	1	26
Total	6	29	5	19	6	10	5	20	100

Table 4.14 Damage of crop

Severe disaster	Damage of crop											Total
	10 dec.	20 dec.	30 dec.	40 dec.	50 dec.	60 dec.	70 dec.	80 dec.	90 dec.	100 dec.	110 dec.	
Cyclone	23	7	8	12	1	3	12	1	1	2	2	74
Flood	2	4	7	2	7	0	2	0	0	1	1	26
Total	25	11	15	14	8	3	14	1	1	3	5	100

Table 4.24 Effect of climate change in fisheries

Climate changing Factor	Effect in fisheries			Total
	Damage fish farm	Affected By disease	Less production	
Cyclone	16	8	4	28
Flood	10	16	9	35
Drought	0	5	13	18
River erosion	0	2	4	6
Salinity intrusion	0	2	6	8
Earth quake	0	2	3	5
Total	26	35	39	100

Table 4.25 Effect of climate change in livestock

Climate changing factor	Effect in livestock		Total
	Grassing field damage	Disease	
Cyclone	12	16	28
Flood	16	19	35
Drought	18	0	18
River erosion	6	0	6
Salinity intrusion	8	0	8
Total	65	35	100

Table 4.29 Adaptation of people

Climate changing Factor	Adaptation of people				Total
	Alternative occupation	Produce adaptive species	Migration towards town	Participation of women in work	
Cyclone	13	3	7	5	28
Flood	7	5	13	10	35
Drought	8	6	3	1	18
River erosion	2	2	0	2	6
Salinity intrusion	3	1	4	0	8
Earth quake	2	0	0	3	5
Total	35	17	27	21	100

APPENDIX-3

PLATES

Plate 1. Interviewers of the gabura union

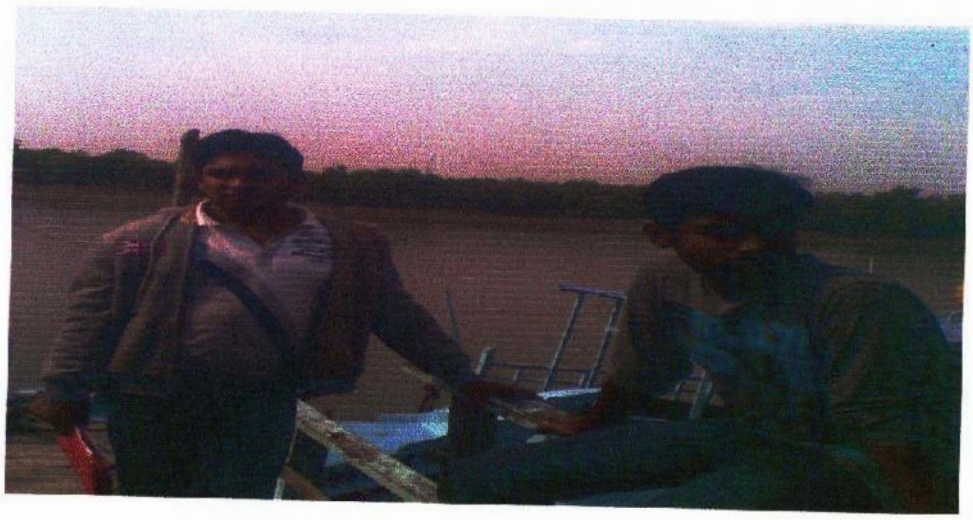

Plate 2. Interviewer of the koikhali union

Plate 5. Interviewers of the burigoalini union

Plate 6. Picture of FGD

Plate 7. Picture of FGD

Plate 8. Damage of house

Plate 9. Adaptation against climate changed.