

**Exploring Gender Vulnerability and Adaptive Capacity to Climate Change
Associated Extremes**

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**MASTERS OF SCIENCE
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**Exploring Gender Vulnerability and Adaptive Capacity to Climate Change
Associated Extremes**

A thesis by
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In partial fulfillment of the requirement for the Masters of Science in
Water Resources Development

**Institute of Water and Flood Management
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CERTIFICATION OF THE PROJECT

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Abstract

The study tried to assess vulnerability and adaptation necessity from gender dimension of climate change adversity. The study has been carried out in cyclone Aila affected Gabura union of Shyamnagar upazila of Satkhira. The study explored the gender dimension of climate change associated vulnerability with developed matrix framework using a scale of 3.0. Climate change associated vulnerability has been assessed from two contexts. Vulnerability of the women has been analyzed by assessing the impact of climate change on water resources considering the user/ gender perspectives. The vulnerability score of water resources is 1.78 in a scale of 3.0 that means water resources are less to moderate vulnerable to climate change, considering the user/ gender perspective. Climate change associated gradual changes or climate change events have been found as the primary cause of vulnerability. Using the matrix framework, vulnerability of gender community was found to be 2.53 in the vulnerability scale of 3.0, which predicts moderate to severe vulnerable condition of women due to climate change. The context specific vulnerability of women has been assessed for climate change events and climate change extremes. The context specific vulnerability due to climate change events is 2.63 whereas for climate change extremes the score is 2.57, both considered in a scale of 3.0. Findings show that women are more vulnerable to climate change associated gradual changes. Study found that any climate change induced disaster can trigger catastrophic consequence considering the existing scenario. The linkage among exposure, sensitivity and adaptive capacity shows that Bangladesh has achieved remarkably success in disaster preparedness; but significantly lacks experience to deal with the ongoing changes taking place in climate. The study assessed future gender needs based on SRES A2 and A1B scenarios for the period of 2040-2069 and 2070-2099 where increasing trend in temperature and decreasing trend in precipitation is visible for the study area. The study explored various complexities experienced by only women due to climate change associated events and extremes and accumulated suggestion for disaster preparedness, improvement in cyclone warning signal and modification for gender friendly design of cyclone shelters. Key suggestions also been assessed in line with climate change coping, adaptation and mitigation directly from the climate vulnerable community. The study analyzed national climate change policies with GIA tool and the finding shows the national adaptation policy documents are gender exclusive. The study finally provided recommendations in line with gender just climate change adaptation and mitigation and suggested 'bottom up-top support' institutional framework for gender mainstreaming.

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List of Acronyms

BCCSAP	Bangladesh Climate Change Strategy and Action Plan
COP	Conference of Parties
CRI	Climate Risk Index
DRR	Disaster Risk Reduction
FGD	Focus Group Discussion
GCM	Global Circulation Model
GHG	Green House Gas
GIA	Gender Impact Assessment
GOB	Government of Bangladesh
IOM	International Organization for Migration
IPCC	Intergovernmental Panel on Climate Change
KII	Key Informant Interview
LFA	Livelihood Framework Analysis
MFI	Monetary Financial Institutions
NAPA	National Adaptation Programme of Action
NCEP	National Centers for Environmental Prediction
NGO	Non-Governmental Organization
PVA	Participatory Vulnerability Assessment
SDSM	Statistical DownScaling Model
SRES	Special Report on Emissions Scenarios
UNDP	United Nations Development Programme

CHAPTER 1

INTRODUCTION

1.1 General

Climate change, its impact and associated vulnerabilities is presently the most burning issue worldwide. The global warming and its consequent effect of climate change are attributed directly or indirectly to human activities and natural variability that alters the composition of atmosphere; the resultant output now threatens the humankind and its achievement with most diversified and erratic atmospheric and environmental condition, which are predicted to be worsen in upcoming future with increased temperature, erratic nature of rainfall and increase in intensity and frequency of disaster events. As described by Intergovernmental Panel on Climate Change (IPCC), “Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level”. However, the climate change and its impact will be felt differently in places with varied magnitude and the poor, least developed and developing countries from Africa and Asia will be the primary victim of climate change [1].

Bangladesh, one of the most densely populated countries in the world - trapped between the melting Himalaya in the north and encroaching Bay of Bengal to the south- has been identified as one of the most vulnerable country to climate variability and change. Climate change is not only the simple „environmental“ concern but „economic“ and „development“ concern as well and the future pathway of the country and its population is greatly dependent on the issue and corresponding activities. The Global Climate Risk Index 2011 developed by „Germanwatch“, recognized Bangladesh as the country most vulnerable to extreme weather events and the one most affected in the period of 1990-2009 [2]. United Nations Development Programme (UNDP) identified Bangladesh as the most vulnerable country in the world to tropical cyclones and the sixth most vulnerable country to floods [3]. During the period of 1991 to 2000, Bangladesh has suffered from 93 large scale natural disasters which killed 0.2 million people and caused loss of properties valued about 59 billion dollar in the agricultural and infrastructure sector only [4].

The adverse effects of climate change undermine human security suppressing enjoyment of their fundamental rights. Though climate change events impacted locally with incidents like loss of life and disruption of livelihood, damage to natural environment and ecosystem, loss

of property and critical resource base- but the effect spread out globally. Climate change has not become evident in one day and nor is the outcome from any single country's activity (though, in most cases, the countries suffering much and impacted more are those least accounted for climate change); so the solution also require combined global willingness and effort, to ensure a safer home for its future generation. Global environmental change and sustainability science increasingly recognize the need to address the consequences of changes taking place in the structure and function of the biosphere. Research demonstrates that vulnerability is not caused by exposure to hazards (perturbations and stresses) only but also registered to the system's sensitivity and resiliency. This recognition requires revisions and enlargements in the basic design of vulnerability assessments [5]. Climate change has a critical and sophisticate gendered dimension and somehow gender perspective of climate change is excluded or overlooked (to a certain degree) in research based work.

1.2 Background of the study

Climate change magnifies existing inequalities, reinforcing the disparity between women and men in their vulnerability to and capability to cope with climate change. Climate change is not gender neutral [6]. The ultimate victim of climate change is the poor and extreme poor community; among which women comprising the major percentage are more vulnerable due to their less access, mobility, ownership and gender differentiated roles and responsibilities. Women historically having less access to the education, employment, property, food, health care, etc. will likely to suffer more than men from poverty, hunger, malnutrition, economic crisis, environmental degradation, health related problems, insecurity and become victim of violence and political crisis due to climate variability related events and extremes. The gendered division of labor becomes critical as gender roles are often re-enforced and even intensified – due to the additional work and changes in environment brought on by a disaster. Violation of women's rights becomes more prominent during disaster [7].

Women's triple roles are highly centered on water resource; their activity and way of living greatly depends on availability, quantity and quality of water, which severely deteriorates in any disaster events and critically vulnerable to climate change and induced disasters [8] [9]. The major threats of climate change to Bangladesh are in water sector and women being the water manager in household level are likely to be severely impacted. Women play critical role as primary caregiver and environmental manager and possess indigenous knowledge of adaptation and mitigation which might become highly critical in enhancing climate change adaptation and mitigation activities. Women suffer climate impacts more than men- they are

also integral to solutions [10]. Despite the pivotal role in household management, their due participation in decision and policymaking and development process is still undermined [11].

The issue of climate change and associated impacts on society especially to the poor and vulnerable groups and on women is a very recent and emerging issue. The Hyogo Framework for Action states that, “a gender perspective should be integrated into all disaster risk management policies, plans and decision-making processes, including those related to risk assessment, early warning, information management, and education and training” [12]. Gender issue is needed to provide adequate focus before formulating policy and strategy of the adaptation and mitigation measures. Previous studies assessed vulnerability analyzing impact on livelihood assets from Disaster Risk Reduction (DRR) perspective- which somehow ignored the overall gender dimension of vulnerability primarily ignoring into account the triple role of women. Due emphasis is needed on reproductive and community managed activities also with their productive activity as those two are also very important to maintain social integrity.

Women in Bangladesh have historically less access to the education, employment, property, food, health care etc. They also have less access to decision-making process and control over resources. The adversity of climate change will be more on the disadvantaged and vulnerable section of the society and ultimate victim would be the poor people and women and children. So while formulating climate change policy and implementation strategy of the adaptation and mitigation measures, due emphasis should be needed on the gender issues.

1.3 Objective of the study

The overall objective of the study is to provide suggestion on climate change adaptation strategies from a gender perspective. The specific objectives of the study are as follows:

- i) To explore the gender dimension of vulnerability due to climate change associated events and extremes
- ii) To analyze the gender specific needs in future changed scenario
- iii) To suggest climate change adaptation and mitigation strategies from a gender perspective.

The study is expected to provide significant insight on women's vulnerability to climate change associated events and extremes and suggest important adaptation and mitigation strategies from a gender perspective; will be beneficial in climate change adaptation and mitigation policy formulation.

1.4 Organization of the study

The study deals with gender dimension of climate change, its possible impact and feasible adaptation and mitigation measures. The study has been organized in five chapters.

Chapter one deals with the background of the problem with specific objectives and possible outcomes.

Chapter two is the literature review related to present problem. It ventures from a global scale to national level implication of climate change and explores the linkage between climate change, gender and vulnerability.

Chapter three describes the detailed design of the study. The methodology of the study and description about the study area are included in the section.

Chapter four presents the results and findings of the study. The results from data analysis are presented with graphs, tables and charts along with detailed discussions. Vulnerability assessment using matrix framework and gender needs in future changed scenario- generated from statistical downscaling also have been included in the section of the study. This chapter also contains the suggestions and recommendations generated from the study. Key suggestions were collected from field using Questionnaire Survey, Focus Group Discussion (FGD) and Key Informant Interview (KII). Suggestions regarding climate change adaptation and mitigation are presented in the section. Also, Gender Impact Assessment (GIA) has been done over the national adaptation policy documents in order to provide the study with important recommendations in relation to gender inclusive climate change adaptation and mitigation.

Chapter five provides the concluding remarks related to the study. Key recommendation and future scope of the study are also presented here along with conclusion.

Questionnaire survey format, topics discussed in FGD and KII are also included in annexure.

CHAPTER 2

LITERATURE REVIEW

2.1 General

The issue of climate variability and change caught global attention due to its adverse impact, predicted threat in present and future scenario, associated uncertainty and immense implication and complexity in socio-economic and development ground that possess the capacity to shift mankind from its present track of advancement.

Climate change, gender and vulnerability are closely linked with one another and in predicted future scenario, gender relations will be adversely affected. Climate change associated extremes will intensify the gender inequality and disparity will result into social disaggregation and conflict- that will affect human development. This section will try to assess the up to date definition of climate change, gender and vulnerability and will explore existing works that tries to describe the gender dimension of climate change. Priority was given to documents related to Bangladesh and support study design and area.

2.2 Climate Change

Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically for decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use [13]. In more simplistic way, climate change refers to any change in climate over time, whether due to natural variability or as a result of human activity. United Nations Framework Convention on Climate Change (UNFCCC) defines „climate change“ as, „a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods“ [14].

In a global scale climate change will be resulted in increased temperature, increase in precipitation in some areas during the mid-century and then decrease in the late-century where as desertification will be intensified along with melting of glaciers and ice sheets and ice in mountains and increase in sea level. IPCC in 4th Assessment Report discloses that there is high agreement and much evidence that with current climate change mitigation policies and related sustainable development practices, global Green House Gas (GHG) emissions will continue to grow over the next few decades. It also included that hot extremes, heat

waves and heavy precipitation events will become more frequent. Future tropical cyclones (typhoons and hurricanes) will become more intense, with larger peak wind speeds and more heavy precipitation associated with ongoing increases of tropical sea-surface temperatures. The apparent increase in the proportion of very intense storms since 1970 in some regions is much larger. Increases in the amount of precipitation are very likely in high-latitudes, while decreases are likely in most subtropical land regions.

The increasing trend of natural disasters could be validated from observed data set in the period of 1900-2011 that supports IPCC's assessment. Figure 2.1 generated from *EM-DAT: the OFDA/CRED International Disaster Database* shows the trends in disaster events, number of people reported killed and affected.

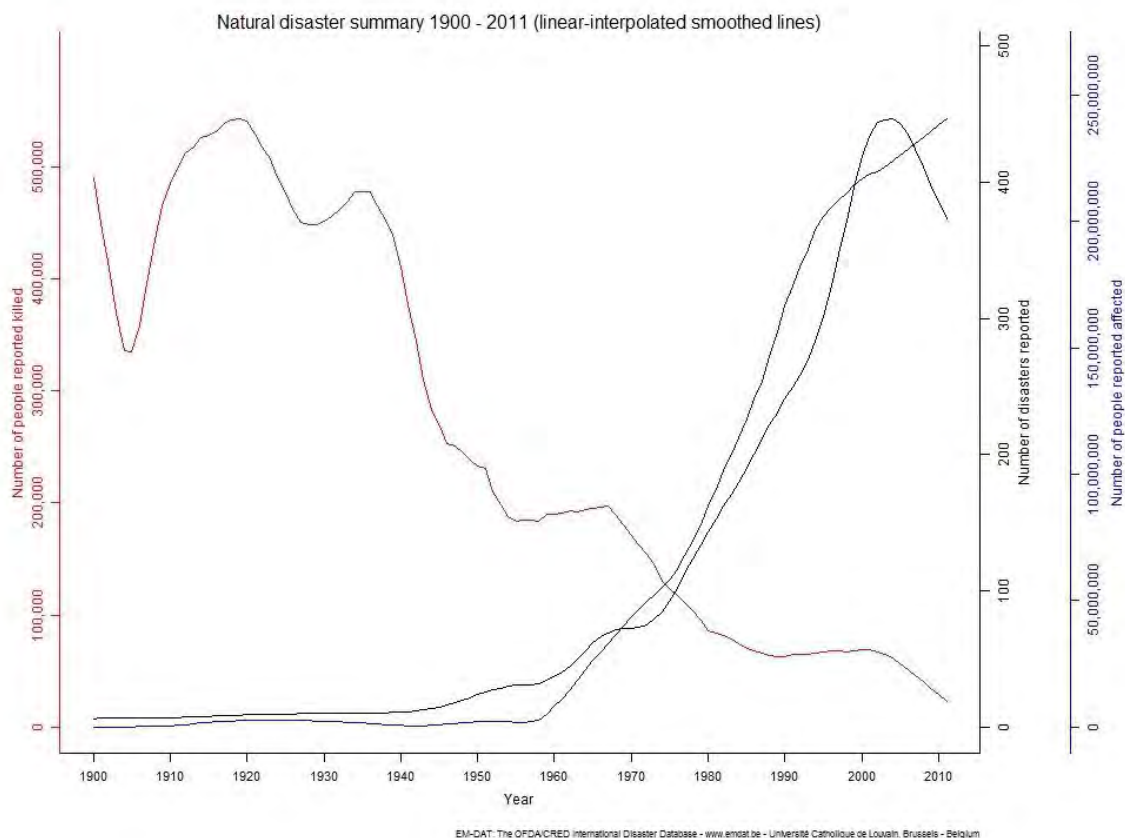


Figure 2.1: Trend in number of disasters reported, number of people reported killed and number of people reported affected in the time frame of 1900-2011 [source: www.emdat.be]

It is interesting to see that the death count of people in disaster events have reduced over the time but number of people affected in disaster events have increased significantly (Figure 2.1). One reason could be the population increase but other reason could be, larger number of population have started living in climate vulnerable areas. This can be attributed to soico-

economic strata that exists in society and vary from country to country that enforce destitute people to live in high risk zones.

Global Climate Risk Index (CRI) 2011 identified that more than 650,000 people died as a direct consequence from almost 14,000 extreme weather events, and losses of more than 2.1 trillion USD (in PPP) occurred from 1990 to 2009. According to CRI, Bangladesh, Myanmar and Honduras were the countries“ most affected by extreme weather events from 1990 to 2009 and all of the ten most affected countries in this period were developing countries in the low-income or lower-middle income country group. The CRI put its concern on the fact that anthropogenic climate change is expected to increase extreme events and in absence of proper adaptation mechanism (including financial and institutional support provided by developed countries), the loss and vulnerability could lead to catastrophic consequences [2].

Among the most affected countries, poor nations from Africa and Asia are predominant. The SAARC region is the most vulnerable area to climate change where 21% of world population resides on only 4% of the world“s physical area. The World Bank identified South Asia to be the most severe victim of climate change.

2.2.1 Climate change and Bangladesh

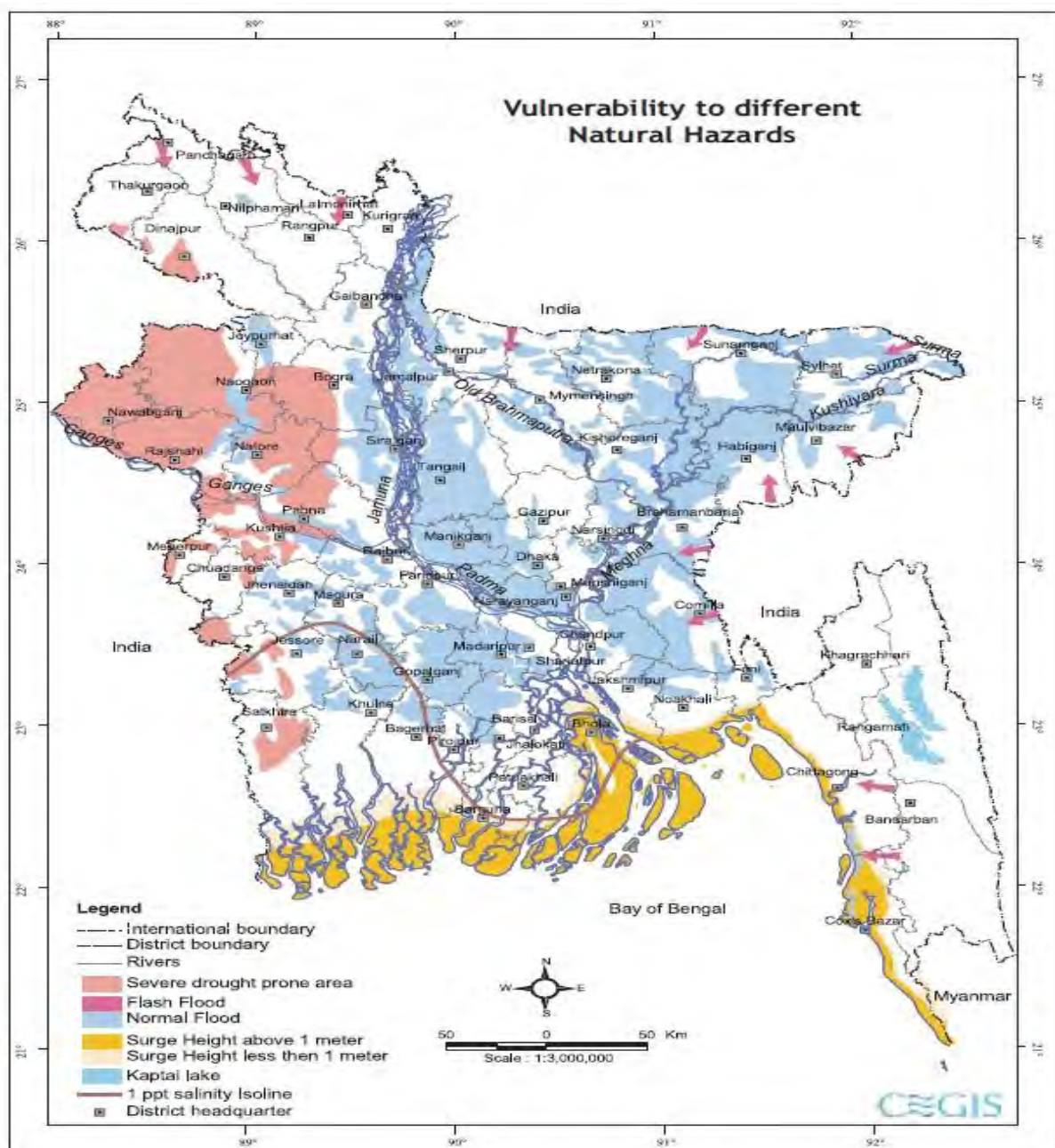
The effect of global warming is changing the fundamental properties of climate and is not known so clearly to people rather than Bangladesh, where each year millions of population lead their life fighting the wraths of climate change. The physical characteristics of the country, geographical location and 710km long funnel shaped coastline have made Bangladesh greatly susceptible to climate change associated events and extremes, along with its physical characteristics and geographical location, population density, poor institutional, infrastructural and industrial development, poor industrialization and unplanned urbanization, environmental pollution and ecological degradation, dependency on decaying natural resources, prevalence of poverty and uncertainty related to livelihood and energy source, poor law enforcement, corruption, illiteracy, social disparity, etc. have multiplied country“s vulnerability to climate change associated disasters.

The impact of climate change over Bangladesh is well recognized. The country criss-crossed with hundreds of rivers has been identified as the country severely impacted by recurring floods and cyclone storm surges that are predicted to increase in future scenario. Experts say Bangladesh could be the ground zero of climate change induced migration, mostly due to sea level rise. The country“s 150 million inhabitants live in delta of three waterways, and the majority of the country sits less than 20 feet above sea level [15]. Bangladesh is prone to a

multitude of natural hazards (e.g. flood, drought, storm surge, salt water intrusion, river erosion, etc.) and vulnerable to the adverse impacts of future change in climatic conditions. It is to be noted that in a country like Bangladesh, climate significantly influences economic opportunities and development prospects. So, it is quite certain that projected climate change impacts would in fact reinforce many of the baseline stresses and must be given proper attention before addressing climate change adaptation in the contexts of development [16]. In most simplest way, it means that Bangladesh is facing many of the climate induced anomalies right now; in predicted future scenarios, these anomalies would likely to increase in intensity and frequency towards the ever so poor and climate vulnerable population of the country.

The deadliest of cyclones ever occurred in human history, several were recorded to landfall in Bangladesh, ravaged the country with millions of death. Sudden, severe and catastrophic floods have intensified and taking place more frequently owing to increased rainfall in the monsoon. Over the last three decades, Bangladesh has been ravaged by floods of catastrophic proportion in 1988, 1998, 2004 and 2007. Heavy downpour over short spell has resulted in landslides. Cold spell claims human lives as well as damage crops. Droughts often affect even coastal districts. Bad weather keeps the coastal waters risky for fishing expeditions. Damages and losses due to climatic extremes like floods, cyclones, tornados, droughts are phenomenal to the victims as well as the state. These are early signs of global warming effects. Sea level rise in the coming decades will create over 25 million climate refugees [17]. IPCC identifies Bangladesh as one of the most „sceptible countries“ of the world to the negative impacts of climate changes. The largest impact of global warming will be felt on the water resources of the country and many projections suggest greater variability in future monsoon patterns, with severe impact upon agriculture and other sectors due to either excess flow or severely low flows and droughts along with more extreme climatic condition. The consequences of climate change in Bangladesh are generally talked of in terms of „extreme events“ and identified as sea level rise, erratic precipitation, tidal inundation, salinity intrusion and soil erosion. The risks are complex and gradual and difficult to differentiate from background variability of climate. Future vulnerability due to climate change would not necessarily add new climatic havoc to the already well known ones as floods, droughts and cyclones, but would enhance both the frequency as well as the intensity of such climatic extremes. The climatic manifestation will in turn be compounded by other factors including land use pattern, water management and control of river flows in the upstream [18].

Bangladesh is the ground zero to visualize climate change associated adversity. Bangladesh has been identified as the most vulnerable country in the world to tropical cyclones, third most vulnerable country to sea level rise and sixth most vulnerable country to floods [3 and 19]. In terms of the impact of climate change, few places in the world will experience the range of effects and the severity of changes that will occur in Bangladesh. These will range from rise in average weather temperatures, more extreme hot and cold spells, erratic rainfall, change in natural hydrological cycle to more intense tornados and cyclones, sea level rise displacing large-scale communities, turning freshwater saline and facilitating more powerful storm surges [20]. Map 2.1 shows the spatial distribution of disasters and hazards that ravage the country and increasing vulnerability potential to climate change.



Map 2.1: Spatial distribution of different climate related natural disasters (source: CEGIS, 2009)

Change in climate over Bangladesh will affect natural resources, such as water, forests, and grasslands. Changes in natural resources will have social and economic effects; some beneficial, some detrimental. The socio-economic effects of climate change therefore arise from interactions between climate and society and these in turn affect both natural and managed environments. Climate change is expected to have major physical impacts on agriculture, industry, infrastructure, disaster, health and energy and consequently on people's livelihood in terms of employment, income and consumption (including food security). Various groups in society will experience the impacts in various degrees dependent upon their initial economic conditions (poor or non-poor), location (coastal or non-coastal, rural or urban) and gender [21]. Another major impact of climate change on Bangladesh will be the forced migration, where millions of people will be displaced due to the recurring disaster events and gradual change in climate. Climate processes such as sea-level rise, salinization of agricultural land, desertification and growing water scarcity, and climate events such as flooding, cyclone and storm surge will further contribute to worsening the situation [22]. Sea-level rise is the most often cited cause of predicted mass-displacement within Bangladesh as a result of climate change. Widely quoted figures range from 13 million to 40 million people displaced, generally based on assumptions of a one metre rise in sea levels [23]. Climate change will affect the human system through increased potential of water and vector borne diseases and food insecurity. Number of death due to climatic disasters will increase. Impact of climate change on agriculture, fisheries and livestock will be negative and associated with production loss. In future scenarios, situation will become even worse, with production loss from the respective sectors and additional price hike in national and international market will reduce people's buying capacity. This might result into wide scale spreading of malnutrition problem over the country, and ultimately increase in death number due to hunger incidence. Poor people are the most susceptible members of society to the destruction caused by cyclones and flooding, and thus will be the primary victims of climate change and women due to their limited access, mobility, gender differentiated roles and responsibility will bear major burnt of climatic adversity.

2.3 Climate change and gender

“Women hold up half the sky” (Mao Zedong) - but in reality women are not visible in power structure, often left out in development process and are the mere victim of climate change. Women are the least contributor to global warming, but it is them who will be the most sufferers in changed context scenarios. Women suffer more in any disaster events but they

are the key player in climate change adaptation and natural resource management. Women hold up the very existence of society and ensure generational advancement. Ensuring safety and security of women is very important especially in the context of climate change when the impact disproportionately falls upon them.

Men and women have distinct roles and responsibilities, which give rise to differences in vulnerability and ability to cope with climate change. Access to information, mobility, education and ownership of resources are very much defined by existing gender disparity and relation that shape up the resilience to natural disaster and gradual changes. Vulnerability of women and men lies in their socially ascribed gender differentiated roles and responsibilities. Thus, it is prerequisite to understand the gender relation to assess the extent of impact of climate change in any particular society.

2.3.1 Gender and gender roles

„Gender“ is not a synonym for „women,“ but gender studies often focus on women. This is because „gender“ is a social construct and the position of women in society is unfavorable to that of men from every aspect – politically, economically and culturally. In the wake of climate change, this becomes even more critical because climate change adds another layer of inequality between women and men, often the difference being between life and death [10].

„In simplest way, gender means what men and women do in a society as a member of the society.“ Gender refers to the different roles of women and men, which is denoted by the social and cultural relationship between them [24]. Gender, is therefore, the social differences between women and men that are learned, changeable over time and have wide variations both within and between cultures. These gender relations are dynamic, characterized by both conflict and co-operation that are influenced by historical, religious, economic and cultural realities and can be changed and reshaped over time.

Gender roles can be divided into three categories namely, productive, reproductive and community. Productive roles are associated with all the activities that produce goods, and services for consumption and trade. Work done in factory, office, farm, etc. falls in this category. Reproductive gender role is of two kinds – biological and social. Biological refers to giving birth, while social refers to caring (past, present and future) and nurturing activities. Community work refers to all those activities necessary to run and organize community life [25]. The unpaid work carried out by both men and women for community benefit could be divided into two; community managing for which women are mostly exploited to obtain their

free service while men play community politics by keeping the decision making power which brings status to themselves [26].

Gender needs are of two types, Practical gender needs that highlights on women's immediate practical needs (such as access to water) and Strategic gender needs give emphasis to address issues of equity and empowerment of women and target factors that discriminate against women (such as access to land or finance). The practical needs of women and men respond to the immediate need and are linked to the socially accepted labor division within the society. The strategic needs of women and men seek to bridge the gender gap by bridging the political, economic and socio-cultural divides and help women become more self-confident, skilled, knowledgeable and capable of making choices, influencing and satisfying her practical needs [10].

There are issue of equity and equality that are required for gender mainstreaming. Gender equality refers to the equal treatment of men and women with respect to their rights and in legislation and policies as well as in providing equal access to and control of resources and services within the family and society. Gender equity is a set of policy measures/special programs targeting women with the aim of compensating them for the historical and social disparities that deprived them of enjoying access to equal opportunities. Gender mainstreaming is a strategy for making women's as well as men's concerns and experiences an integral dimension of the design, implementation, monitoring and evaluation of polices and programmes in all political, economic and societal spheres so that women and men benefit equally and inequality is not perpetuated. The ultimate goal of mainstreaming is to achieve gender equality [27].

Gender differentiated triple role and gender inequality is the root cause of women's disproportionate burden of vulnerability in the face of climate change.

2.3.2 Vulnerability

IPCC defined vulnerability as the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity [9]. Three elements of vulnerability, namely exposure, sensitivity and adaptive capacity can help evaluate the nature and magnitude of climate change threat, detect sources of vulnerability and identify actions to help reduce or deal with the threat under each element [28].

Marshall et al. critically analyzed different definitions used to describe terminologies associated with vulnerability. They said exposure represents the important climate events and patterns that affect the system that also includes other changes in linked systems that might be induced by climate effects. As per IPCC, exposure is the extent to which a region, resource or community experiences changes in climate. It is characterized by the magnitude, frequency, duration and/or spatial extent of a weather event or pattern. Stokes and Howden expressed that some regions or sectors are more exposed to extreme climate events due to their location, range, type of resources they depend upon, or local oceanography. Sensitivity is the degree to which a system is affected by or responsive to climate changes. Johnson and Marshall defined the sensitivity of ecological systems to climate change in terms of physiological tolerances to change and/or variability in physical and chemical conditions and Fenton et al. identified the sensitivity of social systems to be determined by economic, political, cultural and institutional factors. Adaptive capacity describes the ability to respond to challenges through learning, managing risk and impacts, developing new knowledge and devising effective approaches. Gunderson and Levin et al. expressed that adaptive capacity requires the flexibility to experiment and adopt novel solutions. Carpenter et al. and Peterson said that in ecosystems, adaptive capacity is related to genetic diversity, biological diversity, and heterogeneity within landscapes. Armitage, Holling and Meffe, Nelson et al. and Scheffer et al. expressed that in social systems, adaptive capacity can be a conscious or inadvertent characteristic, enhanced by the existence of institutions and networks that learn and store knowledge and experience, create flexibility in problem solving, without compromising the ability to cope and adapt to future change. Adaptive capacity greatly influences the vulnerability of communities and regions to climate change effects and hazards [28]. Vulnerability assessments provide information about the nature and scale of climate change impacts and initiate informed decisions about related adaptation activities and strategies [28]. Vulnerability assessment is essential prior to the formulation of climate change adaptation and mitigation policies. To make the policies gender just- to meet the practical and strategic needs of both men and women, clear understanding is needed to the critical linkage between, gender, climate change and vulnerability.

2.3.3 Climate change, gender and vulnerability: Bangladesh perspective

Impact of climate change is not gender neutral; vulnerability is gender differentiated and context specific. The way women experience vulnerability is many times different from men due to socially constructed gender roles and power relations. Factors, such as lack of access

to and control over basic resources and lack of entitlements, amplify women's vulnerability and undermine their ability to cope with effects of disasters [29 and 30]. Poverty and vulnerability are mutually re-enforcing and brought about by similar processes. However, poverty is not the only influencing factor to vulnerability along with other factors like geographical location, communal conflict or social and ethnic association. Vulnerability pushes people into poverty, keeps in poverty and stops from coming out of poverty [29].

Gender roles and relations are often can be said as major (or primary) cause of poverty if the distribution of poverty is considered between men and women. Gender roles and relations often determine the activity and access and control over resources in a society; the distribution of poverty and percentage of women below poverty line is the testimony to validate the assumption; so it can be concluded that gender also determine and often re-enforce the context specific vulnerability of men and women. So, men and women experience vulnerability differently and considering the extent and magnitude of climate change variability and extremes- often the difference resulted in between life and death.

The gender-poverty links show that 70 percent of the poor in the world are women and their vulnerability is accentuated by race, ethnicity, and age [31]. When natural disasters and environmental change occur, women and men are affected differently because of traditional, socially based roles and responsibilities [32]. As depicted by UN WomenWatch, women are more vulnerable to the effects of climate change than men- primarily as they constitute the majority of the world's poor and are more dependent for their livelihood on natural resources that are threatened by climate change. Furthermore, they face social, economic and political barriers that limit their coping capacity [33]. Mortality ration of women in natural disasters also depicts the differentiated vulnerability of women and men. A study of disasters in 141 countries provided the decisive evidence that gender differences in deaths from natural disasters are directly linked to women's economic and social rights. In inequitable societies, women are more vulnerable to disasters. Women and children are 14 times more likely to die than men during a disaster. In the 1991 cyclone that killed 140,000 in Bangladesh, 90% of victims were women [34].

Impact of climate change on gender groups especially on women is quite new and there is limited resources available comparing to the physical dimension. Even, both the Kyoto Protocol and the UN Framework Convention on Climate Change (UNFCCC) ignored to even mention gender concerns in the first place [30]. It is the fourth assessment report of IPCC that exclusively noted how gender differences affect the vulnerability and adaptive capacity of

women and men. After decades of being gender-blind, international climate negotiations for the first time recognized in December 2010 that gender is integral to actions on both mitigation and adaptation in the UNFCCC text. Ultimately, in Conference of Parties (COP 16) text incorporated women and gender concerns, including on adaptation [10]. Nonetheless still many of climate change policies are almost gender blind or gender neutral, largely ignore any gender specific measures in the climate change adaptation mechanism.

Major research on the gender dimension of climate change primarily initiated after 2007 as the 4th Assessment Report of IPCC succeed to raise tremendous global concern and Bangladesh also provided due importance to the issue. Climate Change Cell (CCC) of GoB carried out a study that summarized the hydro-geophysical situation specific vulnerability contexts for the women, „reported by the vulnerable themselves“ [30]. The goal of the research was to build an information source on specific aspects of vulnerability of women to climate change and to analyze how these specific vulnerability contexts could be addressed with planned adaptation measures, given the sustainable development framework of the country. The study also sought to understand locally practiced coping strategies and provided some key suggestion in line with climate change adaptation and mitigation. Another major success of the study lies in its transparency in describing the existing complexity associated with gender empowerment and gendered adaptation intervention due to political biasness and poor governance that are common in least developed and developing countries like Bangladesh. The report depicts that despite having provisions for inclusion of women representatives in governance processes, gender relationship having a bias towards males, does not allow women to meaningfully participate in any decision making fore, while lapses in good governance practices alienate women“s voices further, leaving virtually no room to contribute towards the reduction of their vulnerability. While the major success of the study lies in assessing spatial vulnerability of women based on different geo-physical context of the country, it does not capture the overall gender dimension of climate change vulnerability. How climate change is affecting existing gender relations and its impact in „activity; and „access and control“ level was not brought under consideration. The study actually ventured impact of climate change associated disaster on women- explicitly acknowledging the gender relations and discrimination. Nonetheless, the study is very important one.

Another major initiative linking climate change, gender and vulnerability was carried out by Bangladesh Centre for Advanced Studies (BCAS). It stated that the greater number of women victims of various natural calamities clearly depicts the unequal risk and exposure across

genders. Women are more vulnerable both to the short term recurring climatic events and long term climate induced changes because of gender differences in socially constructed roles and responsibilities that affect mobility, social networks and access to information and local institutions, as well as access to control and ownership of assets [35]. The study examined the aspects of gender inequalities as social phenomenon that doubly jeopardizes women by contributing to natural phenomenon like climatic disaster; came up with some interesting findings as how gender roles and responsibilities change in pre, during and post disaster scenario and how even traditional dresses like „sari“ increase women’s vulnerability. Though this study analyzed linkage among gender, climate change and vulnerability more analytically, but there are significant gaps in defining vulnerability. It carried out Sustainable Livelihood Framework with a gender lens in the study. Thus, it somehow shifted its focus on the gender analysis from a livelihood viewpoint only and included climate change paradigm to qualitatively assess vulnerability. This reflected the traditional process of vulnerability assessment (even when climate change issue was not surfaced in global community) which is primarily rooted into the relation of livelihood and DRR viewpoint. Nevertheless, it is a very good resource in line with linking gender, climate change and vulnerability and provided some very useful suggestions for climate change adaptation and mitigation strategies.

CARE Bangladesh, in Reducing Vulnerability to Climate Change (RVCC) Project, carried out an extensive vulnerability assessment in implementation areas of southwest regions in Bangladesh. Though CARE has their very own Household Livelihood Security (HLS) approach for vulnerability assessment, but followed DFID’s Sustainable Livelihoods Framework and assessed vulnerability in terms of vulnerability aspect (list of vulnerability contexts). Community ranked vulnerability contexts against well-being indicators and the summarized score was used to calculate vulnerability, quantitatively. Probable adaptation measures were assessed against the vulnerability aspects and during project implementation used to „focus on addressing the most significant climate change-induced vulnerability contexts and well-being indicators/ insecurities, as identified by the project beneficiaries themselves“ [36]. The study was not exclusively focused to linking gender, climate change and vulnerability; but provided important insights on this issue.

There is also Gunter et al.’s study that highlighted the vulnerability of indigenous people from Chittagong Hill Tract (CHT) in the face of climate change. This paper compares the vulnerability due to climate change and variability of the indigenous people in individual

level and in spatial level and provided suggestions on adaptation strategy and policy interventions to reduce the magnitude of climate change-induced vulnerability [37].

Neelormi S. et al. assessed the gender perspective of socio-economic implication due to the water logging events only, which has emerged as a pressing concern at the backdrop of climate change. In water logged areas all types of livelihood option remain stopped for significant amount of time and men were forced to out migration for income generation that in turn increase women's insecurity and vulnerability. Women living in marooned and slippery conditions fall victim to unhygienic reproductive health condition and increasing trends of gynecological problems were reported. Schools become inoperative, which drastically reduces women's opportunity to become self-reliant. As a consequence of absence of land-based productive system, the poverty situation has become so dire that the social fabric is about to be torn apart. The study suggested that , the state must consider gender-specific measures to either build resilience of women or reduce their overall vulnerability by draining off stagnant water from the area – even if the cost of institutional adaptation is staggering. Cost of people's suffering must be weighed against cost of adaptation [38].

Nasreen on the other hand, analyzed existing climate change adaptation policies from a gender perspective. She tried to show the inter relationship of climate change, disaster and gender in Bangladesh context and assessed experiences, contributions and adaptation strategies of women during and post disaster situations [7].

Ahsan in his study linked climate change and socio-economic vulnerability of coastal population that attempted a synergistic interdisciplinary approach to investigate vulnerability, poverty, capacity and adaptation-options, using an index, adopted from „Community-based Disaster Risk Index“ and quantified vulnerability of coastal community. However, the study was not focused on gender issue but still proved to be critical one in line with linking climate change with socio economic vulnerability using an indexing procedure [39].

Pender also assessed gendered implication of climate change in Bangladesh and provided important suggestion in line with future adaptation and mitigation strategies [20].

Another very important literature that upholds the importance of gender inclusion in relation to climate change and associated vulnerability study is been carried out by Kapoor, which precisely depicted how not only women suffering due to climate change but how various policies and social regulations create barrier in their day to day life increasing their poverty and vulnerability potential. Though the study was carried out in India, but one of the study

villages was in West Bengal, near the vicinity of the Sundarbans, so lesson learnt has the potential to be used for southwest region of Bangladesh as well. Kapoor critically analyzed Govt. policies from a gender lens and finally suggested some very useful policies and practices for gender just adaptation [10].

As stated by Aguilar, climate change does not affect women and men in the same way and it has and will have a gender-differentiated impact. Therefore, all aspects related to climate change (i.e. mitigation, adaptation, policy development, decision making) must include a gender perspective [34]. This study is not an initiative to prove women are just helpless victims of climate change; on the contrary, as taking women as powerful „agents of change“ assess how their leadership and active participation is critical for climate change adaptation and mitigation intervention.

2.3.4 Vulnerability assessment: progress so far

Vulnerability assessment provides opportunity to collect relevant information about impending risks before the event occurs so to plan program to minimize potential loss of life and property, as well as to improve the institutional systems, strengthen local community, awareness buildup, information dissemination and improved decision-making in light of risk reduction and disaster response.

After IPCC's 3rd and 4th reports were published in 2001 and 2007 respectively, the very impact of climate variability and change to climate system, ecosystem, biodiversity, plant and animal species were been linked to the adversity towards human society. The attention was drawn to vulnerability when the impact of climate change became more visible in human system. New methodology and tools were developed to assess vulnerability. This section briefly summarizes the development in vulnerability assessment.

Vulnerability assessment contributes to a greater understanding of the nature and level of risks that increase people's vulnerability and what initiative should be taken to reduce threat. Disasters cannot be solved in isolation. Nor is it possible to reduce losses from hazards unless disaster management shifts focuses to cope with the complex factors that contribute to disasters in today's environment. It is human beings, not the nature that determine whether a hazard pose a threat to the well-being of society. How people respond to both hazards and mitigation factors- will determine the nature and extent of preventative measures to be taken. It means that human beings will decide their vulnerability and capacity in the face of disasters [40]. Vulnerability assessment (VA) should be capable of directing development aid interventions, seeking ways to protect and enhance peoples' livelihoods, assist vulnerable

people in their own self protection and support institutions in their role of disaster prevention [41]. Vulnerability assessment was developed and used by development organizations and NGOs to carry out their relief programs. The Capacity and Vulnerability Assessment (CVA), the very first of this kind was designed and tested around 1980s by International Relief/ Development Project (IRDP) to make relief intervention more developmental. It is most widely known and adopted format. It assesses vulnerability and capacity against physical/material, social/ organizational and motivational/ altitudinal context. As major focus was given to aid relief intervention and disaster preparedness, thus fails to capture overall climate variability and change dimension and only gender included if is required for intervention, otherwise, it is gender exclusive [41]. Another major tool was Vulnerability and Capacity Assessment (VCA) developed by International Federation of Red Cross and Red Crescent Societies (IFRC) which was defined as diagnostic tool as well as a planning tool for response design in case of hazards and lacks mechanism to access multi-dimensional vulnerability. Oxfam International's Risk mapping is another vulnerability assessment tool that acknowledges emergencies as integral to the ongoing developmental process. The process uses a matrix format and provides a map of vulnerability to hazards. However, the tool is more focused on assessing capacity of organization/ institutions to tackle vulnerability [41]. CARE's Household Livelihood Security Assessment and DFID's Sustainable Livelihood Framework are also two famous vulnerability assessment tools used in analyzing social vulnerability which are primarily focused to people's livelihood activity. Action Aid developed Participatory Vulnerability Assessment PVA Framework that defines Vulnerability is a term used to describe exposure to hazards and shocks. Their definition of Disaster = vulnerability (internal susceptibility or defenselessness) + hazard (an external event). A disaster cannot occur if there are hazards with little or no vulnerability, or if vulnerability is high but there are zero hazards [41].

Traditional vulnerability assessment in socio-economic dimension primarily focused on assessing the impact on livelihood capitals. Participatory Vulnerability Assessments are done with Livelihood Framework Analysis (LFA) technique that was primarily focused to income generation activities largely done by men, thus shifting the primary viewpoint from other two gender roles and activities. Disaster or hazard possesses threat to developmental intervention, the LFA assess vulnerability considering the impact of disaster/ hazard on the intervention and livelihood sector. The first generation tools assess vulnerability and capacity as opposite of each other, deny the very relation between vulnerability and adaptive capacity as

established by IPCC. The shifting came after the second IPCC report SAR was published which stated, „the extent to which climate change may damage or harm a system; it depends not only on a system’s sensitivity but also on its ability to adapt to new climatic conditions“ [42]. Adger denoted that vulnerability must be contingent on estimates of the potential climate change and adaptive responses. In the mid-1990s the concept of vulnerability to climate change was constructed by Neil Adger in terms of the physical aspect. He defined „Social Vulnerability“ as exposure to stresses from exogenous risks, especially from climatic shocks that paves the way for social marginalization. The concept „Vulnerability“ is considered as a powerful analytical tool for disclosing states of susceptibility to harm, power discrimination and marginality of both physical and social systems. Neil Adger also included that vulnerability (to climate change) need to be explained through a combination of social institutional factors and environmental risks [39].

These advancement laid way for new set of tools for vulnerability assessment, capable of dealing with critical climate change scenarios. IPCC defined vulnerability to climate change as function of exposure, sensitivity and adaptive capacity, but does not present vulnerability in terms of an equation and most frameworks avoid mathematical modelling. Yates in his study explored and carefully assessed the strength and weakness of different vulnerability assessment frameworks. He mentioned that Participatory Vulnerability Assessment (PVA) of ActionAid is one of only few frameworks that combine a mathematical model with community-based data collection. Tearfund also included the quantification of risks posed by climate-related hazards. The International Institute for Sustainable Development (IISD) developed CRiSTAL (Community-based Risk Screening Tool – Adaptation and Livelihoods) as an interactive, step-by-step tool for quantifying livelihood components in relation to hazards (with no account of seasonal or projected changes), coping strategies rather than adaptation, and the impact on projects (rather than communities). Moreover, quantification is not carried forward to make an assessment of vulnerability. The World Bank also presented a methodology that quantifies vulnerability due to change and hazard in terms of existing conditions and livelihood assets. The first set of measurement indicators address the individual/household scale, and the second set explores the bio-geophysical and socio-economic impacts on the community as a whole [43].

Differences in defining the related terminologies by various tools further increase the complexity in vulnerability assessment. In the PVA methodology, exposure is defined as the experience of climate change, The World Bank and Christian Aid refer to climate risk, while

Tearfund and CRiSTAL simply focus on hazards, which may not be confined to those directly attributable to climate change. There is also divergence when the term „exposure“ is explicitly used; IUCN, defines exposure as the experience of climate change, but in practice includes the impacts of climate change as exposure. This differs from the PVA, which places impacts in the realm of sensitivity. In the PVA, sensitivity is defined as the impact of climate change – the impact of long-term seasonal change, short-term/severe climate events, and climate-related hazards/stresses. The majority of frameworks address the impacts of changes, through a hazards-based approach inherited from DRR perspectives. IUCN define sensitivity as impact, but assess sensitivity in terms of dependency on resources that are susceptible to climate change. PVA focuses on the impacts on the socio-economic and bio-physical components of a livelihood system. Adaptation is the least understood component in the frameworks. Many frameworks do not even address the capacity of a community to adapt to change, but rather take a DRR perspective to coping with hazards (e.g. CRiSTAL). In the PVA, adaptive capacity is approached through the notion of assets which is consistent with CARE International’s Climate Vulnerability and Capacity Analysis (CVCA). Simply making the assumption that a certain quantity and quality of assets equates to a certain amount of adaptive capacity oversimplifies adaptation. Adaptation is about the ways in which communities respond to and affect change, both now and in the future. Thus, a series of indicators are required that take into account the capacity to plan, make decisions, and implement decisions for effective adaptation. The majority of frameworks jump from an assessment of risk to climate related hazards to the stage of planning with the community; few seek to undertake a full adaptive capacity assessment. A notable exception is the IUCN framework for adaptation, which sets out specific indicators for adaptive capacity at the individual and community level [43].

The methods developed so far are useful in capturing social or socio-economic vulnerability to climate change. However, after the initial analysis these tools use a gender lens to provide view on gender differentiated vulnerability. These methods are gender exclusive; so to capture the full dimension of gender and gender relations during assessing vulnerability to climate change some modification need to be done in traditional way of climate change associated vulnerability assessment. The gendered climate change vulnerability assessment thus have the potential to lead us to assess the dynamic nature of gender and gender relations in line with climate change vulnerability, adaptation and mitigation, enabling profound understanding and enhanced decision making.

CHAPTER 3

METHODOLOGY AND STUDY AREA

3.1 Methodology

The study is focused to understand the gender dimension of vulnerability and adaptive capacity related to climate change associated gradual changes and disaster. In reality, a large number of population do represent gender groups, like, people from poor and extreme poor segment of society, indigenous people in various geo-physical context, marginalized community, people living in char lands and other climate vulnerable area, children, elderly, disable and women. But in general, women are disproportionately the biggest single unit that represents the gender group in all tier of population. Hence, the study provided its primary focus on women. So, from now on and in rest of the study, it is the women that were reported as gender group or otherwise stated.

3.1.1 Research design

Research differs from field to field, approach to approach and nature of work. To understand the overall dimension of gender implication, vulnerability and adaptation practices in line with climate variability and change, the study took a holistic move combining both descriptive and quantitative approach. Primary data is collected through Questionnaire Survey, Focus Group Discussion (FGD) and Key Informant Interview (KII) and analyzed with appropriate approach to enhance the study best way possible. Questionnaire survey and KII represent individual response and FGD represent community response. . Both were used in conjunction to other to provide valuable insight on the discussed matter, so overlapping into processes is very common in the study design.

3.1.2 Selection of study area and criteria

Climate change impact and associated vulnerability are context specific. Vulnerability is further closely linked with existing socio-economic condition of the specific area. Thus, superimposing the socio-economic condition on to the geo-physical context of any particular area might prove helpful in capturing overall gender dimension of climate change associated vulnerability and practiced adaptation activity of women and targeted community.

Success of any research work in social science premises depends much on the proper selection of the study area [39]. Bangladesh is identified as one of the countries most susceptible to climate change induced disasters and termed as most vulnerable to cyclone and third most vulnerable to sea level rise. In comparison to other areas of the country, coastal

areas are identified as most vulnerable to climatic impacts. For the study, past and recent disaster events have been followed and one cyclone Aila affected, Gabura union from Satkhira district was selected as study area. Detailed description of the study areas is presented in „Study area“ section of the study.

3.1.3 Research objective and methodological framework

The study is complex and requires a systematic methodology to answer the research questions/ objectives (see Section 1.3). The overall study has been divided in some carefully sequential segments, provided in Flow diagram 3.1.

Team	Steps	Activity	Community				
(Active)	Step 1	S1. Problem Identification	N/A				
		S2. Objective Elaboration					
		S3. Literature review & Study area identification Tools identification, review and modification					
		S4. Tools finalization Secondary data accumulation					
		S5. Questionnaire and FGD and KII Discussion topics preparation Statistical downscaling & scenario generation					
		S6. Training of Surveyors, Resource mobilization, etc.					
		(Passive)		Step 2	S1. Household Survey with semi structured questionnaire	(Active)	
					S2. Focus Group Discussion Key Informant Interview		
					S3. Vulnerability Assessment Exposure, Sensitivity, Adaptation capacity to CC		Need Assessment Based on generated future scenario assess the gender needs
					(Active)		Step 3
S2. Draft reporting							
S3. Final reporting							

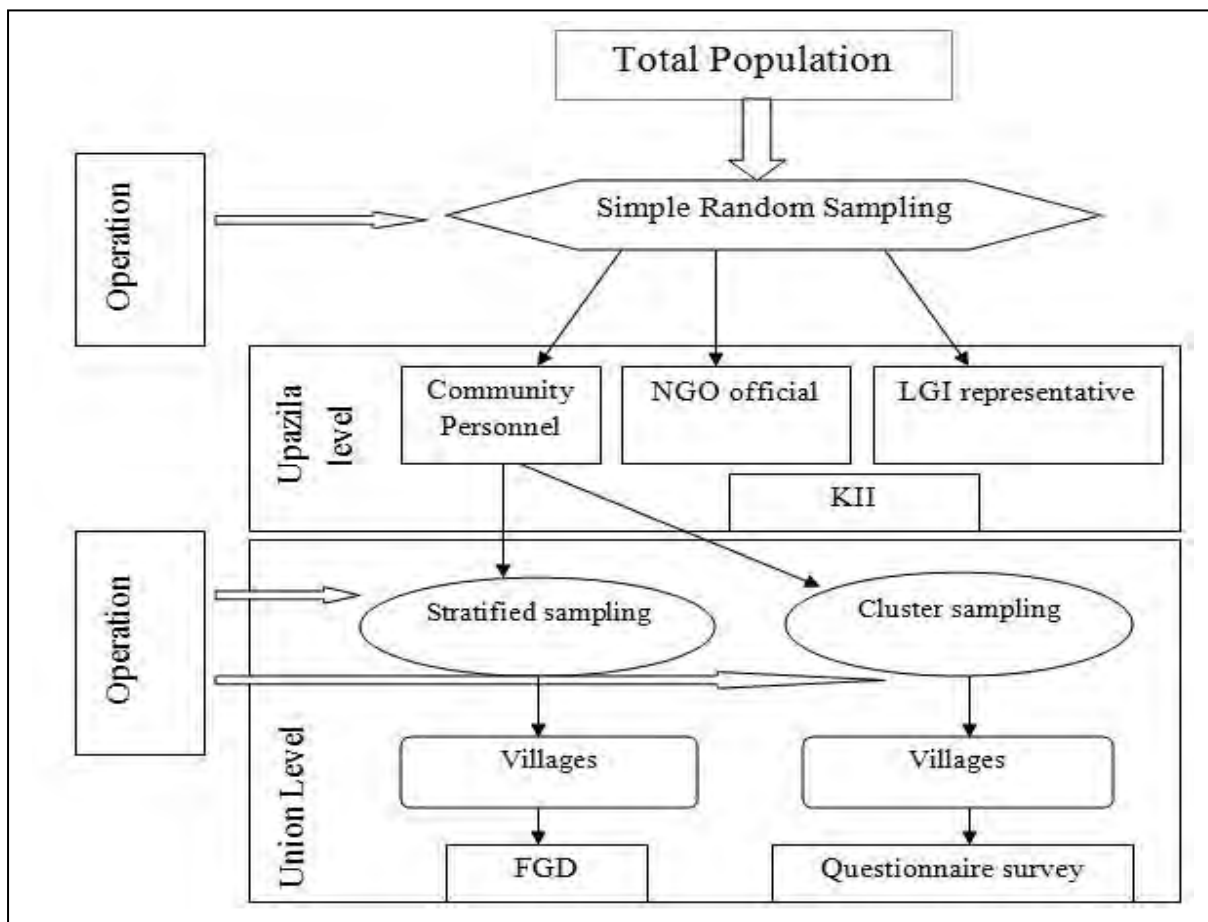
Flow diagram 3.1: Schematic diagram of research methodology

3.1.4 Data and data sources

The objective and purpose of the study, available resource and time limitation plays crucial role in data collection method and usage. For gender analysis, availability and reliability of sex-disaggregated data is critical and rare to find in pre-disaster and post disaster setting. The study used both primary and secondary data. Secondary data played vital role in describing key aspects of the problem, gendered dimension of poverty linked with natural calamity in different geo-physical context, description about study area, general climate change prediction and impact on Bangladesh. Secondary literature helped in selecting and modifying tools used in the study. The study followed Participatory Rural Appraisal (PRA) methodology for primary data collection. Household survey was carried out to get detailed information about the gender perspective of climate change. The study carried out number of KIIs and a FGD to enhance the study with in-depth understanding. Vulnerability assessment using matrix framework was also carried out in the FGD session.

3.1.5 Sampling method

The sampling had been done in two stages and both stratified and cluster sampling method had been followed for sampling purpose.



Flow diagram 3.2: Sampling technique

Only a representative subset of total population was used in the study. It can be seen from the above diagram that simple random sampling was applied in the upazila level. In union level stratified and cluster samplings were used. The former was adopted to conduct FGD and the latter was adopted for questionnaire survey of households. Hence, a „Multi-stage random sampling“ was done in the study.

3.1.6 Sample size

No established sample size determination formula was followed in the study. The length and complexity of the questionnaire format, required time, capacity of surveyor and weather condition collectively backfired during the survey. Available resource became another constrain for data collection.

Finally, the study used only 25 numbers of samples for data analysis. There were two options available during the design of questionnaire. Either to prepare a simple and small size questionnaire format that could only capture limited responses and use that for more number of households. Or prepare a long complex questionnaire format which could capture in-depth perception of the affected community but limit the number of survey households. Generally many studies follows the first option, however, this study choose the second option. The questionnaire was designed with conjunction of open ended and close ended question. During data collection once one household was picked for questionnaire survey- the very next one was chosen after ten households. Primary focus was given to areas affected in cyclone Aila and still identified as climatically vulnerable. After data collection and compilation, necessary cross checking and cleaning was carried out prior to data entry and analysis. The questionnaire survey was carried out only with women members of the community.

There was 1 Focus Group Discussion (FGD) session carried out to access community’s perception regarding climate change related issues. Total 21 female participants were present in the FGD session. Vulnerability assessment through developed matrix framework was also done in the FGD session. The study also carried out 5 Key Informant Interview (KII) sessions with selected members. The KII sessions were carried out with 1 female ward member (LGI representative), 2 sessions with local NGO representatives, 1 session with INGO/ donor representative and 1 session with local young girl.

3.1.7 Data collection

After initial development of survey questionnaire format and FGD and KII topics, pretesting was carried out in the Padmapukur union which was situated beside Gabura- the study union.



Photo 3.1: Pretesting of vulnerability assessment in Padmapukur

Total 5 questionnaire surveys, 1 FGD and 1 KII had been done for pretesting and based on the findings necessary modification had been made.



Photo 3.2: Household Questionnaire Survey

Actual data collection was carried out with hired personnel from a local NGO. One day training was arranged for the surveyor and survey coordinator (also from the same NGO).



Photo 3.3: Verification of Household Survey Questionnaire

Survey coordinator and investigator was all time in the field during the data collection and collectively cross checked 10% of the overall sample.



Photo 3.4: FGD and vulnerability assessment

The FGDs were conducted by investigator himself. Local NGO helped in organizing the FGD session. Vulnerability assessment was also carried out in the FGD session. Almost 3 hours were spent in completing one FGD session.



Photo 3.5: Key informant interview

KIIs were also conducted by investigator in the field level and in Dhaka. 4 KIIs were carried out in field level and 1 was carried out in Dhaka. The KII with the INGOs personnel was carried out in Dhaka.

The data collection was carried out during April 2012 and took more than two weeks to complete the task. After initial suggestions were generated in line with climate change adaptation and mitigation, a sharing meeting was conducted with the stakeholders and based on the feedbacks, necessary modification was done and draft and final report was prepared.

3.1.8 Socio-economic tools used in the study

This study applied two most widely used socio-economic tools with some modification as per study need and suitability of the targeted group and study area.

Harvard Analytical Framework: Gender Analytical Frameworks are defined by the process of understanding the roles of women and men in relation to what they do and what resources they have by setting questions to guide the analysis. Among them Harvard Analytical

Framework is one of the most popular frameworks. It is also known as “Gender Roles Framework” or the “Gender Analysis Framework” and was developed in Harvard Institute of International Development (HIID) in collaboration with USAID’s Office of Women in Development during 1980s [24].

Harvard Analytical Framework is divided into 4 major segments, namely, Activity profile, Access and Control Profile, Factors Influencing Access and Control profile and Project Cycle analysis and proved to be very helpful in project planning, design and O&M. Only the Activity profile and Access & Control profile was used in the study. „Climate change“ has been identified as the primary factor against „Factors influencing access and control profile“ and linked with other socio-economic implication existing in the study area. The household survey questionnaire was designed in such a way so that, these profiles were built inclusively in the question format. Additional, FGD topics were used to complement questionnaire survey regarding activity and access and control over resources.

Gender Impact Assessment (GIA) tool: Gender Impact Assessment (GIA) is the core tool for gender mainstreaming. It helps to estimate the different effects (positive, negative or neutral) of any policy or activity implemented in terms of gender equality [44]. Gender Impact Assessment developed in Netherland by Verloo, M. and Roggerband, C. is an instrument to analyze the potential impact of any strategy and policy or program in relation to gender. Also, the tool is very essential to find out the level of gender inclusion/ gender sensitivity in formulated strategy as well as major gaps in relation to gender.

Government of Bangladesh formulated National Adaptation Programme of Action (NAPA) in 2005 and revised in 2009 along with Bangladesh Climate Change Strategy and Action Plan (BCCSAP) in 2008 and modified in 2009. Gender Impact Assessment tool was applied to the national climate change adaptation and mitigation policies to evaluate the extent of gender inclusion or gender sensitivity. The study is focused to find out major gaps in adaptation and mitigation strategies in relation to gender (if any) and tried to provide recommendation for modification to be gender friendly.

3.1.9 Development of vulnerability assessment matrix

IPCC defined vulnerability in terms of exposure, sensitivity and adaptive capacity and among the most available frameworks and tools, one of the most comprehensive and holistic approach had been suggested by IUCN in „A Framework for Social Adaptation to Climate

Change: Sustaining Tropical Coastal Communities and Industries” which suggested a coupled system module for climate change induced vulnerability assessment.

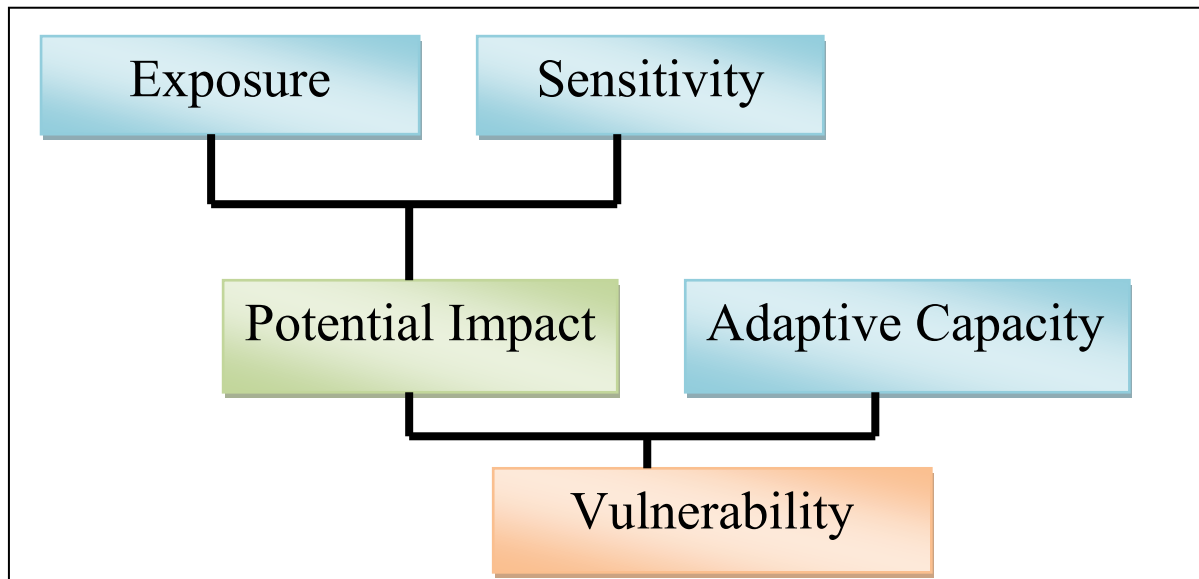


Figure 3.1: Schematic diagram of generation of vulnerability (source: adopted from IUCN, 2010)

IUCN stated that, social vulnerability to climate change can be assessed using knowledge of the three components - exposure, sensitivity and adaptive capacity. Assessments should consider vulnerability from both the individual and community scale, as there are usually important cross-scale interactions. Understanding ecological vulnerability is thus a pre-requisite to understanding social vulnerability for resource-dependent social systems. [28].

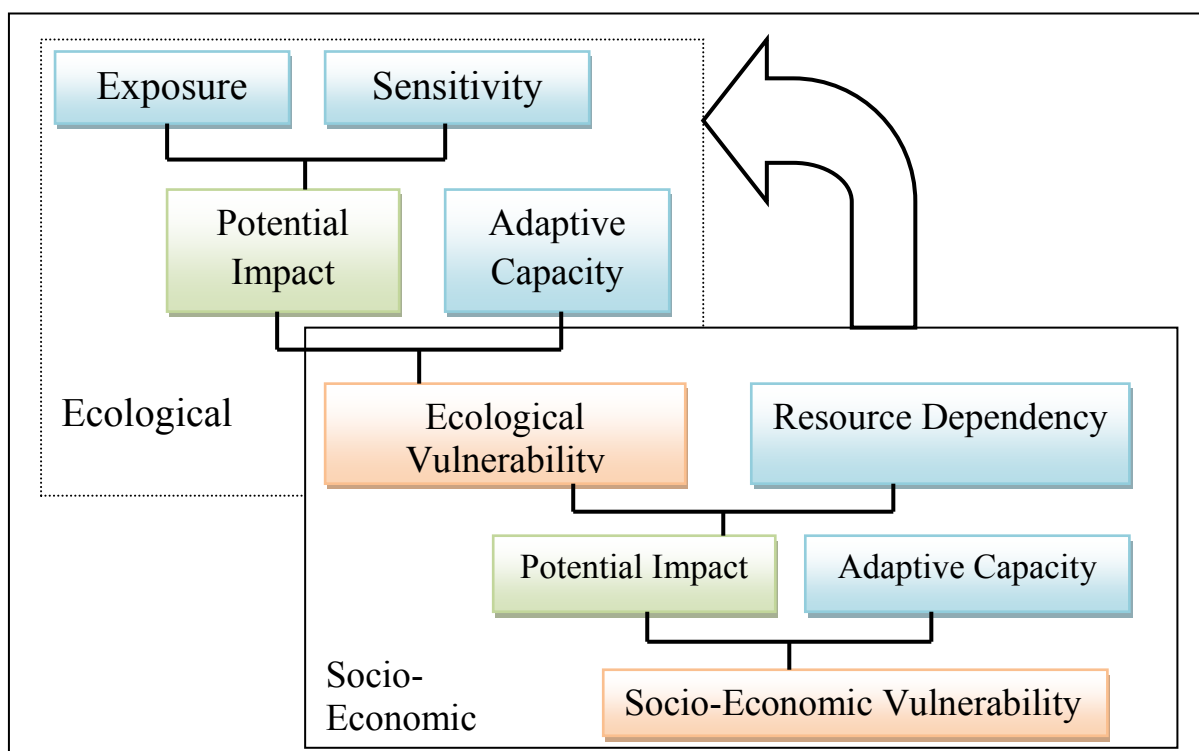


Figure 3.2: Co-dependency of ecological and social system (source: adopted from IUCN, 2010)

IUCN further assessed the co-dependency of ecological and social system and presented the idea of a coupled system that shows dynamic linkage between ecological system with social system and explicitly link ecological vulnerability with social vulnerability (Figure 3.2). The basic idea to assess vulnerability using a coupled system generated from IUCN's vulnerability assessment framework. However, IUCN framework is more like a guidebook than a rigid framework which encourages using multi-scale scientific and socio-economic tools in assessing social vulnerability to climate change. Yates, during comparing existing climate change induced vulnerability assessment frameworks, provided very useful idea for some framework design (see [43] page 20-23). The basic design of the developed matrix framework was collected from Yates" which was adopted from Regmi et al. (see [45]). The ranking system for the vulnerability assessment was incorporated from CARE Bangladesh which was field tested in RVCC project (see [36]). The basic equation for vulnerability assessment was collected from Yates" study.

One matrix was used to assess „vulnerability of water resource from user/ gender perspective“ and the other one was used to capture the „vulnerability of gender group“. There is some basic difference among the designs as two represent to separate system. But the first one can be used for vulnerability assessment of any natural system considering the user/ gender perspective while the second one could be used to assess vulnerability of any livelihood group or simply community level vulnerability. Both matrixes followed same ranking system. Exposure, Sensitivity and Adaptive Capacity is ranked with a score of 0~3 based on severity and strength of impact. In the ranking system, 0 denotes no impact and 1~3 defines impact from less to moderate and then severe. The primary equation of vulnerability assessment is:

$$“V = (E \times S) / A”----- (Eq.1).$$

Here, V= Vulnerability, E = Exposure, S = Sensitivity and A = Adaptive capacity.

The matrix helps in assessing context specific vulnerability (i.e. event wise and extreme wise) and total vulnerability (with average values of exposure, sensitivity and adaptive capacity due to events and extremes).

a. Vulnerability assessment matrix for water resources from user/ gender perspectives

To determine the vulnerability of any system to climate change impacts, it is very important to understand its exposure to gradual change and extreme events. The exposure of water resource to climate change was assessed by identifying the direct impact due to climate variability and change and additional extreme events. The sensitivity of water resource was assessed summarizing the effect due to direct impact of climate change in its bio-physical and

socio-economic regime. Climate change affects the bio-physical regime of water resources. Considering the user perspective the effect of climatic change is also felt in various socio-economic activities, linked with water resource. So, the associated effect due to direct impact of climatic change was summarized under sensitivity heading. Under adaptive capacity heading, coping activities practices in the community and available adaptation and mitigation options- were summarized and ranked as per their effectiveness. The contextual vulnerability could be assessed based on 3 contexts, namely, average seasonal/ gradual change, average extreme events and average projected change. Total vulnerability can be assessed taking average from the three contexts. Average seasonal/ gradual change had been termed as climate change events and average extreme events had been termed as climate change extremes as per modern terminology. Using the basic equation of vulnerability (Eq. 1), vulnerability assessment was completed. The context average projected change was not used due to its complexity and community's level of understanding. The vulnerability assessment matrix used to assess water resource vulnerability (from user/ gender perspectives) is given in Table 3.1.

3.1.9.2 Vulnerability assessment matrix for Gender group- women community

The vulnerability assessment matrix used to assess vulnerability of gender group, i.e. women lies in the concept of Sustainable Livelihood Framework and Harvard Gender Analytical Framework. Livelihood resources and Gender differentiated triple roles and access and control over resources was summarized as the basic coupled system, one is required to sustain and enhance other. The exposure to climate change was assessed by summarizing direct impact of climate change on livelihood resources/ capitals. The associated effect on Activity and Access and Control due to climatic impact on livelihood assets was further summarized under sensitivity heading. Activity profiles were sub-divided in Productive role, Reproductive role and Community Managed role. Access and Control profile was sub-divided into Resources and Benefit. Thus, overall effect of climate change on gender differentiated triple role as well as on access and control over resources were captured. Adaptive capacity was assessed based on coping and adaptation practices. Then using the same ranking procedure (0~3) and equation (Eq. 1), vulnerability of gender group was assessed. It also has the option to provide contextual vulnerability and total vulnerability. Though the special need assessment and average projected change scenario were included with the vulnerability assessment, but for its complexity, assessment was not carried out. Vulnerability assessment matrix is given in Table 3.2.

The study assessed water resource vulnerability and vulnerability of women using „community“ as the basic scale for measurement. The basic idea behind the vulnerability assessment matrix development was to provide a tool that can capture overall gender dimension of vulnerability due to climate change impact. Community, based on their perception ranked impact (exposure), effect (sensitivity) and effectiveness (adaptive capacity). However, for more precise scientific study, ranking can be used against predefined threshold value based on climatic impact. The vulnerability assessment matrix used as a standalone tool for vulnerability assessment without deploying a large number of PRA tools and human resource. The framework can be used as a decision support tool as well.

Table 3.1: Vulnerability assessment matrix for water resource considering user/ gender perspective

Vulnerability Assessment of Water Resource																						
Context	Exposure (direct impact on water resource) [E]				Sensitivity (Sector wise impact) [S]												Adaptive capacity (Change in water use practice) A				Vulnerability (E x S)/A	
	Change in rainfall pattern	Change in water availability	Salinity intrusion	Overall Exposure	Bio-physical impact				Socio-economic impact								Overall Sensitivity	Change in irrigation practice	Alternative source of domestic water supply	Reduce shrimp cultivation		Overall Adaptive Capacity
					Impact on water recharge	Impact on In stream water demand	Impact on water quality	Impact on water dependent ecosystem	Impact on drinking water supply	Impact on Domestic water use	Standard of living	Irrigation	Navigation	Shrimp culture	Fishing	Industrial demand						
Long duration summer																						
Increased temperature in summer																						
Short duration monsoon																						
Monsoon with heavier rainfall																						
No/less rainfall in Pre-Post monsoon																						
No rainfall in Dry season																						
Erratic rainfall																						
More																						
Average seasonal change																						
Increase in flood frequency-intensity																						
Increase in drought frequency-intensity																						
Increase in cyclone storm surge frequency-intensity																						
Sea level rise																						
Water logging																						
More....																						
Average extreme events																						
More devastating flood																						
More devastating drought																						
More Sea level rise																						
More water logging period																						
More erratic rainfall																						
More...																						
Average projected change																						
Overall																						

Score: 0-3 (No, less, medium, high)

* scoring impact for each climate event and then get overall exposure and sensitivity of that event and after giving score to adaptive capacity, derive the vulnerability for such event.

** Provision for comparison between each type of changes and climate events and impacts and associated vulnerability.

Table 3.2: Vulnerability assessment matrix for gender group- women community

Context	Vulnerability assessment of Women																		
	Exposure (direct impact on livelihood capital) [E]					Sensitivity (Sector wise impact) [S]						Adaptive capacity (A)			Vulnerability (E x S) / A	Special Needs Assessment			
						Activity Profile			Access & Control profile					Special needs in emergency period (Pre & during disaster)		Special needs in emergency period (post disaster & relief distribution)	Special needs in rehabilitation and reconstruction period	Basic needs and special requirements in changed scenario	
						Productive role	Reproductive role	Community management activity	Resources	Benefit	Overall Sensitivity								
Natural capital	Human capital	Physical capital	Financial capital	Social capital	Overall Exposure	Paid employment	Income in kind	Activity (without payment)	Activity (No payment- recreation, motivational, empowering)	Resources	Benefit	Overall Sensitivity	Major coping strategy						Major adaptation strategy
Long duration summer																			
Increased temperature in summer																			
Short duration monsoon																			
Monsoon with heavier rainfall																			
No/less rainfall in Pre-Post monsoon																			
No rainfall in Dry season																			
Erratic rainfall																			
Salinity intrusion																			
Tidal surge																			
River erosion																			
More																			
Average seasonal change																			
Increase in flood frequency-intensity																			
Increase in drought frequency-intensity																			
Increase in cyclone storm surge frequency-intensity																			
Sea level rise																			
Water logging																			
River erosion																			
More...																			
Average extreme events																			
Cyclone and storm surge with higher intensity & frequency																			
Higher tidal surge																			
More devastating flood																			
More devastating drought																			
More Sea level rise																			
More water logging period																			
More warm summer & long dry season																			
More erratic rainfall																			
More river erosion																			
More...																			
Average projected change																			
Overall																			

Score: 0-3 (No, less, medium, high)
 * scoring impact for each climate event and then get overall exposure and sensitivity of that event and after giving score to adaptive capacity, derive the vulnerability for such event.
 ** Provision for comparison between each type of changes and climate events and impacts and associated vulnerability.

3.1.10 Statistical downscaling and scenario generation

GCMs held their usefulness in studying climate at global and regional scale as their coarser spatial resolution typically of the order 50,000 km² which restrict them in resolving important sub-grid scale features such as clouds and topography. Here lies the importance of downscaling that derives local scale surface weather from regional scale atmospheric predictor variables. Dynamic downscaling and Statistical downscaling are the two most widely practiced method of downscaling where statistical downscaling has some practical advantages. In situation, where low-cost, rapid assessments of localized climate change impacts are required, statistical downscaling represent the most promising option [46].

Observed data from the period of 1961-2000 has been used in statistical downscaling which was collected from Climate Change Study Cell, BUET. The meteorological data for Satkhira station had been calibrated with National Centers for Environmental Prediction NCEP data from Canadian Climate Change Scenarios Network (<http://cccsn.ca>) website. Also A2 scenario data was assessed from HadCM3 Predictors and A1B scenario data from CGCM3 Predictors, both available in same website. Statistical DownScaling Model SDSM software version 4.2.9 had been used for downscaling. Using the data, change in maximum temperature (Tmax), minimum temperature (Tmin) and Precipitation was analyzed for the period of 2040-2069 and 2070-2099 for both A2 and A1B SRES scenarios. The findings (graphical representations) were shared with women participants in FGD session. Then based on the generated future scenario, feedback were collected and summarized on practical and strategic gender needs in line with predicted future climate scenario.

3.1.11 Data input and analysis

For data entry and analysis, the whole questionnaire survey was converted from word format to excel format. Then, it was inserted in Epidata software. Data entry has been completed using Epidata version 3.1 software. However, the software is capable of working with text files less than 999 lines only so the survey format had been divided in two parts and inserted in the Epidata software. After the data entry task was completed, the data set was exported in SPSS and the two parts were merged into one. Statistical Package for Social Science (SPSS) software version 16 was used for data analysis. Exported data set from Epidata software, were coded, and then manually analyzed as per study objective in the SPSS software. For presentation and reporting purpose, the output from SPSS software further rearranged in Microsoft Excel environment. For reporting purpose, Microsoft Office package version 2007 had been used.

Qualitative data have been manually compiled, analyzed and used according to diverse issues considering the research sites.

3.1.12 Limitation of the study

The major limitations of the study are as follows:

- During the survey some respondents thought that some kind of pre-assessment was taking place for relief work. So, attempted to provide information that represented worse scenario. Some adjustment was made while compiling such data, although they are rare.
- The data collection took place in April, which was the pre-monsoon disaster season. There were several incidence of thundering typhoon in the area during the data collection. Storm with heavy rain also hampered the household survey. Also, due to a 3 day long political strike data collection suffered and the team had to run against available resource.
- Time constraint had always been a great challenge for the study.

3.2 Study area

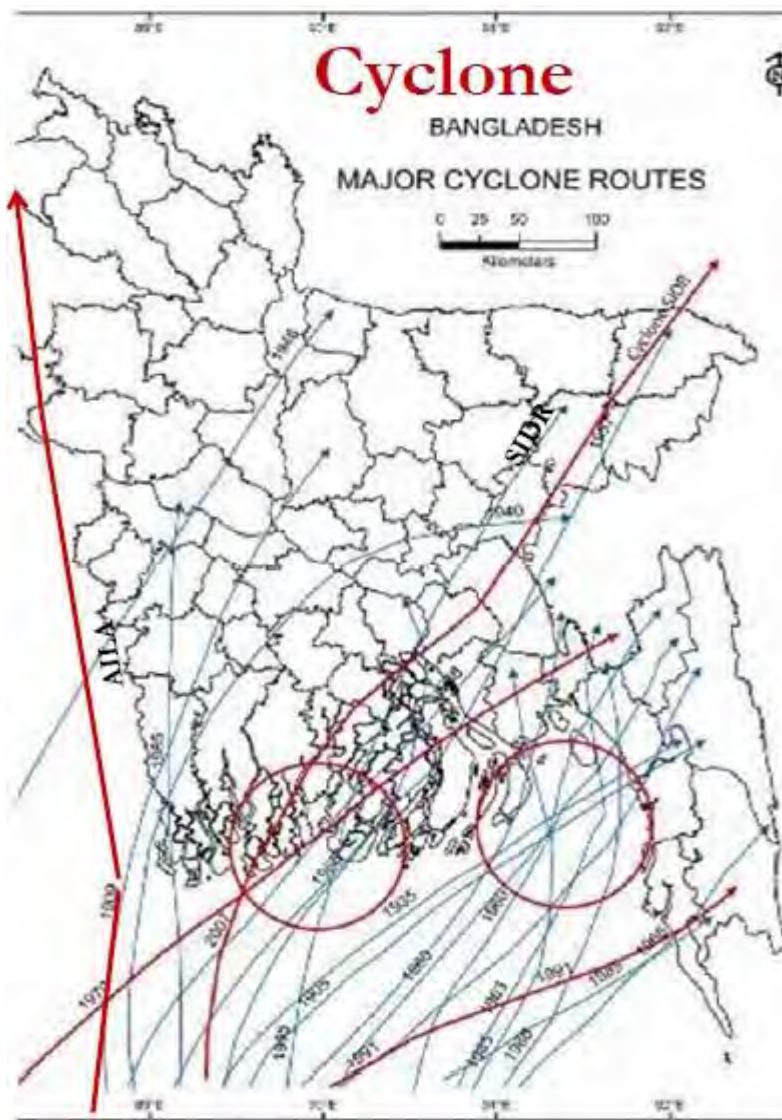
International Organization for Migration (IOM) stated that, the Aila affected communities are at the forefront of climate change: the results and learning from upholding their rights and addressing their needs will be pivotal in improving national and international strategies to address present and future challenges amplified by climate change [47]. Bangladesh has been identified as number one country vulnerable to cyclone and number third country vulnerable to sea level rise. Since 1970, Bangladesh has experienced 36 cyclonic storms resulting on over 450,000 deaths and immeasurable economic losses [48]. The coastal areas of Bangladesh comprising a total area of 42,500 sq. km (32% of the total country) and population of 35 million (around 25% of total population) [49], is the most vulnerable area to the negative impacts of climate change and sea level rise.

Country disaster portfolio and future threats had been analyzed and Satkhira was chosen for its high vulnerability potential to climate change. Satkhira was among the districts most affected by cyclone Aila. Water logging due to breaching of embankment made a long lasting impact on socio-economic activity and livelihood in the area. Salinity intrusion is also severe in the study area as well as river erosion and sea level rise.

3.2.1 Impact and aftermath of cyclone Aila

Cyclone Aila hit the west border of Bangladesh on 25 May 2009 affecting an estimated 3.90 million people in 11 coastal districts of Bangladesh. The cyclone hit during the high tide cycle that resulted tidal surges up to 22 feet high. The surge caused portions of the

embankments to collapse and people failed to evacuate. In cyclone Aila, the storm spent more time over-land than the cyclone Sidr in 2007. A total of 190 deaths have been recorded. Some 100,000 livestock were killed and over 340,660 acres of cropland were destroyed. The Government of Bangladesh reported that over 6,000 kilometers of road were damaged or totally destroyed and around 1,400 km of flood protection embankments were washed away. Cyclone Aila made 375,000 people homeless [50].



Map 3.1: Different cyclone tracks over Bangladesh along with cyclone Aila and cyclone SIDR tracks (source: BCAS, 2011)

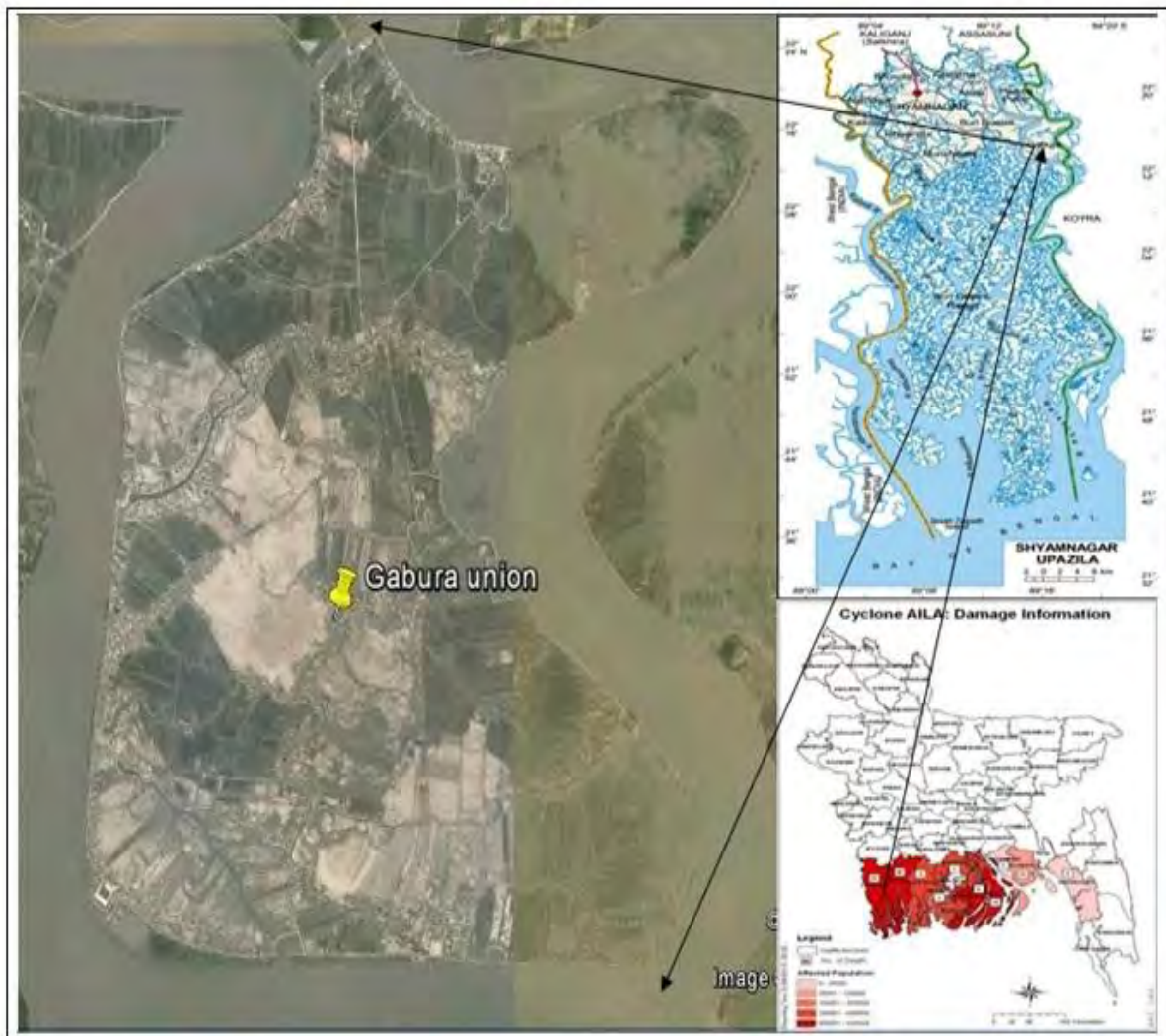
Cyclone Aila followed a typical track. The cyclone had a near-northerly movement which is quite rare (Map 3.1). In Bangladesh, generally cyclones follow eastward movement which didn't take place in case of Aila due to the presence of an anticyclone in the east. The maroon circles show the areas most affected by previous cyclones. As the occurrence of cyclonic events is uncommon in the affected area, so the impact became quite pronounced. Also various socio-economic activities common in the area significantly reduced the capacity of existing

protection works. Thus cyclone Aila became a perfect demonstration to visualize the long lasting impact that could get triggered due to any climate change induced extreme events. Therefore, the learning from cyclone Aila was given utmost importance as the climate change induced disasters are predicted to increase in future scenarios affecting socio-economic activities and development pathways of Bangladesh.

It was found that, after two years of cyclone Aila, there were approximately 54,530 individuals were still living on embankment [51]. Till to date, all the people displaced by cyclone Aila, couldn't return to their home. Before cyclone Aila approximately 47% of the land was used for agriculture which dropped to only 10%, due to long inundation of salt water over the land- lasting around 18 months. It is estimated that, salinity would not allow cultivation for a long time in the locality. Two years after Aila 21,683 households do not have access to sufficient quantity and quality of safe drinking water. The progress of recovery was insufficient and had not produced the expected results, possibly due to the lack of a comprehensive and coordinated approach. Among the areas affected by cyclone Aila, Koyra and Dacope upazila of Khulna district and Shyamnagar upazila of Satkhira are most severely damaged [51].

3.2.2 Description of the study area

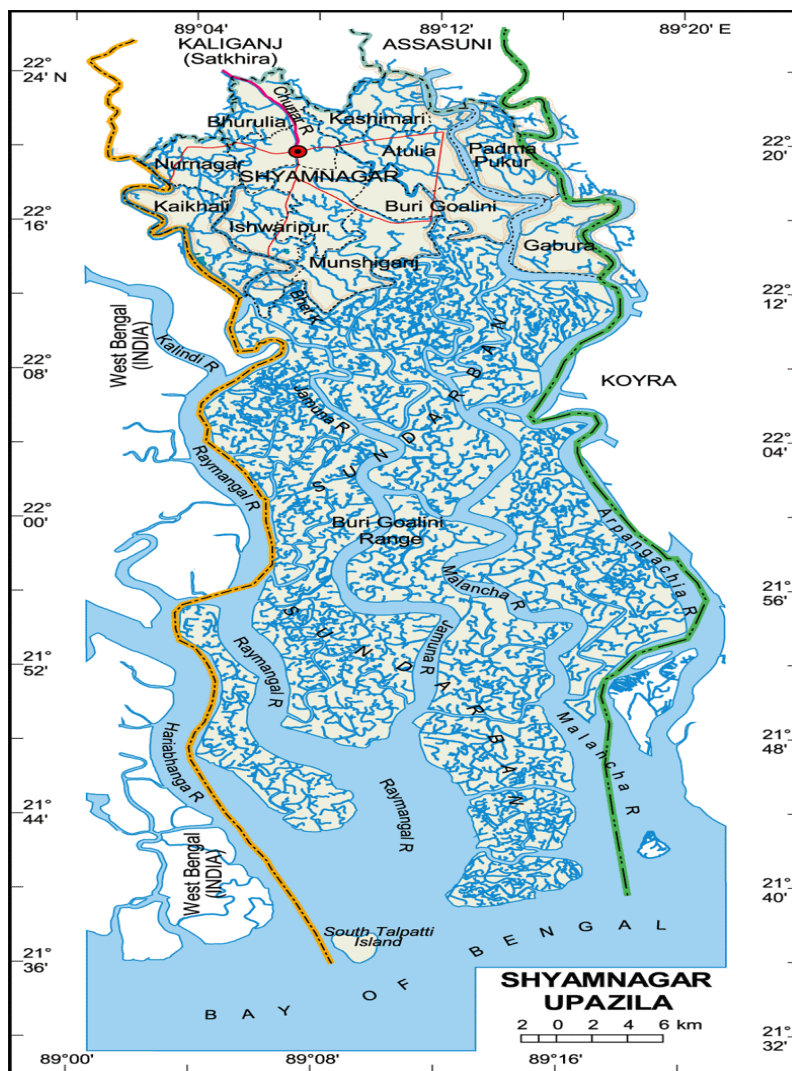
Gabura union of Shyamnagar upazilla of Satkhira district had been selected as the study area for the research work.



Map 3.2: Map of study area (Gabura union- Shyamnagar, Satkhira)

Only one union from Shyamnagar upazilla had been used for the study purpose due to resource and time constraint. Severe impact of cyclone Aila and high disaster vulnerability potential were other causes for selection of Gabura union. Map 3.2 shows the study area.

Shyamnagar Upazila: Shyamnagar upazila of Satkhira district is one the largest upazila in Bangladesh and has border with India in the west. The upazila has a total area of 1968.24 sq. km. and major rivers are Raymangal, Kalindi, Kobadak, Mother Kholpetua, Arpangachia, Malancha Haribhanga and Chuna. It was the capital of Raja Bikramaditya and Raja Pratapaditya during Sen period and famous for archeological sites. Shyamnagar was turned into an upazila in 1982. It consists of 13 union parishads, 127 mouzas and 216 villages. Total population is 2, 65,004 comprising male of 50.46% and female of 49.54%. Major religions are Muslim of 74.14%, Hindu of 25.40%, Christian of 0.06%, Buddhist of 0.01% and others of 0.39%. Ethnic nationals: Munda (Buno). Average literacy rate is 28.1% where male of 38% and female of 17.4%.

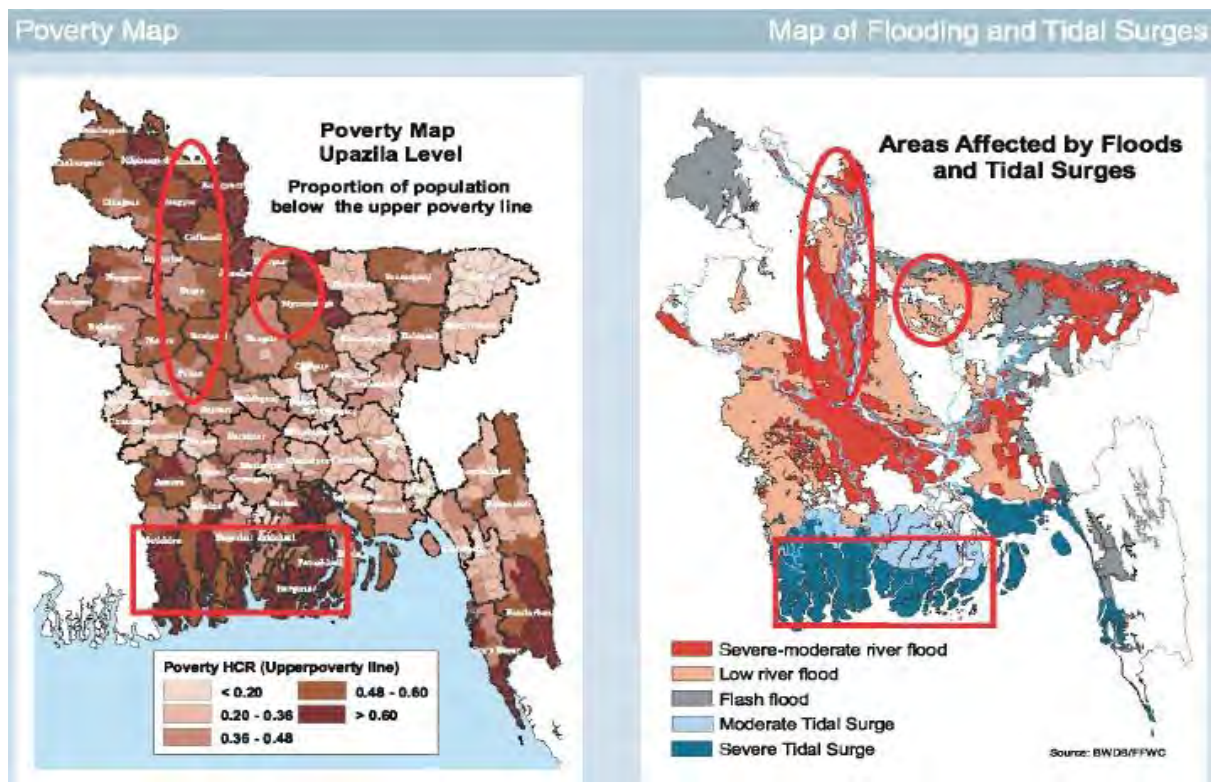


Map 3.3: Shyamnagar Upazila (source: www.banglapedia.org, 2012)

Major income generation activities are agriculture 32.93%, agricultural labor 25.81%, wage labourer 6.21%, forestry 2.34%, fishing 5.5%, transport 1.61%, commerce 10.11%, service 3.38% and transport 12.11%. Total cultivable land area is 38552 hectares, fallow land 6257.79 hectares. Land control patterns among the peasants are 19% are landless, 30% small, 28% marginal, 16.5% intermediate and 6.5% rich; cultivable land per head 0.13 hectare.

Main crops are paddy, jute, potato, linseed, sesame, pumpkin, mustard seed, kanchu and vegetables. There are 81 Poultry, 52 dairy, 29 hatcheries (poultry) situated in the upazila. Also, there are 2 printing presses, 4 ice factories, 11 saw mills are available in the area. Major export items are paddy, jute and shrimp. Important operational NGOs are BRAC, CARITAS, ASA, Sushilan, Nakshi Kantha Mohila Unnayan Sangstha, Shyamnagar Mohila Attakarmasangsthan, Setu, Bharasa [52].

Gabura union is situated in Shyamnagar upazilla of Satkhira district. The area is close to the Sundarbans forest. A major portion of population in the research areas is dependent on natural resource base of the Sundarbans for their livelihoods. However, the area is also associated with high rate of poverty and disaster vulnerability (Map 3.4) [53].



Map 3.4: Spatial distribution of poverty and disaster vulnerability (source: BBS, 2010)

In future scenario, the situation is likely to become complex due to climate change. Considering the present and future context of Gabura union, the area is used as the study site for the research work.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Data analysis and key findings

The study followed a holistic move combining both descriptive and quantitative approach in data analysis. Chapter four presents key findings related to climate change associated gender dimension of vulnerability considering both gradual changes (i.e. events) and natural disasters (i.e. extremes). This section incorporated the key aspects of various issue related to climate change, water stress, gender vulnerability and coping and adaptive strategies.

4.2 Key features of Questionnaire Survey, Focus Group Discussion and Key Informant Interview

In total, 25 questionnaires survey had been carried out in the study area. Though the number seems small, but the study found it satisfactory to depict the picture of women community in accessing the gender dimension of vulnerability along with practiced coping and adaptive strategy. Questionnaire survey was carried out with women only. Among the respondents, 92% was Muslim and 8% was of Hindu religion. The minimum age of survey respondent was 24 and maximum age was of 50 years. So, women aging from 24-50 years participated in the household survey.

The educational status of survey respondents are as follows:

Table 4.1: Educational status of survey respondents

Educational Status	Response in percentage (%)
Illiterate	16
Can sign only	56
Primary education (completed class 5)	20
Secondary education (completed class 8)	8
SSC passed	0

From the table, it could be seen that about 56% of the survey respondents (i.e. women) could sign only. Though it is a positive shift towards adult literacy, however, in reality signing the name could be attributed as „drawing the name“. Even those who sign their name are not fully aware, what they are writing as sign. Signing required for getting relief and credit assistance from NGOs is another reason behind learning how to sign (draw) their name. So, without the ability of reading and understanding, only signing could bring negative circumstance and thus should be given proper attention. It was seen that about 20% and 8% respondents completed primary and secondary education respectively. It depicts the picture that dropout rate goes high in higher level of education where no respondent could be found completed education of

SSC level. Poverty is the main reason as found in FGD. Another major reason is early marriage, when they get involved in household activities leaving schools.

In HH survey, 12% respondents found to be household head herself, while 80% are wives. In laws/ old dependent member of the household and mature children, each represents 4% in the household survey. Among the respondents in survey, 80% found to be married. Also, there were 4% unmarried respondents and divorced and widow respondents each represents 8%. Though there were abandoned females in the community, the survey failed to interview them. But their voice had been captured during FGD sessions. Among the households surveyed, 80% were single families and remaining 20% are joint families. About 92% of households have young or old age dependent person in the family. The number of dependents ranges from 1 person to as high as 8 persons in a single family. About 92% survey respondents were living in the area since their birth and the remaining 8% arrived in the area after marriage.

There were 21 female participants in the FGD session carried out in Chakbara village of Gabura union where Aila causality was 22 deaths. The study also carried out 5 key Informant Interviews (KIIs). There was 1 LGI representative (female ward member), 2 NGO representatives from local NGOs (Asroy Foundation and Noabaki Gonomukhi Foundation), Program Engineer from Islamic Relief (donor organization) and 1 community personnel (village teen age girl) were interviewed.

Key findings are described in the following sections.

4.3 Gender Status in the study area

Women were found in a complex situation comparing to their male counterparts for the gender differentiated roles and responsibilities and disproportional access and control over resources. Climate change is another added layer to increase the overall complexity, bringing newer dimensions of threat upon the already stressed community. Before going deep into exploring gender dimensions of climate change associated vulnerability and coping strategy, it is required to have some knowledge about the status of women in the area. Gender status would give an idea on how present setting is laying ground to perpetuate vulnerability due to climate change induced events and extremes.

4.3.1 Socio-economic condition and access and control over resources

The socio-economic condition denotes the social and economic strength of the population as well as the status of women in the forefront of climate change. The occupational pattern of respondents (women in our case) shows some changes over the time comparing between

current (present) time and previous (before cyclone Aila) period. This notion is followed throughout the study unless otherwise stated.

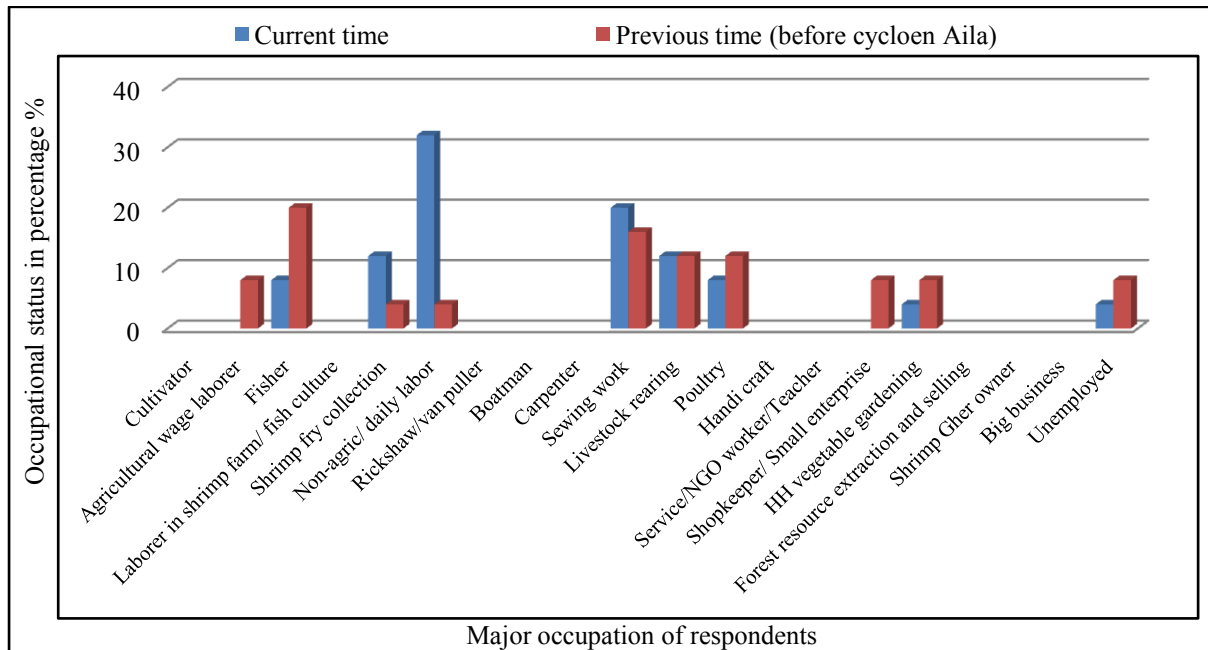


Figure 4.1: Occupational pattern of survey respondents in present time and before Aila

The shifting in occupational pattern by women is readily visible from the Figure 4.1, Major shifting happened in fishing and non-agric/daily labor activity. It is seen that cultivation was not an option for women even before cyclone Aila. Women were only involved as agricultural wage labor. Due to water logging and salinity intrusion, cultivation could not remain as a major income generation activity in the area. About 20% of women, before Aila, were involved in fishing activity, which has been reduced to 8% after cyclone Aila. At present, non-agric daily labor became the major income generation activity among women. In absence of any formal income source, women live through working in NGO/Govt. supported cash for work programs- mainly earthen works. Though the daily income is good (ranging from 120-150 taka), job is difficult to get on daily basis. NGOs involve women by rotation. Though workers are fully paid in NGO driven activities, but in Govt. implemented cash for work program, their one day's payment had to be sacrificed as bribe to officials and local leaders to enlist their name. When the work schedule gets almost finished, they are put in grave uncertainty about future source of incomes. Involvement in sewing and shrimp fry collection has been increased in post Aila. Involvement in livestock rearing remains unchanged, and has been reduced in case of poultry (duck) rearing. Ducks were affected by some unknown diseases and died with broken necks. Hence, duck rearing business incurred substantial capital loss. Continued water logging, increasing shrimp farming led to

enhanced salinity problem and replaced vegetable gardening as a source of income generation. Vegetable gardening is no more a livelihood option and gender involvement in the productive role had been reduced after cyclone Aila. Before Aila, only the household heads especially men were capable to meet all household needs. But after Aila together with the climate change, the family income shrunk and only one income from family head (men) became insufficient to meet the needs. To meet up daily family expenses, housewives were bound to be involved in outside activities. It was also found in FGD session that for increased poverty and hunger, women were forced to come out of houses and got involved in income generation activities. Many tried to show this short term income generation activities of women as empowerment. In fact, it is nothing but additional physical stress to poor women.

This study also reviewed the occupational activities of household heads or other major income earners in order to understand the socio-economic status, strength and capacity of the gender community in the study area.

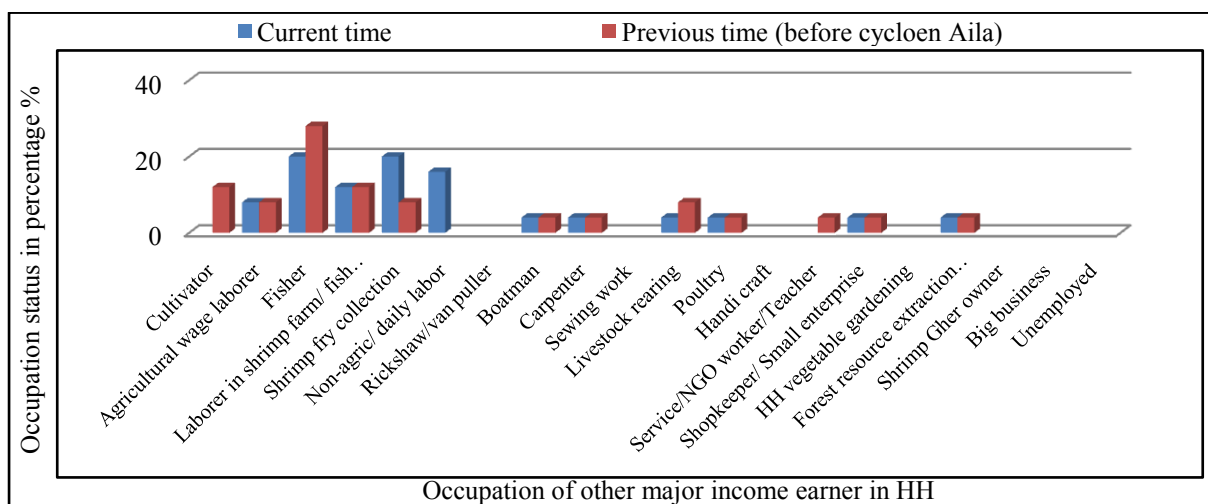


Figure 4.2: Occupation of other major income earners in present time and before cyclone Aila

Understanding the occupational pattern of other major income earners in HHs is important, as in many cases the respondents are not main income earners. The change in occupational pattern might be readily assessed from the Figure 4.2. Major changes are visible in fishing and shrimp fry collection activities. However, no change is visible in income generation activities like labor in agricultural wage, shrimp farm, boatman, carpenter, poultry, shopkeeper and forest resource extraction activities due to limited number of households studied. It could be seen that no male remained unemployed. However, Aila injured males and tiger attacked victims during forest resource extractions were found disabled and remained unemployed. In those affected families, women had to take the major burdens of income generations in case of no adult males in the family. It was also found that males often

go outside of the study area for income generation. Seasonal migration of males for income generation mainly takes place during the harvesting season in the northern and the eastern part of the country. Males also go outside to work in brick factories for a few months together. Sometimes males get married afresh in new job locations bringing increased burden, grief, conflicts in family life and above all vulnerability of women. Women, in general, are left in insecurity in absence of male members. However, such kind of income generation is not discouraged as it brings new cash flow into the family life. It was also found from FGD that child labor is a common picture in the study area

Table 4.2: Change in gender differentiated income generation activity (before and after cyclone Aila)

Income Earner	Involvement in percentage (%) in different income generation activities																			
	Cultivation	Agricultural wage laborer	Fisher	Laborer in shrimp farm/ fish culture	Shrimp fry collection	Non-agric/ daily labor	Rickshaw/van puller	Boatman	Carpenter	Sewing work	Livestock rearing	Poultry	Handy craft	Service/NGO worker/Teacher	Shopkeeper/ Small enterprise	Home stead vegetable production	Forest resource extraction and selling	Big business	Shrimp Gher owner	Other
	Before cyclone Aila																			
Male	20	4	16	28	16	4		4	4						12		4			
Female		16	4	4	12	12				20	20	60				44				
Both			40																	
	After cyclone Aila																			
Male	4		24	24	16	24		4	4						12					
Female			4		32	32				28	12	44				20				
Both	12	12	16	4	8							16				16				

The major reasons for changes in income generation activities are „natural disaster“ and „production loss due to climate variability and associated change“. The other reasons found in HH surveys are „not paying well“ and „health reason“. It was found that many of households utilize multiple sources of income generation for their livelihoods. The tendency was exacerbated after cyclone Aila and identified as coping strategy as maintaining daily life based on single income source became impossible. From the survey, women headed households were found as more vulnerable. From the Table 4.2, it is seen that occupational pattern did change before and after cyclone Aila. The gender differentiated participations in different activities are also noticeable. Involvement of both sexes was significantly reduced in

fishing activity, while was increased significantly in shrimp fry collection and in non-agric daily labor activities. Involvement of women got reduced in livestock and poultry rearing activity as both male and female members got involved in poultry rearing in post Aila stage. Women’s involvement was also substantially reduced in homestead vegetable gardening for water logging and increased salinity of soil. Multiple income sources were used just to cope with the income shortage compared to pre-Aila period.

Housing pattern and land ownership has been explored to assess gender segregated status of women. Table 4.3 shows the common housing pattern in the study area.

Table 4.3: Common housing pattern in study area

Housing pattern	Status, %
CI sheet roof brick made (semi pucca house)	0
Corrugated iron sheet roof house	20
Straw mat roof house (katcha house)	16
Polythene made temporary shelter in own land	40
Polythene made temporary shelter on embankment	24
Living in shelter	0

Though some brick made houses and some CI sheet roof brick made houses are available in the area, no survey respondent does belong to them. As primary target group of the study was women from poor and extreme poor community; the housing pattern depicts the major options available for them in the study area. Those who are comparatively well-off among the group reside in CI sheet roof house (20%). However, during FGD, it was found that many of these houses were built by NGOs during Aila rehabilitation works. Other types of housing option are the straw mat roof house (Katcha house) where straw or ,golpata (large leaf from a native tree of the Sundarbans)’ is used as roofing and fencing material. One interesting thing is that residing in these houses could be termed as coping strategy against recurring natural disasters. The golpata is cheap and easy to collect and so the rehabilitation becomes easy due to availability of material. Mud built houses, common to rural Bangladesh is not feasible for the area as they are easily washed away during storm surge or gradually deteriorate in water logging. Also, managing required earth is quite impossible as the area is facing severe river erosion in parts. They also bind the roof with nearby trees or earthen base structure/ plinth of the houses. However, majority of the households even can’t afford such type of housing. Around 40% of households living in polythene made temporary shelters in their own land didn’t get any external support or couldn’t manage money to repair house. Nearly one quarter of households (24%) still living on polythene made temporary makeshift houses on

embankments after three years had passed since cyclone Aila. It was reported in FGD session that almost 100% of houses got damaged during and after cyclone Aila. Those who couldn't repair or failed to receive support, still living on embankments with polythene and sack made houses in miserable condition. Even the materials were provided by NGOs. Those who permanently lost their land were migrated from the area. Some of them migrated to India and some went to Khulna, Satkhira, Barisal, Chittagong, Dhaka and other parts of the country. The LGI representatives also clarified that after the cyclone in 2009, the number of resident actually got lowered. The number of voter just decreased.

To understand women's access and control over resources, it is helpful to see gender differentiated land ownership pattern. The key findings are as follows:

Table 4.4: Land ownership pattern by gender

Gender	Land ownership pattern by gender in percentage %						
	Homestead	Agricultural land	Sharecropper out land	Shrimp firm	Pond/ fish culture pond	Fallow land	Other
Male	76	12			4	4	
Female	4	12				4	
Both							

It could be seen that only 4% of homestead land and 12% of agricultural land are owned by women. The remaining gap is the percentage of respondents who don't even own any homestead land. Those (20%) are the poorest of poor, the most destitute among the extreme poor segment of the community. The overall situation shows the existing gender discrimination issue in access to capital and resources. Women's less access even to homestead ownership reflects their greater vulnerability in existing socio-economic setting in the study area. It was added in FGD that the small amount of agricultural land they possess became non-productive due to cyclone induced tidal surge, high level of salinity and prolonged water logging. No production could be yield from agricultural lands and fish culture became quite impossible due to increased salinity in water bodies. Women further reported that as they lack access to hard cash, so they couldn't purchase any lands. Even, they are avoided in decision making regarding buying/ selling land even in house sphere; all the decision regarding to land or other types of capital assets are made by men.

Based on visual observation and respondents' perception, the study tried to assess the wealth wise economic classification of the study area. During the survey, the respondents were asked to classify their economic condition. Considering the length and depth of the survey format, the traditional way of wealth wise household class determination was avoided in the study.

The study simply based on visual understanding and surveyor's and respondents' perception assessed the wealth wise class ranking.

Table 4.5: Wealth wise economic status of households

Wealth wise HH class	Status in percentage %
Extreme poor	48
Poor	32
Middle class	20
Rich	0

It was found that no respondents from rich community were interviewed in survey. Interestingly, in the FGD sessions respondents reported that those who were rich in actual sense do not live in the area. They live in towns or in big cities. They were characterized as big shrimp farm owners or business man controlling fishing business. It was seen that almost half (48%) of the survey respondents fall to the extreme poor segment whereas around one-third (32%) fall in poor category based on their economic status. FGD and KII participants also supported the survey findings. The middle classes are involved in local politics, have moderate size shrimp farms or large pond for fish culture, have shops in main land area, etc. It was reported that many middle class families became poor due to cyclone Aila whereas many poor families fall down into extreme poor category. However, in the course of the cyclone Aila, many poor families became rich using unethical or corrupt measures and political power. They biased relief distribution and rehabilitation work and changed their economic status. However, LGI respondent denied such acquisition. The respondents also told that most of them haven't eaten three meals a day after the cursed event and still there are many families that hardly afford one meal a day. The updated poverty map (Map 3.4) also support their statement considering both income and calorie intake status [see 53].

Cross checking wealth wise household class with housing condition, it was found that 100% of middle class households live in corrugated iron sheet roof house. Major housing option for poor households are straw mat roof house (37.5%), polythene made temporary shelter in own land (37.5%) and polythene made temporary shelter on embankment (25%) whereas extreme poor households live in straw mat roof house (8.33%), polythene made temporary shelter in own land (58.33%) and polythene made temporary shelter on embankment (33.33%) which shows the more vulnerable living condition of extreme poor households. Wealth wise household class was further cross checked with marital status and finding shows that women, who are unmarried, divorced and widow only belong to extreme poor category. 100% of

women belonging to poor and middle class are married whereas in extreme poor group 58.33% are married, 8.33% are unmarried, 16.67% are divorced and 16.67% are widow.

To understand women's access and control over resources and their socio-economic status, savings and loan taking tendency were analyzed to assess economic strength and range of activity. About 28% survey respondents were found to build up some savings whereas the remaining 72% couldn't afford to save anything. Major heads where savings is used are, in business, fish culture, raw material purchase, preparation for fishing, poultry rearing, emergency use, treatment purpose and house repairing. On the other hand, 80% of survey respondents do take loan to meet up their needs and remaining 20% do not take loan. The major sources of loan are mohajon, NGO, shopkeeper, relative, bank and neighbors. The interest rate varies from 5% to 15%. Loans are taken mainly due to meet up deficiency related to buying food, treatment, payback other loan or NGO installment, preparation for fishing season, buying net, boat and other raw material, sewing machine, poultry rearing, pond excavation and vegetable gardening. It was found that 100% of households belong to middle class try to build up savings. About 25% of poor households also try to sum up some savings however, household belong to extreme poor category could not afford to save anything. Loan taking is quite common in the extreme poor community and 91.67% extreme poor households do take loan to meet up day to day deficiency or for emergency use. About 62.50% and 80% households from poor and middle class also take loan respectively. Interestingly, it could be seen that loan taking tendency is higher in middle class households comparing to poor households. If the practice is cross checked with loan using heads, it would become clear that middle class families take loan to expand business or asset buildup while poor families take loan to meet deficiencies or for emergency need. How loan and savings is used shows the economic strength of the community and also depicts the more severe condition of extreme poor community. Women further reported that they had been exploited as a tool to collect loan from NGOs. They do not have any control over the loaned money. They added that as kidnapping had been increased in sea and in forest, so they take loan on emergency basis to meet the ransom amount fixed by pirates to save their dear ones.

They complained that people don't make deals with them. They can't go to outside of the area for income generation and had to go through immense hardship for earning, in absence of any stable job option in the study area. Women don't go to forest for resource extraction. They gather whatever they could in local vicinity. They have very limited access to productive system and don't have control over any resources.

4.3.2 Mobility, security, workload and working condition

There are very few brick soling roads in the study areas; no paved roads at all. Mud build roads are the major communication system which become totally muddy during the rainy season and inundate in water logging. Major transportation is motor cycle and shallow engine driven vans. Women only ride motor cycles in presence of male member, otherwise they just walk. It saves money but brings immense hardship. Women need husband's permission to go out of the villages or to NGO trainings and in income generation activities. Usually husbands do not restrict women from going to such activities as it brings money.

Women reported that social restriction had reduced after cyclone Aila. Leading life on embankment without managing any form of „parda“ (curtain, religious protocol of Muslim women to hide their face from outside males) reduced their shame and dignity. Though there were no visible religious restriction in going outside of the area for income generation, but women fear that religious pressure would be put down to their family. So, they do not prefer the option. Getting involved in Govt. or NGO implemented cash for work program reduce women's social status. People talk in their back and thought them cheap and easy to exploit. Child marriage is common and keeping aged girls in home seemed disgraceful. No marriage is commenced without dowry. Women reported that torture by their husband or members of in-laws family is also common. They said that it is their luck to become women and fell victim of such adversity. “Women's life is always floating. Either they belong to their father's house or to their husband's house. Women don't have any house to tell as their own.”

In absence of any medical facility, the poor and extreme poor community hardly gets access to any treatment opportunity. They said that maternal death rate is high and is around 10-15 death per 100 child birth. Also, around 10% child dies during their birth. As the values came only from women's perception, so it needs further verification.

Women reported that incidents of women and child trafficking though common but reduced after cyclone Aila. Insecurity is another concern for women, particularly in absence of male members of the family. The situation is even worse for divorced and abandoned women. Sexual harassment during collection work also increases their insecurity where young girls are more vulnerable. Women reported that leading life on embankments with water logged surroundings is the most disgraced condition anyone can imagine. There was no security and there was no one to care for them. Data collected from KII shows that there were many incidents of rape and sexual assault just at the aftermath of cyclone Aila. Women living on embankment fall easy victim of harassment after the nightfall. Many young girls became

pregnant after cyclone Aila. Even neighboring males tried to take advantage of the situation. Some NGO officials exploited young women during the relief distribution. However women didn't bring the issue in light as they were targeted as the culprit in such cases. In the study area, in post Aila many women were forced to take up prostitution due to poverty and lack of income generation opportunities just to feed their children in times of acute distress.

Women do all the works associated to their households. It is general perception that only males work outside and take the major responsibility of income generation. But it is an irony that though women work outside for income, even they do not value their outside income activity equal to males' income. Their contribution to family does not translate into monetary value. Women did those jobs to meet up household deficiencies and feed up children. Women have to work all day long - from very early morning to till dead night. All the collection work is done by women, even when they are sick, pregnant or newly mother. They do not have any time for their own and delay in any household task met with scolding or beating. In the field, women do equal work as men or even more as reported by KII respondents. However, the works are actually not suitable for their physique and they face immense hardship and difficulty. Also, there were no additional facilities kept in the work place considering women's requirement which further increase their suffering. Increased incidents of diseases among household members had significantly increased their workload of nursing and caring. Women reported that majority of the preparedness tasks are carried by them and it is also them who are responsible to collect the relief materials. As climate is changing, their workload is just increasing day by day, making them more vulnerable considering every aspect of their life and way of living.

4.3.3 Women and water

The study tried to explore climate change associated vulnerability on gender community (women) from two different perspectives. Climate change induced vulnerability was assessed considering climatic impact on natural resource base and on the community itself, where the natural resource taken was water resource and the community was women themselves. Women and water are closely linked- availability and quality of water thus greatly affect their overall gender differentiated roles and as well as their very safety and security. Women are the water manager in household and more or less in community sphere. Water collection, transportation, storage, utilization are women's basic responsibility. Their productive and reproductive activities greatly depend and influenced by access to water sources. The study tried to explore the gender dynamics in relation to water resource. How gender roles and

responsibilities are shaped by access to water resource and in return their usage affect the water resources in the context of a changing climate is important and explored in the study. The major sources of water and their usage in Gabura union are as follows:

Table 4.6: Water sources and associated usage in the study areas

Sectors of water usage	Source of water - (response in percentage %)						
	Deep tubewell	Shallow tubewell	Pond	PSF	Canal	River	Rain water
Drinking	60		76	20			68
Cooking	8		96	12			44
Bathing			96		4	16	
Washing	4		76		4	28	
Agriculture			32		24		60
Fisheries			8		32	48	
Livestock			44		20	4	8

Considering 100 percent response of each sector wise usage, the actual response was collected considering the sources of water. It shows the percent of population having access/collect water from the different sources. It could be seen that highest percentage of population depend on pond water for various domestic usage like, drinking, cooking bathing and washing works. The respondents added that deep tubewell is not feasible in the area due to depth of water bearing strata, rock layer obstructing water table and salinity in water. Water used from deep tubewell actually collected from the adjacent Dakhin Bedkashi union of Koyra, Khulna. The water was collected by boat using jericin, pitcher, bottle and small drum and brought into the union crossing the river.



Photo 4.1: Water collection from Dakhin Bedkashi

Pond has been identified as the main source of water for different usages. Pond Sand Filters (PSFs) become nonfunctional due to water logging, high salinity and lack of maintenance. Rain water also has been identified as a major source of drinking water. However, extreme poor community couldn't enjoy the facility as they don't have large drums to store water. So, higher incidence of poverty also resulted in people's incapability to manage storage facility for rain water utilization. Canals though used as water source for agriculture, livestock and

fisheries however, perceived as bad. River mainly used for fishing as well as washing tasks. People do bath in river finding no other alternatives. It is seen that sources are greatly influenced by climatic condition and disasters, upstream flow and salinity intrusion from the sea. Level of salinity determines their usage and any change in rainfall might increase or decrease the overall rain water harvesting potential over the study area. Due to recurring water logging, storm surge and tidal surge, deep tubewells and ponds fails to remain a source of safe water, triggering acute water stress among the community.

Considering the quality of water from different sources as per their usage, deep tubewell water was perceived as excellent to good by majority of respondents, which seemed also true for pond water due to usage by larger percentage of respondents. PSF water was identified as average quality due to limited usage. Canal water was perceived as poor to very poor by respondents whereas river water was identified as very poor by majority of respondents. Rain water also been identified as of excellent quality.

Water collection is universally one of the most distinguished gender differentiated duty that women had to bear. In a household sphere, though young children and adult male assist in the collection activity however the participation is minimal as could be seen from Figure 4.3.

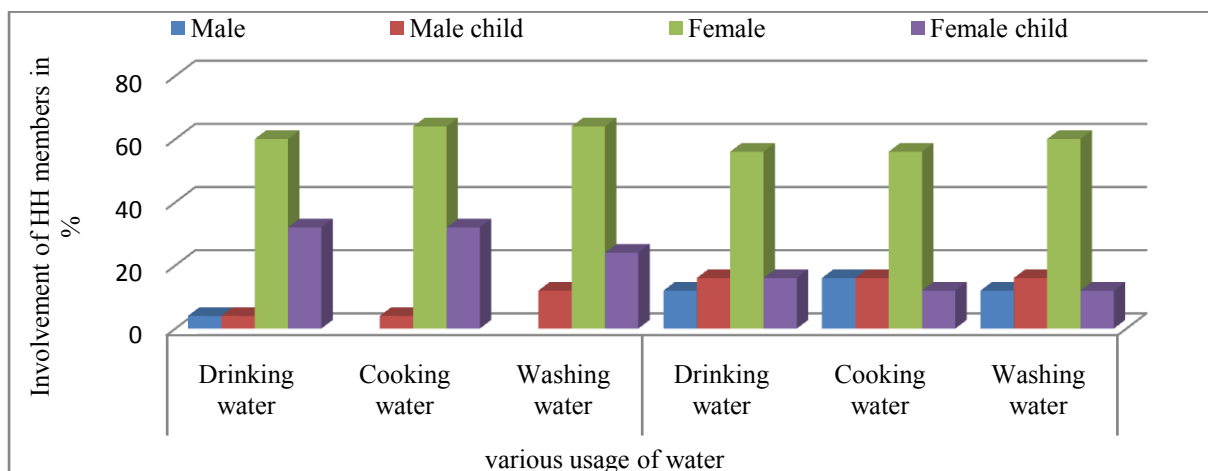


Figure 4.3: Domestic water collector in normal time and post disaster period

The figure clearly depicts women’s involvement in domestic water collection activity, which though got lowered in post disaster period is still quite high comparing to other members of the household. Interestingly involvement got reduced of young female child in post disaster period and it was reported that due to increased threat of sexual harassment and abuse into the way of collection, often women don’t allow them to go for water collection which translated into increased burden on the women herself. In post disaster period, involvement of male and

male child slightly got increased but not so significant comparing to women. Figure 4.4 shows the distance traveled for water collection in normal time and in post disaster period.

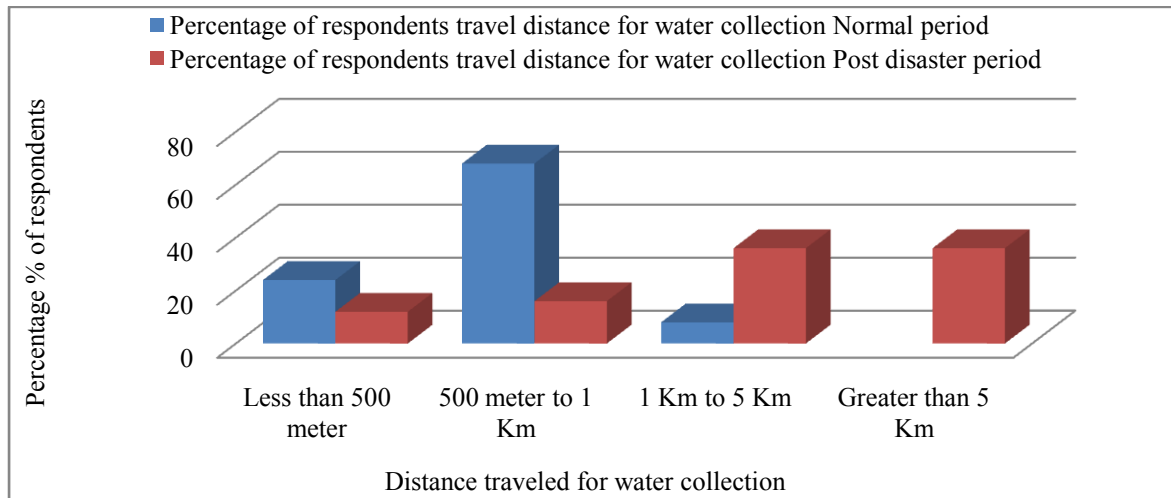


Figure 4.4: Distance travelled for water collection

The findings show that women collect water from less than 500 meter distance to as far as even from 5 kilometer distances in the two differentiated time interval. It could be seen that, majority of women collect water from a distance of 500 meter to 1 km in normal period however water access become difficult in post disaster period and they have to travel long distances even greater than 5 km just to meet the household demand. Crossing hip to shoulder high water for collection purpose also another complexity they had to face. Threat of harassment adds another layer of complexity upon the overall situation.

Respondents reported that open defecation became only sanitation option after any disaster took place. Hanging latrine also remains another major sanitation option in the Aila affected area. Other options are brick made sanitary latrine, sanitary pit latrine and pit latrine available to well off households. Women added that though they are forced to take open defecation, but they had to do it very early in the morning or late at night, just to maintain their privacy. Consuming the pressure whole day long is like a nightmare to them which create additional problem to their health and other activity.

Poor sanitation condition further resulted into increased rate various water borne diseases like Diarrhea, Cholera, Typhoid, Jaundice and skin irritation problem where prevalence get significantly increased after any disaster incidents. Among the water borne diseases, Diarrhea and skin irritation was identified as most problematic. Women also suffer from various gynecological problems due to leading their life in marooned condition. Although some studies reported death from still birth problem (blue baby syndrome) due to salinity in water,

but the respondents couldn't relate any incidents. However, they informed that new born child also become victim of diarrhea and got died.

Respondents further identified the major sources of water pollution in the study area. Salinity intrusion (100%), increased height of tidal wave and overtopping of embankment (96%), water logging (96%), shrimp farming (88%) and latrine waste (48%) had been perceived as major sources of water pollution in the area. If the pollution sources are carefully checked, it could be seen that the three major sources are somehow linked with climate change scenario, where anthropogenic activity like shrimp farming further bringing additional complexity.

The respondents also suggested useful options to stop/ minimize water pollution based on their local knowledgebase and perception. Increase the height of embankment to prevent overtopping of tidal surge and stop shrimp farming had been suggested by 100% of survey respondents. Though many of them depend on shrimp farming for income generation, however, suggested that it should be stopped considering future adversity. Installation and use of sanitary latrine (72%) and construction of improved drainage system (60%) also been suggested as potential solution to prevent water pollution in the area.

4.3.4 Women after cyclone Aila

The study areas were full of greenery before Aila. There were trees, grass and livestock, people though poor were lived in harmony. But after Aila, only the roofs (of houses) were visible. Everything was just under water. The whole union went under water only in 3-4 hours, ironically, it took more than two year to remove the water. Still there are places not recovered fully. Women reported that they received the cyclone signal at night but Aila made its landfall during noon. The cyclone warning didn't benefit them, there was no Disaster Management Committee (DMC) or cyclone shelters in the area. They just tried to survive moving to wherever they could. They added that if the cyclone hit at night after dark fall, then the causality and destruction could be staggering. They received any external support after four days of cyclone Aila. There were no place for defecation and women especially those who were pregnant and elderly suffered most. There were dead animals everywhere and water so polluted and stinky that it was hard to breathe. Lacking physical strength, managing preparedness task and carrying the child made them delayed from evacuation. They got afraid watching the rushing column of water. There was reported case of heart attack just watching the incoming water. They never saw such height of water in their life time. Women said that it became tough for them to manage their cloth (sari) in the current. To keep their self dignity they can't lose their cloth. As a result many just drown away while swimming getting rapped

in their own clothing. Losing cloth means severe humiliation towards them. Water logging triggered by Aila made it impossible to bury the dead bodies. They said that Aila had made them totally shameless. Leading life on embankments had reduced their self respect and dignity. Aila have turned them into animals, they jumped and pushed one another without any sympathy just to lay their hands on relief. Afterwards the situation became even worse. There were no place to live, work to earn, savings to purchase food, trees to collect fire wood and all the water sources were polluted. Young children suffered much in diarrhea and water borne diseases and many died in absence of any treatment facility. Women reported that no one recorded how many people died in the aftermath of cyclone Aila and their sufferings failed to capture proper attention in newspapers and media. Govt. and other organizations were slow in relief distribution and whatever given was not enough. Respondents said that minimum 1% of total women died in the area in the aftermath of cyclone Aila due to lack of treatment facility. Women were and still are the major victim in any natural adversity and suffer immensely.

4.4 Climate change, water resources and vulnerability

The study would try to explore gender vulnerability from two different aspects and one would be to access the vulnerability due to climate change impact on water resource considering the user perspective. When the climate change issue was discussed in field, it was found that people are pretty aware of the term thanks to NGOs and awareness campaign. People can relate symptoms/ patterns of change to climatic variation and could provide useful insights based on their experience and knowledge that might prove important in relation to formulating climate change adaptation and mitigation policy and intervention strategy.

4.4.1 People's perception on climate change

The study didn't use complex scientific data to assess climate variability and change. The study was focused to gain people's valuable perception and tried to link that with existing literature and scientific statements for assessing climate change rather than using complex scientific dataset. This might prove beneficial from several contexts. One point is to see the strength of people's perception and compare it with existing literature to assess similarity or dissimilarity and value add to both contexts. Another point is to uphold the benefit of using local perception in the study instead of deploying critical and scientific measures which could be costly and time consuming. The third and most important point is to include community in problem identification, analyzing situation, measure vulnerability and provide suggestion so, to enhance existing knowledgebase, empower community and increase participation in

different segment of the study and in their life as well. However, the study was very careful in data dissemination so to avoid complexity in their ever so critical life.

It was quite interesting to see that almost 100% of respondents in household survey informed that they notice changes in their climate. The survey collected their response in order to access perceived changes in climate, summarized in Table 4.7.

Table 4.7: Perceived response on noticed changes in climate

Noticed changes in climate	Response in percentage %
Increased temperature in summer	100
Increased intensity and frequency of cyclone and storm surge	96
Increasing trend in salinity intrusion	92
Increased height of tidal wave due to sea level rise	92
Erratic nature of rainfall	80
Increased river bank erosion	80
More water logged areas	72
Long duration summer	56
Monsoon with heavier rainfall	48
No rainfall in dry season	48
Short duration monsoon	44
No/less rainfall in Pre-Post monsoon	40
More areas become prone to drought	20

Almost 100% respondents had identified that temperature had increased in summer time. About 96% identified that intensity and frequency of cyclone and storm surge had increased over the time. During data collection in pre-monsoon season, it was found that the river and adjacent sea occasionally got rougher while no.3 signal had been issued. Though, no cyclone actually generated, however, rough weather and strong wind hamper livelihood activity quite randomly. About 92% survey respondents identified the increasing trend in salinity intrusion and height of tidal wave due to sea level rise respectively. Although sedimentation deposition and gradual rise of river bed along with subsidence of land mass also contribute to increase height of tidal wave but people linked them to sea level rise which might be the contribution of awareness raising programs. Erratic nature of rainfall and increased riverbank erosion had been identified by 80% of respondents whereas about 72% perceived that more area become prone to water logging nowadays. Increased length of summer time, monsoon with heavier rainfall, no rainfall in dry season, short length of monsoon season, change of rainfall pattern in pre-post monsoon ranging from less to no rainfall and more areas going under drought is also been identified as symptoms associated to climate change.

The study team cross-checked community's perception with BMD data and it was found that respondents' perceptions regarding mentioned changes are valid to some extent. There are visibly increasing trend in Temperature (both in maximum temperature Tmax and minimum temperature Tmin) and reducing trend in Precipitation (Figure 4.7).

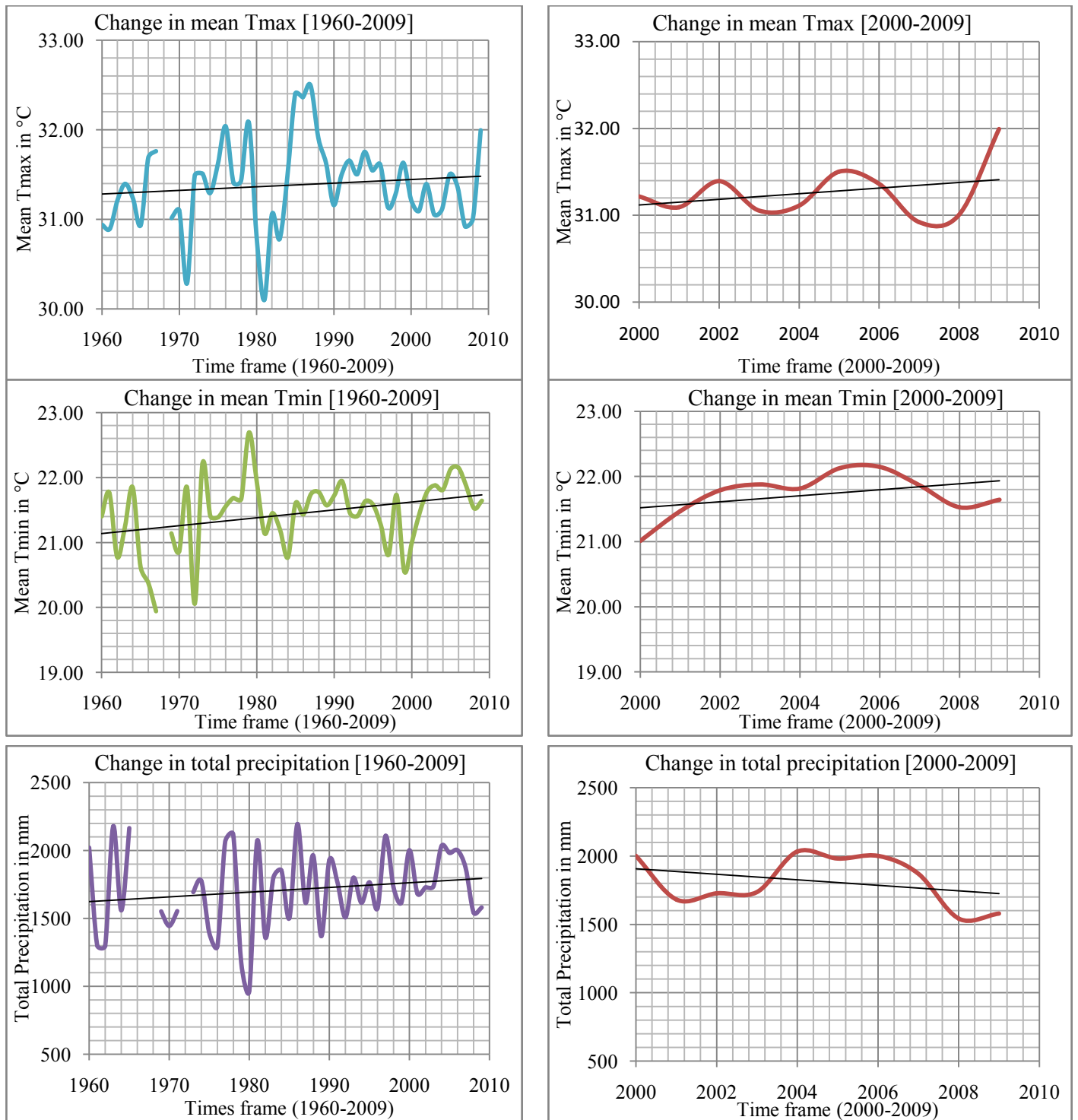


Figure 4.5: Trend in Temperature and Precipitation for time frames (1960-2009) and (2000-2009)

When the climate change issue was discussed in FGD and KII sessions, respondents informed about sensing change in last 25-30 years, which became more prominent in the new millennium and changes became quite rapid after the two consecutive cyclones (cyclone SIDR in 2007 and cyclone Aila in 2009). Previously there were six seasons but nowadays only three could be identified namely summer, monsoon and winter where summer is increasing in duration and monsoon and winter became gradually shorter. Temperature had increased in summer as well as in winter. But in winter, there came sudden cold spells for several days and the situation became relatively worse in those times. Changes in precipitation became more acute. The monsoon became shorter in duration which means, total rainfall fall in relatively short span of time- intensifying drainage congestion and water logging in the area. Pre-post monsoon becoming shorter by days and there are hardly any rainfall in dry season. However, in monsoon rain falls continuously for 2-3 days and then suddenly stops for several days and then start again. Erratic nature of rainfall hampers any type of livelihood planning. They added that after cyclone in 2009, there was very little rainfall in 2010 but intense rainfall in 2011. They linked this erratic nature of rainfall directly with climate change impact. During the discussion, they reported that they never experienced anything like cyclone Aila in their life time. The intensity and frequency of land falling cyclones had increased over the period with increased damaging power. Water logging and salinity intrusion became most severe problem in the area. Now there is salinity in both surface and ground water, as well as in soil also. Due to sea level rise, the height of tidal wave had increased. Even in winter season, when the sea remains relatively calm, the tidal waves often overtop embankments. They reported that drought was not much visible in the areas. Some parts of the study areas are experiencing severe river bank erosion and total area and land mass is decreasing by days. FGD respondents also informed that nowadays there arise sudden north-waster storms in pre-monsoon season with severe intensity. These storms generally take place in the summer. Although the suddenly formed storms are relatively short lived, but damage done was severe especially for those who live in polythene made huts on embankments. Respondents said that they have never experienced hailstone coming down along with rain during the storms in the area. The damage done by north-waster became quite worse comparing to many other extremities.

4.4.2 Impact of climate change on water resources

Climate change related studies are primarily focused to climate change associated extremes or disaster events; but there are gradual changes taking place which are shaping the climatic

behavior in a way unknown to population and hence demand for equal attention. The primary impact of climate change on Bangladesh will be on its water resources. The exposure of water resource to climate change could bring severe consequences to the country as many of its socio-economic activities depend or influenced by the resource. The exposure of water resource to climate change could be assessed by analyzing the direct impact of climate change on the resource itself. The identified major impact of climate change are, change in rainfall pattern, change in water availability and salinity intrusion. Almost 100% of survey respondents identified that the exposure of water resource to climate change become visible through change in rainfall pattern and salinity intrusion whereas 88% survey respondents perceived that change in water availability is also attributed to climate change. The study tried to assess respondents' perception on the exposure of water resource to climate change impacts with a simple ranking procedure to understand the extent of adversity.

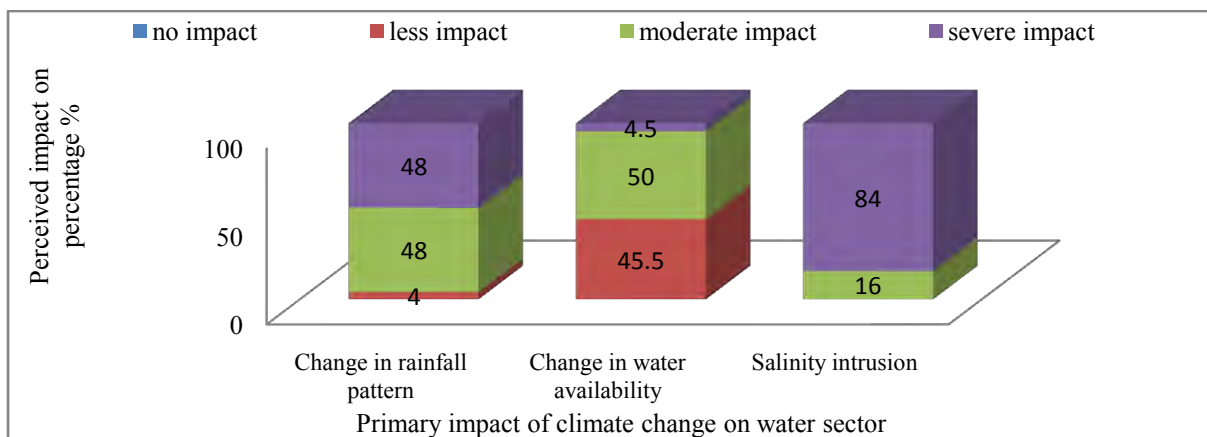


Figure 4.6: Perceived response on direct effects of climate change impacts on water resources

It could be seen that respondents identified salinity intrusion is the most severe impact of climate change on water resource due to their long last suffering, disruption of livelihood opportunities and deteriorated living condition. Change in rainfall pattern was identified as second most severe impact of climate change. Though rainfall and salinity intrusion are inversely associated, however, due to gradually increasing summer season and reduced rainfall, the salinity intrusion problem had become more pronounced. Considering both the quantity and quality of water, change in water availability had been identified as moderately impacted due to changing climate by 50% of survey respondents.

Respondents clarified that their life and livelihood primarily depend on the water resources in the area. Coastal areas are associated with multiple opportunities and threats where water resource is the most critical one for development and danger. People living here directly or indirectly linked to water resources to manage livelihood. A great portion of women's gender

differentiated triple role depends directly on water resources. Due to the negative effects on water resource due to climate change impacts they are suffering the most. Many livelihood opportunities became stopped or limited due to the climatic effects on water resource. Salinity intrusion and change in water availability is directly impacting their health and well being. The exposure of water resource to climate change impacts further define the sensitivity of the resource which had been perceived by the associated effect from direct impact on related bio-physical property of the resource itself and activities/ sectors dependent on the resource. Climate change associated impacts on water resources ultimately resulted in water stress related vulnerability. Water stress generally refers to scarcity of water. However, the study thinks that too much unwanted water in a given situation is also problematic as the quality of water often increases adverse impact on community, limit livelihood opportunity and deteriorate standard of living. Considering both aspects, the study tried to analyze the sensitivity of water resource due to direct climate change impacts.

Table 4.8: Perceived response on sensitivity of water resource due to direct impact of climate change induced water stress related vulnerability

Bio-physical property and socio-economic activity affected by climate change induced water stress related vulnerability	Perceived response in percentage %
Impact on underground water recharge	80
Impact on In stream water demand	68
Impact on water quality	92
Impact on water dependent ecosystem	100
Impact on drinking water supply	100
Impact on Domestic water use	84
Standard of living	84
Agriculture	100
Navigation	36
Shrimp culture	96
Fishing	92
Women's home stead vegetable gardening	100
Rearing of livestock and poultry	100

Table 4.8 presents the bio-physical property and socio-economic activities affected due to water stress related vulnerability because of the exposure of water resource to climate change. The response is varied however, about 100% of survey respondents perceived that water dependent ecosystem, drinking water supply, agriculture, homestead vegetable gardening, livestock and poultry rearing are surely to be affected due to climate change induced water stress related vulnerability. Respondents added that though all the properties and activities will be affected negatively, only shrimp culture will be affected positively. The study further tried to explore the sensitivity of water resource using a simple ranking procedure.

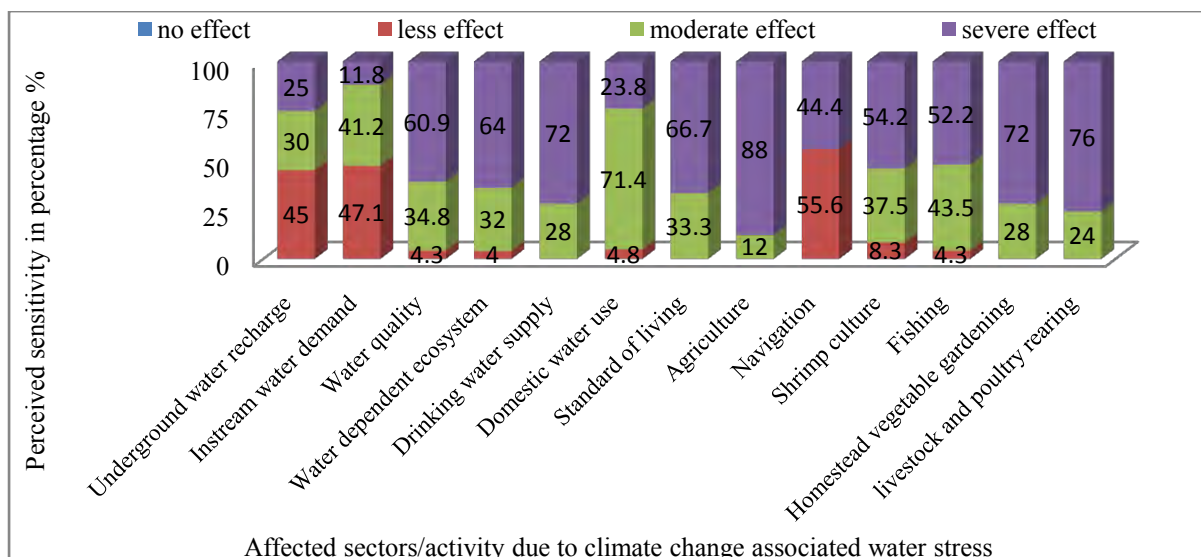


Figure 4.7: Perceived response on sensitivity of water resources due to direct impact of climate change induced water stress related vulnerability

Women, based on their experience and knowledge, perceived the potential threat on various bio-physical property and socio-economic activity due to water stress associated vulnerability. Direct impact of climate change will affect various properties of the water resource as well as sectors and activities dependent on it which is translated into sensitivity of the water resource to climate change. Some properties and activities are perceived as severely affected where involvement or dependency of women is more due to their day to day activity and income generation opportunity. However, though involvement is less comparing to male members, but considering the food security issue, about 88% respondents perceived that agriculture would be severely affected whereas 12% perceived the effect would be of moderate magnitude. Around 76% and 72% perceived that livestock and poultry rearing and homestead vegetable gardening respectively would be severely affected due to the direct impact of climate change on water resource. Also, 72% survey respondents thought that drinking water supply will suffer severely whereas the remaining percentage thought the affect to be of moderate scale. Though 44.4% respondents identified that navigation would be severely affected however, 55.6% surveyed thought it would be affected less. Though the response is varied, but in most of the cases, respondents perceived the impact would be negative and would range from moderate to severe adversity.

To fight against climatic adversity and meet domestic and livelihood demand, the community tried to cope with the situation following some simple measures. The study explored the coping strategy/ activity of local community utilized against the water stress related vulnerability generated from climate change induced direct impacts and associated effects.

Table 4.9: Practiced coping strategy/ activity related to climate change associated water stress

Coping activity against climate change associated water stress	Perceived response in %
Water collection requires more visit	32
More distance need to be travelled for water collection	84
Pond water is used for cleaning utensils and washing purpose	92
Pond-river water is used for bathing purpose in lieu of salinity	96
Young children sent for water collection hampers school going	72
Stopped rearing of livestock	40
Stopped home stead gardening	76
Change of occupation	24
Purchase drinking water	52
Rain water harvesting and utilization as alternative source	100
Decrease water use in sanitation purpose	28

The study also tried to access the effectiveness of each appointed coping mechanism using a simple ranking system through questionnaire survey. Key findings are showed in Figure 4.10.

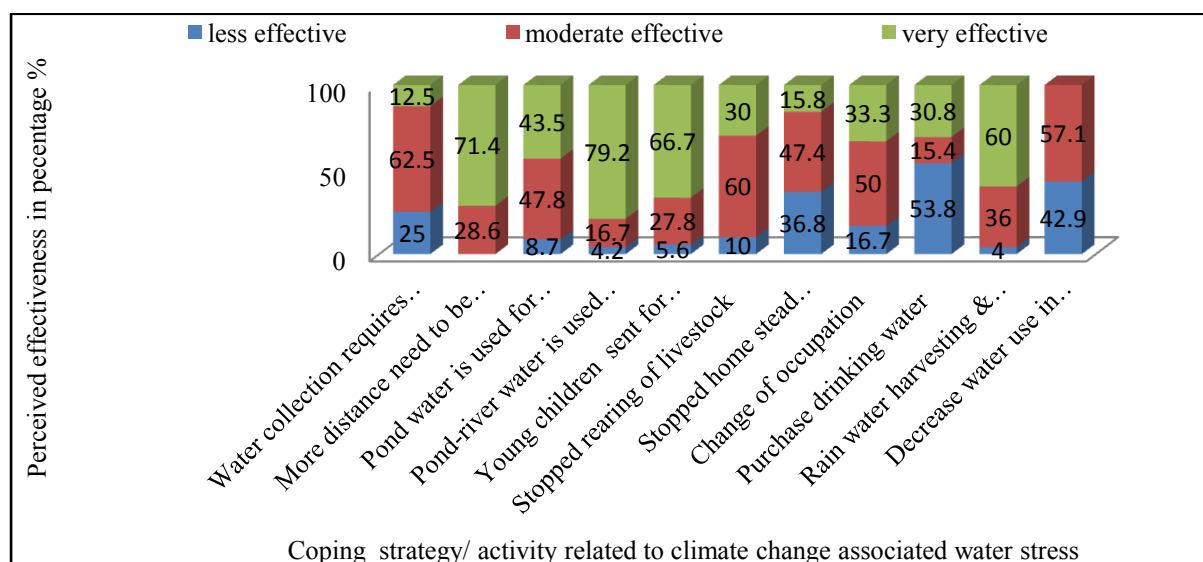


Figure 4.8: Perceived response on the effectiveness of coping strategy/ activity related to climate change induced water stress

The survey respondents identified the major coping strategies they followed against climate change associated water stress related vulnerability and further ranked the effectiveness of each activity. The perceived effectiveness of coping strategies ranged from very effective to moderate and less effective. The issue was also discussed in FGD session where respondents reported that they were forced to take the coping strategy in absence of proper assistance from proper authority. Finding no alternative they became forced to send young child in collection activity, bath on pond-river water, purchase water for drinking purpose, changed occupation, stopped livestock rearing and homestead gardening etc. They also added that though rain water utilization had increased significantly, but the poor and extreme poor

community is quite unable to use its full potential due to lack of storage facility. It was further added that rain water is not satisfactory for vegetable gardening. Walking more distance for collection purpose affected them severely. There were not enough sources on the locality; they don't have much access to many of water sources installed in rich men's houses and the gradual changes and recurring disaster events just deteriorated the water security in the area. In the situation, just to survive the adversity they are trying to use the mentioned coping activity with varied level of success and satisfaction as depicted in the figure.

The study further explored the possible adaptive measures that along with people's coping strategy could work in parallel to enhance resiliency and adaptive capacity of the water resources with providing time and opportunity that might benefit the resource and resource dependent community. Respondents identified several possible adaptive measures to reduce/prevent the negative effect/ damage on water resource due to climate change impacts.

Table 4.10: Possible adaptive measures to reduce the adverse impact of climate change on water

Adaptive measure related to climate change associated water stress	Perceived response in %
RWH and utilization in domestic activity	96
Digging of protected pond and PSF installation	88
Change in traditional irrigation practice	24
Reduce shrimp cultivation	96
Increase the height of embankment	100
Improved drainage system installation	68
Plantation of saline tolerant tree species	100

The study further tried to explore the effectiveness of the identified adaptive strategy based on community's perception. Increasing the height of embankment and reduce shrimp cultivation were perceived as most effective by almost 92% of respondents. Plantation of salinity tolerant tree species also found very effective by 72% of respondents whereas about 54.2% perceived that rain water harvesting would be moderate effective. Around 21% perceived rain water harvesting as very effective while 25% found in to be less effective. Changing traditional irrigation practice was found not effective by 16.7% respondents and digging protected pond and installation of PSF perceived as very effective adaptive measure by 45.5% survey households. The identified adaptive measures to reduce climate change induced negative impact on water resource was further discussed in FGD and though many of the respondents earn their livelihood directly or indirectly from shrimp farming agreed that it should be stopped in the area. They added that not stopping abruptly, shrimp farming should be stopped gradually in areas, where inauguration of rice cultivation should be carried out. Research and experiment is much needed to invent and popularize different salinity tolerant

tree and plant species. The community also suggested for desalinization plant where river water could be used as input to provide community with safe saline free water.

Climate change has two basic components, one is less visible gradually onset change and the other one is more visible, suddenly appearing climate change induced disasters. Respondents reported that major natural disasters that strike the study area are generally in the form of cyclone and storm surge, water logging, river bank erosion and tidal flooding. Also there is sea level rise associated to global warming and climate change. Considering the impact, severity and destruction, they placed cyclone storm surges in number one position of natural calamity that occasionally ravaged the study areas, followed by water logging and river erosion. They added that river erosion further build up sand deposition in the river and as a consequence, the height of tidal surge had increased significantly overtopping the embankment. Gradual salinity intrusion in summer time and abrupt salinity infestation due to storm surge and tidal surge associated water logging is also critical phenomenon in the area. Along with the disaster events, there is increasing trend in temperature and erratic rainfall, that in combination severely damaging the water resource in the area. To fully understand the impact of climate change on water resource, the socio-economic dimension needed to be analyzed parallel with environmental and physical scenario.

4.5 Climate change and gender groups

The impact of climate change would be disproportionately fall upon the poor and extreme poor community whose, lack of access and control over resource, dependency on natural resource and uncertainty related to livelihood and living on climate risk zones, all in combination will make them more vulnerable to climate change associated events and extremes. They have poor institutional capacity, often overlooked in development intervention and with poor governance and political conflict they remain the major victim in any natural calamity. In predicted future scenarios, when the changes in climate would be rapid and natural disasters would increase in intensity and frequency, their situation would become even worse with large scale displacement and ultimately humanitarian catastrophe.

Generally gender group refers to the poor and extreme poor community, children, old age and disable community. Among the group women are even more vulnerable. Women suffer more than men due to changing climate. On the other hand, women are the very essence of society, up bringer of life and carefully hold the advancement of society. Vulnerability of women thus translated into vulnerability of children and future generation. So, ensuring security of women especially on the backdrop of climate change has become a dire necessity.

4.5.1 Climate change and women

Climate change is not gender neutral. Climate change and induced disasters are gender specific and women experience changes differentially than men. Women are particularly vulnerable to climate change for not only from the threat of natural disasters but also due to existing social, political and religious rules that barrier and limit their access, control, movement, empowerment and preparedness. Their limited adaptive capacities arise from prevailing gender inequalities and ascribed social and economic roles; leave them highly vulnerable to the vagaries of climatic crisis. Women are almost overlooked as potential contributors to climate change solutions, which might jeopardize any effort for future sustainability, security and development as a whole.

The literature review chapter briefly discussed the gender specific vulnerability of women due to climate change. However, it was found that many of existing literature assess vulnerability based on gender differentiated productive activities only and it is quite common to overlook women, as many of their activities couldn't be transformed into monetary value. Hence, the traditional way of vulnerability assessment lacks in capturing overall gendered dimension of vulnerability in the face of changing climate. Women's reproductive and community managed activities are even more necessary comparing to their productive activity for social equilibrium and very sustenance of society itself. Additionally, climate change is different from DRR perspective as it has a component not so visible continuous gradual change in itself and the other one is more visible, sudden extreme events in the form of natural disasters. But, traditional vulnerability assessment generally assess vulnerability considering only the disaster aspects where, the adversity due to gradual changing is not properly analyzed which further limit capture women's vulnerability in true sense. To link with existing literatures, the study took a holistic approach and developed and utilized a matrix framework to assess gender dimension of vulnerability due to climate change.

4.5.2 Impact of climate change on livelihood capital

Livelihood framework suggests that poverty is not only a product of material deprivation but of a set of interlocking factors, including physical weakness, social isolation, vulnerability and powerlessness. As defined by Sobhan, extreme poor households are often denied access to traditional productive system and forced to remain in insecure, disempowered condition. Their lack of participation in social sphere not only increase their self vulnerability but also increase tension in society and become threat to the sustainability of different democratic institutions [54].

Livelihood capitals had been divided into five major types in development studies, namely, natural, physical, human, financial and social capital. Nowadays, political asset also been identified as another major livelihood capital. Access and control over resources often determine the income generation options, strength of livelihood opportunity and standard of well being. Lack of access not only underpin the community into poverty but also limit their development in all regards. Impact of climate change often intensifies the level of vulnerability among specific community. The study perceive that importance of livelihood capitals are not only attributed to income generation only, proper access and control ensure social security and status in community, influences certain well being factor of living and affect gender differentiated reproductive and community managed activity. From the viewpoint, the study tried to assess the impact of climate change on livelihood capitals.

a. Impact of climate change on natural capital

Poor community disproportionately depend on natural capitals for their livelihood generation and due to power play of local elites, political biasness and corruption, low level of governance and poor law enforcements often strictly limit their access to the capital. Among the group, women enjoy even lower access comparing to their male counterparts. Major natural capitals in the area are water resource and forest resource; however, women enjoy very limited access to water resource and collect whatever comes flowing in the river from forests. They just catch whatever they could standing in the river banks like, small fishes, crabs and shrimp fries, etc and try to collect broken branches of trees that come from The Sundarbans. The study tried to assess the impact of climate change on natural resources based on a simple ranking procedure and the key findings are summarized in Figure 4.11.

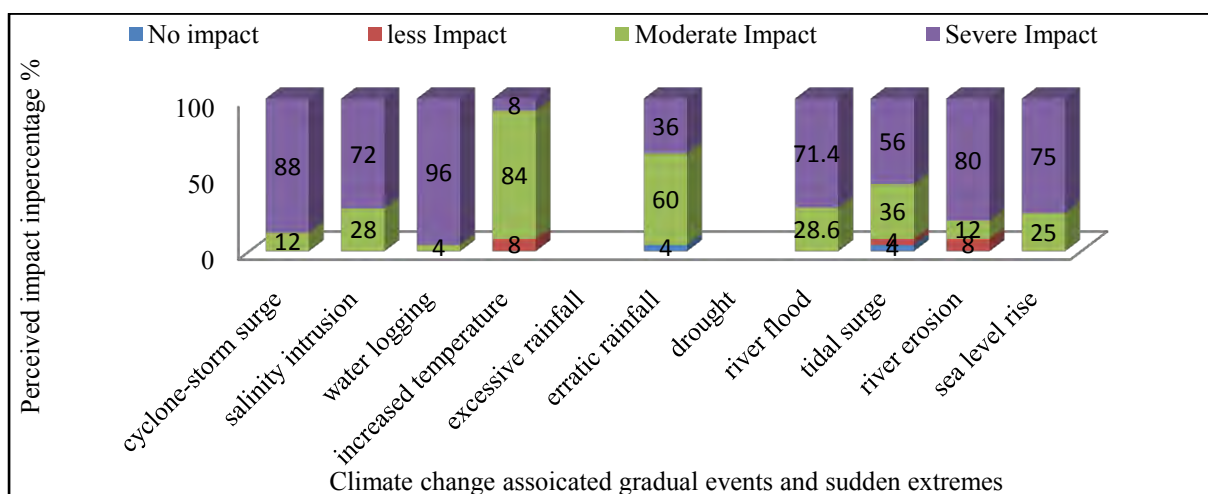


Figure 4.9: Perceived response on impact of climate change on natural livelihood capital

It could be seen that about 96% respondents perceive that climate change induced water logging is the major threat to natural capital. Cyclone storm surge and river erosion are also perceived to have severe impact on natural capital whereas sea level rise and salinity intrusion also been identified to have severe impact. During assessing the impact, women were encouraged, not only to consider the income generation but also their reproductive and community management activities also in present and future scenario. Though, respondents perceived that trend in temperature and rainfall does have moderate impact, but added that could bring catastrophic consequence in future as they directly linked to and influence, cyclone generation, salinity intrusion, water congestion, water stress, etc. Also, community considered river flood to have severe impact but only considering the future scenario; at present, river flood is not so prominent in the area. They added that the adverse impact of climate change on natural resources becoming much pronounced with the changing climate and increased intensity and frequency of natural disasters. In absence of planned intervention the impact could become totally irreversible destroying the natural resource base completely.

b. Impact of climate change on human capital

In reality the poor community only has their brute physical strength to carry out the labor intensive jobs. Health, knowledge, skill, education etc. are various components of human capital that got influenced and impacted by gradual climate change and sudden extremes.

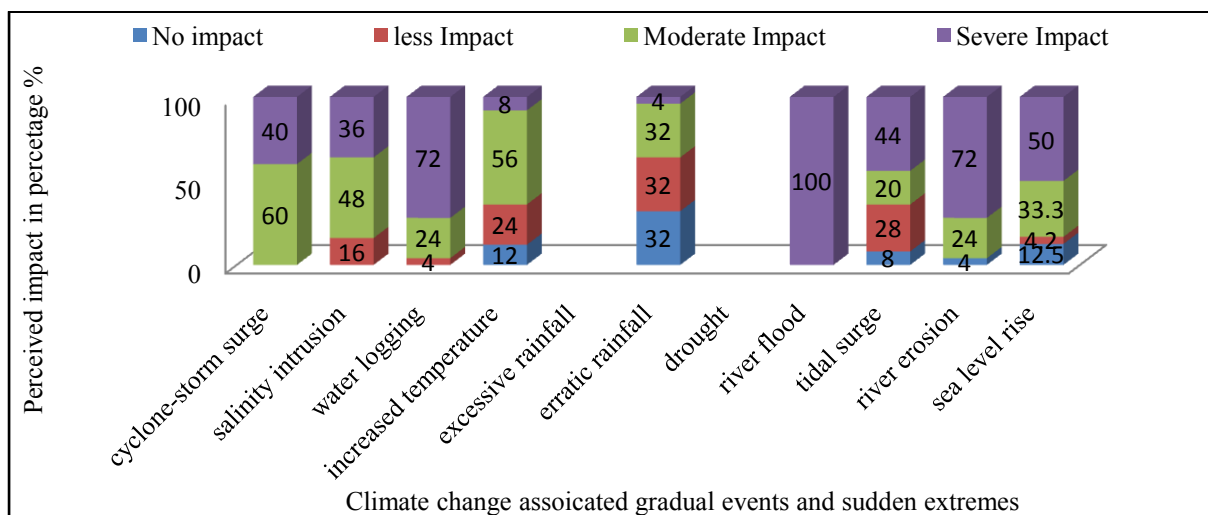


Figure 4.10: Perceived response on impact of climate change on human livelihood capital

River flood had been identified as major threat considering the future scenario, where in absence of any high residing place, distress migration might become the only alternative. River flood though not a major threat at present, but could bring severe consequence upon human capital in future. River erosion and water logging also been identified to have severe

impact on human capital. The response is varied and about 12%, 32%, 8%, 4% and 12.5% respondents perceived that increased temperature, erratic rainfall, tidal surge, river erosion and sea level rise respectively, would not have any impact on human livelihood capital at all. Women reported that even in normal condition they lack the physical strength like men due to the biological differences. Men are much stronger due to carry out heavy works in forests, fields and on deltas and seas; where women don't have access to venture. In most of the times, they remain half fed, girls children are always malnourished and of broken health due to child birth at early stages of life. They don't get any treatment if they got sick. They are restricted to learn swimming, climb trees and other important skills for surviving. They have poor access to information and education system. Considering human assets of livelihood capital they are always remained the underpinned segment of society and in the course of climate change they would be hardest hit in every aspect of life and livelihood.

c. Impact of climate change on physical capital

The area situated in one of the most remote part of the country lacks proper physical infrastructure to sustain livelihood and promote development. The major physical capital is embankment in the area, which not influences livelihood mechanism only but also provides security of the community from various natural calamities. Women further added that poor communication and road networks not only limit their mobility in line with livelihood management but also hamper security in time of disaster.

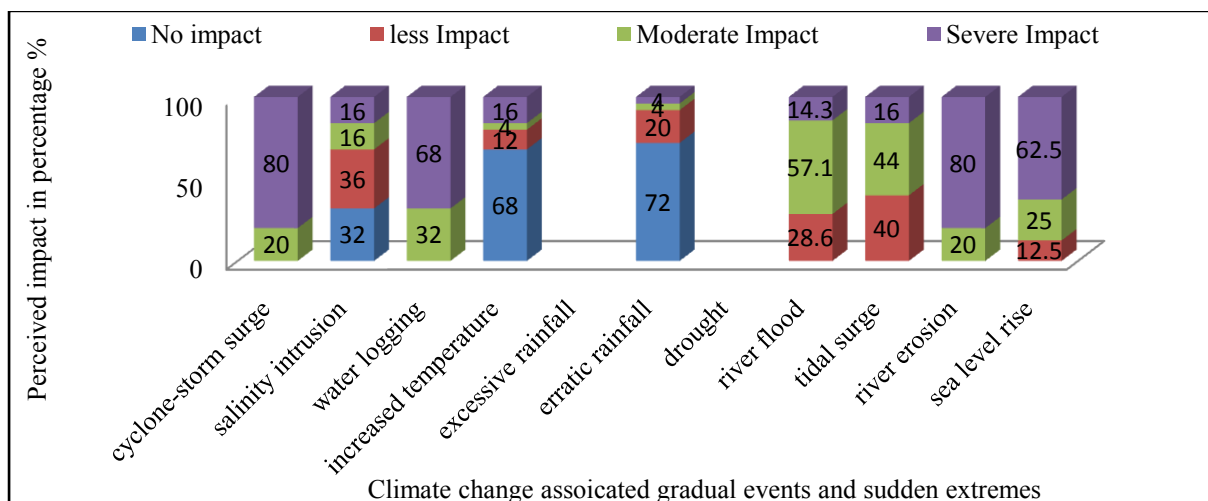


Figure 4.11: Perceived response on impact of climate change on physical livelihood capital

Majority of respondents perceived that increased temperature and erratic rainfall would have no impact on physical capital, however, climate change associated extremes like cyclone storm surge, water logging, river erosion and sea level rise would have severe impact. River flood and tidal surge also been identified to have moderate impact on physical capital

whereas, only 16% of respondents thought salinity intrusion would have moderate and severe impact respectively. Respondents in FGD and KII further added that due to combined effect of cyclone storm surge, prolonged water logging, tidal surge and sea level rise, the embankments are in poor condition which is continuously decreasing in length in unprotected areas due to river erosion. Anthropogenic activity like shrimp farming is further damaging the embankments. Though there was some development done in the aftermath of cyclone Aila regarding physical infrastructure but in absence of poor monitoring and miss-management their sustainability is questionable. They added that only the rich and elites hold access and control over the physical resources. Their lack of participation (due to being poor and women) in development also results into less willingness to get access to certain facilities.

d. Impact of climate change on financial capital

Among the major five livelihood capitals, financial capital is the one to which poor community has most limited access. The scenario for women is even worse. Their husband determines the expenditure heads. Whatever they earn goes into household consumption by default. In most cases, they can't make any deeds and mohajons and shop owners don't accept them for monetary dealings. In absence of any institutional and financial support women can't venture any new income generation options or even carry out traditional home based craft works in professional level. The poor don't have access to local banks and women can't even think about that. The only institutional facility they could avail is the MFI NGOs.

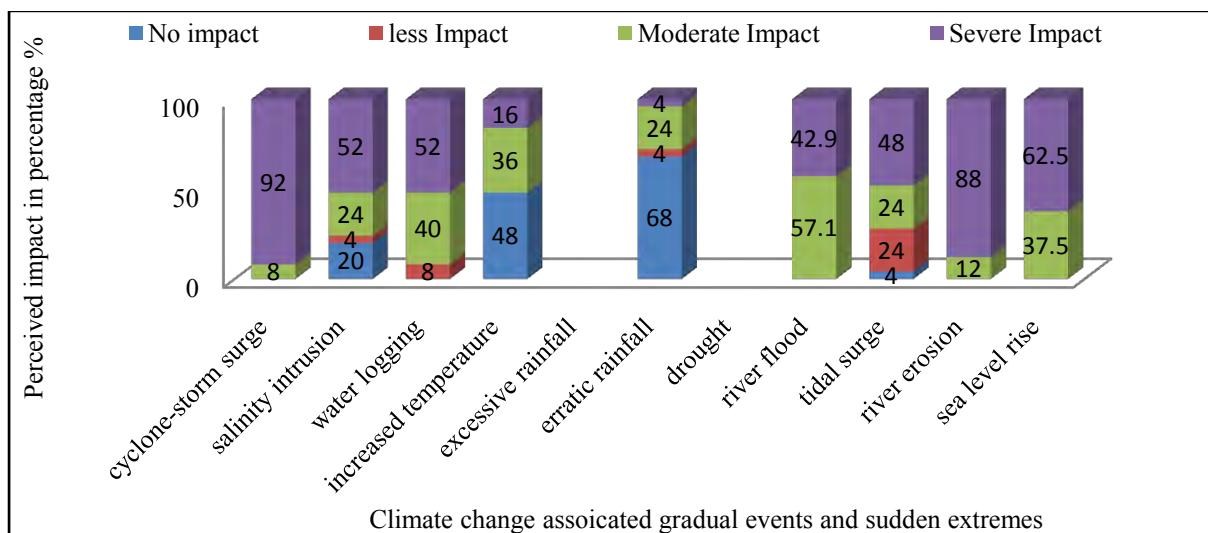


Figure 4.12: Perceived response on impact of climate change on financial livelihood capital

Cyclone storm surge, river erosion and sea level rise were perceived to have severe impact on financial capital by 92%, 88% and 62.5% respondents respectively. Almost half of the survey respondents perceived that salinity intrusion, water logging and tidal surge will have severe

impact whereas the remaining showed varied responses. About 68% and 48% respondents perceived that erratic rainfall and increased temperature would have no impact on financial capital however, around 24% and 36% respectively thought it to be of moderate magnitude. It was found that often the impact of climate change couldn't be translated into direct impact. Due to encroachment of livelihood outcome and intensified income loss due to salinity intrusion and water logging, the financial institutions showed unwillingness to sanction further loans. Community perceives this as the indirect impact of climate change. On the other hand, NGO representatives in the KII session informed that they couldn't recover the loans disbursed before Aila and due to the damage of the cyclone, they pledged to the donor organization (in this case PKSf) to make sanctioned amount free of recollection. However, the donor didn't approve the application and they feared to face great monetary loss as many of indebt families just migrated. In many cases the interest had outcome the original sanctioned amount. Another interesting fact is the inflow of money in the area due to rehabilitation work which created income generation opportunity for women community. However, the middle classes suffered much as couldn't go to such works considering their social status. That was the first time woman hold real money on their hands, which enable them some decision making power regarding the expenditure. However, some local elites and LGI representatives also ripped the benefit using power and influence and became rich.

e. Impact of climate change on social capital

Social capital is very important for poor and extreme poor community for their survival, security and sustainability. Generally social bonding and relationship is quite valued in rural Bangladesh and very important for women not just in the sense of income generation but further fulfilling their reproductive and community managed activity.

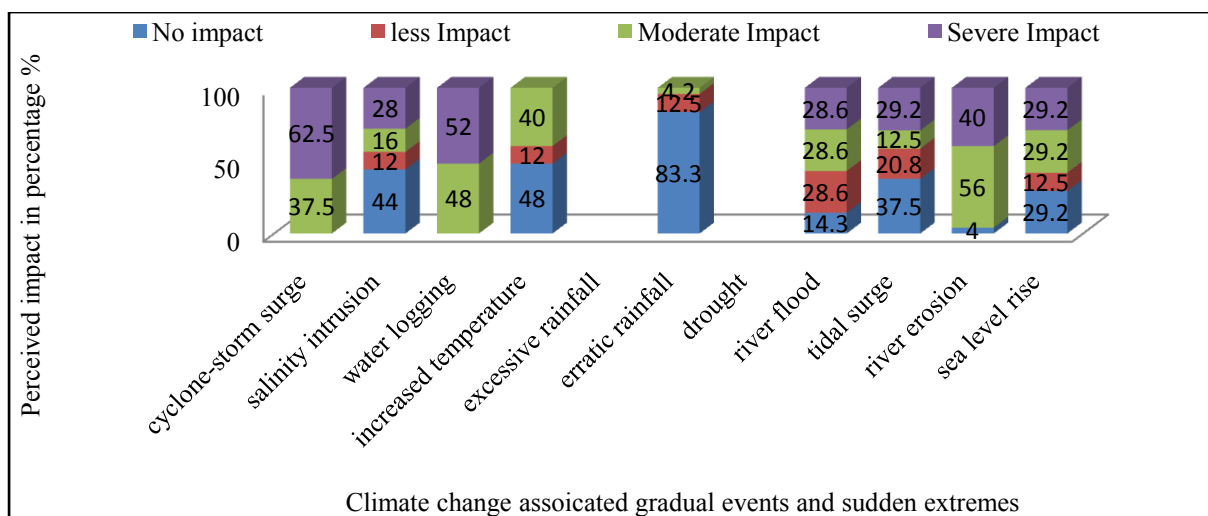


Figure 4.13: Perceived response on impact of climate change on social livelihood capital

Cyclone storm surge was perceived as severely threatening to social capital by 62.5% of respondents where the remaining thought the impact to be of moderate scale. About 52% and 40% of respondents perceived water logging and river erosion respectively to have severe impact enforcing distress migration. Respondents indicated that the ultimate impact of climate change on social capital is the forced migration. Community identified that climate change induced extreme events are comparatively more threatening than gradual changes. Respondents told that for women social capital ensures involvement in income generation activity as well as social security. However, considering other types of capital that are more visible, social capital is often assumed or perceived and hence it is very difficult to identify any impact on it especially when the contributing factor is critical and sensitive like climate change. Along with distress migration, scarcity of livelihood options and conflict over resources also the consequence of climate change that negatively impact social capital.

Cases that received below 10% response during household survey were not used in analysis. It was assumed that respondents perceive that those incidents didn't take place in the study areas to any visible extent or the impact was negligible. For this reason, drought and excessive rainfall do not show any response in the analyzed data.

f. Impact of climate change on political capital

Comparing to major five types of livelihood capitals defined by sustainable livelihood framework, political capital is more or less invisible, often perceived and has the power to influence access, control and ownership of other livelihood assets. Respondents reported that in the aftermath of any disaster events and in the course of climate change, political capital has become the most critical one for the community in presence of low level of governance and poor law enforcement. The poor community especially the women as having no access to the political sphere, identified themselves as the most vulnerable one regarding the issue.

They said that political power along with poor governance and corruption of LGI representatives and local elites are the major reason to bring the major sufferings in the area; which just intensified in the course of climate change. People after three years of Aila residing on embankments could be presented as an example as how political conflict and biasness and poor governance affect the vulnerable people and increase their suffering. Respondents described that during her visit in 2010 Sheikh Hasina, the Prime Minister had promised to construct 20,000 houses for the Aila affected victims. Oxfam in their report in 2011 confirmed that no houses were built till then [51] and when, this study was carried out (April 2012), the respondents said that still the house building had not been initiated due to

political conflict between the MP of Satkhira and Chairman of Gabura union which was confirmed by LGI representative also. People from outside, fueled the grid of local leaders and elites and with their help captured land or forcefully bought land from poor community and used in shrimp farming. Also, with the help of BWDB officials, they made a hole through embankment to install pipeline in shrimp farms which was the major reason for collapsing of embankment during Aila. Relief and rehabilitation works also been influenced by those who had control political capital. Due to the political conflict many families were not given any relief and rehabilitation support. However, the political capital only become beneficial if the party is in ruling Govt. Supporters of opposition parties became the major victim in this situation even comparing to any normal household. Women reported that they do not have any voice even in community level and can't even think to get involved in politics. However, the mere benefit they got, come from the involvement of their husbands. It also dictates that women who are abandoned or widow are even more vulnerable in terms of access to political resources. Even the female LGI representative said that their involvement in local politics is pretty much invisible. The respondents added that poor governance and law enforcement are always biased to rich and elites and being women and being poor they don't even have access to many services. Govt. rules and regulations further limit their livelihood options. They included that Govt. restricted forest resource collection and fishing in river for certain period of time. But those who have access to political capital, extract resource from forest, cut trees and do the fishing work in time active regulation. But the law enforcement agency don't take any measure against them, it is always the poor community who remain the victim.

4.5.3 Impact of climate change on productive role

The study respondents reported that climate change has severe impact on productive role and income generation activities. In the course of changing climate women are forced to come outside of household just to support their families. But due to climate change and recurring extreme events, their overall income generation is greatly reduced. Hence, most of the families try to earn from multiple sources. Only the males go to forest and make seasonal migration. The study tried to explore the impact of climate change on productive role and income generation activities using a simple ranking procedure through questionnaire survey. The figures were presented in Annex 1 Figure 1a.

Impact of climate change on productive role and income generation activity was ranked considering present complexity and potential future adversity and it was found that cyclone storm surge, water logging and river erosion- all associated with climate change extremes

were perceived as major threat to gender differentiated productive roles. However, salinity intrusion also been identified to have severe impact on various productive activities along with less to moderate scale impact of temperature increase, erratic rainfall, tidal surge and sea level rise. The impact of cyclone storm surge and water logging was perceived to be of severe scale for agriculture by 69.2% respondents. About 66.7% and 58.3% identified river erosion and salinity intrusion also to have severe consequence. For other climate change associated events and extremes the response were varied, however, in most cases response ranged between moderate to severe impact. Due to close linkage between agriculture and agricultural wage labor, the response is quite similar for agricultural wage labor activity, however with different magnitude of severity. Poor and extreme poor community earn living from wage labor activity, so for them, the impact of climate change is much severe, where 87.5% and 75% respondents identified that cyclone storm surge and water logging severely impact agric wage labor activity. Interestingly, about half of survey respondents perceived that temperature increase and erratic rainfall don't have any impact in such activity, might be due to the low level of involvement in such activity. Water logging had been identified as major barrier to non agric/ daily labor activity where 100% of participants agreed that the impact is of severe magnitude. Also, 80% and 60% survey respondents perceived that cyclone storm surge and river erosion respectively also have severe impact on non agric/ daily labor activity. Cyclone storm surge that can instantly destroy any shop and water logging that stops functioning for prolonged period had been identified as major two threats for shop keeping/ selling in bazaar activity by 100% of respondents. Considering cattle rearing, 100% respondents perceived that cyclone storm surge and water logging to have severe impact whereas about 83.5% and 50% respondents identified that salinity intrusion and river erosion respectively also have impact of severe magnitude. Fishing activity received varied response ranging from no impact, considering erratic rainfall to even severe impact due to cyclone storm surge. Salinity intrusion had been perceived to have most severe impact on homestead vegetable gardening followed by river erosion, cyclone storm surge and water logging. Also, temperature increase, erratic rainfall, tidal surge and sea level rise have severe consequences for vegetable gardening as perceived by respondents. It could be seen that only cyclone storm surge and water logging had been identified to have some severe impact on sewing activity where 100% respondents perceived that temperature increase, erratic rainfall and sea level rise do not have impact at all. River erosion had been identified to have severe impact on forest resource extraction as due to erosion, the forest area is gradually decreasing. Also, about 75% respondents identified that cyclone storm surge, salinity intrusion, water logging

and sea level rise respectively also have severe impact on such productive activity. Cyclone storm surge and salinity intrusion had been identified to have severe threat to labor in shrimp farm/ fish culture activity where threat due to river erosion, sea level rise, salinity intrusion and tidal surge is also persistent. About 95.8% respondents identified that cyclone storm surge have severe impact on poultry rearing activity, whereas 75%, 73.9% and 62.5% respondents perceived that water logging, river erosion and salinity intrusion respectively pose severe impact on the activity as well. For shrimp fry collection, water logging had been identified as major threat. During the time of water logging, most of the shrimp farms become non-operational stopping any type of earning opportunity from the activity. Also, cyclone storm surge and salinity intrusion identified as major threat on such productive activity. It could be seen that those activities where involvement of women is high are more exposed and critically sensitive to climate change associated events and extremes which depict women's increased vulnerability in the course of climate change in the future contexts.

4.5.4 Impact of climate change on reproductive role and community managed activity

Gender differentiated triple role/ activity is been divided into three major sphere where reproductive role denotes the activities performed in household sphere related to generational advancement and caring of family members whereas community managed activities are performed to run and organize community life. Reproductive and community managed roles are performed freely for the betterment of family and community. Often these activities are overlooked in traditional study and not properly recognized as no monetary value could be attributed. Gender biased views rooted to the patriarchal power play is another cause to properly assess the importance of such activities. This study denotes that women's reproductive and community managed role are very important and equally necessary (if not more) comparing to their productive activity. Considering the viewpoint, the study tried to assess the impact of climate change on reproductive role and community managed activity.

The impact of climate change on reproductive role and activities as perceived by survey respondents were presented in Annex 1 Figure 1b. Water collection is one of the most gender differentiated reproductive activity done by women. Respondents perceived that cyclone storm surge severely impact water collection activity. However, considering the associated impact of sea level rise, they gave varied response ranging from no impact to severe impact. It was perceived that even temperature increase, erratic rainfall and tidal surge also could become threatening to water collection activity. Fuel collection activity also received similar response from respondents, however, some 36%, 20%, 24% and 21.7% respondents

perceived that erratic rainfall, temperature increase, tidal surge and sea level rise respectively would not have any impact on fuel wood collection activity whereas the remaining percentage of respondents provided varied response ranging from less to severe impact. Cyclone storm surge, water logging and salinity intrusion had been identified to have severe impact on fuel wood collection. Cooking activity got severely impacted by cyclone associated storm surge and water logging perceived by 80% and 76% respondents respectively. For washing and cleaning activity, water logging had been identified to have severe impact followed by cyclone storm surge. About 65.2% and 52.2% respondents perceived that river erosion and salinity intrusion respectively have impact of moderate intensity on such activity, however, about 56.5%, 47.6%, 30.4% and 13% respondents perceived that sea level rise, tidal surge, erratic rainfall and temperature increase respectively don't have any impact at all. Control of water use would be severely impacted by cyclone storm surge, water logging and salinity intrusion as perceived by 71.4%, 57.1% and 35.7% respondents respectively. Also, river erosion could bring severe impact on water use as identified by 30.8% respondents. Caring of household members got difficult during climate change induced disasters and about 66.7%, 58.3% and 47.8% respondents perceived the impact due to cyclone storm surge, water logging and river erosion respectively have severe consequences on such activity. However, impact of gradual change is significantly less on caring of household member activity. It was found that about 88% of survey respondents perceived salinity intrusion to have severe impact on household vegetable gardening whereas 84%, 72% and 70.8% respondents identified cyclone storm surge, water logging and river erosion respectively also threatening to such activity. About 56% and 48% respondents perceived the impact of temperature increase and erratic rainfall to be of moderate intensity whereas around 16% and 20% thought it of severe intensity. Cattle rearing and fishing activity received similar response however, in case of cattle rearing, the severity of cyclone storm surge, salinity intrusion and water logging is significantly higher as perceived by respondents. Respondents reported that carrying out their gender differentiated reproductive role had become quite tough in the backdrop of changing climate. They are always overburdened with increased workload and couldn't manage any time for their own.

Community managed activities are primarily done by women. They feel that their community managed activity made them much aware, conscious and empowered in various regards. The impact of climate change on community managed activity had been summarized in Annex 1 Figure 1c. It was seen that community perceived climate change associated extreme events

are major threat to involve or participate in community activities. Attending marriage, funeral, cultural events got severely hampered by cyclone storm surge, water logging and river erosion. Climate change associated gradual changes are less threatening to such activities. However, they informed that impact of climate change on productive activity made them poor and reproductive activities increased workload that enforce less participation in community sphere. Though women are willing, however, water logging limit their mobility and hence, perceived to have severe impact on participation on VDC and WMC meetings. Respondents identified cyclone storm surge and river erosion also to have severe impact. Almost 100% respondents identified cyclone storm surge have severe impact on participation to any type of training activity organized by either Govt. or NGO. Water logging limit their movement and also identified as major potential threat. River erosion ultimately resulted into distress migration which also brings severe impact on community activity. Becoming active in Govt. or NGO implemented development activity is also severely impact by water logging where cyclone storm surge and river erosion also perceived as severely threatening.

Women mentioned that in contrast to their male counterparts, who can remain alone, women need a society for their existence and security. Hence, they remain quite active in managing community level activities. They try to carry out the collection work in group, which provide them with security. In absence of any medical facility and trained mid-wife, it was them who help one another during the time of child birth and also helps in taking care of the infant. When marriage couldn't be arranged for a girl, they try collectively to gather what they could for dowry. However, at the backdrop of climate change, their social and financial condition is deteriorating and everyone getting self centered just to survive against recurring calamities. They referred that no one can take care of another in the time of cyclone, water logging had limited their mobility and they had to remain in a state of prisoner in their own homes. Mental stress often lead to conflict and hampers social harmony. Access to the limited resources also increasing conflicts further, decreasing involvement in community managed activities. They said that climate change is a curse and no one from outside can understand how miserably they are leading their life against so much adversity.

4.5.5 Impact of climate change on access and control over resources and benefit

Women are more vulnerable not only for their high dependency on natural resources but also due to disproportionate lower access to the assets and capitals. Limited access, control and ownership of resources transformed into more exposed to climatic shocks and reduced coping capacity. One of the major reasons behind women's increased vulnerability to climate change

arises from the unequal power relations and differential access to resources and economic opportunities. It was observed that climate change associated gradual changes and sudden extremes not only hinder the gender roles but also severely affects access and control over important resources and benefits required to sustain life. The impact became intensified among the poor community who were already under stress due to limited access to opportunity. Access and control over resources not only required for income generation only, but needed for very sustenance of the family and gradual improvement. To understand the critical linkage between gender dynamics in relation to changing climate, the study explored the impact of climate change on women's access and control over resources and benefits.

Annex 1 Figure 1d and Figure 1e summarized the impact of climate change on access and control over resources and benefit respectively. Respondents perceived that climate change associated extremes have severe consequences on residential land tenure and housing tenure/condition. In both the cases, it could be seen that cyclone storm surge, water logging and river erosion had been perceived to have severe impact on their access and control to such facilities where forced migration could be the ultimate result. Considering agricultural land tenure and productivity of agricultural land, respondents perceived that salinity intrusion, water logging and cyclone storm surge have severe impact. They added that productivity loss of agricultural land had severe consequences in regard to food security, due to which they suffer. They identified that access to sanitation facility got severely affected by cyclone storm surge followed by water logging. As women, they become more affected in such occasions which further bring other health hazard towards them. River erosion had also been identified to have severe impact on access to sanitation facility. They assumed cyclone storm surge and water logging to severely affect their access to livelihood related infrastructure. Also, as production loss becomes prominent due to salinity intrusion, this could further impact on their access to such services from a moderate to severe scale. However, they perceived that their access to crop production related facility and infrastructure could only be affected by cyclone storm surge and water logging. They mentioned that their access and scope to work as labor been severely impacted due to cyclone storm surge and water logging; in time of cyclone storm surge there remain no job option and water logging reduce mobility and encroach job options. Salinity intrusion also perceived to have moderate impact as agric daily labor activity just stopped reducing income earning options in the area. Impact of climate change on livelihood capital had been discussed in details previously and this section shows how their access to livelihood capital got impacted by climate change. Considering present

scenario, majority of respondents perceived that cyclone storm surge, water logging and river erosion could have severe impact on access to education and training. They also added that considering future scenario, sea level rise also could bring severe impact on access to education and training. Cyclone storms surge, water logging and river erosion could bring severe impact on their access to health services directly and indirectly. Salinity intrusion and temperature rising could also increase rate of illness and hence expenditure. Considering their access and control over embankment facility, cyclone storm surge had been perceived as major threat followed by river erosion and sea level rise. The response is also quite similar when access to cyclone shelters had been explored. Cyclone storm surge had been identified to be the major threat on their access to such facility. However, they identified that as cyclone shelters are situated near to river shores, so river erosion and sea level rise could bring moderate to severe impact as well. Considering access to cyclone warning signal, only cyclone storm surge had been identified to have severe impact. However, they added that river erosion is significantly damaging the communication road networks and hence could have moderate impact in time of distributing cyclone warning signal. Cyclone storm surge, water logging, river erosion and sea level rise are perceived to have moderate to severe impact on communication network which could hamper their access significantly. Access to NGO implemented activity and different facility could be severely impacted by water logging followed by cyclone storm surge. They feared that due to recurring disaster events and not so good working environment due to water logging, NGOs could withdraw their work from the area. Salinity intrusion also limited different productive activity, which further enforce NGOs to stop their activity in the area. The same response goes for MFI organizations and institutions. Due to river erosion people are forced to migrate from the area making any monetary investment risky. Cyclone storm surge and water logging also jeopardize any type of investment. Hence, the MFIs are limiting their activity and community's access to such facility is becoming limited. Access to different forest resource also been severely affected by climate change. A large group of population directly depends on forest not only for income generation but also for supply of food, fuel and shelter materials. Respondents perceived that cyclone storm surge, river erosion and salinity intrusion have moderate to severe impact on their access to forest resources. Sea level rise also could bring severe impact in future scenario and gradual changes like temperature increase and erratic rainfall could also moderately impact their access to forest resources.

Climate change does not only impact on access to different resources, facilities and services but also influences their access and control over various benefits; which as a humane being they should avail or enjoy in a society for carrying out their gender defined roles and responsibilities. About 68% respondents perceived that cyclone storm surge and water logging severely impact on standard of living, where cyclone affects instantly and water logging affect slowly but gradually. They also identified that river erosion, salinity intrusion and sea level rise also affect standard of living with varied magnitude ranging from no impact to severe impact; which are also true in case of temperature increase, erratic rainfall and tidal surge. Access to asset ownership also been severely impacted by cyclone storm surge as perceived by majority of respondents followed by water logging and river erosion. Salinity intrusion and sea level rise could also bring potential threat to asset ownership. Access and participation to development initiatives are greatly affected by water logging and about 68% respondents perceived the impact to be of severe scale where the remaining respondents perceived it to be of moderate scale. About 62.5% and 60% respondents perceived that river erosion and cyclone storm surge respectively have severe impact on access and participation to development initiatives whereas the remaining ones identify the impact as moderate intensity. Cyclone storm surge had been identified as major threat to financial development followed by water logging and salinity intrusion. River erosion and sea level rise also been identified as potential threat to their access to financial development.

4.5.6 Climate change and gender differentiated vulnerability

Climate change is gender specific, men and women experience change differently with varied level of vulnerability. Different segment of society face climatic change differently. Perpetuation of poverty and lack of access and control over resources and capital often determine the resiliency of different groups in a single society. It could even expand to household sphere where different members of a family experience climatic change associated events and extremes with varied intensity. Age, sex, gender differentiated roles, etc. further exacerbate the gender differentiated vulnerability. The study tried to explore perception regarding gender differentiated vulnerability due to climate change in order to understand, who are the major victim in climate change events and extremes. Perceived response was captured on various factors that determine family/ household's standard of well being.

It was found that about 96% of survey respondents identify that male, female and children are differently vulnerable to climate change associated events and extremes. However, the

remaining 4% respondents perceived that male, female and children are equally vulnerable to climate change shocks.

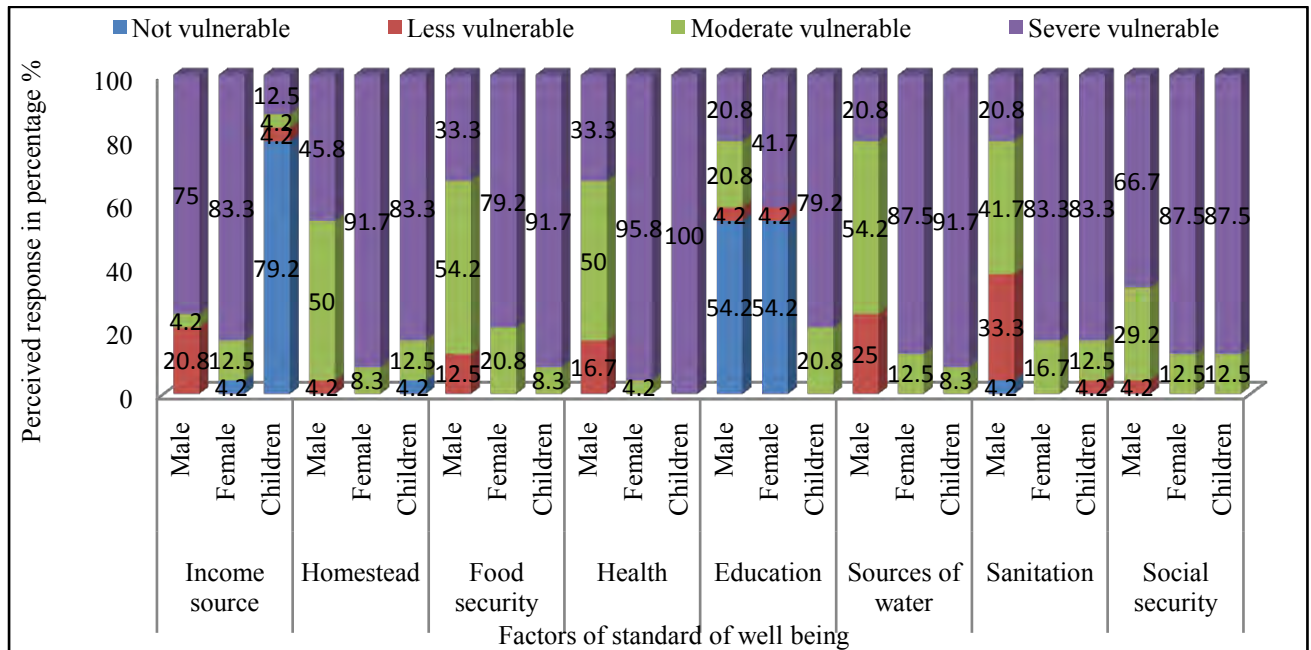


Figure 4.14: Perceived response on gender differentiated vulnerability due to climate change

In second step, the study tried to explore the gender differentiated vulnerability due to climate change against some predefined factors of standard of well being and the response was summarized in Figure 4.21. Perceived response showed that children are most vulnerable due to the changing climate. Women were perceived as most vulnerable when impact of climate change on income sources was considered. Though some find it irrelevant, children been impacted due to the climatic shocks in income sources, but it was found that child labor is common in the area. They added that unlike males they can't go outside of the area and without any formal income generation option they face severe vulnerability due to changing climate. Women can't live under open sky, there are other issues related to security, self dignity and social acceptance. So, women were perceived as most vulnerable followed by children and male due to climate change impact on homestead. Small children can't stand hunger and suffer more in malnutrition when food insecurity is more pronounced. So, when impact of climate change was assessed against food security, respondents identified that children are most vulnerable followed by female and male. Increased number of disease and death count is associated with climate change especially with disaster events. Children can't survive by themselves. Also, they lack the physical fitness to withstand continued starvation. Considering the impact of climate change on health, children are found to be most vulnerable. Women come in second place and males are least vulnerable. They further added that among

the children, girl children are even more vulnerable than boy children as they are comparatively well fed and taken care of. When impact of climate change was considered on education, children are assumed to be most vulnerable. Also, majority of respondents perceived that male and female are not vulnerable at all due to climatic impact on education system, however, some respondents identify that male and female could become vulnerable due to varied intensity based on indirect consequences of climate change. Children become easy prey to various water borne diseases. Also, they assist family in collection work which brings severe direct and indirect adversity towards them. Women being the appointed water manager in household level also go through much stress for water collection and management. Considering both aspects of water sources (quantity and quality), children was perceived as most vulnerable followed by female and male. In case of sanitation, women and children are assumed as most vulnerable and even a very small portion of respondents perceived that male are not even impacted at all due to climate change. When social security is considered at the backdrop of changing climate while gradual changes becoming more pronounced and extreme events are increasing in intensity and frequency, it was perceived that female and children are most vulnerable followed by male. Women and children are primary victim of social insecurity not only during and after disaster events but in normal period as well. Young children are more threatened by trafficking and women are always at risk of sexual harassment, abuse, abandonment, etc. Considering the gender dimension of vulnerability, children were perceived as the most vulnerable in the changing climate. Women were also scored high level of vulnerability considering various aspects against factors of standard of well being. Males are perceived as the least vulnerable due to adverse impact of climate change.

4.5.7 Gender differentiated preparedness and post disaster activity

The study tried to explore the gender differentiated preparedness and post disaster activity. Questionnaire survey was used to collect analytic data whereas discussion was carried out in FGD sessions to build up in-depth understanding.

The findings shows that in preparedness period involvement of women are significantly higher in water and dry food collection activity, however, in post disaster period, involvement of both male and female scored high. For fuel wood, match, candle, etc. buying work involvement of all members are significant, though women reported that considering the time of land falling cyclones, which is fishing time, males do remain at sea and hence they have to go to shops for purchasing. Starvation to meet food deficit mainly done by women in

preparedness phase, but during acute food crisis at the aftermath of disaster period, adult males and females both go through starvation feeding the young ones first. Selling household utensils, poultry and ornaments are done by women however, for selling livestock, males make the final decision. Taking loan and use of deposit money is mainly carried out by male members where involvement of women is close to zero. As preparedness and post disaster survival, they move to relative's house outside the primary affected area. Though permanent migration is also common, in the post disaster period; however, the study didn't meet any correspondent who actually moved into the study area for living. It means that the area is so exposed to climatic stress that people only migrate from the area to outside cities. Interestingly, it was found that higher percentage of people moved to cyclone shelter in post disaster period. They added that cyclone shelters are situated in far distance from their household. There was only one shelter in the area during the time of cyclone Aila, however, women considering future consequences and in absence of their husband, didn't went to shelters and rather moved to embankment. Also, few tried to survive climbing on trees or going to brick made houses in the locality and later moved to embankment. Alternative income generation mainly started by women or by both male and female in the aftermath of cyclone Aila to survive the situation. Duck rearing was carried by women only and involvement in shrimp fry and crab catching significantly increased in post disaster period by male and female members. Forest resource extraction was only carried out by males however; involvement got reduced in post disaster period. Though met with several failure and production loss, women are still trying vegetable gardening not only for income generation but also to meet household food deficit. In many families, it was seen that women became the appointed member for relief collection, though involvement of both male and female did remain higher in percentage. Participation in NGO/ Govt. implemented rehabilitation work was primarily carried out by women in post disaster period. Women informed that majority of the preparedness task is borne by them, as males remain outside of the area for fishing or went in seasonal migration. Managing children with one hand and carrying out the preparedness work with other hand is problematic and prevent them from timely evacuation. Also, women remain in house believing that no harm would come to the house if they remain in it. Another reason for staying is to ensure household security. But when the situation become worse and they try to move to safe location, they only get drowned in the water. They further added that they have to manage water and food in the aftermath of disaster events and failing to do so, made them even more vulnerable because they can't bear the hunger stricken face of their children. They go through continuous

starvation and in such condition carry out the entire caring task. Relief collection became another concern for them. Women also get involved in all type of repairing task. However, in absence of sanitation facility and starvation, they remain in weak condition and getting involved in this additional activity took great toll on their health. The situation is even worse for pregnant and newly mothers. Respondents reported that majority of task related to caring of newborn, young children and old age-disable are done by them. Women act as primary generational caregiver and environmental caretaker in household and community sphere. Women complained that though they want and try to live in harmony with existing environment (pre-Sidr and Aila) however; it was always the males who wanted and tried to exploit the environment for economical benefit, for which so much adversity came upon them and they become the primary victim without doing anything bad. Women are always more willing to environmental adaptation but it is male that always finds way for economical development by exploiting natural resources. However, considering the existing situation and forthcoming future, some of them also found it more tempting to go for full fledged economic development with proper scientific mechanism where balance could be maintained between exploitation and preservation.

4.5.8 Major problems faced by women only due to climate change extremes

Women experience climate change and induced disasters differently than men. They added that lack of access to information often restrict them from timely evacuation. Disproportionate burden of disaster preparedness and reduced mobility made them stay in house during disasters. They suffer severely due to insecurity and lack of privacy during and after any disaster. Even, their traditional dress sari, restrict their movement. Lacking the physical strength and managing child in one hand, they can't swim against the strong current. They don't know how to climb trees or swim effectively against strong current. In darkness, they lose their path to shelters and often washed away with the storm surge.

It was found that often women don't become willing to go to cyclone shelters due to insecurity and lack of privacy. Often boys and men try to take advantage in the congested condition which brings immense embarrassment towards them in post disaster period; for this reason the number of suicidal incidents increases in post disaster period. Placement and gender biased design of shelters (no room for women, no sanitation facility, raised height of stairs, low elevation of approach road, etc) made them more unwilling to go to such facilities. Furthermore, rich and elites restrict their entry in time of emergency and they had to go again

to embankments. They also reported that cyclone warning signal was only given to areas adjacent to shelters and as they lived in distant areas, so didn't receive any warning.

Women also suffer more due to their incapability to manage food for their children. Lack of access to food means long term starvation and ultimately in broken health for the rest of the life time. During and after disaster events, women have to carry out the collection work, going through hip to shoulder high water create various problem for them. Also, incidents of abuse and harassment are common which made them more vulnerable. Even for enlisting their names in relief distribution list, sometimes they have to surrender themselves to the wishes of NGO officials. Furthermore managing bribe to enlist name for relief and rehabilitation works increase their sufferings.

The situation of pregnant, newly mother, old age and disable are even worse among the women. Often they were left in the house during disaster. In post disaster period, the pregnant and newly mothers have to get involved in all rehabilitation and collection activity that further increase their vulnerability. They suffer a lot due to absence of any medical and treatment facility. Lack of sanitation option in post disaster period made them significantly vulnerable. They have to consume the pressure for whole day long and only go for defecation after night falls. This creates immense pressure on their health and other activities.

Water logging made them totally prisoner in their household. It had limited all types of socio-economic activity and interaction, access and control and mobility. Men can migrate to outside for income generation; but being women they had to remain in the locality and in absence of male member lead their live in increased vulnerability due to threat of insecurity and sexual harassment. Water logging further creates various gynecological problem and skin diseases. Arranging marriage for girls suffered through skin diseases is quite difficult and requires more amount of bribe. In times of water logging managing sanitation and health hygiene become a severe problem, where women and young girls become the major victim. Water borne disease becomes more common and they become over burdened with increased load of caring activity. Children could easily drown in the stagnant water and so they have to keep a careful eye on them continuously which prevent them from taking any rest. Salinity intrusion had limited income generation option in the area and increased food insecurity where being women they became the primary victim. Salinity intrusion further created severe gynecological problem and skin disease where being women they suffered severely. River erosion only leads to forced distress migration and they embark a future with full uncertainty.

4.6 Vulnerability assessment using matrix framework

The study assessed the vulnerability of gender community considering two different perspectives. The indirect approach used the matrix framework to assess the vulnerability of any specific resource base considering the user perspective while as the other approach directly assessed the vulnerability of targeted community due to climate change impact. In the indirect approach the matrix framework was used to assess the vulnerability of water resources due to impact of climate change considering the user/ gender perspective. This helped to understand how gender community is becoming vulnerable due to climatic impacts on any particular resources.

The vulnerability of women due to direct climatic change impact as well as due to the climatic impact on water resource has been discussed in details in previous sections of the study. However, people believe in figures rather than facts and assess vulnerability differently based on their perception, experience and mindset. Detailed discussion is time consuming and could shift the focus to other direction from the primary objective- which might hamper decision making necessary for policy formulation and implementation. Vulnerability assessment due to climate change is of utmost importance for enhanced decision making to reduce the extent of adverse impact. To support enhanced decision making in precise way addressing specific issues, the study developed matrix framework to assess vulnerability in a quantitative way. IPCC identified vulnerability in terms of exposure, sensitivity and adaptive capacity which is well recognized in global scientific community. One matrix was used to assess „vulnerability of water resource considering user/ gender perspective“ and the other one was used to capture the „vulnerability of gender group i.e. women“. There is some basic difference among the designs as two represent two separate systems. But the first one can be used for vulnerability assessment of any natural system considering the user/ gender perspective while the second one could be used to assess vulnerability of any livelihood group or simply community level vulnerability. Both matrixes followed same ranking system. Exposure, Sensitivity and Adaptive Capacity is ranked with a score of 0~3 based on severity and strength of impact. In the ranking system, 0 denotes no impact and 1~3 defines impact from less to moderate and then severe. The primary Equation 3.1 has been used in calculating vulnerability. The matrix helps in assessing context specific vulnerability (i.e. event wise and extreme wise) and total vulnerability (with average values of exposure, sensitivity and adaptive capacity due to events and extremes).

4.6.1 Vulnerability assessment matrix for water resources considering user/ gender perspectives

To determine the vulnerability of any natural system from user perspective to climate change impacts, it is important to understand its exposure to gradual change and extreme events, sensitivity of associated sectors and inbuilt adaptive capacity in the system and practiced coping and adaptation and mitigation action taken by the user group. The exposure of water resource to climate change was identified as change in rainfall pattern, change in water availability (quality and quantity) and salinity intrusion. The sensitivity of water resource was assessed summarizing the effect due to direct impact from climate change in its bio-physical and socio-economic regime. Any impact from climate change affects the bio-physical regime of the water resources and considering the gender perspective- the effect is also felt in various socio-economic activities, centered/ dependent on water. So, the effect due to direct climatic impact was summarized under sensitivity heading. In adaptive capacity coping mechanism of water resource itself and practiced adaptation and mitigation options in human society were summarized and ranked as per their effectiveness.

To analyze the vulnerability of water resource the whole system was considered as coupled one where direct impact due to climate change further spread out effect (both positive and negative) in bio-physical and socio-economic sectors associated or dependent on the resource. Understanding ecological vulnerability of any natural resources is pre-requisite to understand the social vulnerability of the user group if they are primarily dependent on the resource. Exposure of the resource due to climate change further affect the associated various ecological aspects of the resource as well as social and economic activities. They are secondary effect of the direct impact on the resource and generally take place in relation with the primary or direct impact so, are summarized under sensitivity heading. Exposure multiplied with sensitivity determined the magnitude of climatic impact. There is also adaptive capacity to reduce the impact potential. The natural resource has its own mechanism to reduce the adverse impact without any human intervention to some specific threshold limit. There are also regulatory measure and change in usage/ consumption pattern that can boost the adaptation process. Both are summarized under adaptive capacity heading. Then using the basic equation of vulnerability assessment, climatic impact (exposure x sensitivity) is divided by adaptive capacity and vulnerability of the system considering the user/ gender perspective had been measured. Vulnerability assessment had been done taking women as the primary user group of the water resources.

Table 4.11: Vulnerability Assessment Matrix for Water resources considering user/ gender perspectives - Gabura union, Shyamnagar upazila, Satkhira

Context	Exposure (direct impact on water resource) [E]			Sensitivity (effect due to direct impact) [S]											Adaptive capacity (Change in water use practice) [A]			Specific Vulnerability (E x S)/A	Total Vulnerability (E x S)/A		
	Change in rainfall pattern	Change in water availability	Salinity intrusion	Overall Exposure	effect on Bio-physical regime				effect on Socio-economic regime						Overall Sensitivity	Coping mechanism in nature	Alternative use of water in human society			Overall Adaptive Capacity	
					Impact on water recharge	Impact on in stream water demand	Impact on water quality	Impact on water dependent ecosystem	Impact on drinking water supply	Impact on domestic water use	Standard of living	Cultivation	Navigation	Shrimp culture							Fishing
Long duration summer	2	2	3	2.22	2	2	3	3	3	3	2	3	1	2	2	1.86	2	2	1.75	2.37	
Increased temperature in summer	0	2	2		1	2	1	2	2	3	2	2	0	2	2		2	1			
Short duration monsoon	3	2	3		3	3	2	2	2	2	1	3	0	2	2		2	2			
Monsoon with heavier rainfall	3	2	2		1	1	2	1	2	2	2	2	1	2	2		2	2			
No/ less rainfall in Pre/post monsoon	3	2	3		2	2	2	2	2	3	2	3	0	1	2		2	2			1
Erratic rainfall	2	2	2		1	1	2	2	2	2	2	2	0	2	1		2	2			1
Average seasonal change																					
Increase in cyclone storm surge frequency-intensity	1	2	3	1.42	0	0	3	2	3	3	3	2	1	3	2	1.43	2	1	1.63	1.25	
Increase in tidal surge height	0	0	2		0	0	1	0	1	1	2	1	0	1	0		2	2			
Water logging	0	3	3		2	0	3	1	3	2	3	2	0	3	1		2	1			
River erosion	0	1	2		0	0	1	0	3	2	3	2	0	3	0		2	1			
Average extreme events																					

(Score: 0 = no impact; 1 = less impact; 2 = moderate impact; 3 = severe impact)

a. Key findings from vulnerability assessment of water resources considering user/ gender perspectives

- Vulnerability of water resource considering the user perspective has been assessed for Gabura union of Shyamnagar upazilla of Satkhira district and the calculated vulnerability score is 1.78 which falls into less to moderate vulnerable category.
- Considering water resources, average of context specific vulnerability and total vulnerability is not equal. Average of specific vulnerability shows slightly higher value.
- Respondents perceived that water resource is more vulnerable to climate change associated gradual changes or climate change events. Specific vulnerability of water resource due to gradual climate change is 2.37 whereas that for climate change extremes is 1.25.
- It could be seen that water resource of Gabura union is more exposed to climate change events as perceived by women community. From the matrix framework it could be said that exposure is linked with sensitivity especially when any natural resource is considered and user community is heavily dependent on the resource. Higher exposure of water resource to climate change associated gradual changes termed into higher sensitivity due to the associated effect from direct climatic impact.
- Though as per general assumption it could be perceived that higher exposure and higher sensitivity could significantly reduce overall adaptive capacity; however is not always stands true. As seen from the vulnerability assessment matrix framework, though exposure and sensitivity of water resource score is higher due to climate change events, does not necessarily mean that adaptive capacity would be lower due to increased threat of climatic shocks (exposure x sensitivity).
- Interestingly, it was seen that respondents perceived that at present water resource is more vulnerable to climate change associated gradual changes comparing to climate change induced extreme events. So, during designing intervention strategy for the area, this consideration need to be followed otherwise would result into mal-adaptation.

The perceived response of respondents who are women and primary user of water, helped in quantifying vulnerability of the water resource of the area to climate change impacts. They assigned scores considering the impact and associated effect of climate change and later assessed the inbuilt coping mechanism of resource itself and primary mechanism they follow in their community to fight back or manage the adversity. After ranking and calculating the scores final vulnerability score is accessed which depicts the vulnerability of water resources considering the user/ gender perspective.

4.6.2 Vulnerability assessment matrix for gender group- women community

The targeted group of the study is women due to their differentiated high level of exposure and sensitivity to climatic adversity. Also, their limited access and control to various resources and benefits further lower their adaptive capacity and made the highly vulnerable to climate change impacts. Hence, the vulnerability assessment should be designed in a way which could capture the impact of changing climate over their gender differentiated activity as well as access to various commodity and resiliency due to practiced coping strategy.

The development design of the matrix lies in the concept of Sustainable Livelihood Framework and Harvard Gender Analytical Framework. Livelihood resources and gender differentiated triple roles and access and control over resources was summarized as the basic coupled system, one is required to sustain and enhance one another. The exposure to climate change was assessed by summarizing direct impact of climate change on livelihood resources/ capitals. Livelihood capitals are not only determine their income generation activity but critically influence the way of living in a particular society. The sensitivity was further analyzed incorporating the basic design from Harvard Gender Analytical Framework. Livelihood capitals often determine and critically influence the gender differentiated activity and access and control over resource base of a specific community in a society. The associated effect on „activity“ and „access and control“ due to climatic impact on livelihood capital were further summarized under sensitivity heading. „Activity“ profile was sub-divided in productive role, reproductive role and community managed activity and „access and control“ profile was sub-divided into resources and benefit. Thus, overall effect generated from direct impact on livelihood capital was accessed on gender differentiated triple role and access and control over resources and benefits. The magnitude of climatic adversity could then be readily assessed by multiplying the exposure (impact on livelihood capital) to the sensitivity (effect on activity and access and control due to impact on livelihood capital). Adaptive capacity was assessed based on practiced „coping“ and „adaptation“ heading. Then using the same ranking formula and equation (Eq. 3.1), dividing climatic shocks by adaptive capacity, vulnerability of gender group i.e. of women was measured. The vulnerability assessment had been carried out in FGD session where women community used their perception in ranking climatic impacts on livelihood capital and associated sensitivity on their gender differentiated activity and access and control over resources. Then ranking the adaptive capacity and using the basic equation of vulnerability, the vulnerability of the women community of Gabura union was assessed.

Table 4.12: Vulnerability Assessment Matrix for Gender group- women community - Gabura union, Shyamnagar upazila, Satkhira

Context	Exposure (impact on livelihood capital) [E]					Sensitivity (effect associated with direct impact) [S]					Adaptive capacity [A]					Specific Vulnerability (E x S) / A	Total Vulnerability (E*S)/A			
	Livelihood capital					Activity Profile			Access and Control profile		Major coping strategy Major adaptation strategy									
						Productive role	Reproductive role	Community management activity	Resources									Overall Sensitivity		
	Natural capital	Human capital	Physical capital	Financial capital	Social capital	Overall Exposure	Paid employment	Activity (without payment)	Activity (No payment-recreation, motivational, empowering)	Resources	Benefit	Experience of survival against cyclone and storm surge	Income generation through informal activity (Ex: crab catching, fishing, daily labor, etc)	Embankment	External Migration				Multiple sources of income generation	Cyclone shelter
Long duration summer	3	3	3	3	3	1.91	2	2	0	1	0	1.14	1	2	0	2	1	0	0.83	2.63
Increased temperature in summer	2	2	0	0	0		1	1	1	0	0		0	1	0	1	0	0		
Short duration monsoon	3	1	1	2	1		2	0	0	2	2		1	1	0	2	1	0		
Monsoon with heavier rainfall	3	3	3	3	3		2	2	1	1	0		2	1	2	1	1	1		
No/less rainfall in Pre-Post monsoon	2	0	0	1	0		1	0	0	0	0		0	1	0	2	0	0		
Erratic rainfall	3	1	1	1	1		1	2	0	1	1		0	1	0	1	1	0		
Salinity intrusion	3	3	3	3	3		3	3	3	3	2		1	2	2	2	1	0		
Average seasonal change																				
Increase in cyclone storm surge frequency-intensity	3	3	2	3	1	2.25	3	3	2	3	2	2.05	3	1	3	3	1	3	1.79	2.57
Increase in tidal surge height	2	3	1	1	0		2	1	1	2	2		2	1	3	2	2	2		
Water logging	3	3	3	3	2		3	2	1	3	2		1	2	2	2	1	2		
River erosion	3	2	3	2	2		2	2	1	2	2		1	1	1	2	1	1		
Average extreme events																				

(Score: 0 = no impact; 1 = less impact; 2 = moderate impact; 3 = severe impact)

b. Key findings vulnerability assessment of gender group- women community

- ❖ Vulnerability of gender group i.e. women from Gabura union of Shyamnagar upazilla of Satkhira district has been assessed using the vulnerability assessment matrix framework and the calculated vulnerability score is 2.53 which predicts moderate to severe vulnerable condition of women due to climate change impacts.
- ❖ It could be seen that average of context specific vulnerability and total vulnerability is not equal. Average of specific vulnerability shows slightly higher value.
- ❖ Interestingly, some linkage could be established among exposure, sensitivity and adaptive capacity. Lower exposure termed into lower sensitivity as well as lower adaptive capacity when the impact of climate change was directly assessed upon gender community.
- ❖ It could be seen that respondents perceived themselves more vulnerable to climate change associated gradual changes or climate change events. Though in case of climate change events the exposure and associated sensitivity is less comparing to climate change extremes however, respondents perceived their adaptive capacity to be significantly less which later resulted into increased vulnerability score for gradual climate change. They mentioned that the change taking place in climate is something new to them and their traditional knowledge base and coping strategy is not sufficient to withstand the adversity.
- It is quite clear from the vulnerability matrix that Bangladesh has achieved some remarkable success in disaster preparedness. Though livelihood capitals are more exposed to climate change extremes and so the associated sensitivity of gender differentiated activity and access and control over resources and benefits but, thanks to the DRR programs and infrastructure development, community has significantly higher adaptive capacity against climate change extremes. Community identified that impact of climate change associated gradual change has become more pronounced at the aftermath of cyclone Aila where the long lasted adversity in absence of proper rehabilitation program and external support significantly reduced their adaptive capacity to climate change associated events. They also added that unlike disaster preparedness programs there is no assistance to overcome the ongoing challenges and hence due to the direct impact on livelihood resources and associated effects on gender differentiated roles and responsibilities their vulnerability is just increasing along with the changing climate.
- ❖ It could be said that higher exposure and sensitivity does not necessarily result into higher vulnerability as could be seen from the matrix framework. So, careful attention needs to be provided when dealing such cases. In the case of Gabura union, the women community

requires support against climate change events which should be considered during designing intervention strategy for the area.

The matrix was developed to access gender dimension of vulnerability in simplest way possible, the matrix follows simple equation and calculation, there is no complexity in absence of any weighted value, provide good opportunity for comparison and indicate areas that need immediate attention. It is believed that the matrix framework can support improved decision making considering climate change adaptation and mitigation requirement for future sustainable development.

4.7 Gender specific needs in future changed scenario

The study tried to assess the gender specific needs of women community in future changed scenario. To assess the future climatic condition as well as to observe the trend in climate, future scenario was generated using statistical downscaling method for the period of 2040-2069 and 2070-2099. Trend in Maximum Temperature (Tmax), Minimum Temperature (Tmin) and Precipitation (Prcp) had been generated and visually represented and shared with community. Based on their perception community identified the problems that are likely to take place in absence of planned adaptation and mitigation intervention. Community also pointed out the gender specific needs based on generated future scenario.

4.7.1 Future scenario generation for the period of 2040-2069 and 2070-2099 for A2 and A1B SRES scenarios

There had been always a gap observed between what the climate models generated (output) and what the climate impacted community really needs (requirement). To bridge between these two opposite ends, downscaling plays a very critical role. As described by Fowler and Wilby, “.....,downscaling” techniques, (are) commonly used to address the scale mismatch between coarse resolution global climate model (GCM) output and the regional or local catchment scales required for climate change impact assessment and hydrological modelling” [55]. General Circulation Models (GCMs) indicate that rising concentrations of greenhouse gases will have significant implications for climate at global and regional scales, however, their usefulness became restricted when the time comes for local impact studies due to their coarse spatial resolution (typically of the order 50,000 km²) and inability to resolve important sub-grid scale features such as clouds and topography. Also GCMs are less certain in the extent to which meteorological processes at individual sites will be affected. Here lies the usefulness of Statistical Downscaling where the so-called „downscaling” techniques are used

to bridge the spatial and temporal resolution gaps between what climate modelers are currently able to provide and what impact assessors require [46].

Considering the usefulness and effectiveness of statistical downscaling for local scale future scenario generation in order to assess future gender specific needs and requirements, SDSM 4.2 (Statistical DownScaling Model) had been used. The study generated future scenario considering IPCC's SRES A2 and A1B scenarios for the period of 2040-2069 and 2070-2099. BMD data for Satkhira station was used as baseline data for the period of 1960-2000 which was calibrated with NCEP data. Baseline data was collected from Climate Change Study Cell, BUET and NCEP data as well as A2 and A1B scenario predictors' data was collected from Canadian Climate Change Scenarios Network (www.cccsn.ca). For SRES A2 scenario, data was used from HadCM3 predictors and for SRES A1B scenario, data was used from CGCM3 predictors. The generated scenarios for the period of 2040-2069 and 2070-2099 are graphically presented to assess the trend in climate regarding maximum temperature, minimum temperature and precipitation.

The model calibration for scenario generation was showed in Annex 1 Figure 1f and the generated future scenarios for the period of 2040-2069 and 2070-2099 for A2 and A1B SRES scenario through graphical representation was presented in Annex 1 Figure 1g. Changes taking place in climate is summarized in Table 4.13.

Table 4.13: Trend in climate in 2040-2069 and 2070-2099 timeframe for A2 and A1B SRES scenarios for Satkhira

Climate Indicator		Observed BMD data	A2 Scenario		A1B Scenario	
			Base line 1961-2000	Trend in 2040-2069	Trend in 2070-2099	Trend in 2040-2069
Tmax (°C)	mean	31.42	(+) 1.29	(+) 2.18	(+) 1.31	(+) 1.69
Tmin (°C)	mean	21.38	(+) 2.11	(+) 2.11	(+) 1.24	(+) 1.67
Precipitation (mm)	mean	4.63	(-) 0.62	(-) 0.96	(-) 0.77	(-) 0.71

The generated future scenario for the period of 2040-2069 and 2070-2099 clearly depicts the changing pattern in temperature and precipitation. The trend in Tmax is depicted in Annex 1 Figure g1 and change in Tmin is readily assessed from Annex 1 Figure g2 for the timeframe of 2040-2069 and 2070-2099 in A2 and A1B SRES scenarios. The increasing trend in temperature baseline values is presented in Table 4.13. From the graphical representation of generated future scenario for Satkhira, it could be said that the pattern of change is

significantly similar. This similarity is thus helpful in designing adaptation and mitigation implementation strategy for the study area. Increasing trend in mean temperature is significant and noticeable throughout the time period in both SRES scenarios. For A2 scenario, the change in maximum temperature is more prominent in winter season. The change in mean Tmax is almost insignificant in summer season for the period of 2040-2069; however, the change became visible for the period of 2070-2099. Alike maximum temperature, minimum temperature also exhibits a rising trend which shifts towards higher positive value in both time periods. Change in average value of minimum temperature is significant in October-March months continuously for both in 2040-2069 and 2070-2099 period which means that winter season will be less chiller. The other six months of the years also shows positive shifting towards higher value in both time intervals meaning that the difference would become lesser between maximum and minimum temperature in future. Along with the increasing trend in temperature, the decreasing trend in precipitation is also noticeable. Trend in mean precipitation shows negative trend in both the time periods. Though the change is insignificant in dry periods considering mean precipitation, however, decrease in pre-monsoon precipitation is alarmingly higher. It is also noticeable that during 1961-2000 period, precipitation clearly exhibits three peak intensity in pre monsoon, monsoon and post monsoon period in a year but in generated future scenarios, the tendency to rising towards the peak will be lost whereas, a gradual pattern means that the same intensity rainfall would be available throughout the time periods with relatively lower magnitude. Annex 1 Figure g3 represents the trend in precipitation. The trend in climate is quite similar in both A2 and A1B SRES scenario, as mentioned earlier however, the percentage of change is lesser in A1B scenario comparing to A2 scenario.

4.7.2 Gender specific needs assessment in future changed scenario

Due to the sensitivity of the issue, extra caution has been followed during discussing the predicted change in climatic condition. The audience listened attentively and carefully reviewed the colored figures and provided their perception regarding future problems and gender specific needs to withstand such situations.

Participants told that increase in temperature will be deadly towards them. The blow of increasing temperature will be severe on gradually depleting natural resources. Increasing temperature will severely hamper all the livelihood options where some will become non-functional triggering large scale migration from the area. The water scarcity would be much severe along with acute salinity intrusion. Increasing temperature could bring newer types of

diseases among poultry and livestock and in future, the problem could exacerbate and affect human community as well. Increasing temperature in summer means suitable condition for the generation of north wester storms on land and depression in sea which might turn into cyclone. The community will then be in continuous threat of cyclones that certainly will affect their mental stability as well as income generation activity. Social unrest and conflict will increase and being women they will be primary victim of such adversity. In order to fight back future uncertainty community demanded holistic approach from Govt. and service providers, civil societies and donor and NGO organizations as well as private sectors. They told that to reduce the damage from cyclones, the disaster prevention and preparedness activities must be strengthened. To enhance protection work, proven scientific technologies should be deployed in the risky zones. Considering the threat level, land zoning could be carried out which will determine the level of protection needed. More cyclone shelters need to be constructed with facilities to be readily converted into temporary makeshift housing. More water points and alternative options need to be installed along with option of desalinization plants for water supply in critical situations. Extensive tree plantation should be carried out, carefully choosing tree species that could withstand higher level of salinity. The community asked for industrialization in the locality, where they could get job and reduced dependency on natural resources. They demanded equal participation in decision making and implementation of adaptation and mitigation activities.

The respondents told that decreasing trend in precipitation will just bring catastrophe. The community primarily depends of water resources for livelihood generation which is influenced by monsoon and rainfall. Change in monsoon and reduction in total rainfall will just destroy their livelihood pattern and in absence of specific income generation options, they will just have to migrate. They further added that comparing to male members, the women would suffer more due to their gender differentiated roles and responsibilities. Not only their activities but their basic human needs and rights will be violated. Trend in precipitation will significantly amplify their workload and mortality rate of mother and infants will increase. Women will become victim in domestic violence also, which will lead to more suicidal incidence in community. The condition of poor and extreme poor community will become unbearable. To withstand the shifting in precipitation pattern, carefully designed adaptation and mitigation measures will need to be implemented. Extensive research must be carried out to compensate the water dependent community against water deficiency. Feasible water sources and alternative water options should be

installed along with technologies like desalinization plants. Tree species which require lesser water and can withstand increased salinity need to be planted in the area. Industrialization or other type of income generation activities should be established in the area that will reduce dependency on water resource for income generation. Improved water management is necessary to reduce water pollution and enhance recycling for continued use. Women should be given due importance in water management. Locally developed indigenous knowledge for water management should be included with modern technology as per their feasibility with proper research and piloting. The respondents suggested integrated approach in managing water resource where balance could be maintained between domestic usage and income generation activities.

The climate vulnerable community also advised to inaugurate compensate mechanism and credit facility for affected community. The facility of different service providers should reach locality where women accessibility should be equal like male community. Gender equity and equality need to be maintained in all level of activity to enhance improved operation, maintenance and management of adaptation and mitigation activity to ensure sustainability in order to withstand future climate variability and change.

4.8 Suggestions in line with climate change adaptation and mitigation

Women experience climate change differently and more severely as assessed in previous sections of the study. So, their vulnerability needs for different set of intervention approaches that could meet their special demands. The study tried to collect suggestions in line to disaster preparedness and climate change adaptation and mitigation activities directly from the community. The key suggestions are compiled below:

4.8.1 Major coping strategy/ activity practiced or perceived to be effective

Local community tries their best to cope with the climate change. Respondents identified some coping measures that could reduce the impact of climate induced adversity. Some of the coping activities are practiced in household level and some are just identified for future interventions. Key suggestions in line with coping activity are discussed in bullet points.

❖ General

- Food rationing. Preserve dry food, water and candle. Save valuable documents in raised shelf. Family members should stay together. Keep pregnant and children in safe location.
- Tree plantation around homestead and courtyard. Large scale salinity tolerant tree plantation in the area. Banana tree plantation.

- Temporary migration to outside/ relatives house. Makeshift housing on embankment.
- ❖ Construction/ Water Supply and Sanitation
 - Plinth raising of homestead. Construction of homestead in raised ground and construction of two storied house.
 - Raise the height of embankment. Construction of drainage system.
 - Rainwater harvesting. Installation of tubewell with raised platform. Protected pond and PSF construction
 - Installation of proper sanitation facility which will be operational even in disaster periods.
- ❖ Livelihood
 - Income generation from diversified sources. Make savings for emergency use. Take loan for emergency use. All capable members to be active in income generation. Earning from rehabilitation works. Seasonal migration.
 - Homestead vegetable gardening. Poultry rearing. Integrated cultivation.
 - Work options need to be created in the area with ensuring equal access for women.
- ❖ Awareness/ Training
 - Awareness raising in household and community level about disaster preparedness, cyclone warning signal and coping mechanism. Hands on training on emergency duties to be performed during cyclone. Everybody should work as a team.

4.8.2 Major adaptation/ mitigation strategy/activity perceived effective

The local community is at the forefront of climate change associated adversity. Considering the future scenarios, the respondents provided valuable insights on measures that might be effective to reduce the impact of climate change associated adversity. The adaptation and mitigation measures suggested by community are discussed below.

- ❖ General
 - ❖ Plantation of salinity tolerant tree species. Preserve and increase forest resources. Inauguration of rice cultivation.
 - ❖ Stop shrimp farming.
 - ❖ Stop saline water intrusion and utilization. Emergency mechanism to drain out saline water.
 - ❖ Stop environmental pollution and GHG emission from industries.
 - ❖ Health care and treatment facility need to be established in the area.
- ❖ Construction/ Water Supply and Sanitation
 - Increase the height of road network and construction of new paved roads.

- ❖ Increase the height of existing embankments. Construction of new ones with increased height. Proper management and protection work with CC blocks and tree plantation.
- ❖ More shelters need to be constructed- at least one shelter per village.
- ❖ Construct houses in raised ground. Install sanitary latrine in raised ground.
- ❖ Construction of drainage network.
- ❖ Dredging work to maintain river flow. River erosion must be prevented using CC blocks.
- ❖ Installation of more water points and rain water harvesting system. Installation of desalination plants to serve fresh water.
- ❖ Livelihood
- ❖ Create job opportunity in local area. Establish industry and garments.
- ❖ Awareness/ Training
- ❖ Disaster preparedness, awareness and capacity buildup training should be organized regularly where women should be given equal access.
- ❖ DRR/ Relief-Rehabilitation
- ❖ Disaster Risk Reduction initiatives need to be strengthened in the affected areas. Relief distribution should be carried out with proper listing of affected HHs.

4.8.3 Key suggestion to address complexities experienced by only women during and at post disaster period

Women suffer differently in any disaster events and hence ask for different set of intervention measures to reduce their sufferings. The study collected the effective measures that could reduce women's sufferings experienced during and after of any disaster event. However, the suggestions are not exclusive to women only and have the inbuilt effectiveness to be beneficial for affected community. The key suggestions are discussed below.

- ❖ DRR/ Relief-Rehabilitation
 - Emergency and transparent relief support mechanism. Include women in distribution activity among female groups. Specially designed relief package for different target groups in the society. Effective monitoring of relief activity.
 - Emergency doctor and medical facility/ provision of midwife and treatment for pregnant/ separate provision for pregnant, newly mother and children in shelters or in some safe locations. Provision of female doctor for female and children patients.
 - Emergency restoration of water points and sanitation facility.
 - Emergency supplies of food, water, dry cloth, etc. Support for makeshift housing facility. Provision for relocation, if needed.

- Supply hygiene product with relief package/ supply locally practiced materials used for hygiene management.
- Emergency restoration of road and communication network. Repairing of embankments.
- Operationalize satellite clinic immediately with medicine support.
- Credit support with no/ less interest for rehabilitation purpose.
- Provide income generation through rehabilitation activity.
- Proper burying of dead, dumping of dead animals, etc.
- Provide support to mentally stressed patients in the affected area.
- Emergency provision to drain out saline water from the affected areas.
- ❖ Awareness/ Training
- ❖ Emergency restoration of peace and security in affected area especially for women and children. Social mechanism to stop abuse and harassment towards women in and after any disaster events.
- Training of young boys and girls on emergency treatment who could provide initial support when needed.

4.8.4 Suggestion for mobility related problem faced by only women during cyclone and storm surge

Women encounter immense difficulty in their movement during the time of land falling cyclone. The community provided valuable response on how to overcome the mobility related problems and the suggestions are discussed here.

- ❖ Construction/ Water Supply and Sanitation
 - Construct more cyclone shelter in close vicinity. Separate room for women in shelter.
 - Signal/ search light facility from shelter and road marking to denote way to shelter.
 - Construction of raised paved roads. The height should be above the inundation level.
- ❖ Awareness/ Training
 - Provision of boat to shift women, sick, disable and children. Inbuilt provision in community to move women and children to safety prior to cyclone.
 - Teach swimming and tree climbing to women.
 - Women should wear salwar kamiz as emergency dress. The community should be provided with life jackets.
 - Warning should be given earlier for in time evacuation.
 - Men should assist women in preparedness work and also help them to move to safety.

4.8.5 Possible solution to overcome the problems faced by only women in water logging

Water logging has become a major problem in the study area. Women suffered severely due to prolonged water logging triggered by cyclone Aila. The study tried to explore the solution to overcome the adversity associated to water logging and the key suggestions are as follows.

❖ General

- Provision of cooking in shelters for long term staying.
- Arrangement of boat for movement.
- Provision to provide doctor and healthcare facility to HHs even in water logged condition.
- Provide support for skin diseases and gynecological problems.

❖ Construction/ Water Supply and Sanitation

- More shelters need to be constructed with at least one per village.
- Provision to drain out stagnant water quickly. Construction of drainage network.
- Increase the height of embankment. Making pipeline through embankments must be stopped. Increase the height of existing roads and construct new paved road facilities.
- Installation of more tubewells with raised platform. Ponds should be protected with raised boundary. Emergency restoration of water points. Support for rain water harvesting.
- Houses should be constructed on raised ground. Raising the overall land mass of the area by tidal river management could be effective. Kitchen, latrine, vegetable gardens should be constructed on raised ground to prevent inundation even in water logging.

❖ DRR/Relief-Rehabilitation

- Emergency relief distribution. Emergency supply of food, fuel wood and cooking materials. Financial support for rehabilitation.

❖ Livelihood

- Creation of opportunity for income generation in the area. Industrialization should be done in the area where women could get equal access. Establish income generation options for women even remaining at home in case of water logging.

❖ Awareness/Training

- Awareness creation on violence, insecurity against women. Strengthen social security of women.
- Awareness raising session on health hygiene management for adolescent girls which could help them in water logged conditions.

4.8.6 Possible solution to overcome the problems faced by only women due to salinity intrusion

Salinity intrusion is one of the major problems in the study area. Respondents provided key suggestion to overcome the problems of salinity intrusion. Suggestions are discussed below.

❖ General

- Stop shrimp farming.
- Stop saline water utilization in any kind of activity.
- Plantation of salinity tolerant tree species. Tree trunks should be protected with raised boundary made of soil.
- Provide free treatment facility for skin disease victims.

❖ Construction/ Water Supply and Sanitation

- Raise the height of embankment to prevent saline water intrusion.
- Establish drainage network for quick removal of saline water.
- Installation of more water points. Provide support for installation of rain water harvesting.
- Excavation of protected pond and installation of pond sand filters.
- Inauguration of rice cultivation.
- Stop river bank erosion using CC blocks.
- Installation of desalinization plants to serve fresh water.

❖ Livelihood

- Alternative income generation option in the area where women could get equal access.
- Industry and garments factory should be established in the area.

4.8.7 Suggestion for the improvement of cyclone warning system

The respondents provided important suggestions on how to make existing cyclone warning signal more effective and beneficial to the community. Key suggestions for the improvement of existing cyclone warning system are discussed below.

❖ General

- Cyclone warning should be accurate.
- Warning should provide additional information on surge height, duration, inundation length, etc.
- Miking/sirens from shelters. Additionally colored flags could be placed upon cyclone shelter for warning where different color could represent different number of signal.

❖ Institutional

- LGI should be in charge in issuing and managing cyclone warning in local level.

- Extensive use of miking from mosque by Imam will be more effective.
- Warning issued by authority sent to individuals by mobile call or message.
- Volunteer team formed and managed in each village.
- Warning should be given early for effective evacuation.
- ❖ Awareness/Training
 - Training to interpret cyclone warning message and emergency response.
 - Cyclone warning should reach all areas- not just around cyclone shelters.

4.8.8 Suggestion for the improvement of design of cyclone shelter

Gender blind design often restricts women from going to shelter even in most extreme situations. These jeopardize the primary objective of construction of shelters. Respondents opined for some modification in the design of shelters to make them more gender and user friendly. Key suggestions for the improvement of cyclone shelters are discussed below.

- ❖ General
 - Cyclone shelters should have emergency treatment and medical facilities.
 - Should have provision for water, food and cooking facility.
 - Must have capacity to accommodate target community.
- ❖ Design Criteria
 - Separate room and latrine facility for male and female.
 - Shelters should have provision of electricity and light facility.
 - Construction of wide and raised paved approach road with luminous marking.
 - Provision of separate room for pregnant women and children with emergency healthcare facility.
 - Provision of cattle yard in ground floor.
 - Positioning is important to be readily accessible.
 - Red warning light and additional search light on shelter roof.
 - Cyclone shelters should have provision to convert into makeshift housing.
- ❖ Awareness/Training
 - Security of women should be ensured in any shelter.
 - Media campaign should be carried out on the importance of the shelter in saving lives and arrange training on how to manage and utilize such facility.

Changing the view and attitude towards women can significantly reduce women's vulnerability. From the suggestions it is clear that simple modification in social and religious norms and regulations and small assistance from male can significantly reduce women's

vulnerability and significantly improve their overall condition. For this respondents suggested for mass scale awareness campaign in all regards parallel to technical intervention.

4.9 Gender impact assessment of national climate change policy

Climate change adaptation and mitigation should be gender inclusive and equitable. It has been identified that developments initiatives should have inbuilt climate-proofing strategy. Sustainable development only could be ensured if gender equality is achieved. To fight back climatic adversity considering the gender specific impact, gender just climate change adaptation policy formulation and implementation have become an important issue. Gender mainstreaming in climate proofing is now a development concern.

To access the gender specific approach in Bangladesh adaptation policies, the study has applied Gender Impact Assessment GIA tool to the major policy documents that are Bangladesh Climate Change Strategy and Action Plan and National Adaptation Programme of Action. Gender Impact Assessment is a core tool for gender mainstreaming and very effective for policy review. GIA tool explores the proportional involvement of related stakeholders in the policy formulation and then finds out who will be the affected group for the policy and implementation strategy and based on that tries to access the level of affectivity and finally proposes strategies to mitigate the complexities.

NAPA has 33 priority actions compiled for implementation [21]. Involvement of female experts in preparing NAPA is minimal comparing to male members. Interestingly, no distinct participation was found in NAPA formulation from the Ministry of Women and Children Affairs, which is an important line ministry for implementing NAPA. There was no involvement of root level stakeholders in preparing NAPA. NAPA didn't explore the gender vulnerability of climate change induced adversity in the policy document. It only mentioned that women and children are more vulnerable compared to males. But why and how women are more vulnerable wasn't explained. Impact on women and impact on gender relation is not same. So, women are more vulnerable to climate change doesn't really reflect the gender implication of climate change. Without establishing gender relation to climate change, the policy paper directly stated that „poverty reduction and security of livelihoods with a gender perspective will be used as the most important set of criteria for prioritization of adaptation needs and activities.“ It also included „Gender Equality (as cross-cutting criterion)“ as one of 6 major criteria. But how the gender equality would be achieved and measured, monitored and evaluated was not mentioned. The NAPA kept a big gap in the policy document that kept it further apart from being even gender sensitive. In the prioritized short term and medium

term activities, how the gender equality approach would be followed during implementation was not described - which poses threat to further increase the gender disparity during and after implementation. No activity was identified for climate refuges of which a large portion is women and children. Popularization of salinity resistant crop species was taken under short term priorities whereas Govt. is supporting shrimp farming- a conflicting issue that need to be answered. NAPA also didn't find it important to carry out monitoring in socio-economic ground to assess the impact of climate change. There was no priority action on how women and gender community would be empowered to receive and be part of the adaptation activity which is also a barrier in line to achieving gender equality. However, providing drinking water to coastal communities, dissemination of climate change and adaptation information to vulnerable communities, construction of flood shelters, development of eco-specific adaptive knowledge (including indigenous knowledge) are welcoming initiatives which might lead way for gender sensitive intervention approach in future [21].

BCCSAP states that the needs of the poor and vulnerable, including women and children, will be prioritized in all activities implemented under the action plan. The BCCSAP is built on six pillars among which „food security, social protection and health“ stated about the disproportional vulnerability of poor and vulnerable group in society including women and children due to climate change and that all programs should focus on the needs of the group for food security, safe housing, employment and access to basic services, including health [56]. However, when the sub-programs were explored, it was found that how the climate change would impact upon women's livelihood and how the complexities would be addressed were not mentioned. One of the sub-programs (T1P9) only stated to carry out study of the impact of climate change on women and gender relations and for the development of recommendations to address those in all actions under the BCCSAP. This clearly reflects that the present strategy paper is gender exclusive, where no gender inclusive approach is incorporated due to lack of resource on assessing gender implications due to climate change and necessary recommendations for intervention. Another sub-program (T6P4) further stated for the development of criteria and approach for inclusion of gender consideration in all climate response activities which also expresses the absence of method for gender inclusive implementation strategy. BCCSAP stated more precisely comparing to NAPA that women would be severely affected to climate change impacts. However, it didn't explore the gender specific adversity to climate change events and extremes. Stating that women will be severely impacted is not just enough. Why and how women will be differently impacted need to be

explored in order to sort out strategy for gender just adaptation. Paper statement like women would be more vulnerable than men would not lead way to ensure gender equality in adaptation strategy. The policy paper didn't explore the impact of climate change associated gradual changes and sudden disasters on women's livelihood and triple activity which further pose barrier on assessing the impact of adaptation activity on women considering workload and imbalance with other activity. The BCCSAP was developed through a participatory process involving all relevant ministries and agencies, civil society, research organizations, the academia and the business community. The programs funded under the action plan will be implemented by line ministries and agencies, with participation, as appropriate, of other stakeholder groups, including civil society, professional and research bodies and the private sector [56]. From the statement, how the local community was involved in preparing the policy is not clear. Furthermore, how the local community especially women will be involved in adaptation activity is completely missing. However, BCCSAP provides instruction on research on gender implication of climate change and how gender mainstreaming can be achieved in all action along with developing criteria and approach for gender inclusion in all intervention actions in line with climate change adaptation- which is quite encouraging.

Bangladesh is trying to incorporate climate change concerns in all its developing activities and trying to incorporate BCCSAP and NAPA with other development policies. Though the policies stated to follow gender inclusive implementation process to bring gender equality, but still don't have any strategy to incorporate gender consideration in its activities that means the ongoing projects are gender exclusive. The implementation of gender exclusive adaptation policies, ongoing with „no to low level“ of participation might increase the existing gender disparity which could finally resulted into failure of overall intervened activity.

4.9.1 Recommendations for gender just climate change adaptation and mitigation

The climate change adaptation and mitigations works ongoing in Bangladesh are primarily lead by Bangladesh Climate Change Strategy and Action Plan 2009 and National Adaptation Programme of Action 2009. The study tried to assess the level of gender inclusiveness in the climate change policies through Gender Impact Assessment and the findings shows that the existing policy documents are more or less gender exclusive that might further increase social inequality and increase the vulnerability of gender community especially women.

In order to advance country's adaptation and mitigation activities in gender inclusive way, the study provided some recommendations in line with gender just climate change policy formulation and required modification. The key recommendations are discussed here.

- ❖ The policy and action plan documents are written in a language that often restrict clear understanding and participation of different stakeholders. The targeted community does not possibly understand any action plan which is supposed to improve their situation. The complexly developed policy documents often create misconception in different implementation body which further increases sufferings of the community. Incorporating simplified gender responsive language in the national adaptation policy thus could be the starting point for gender mainstreaming.
- ❖ Traditionally, women's activity for livelihood generation is treated as informal sector of income that restricts understanding the impact of climate change on women's livelihood. Even, policy documents failed to acknowledge women's involvement in agriculture, fisheries and small industries. This viewpoint needs to be changed. Women's activity for livelihood generation from informal sectors of income should be given due importance as like men. Women's involvement in reproductive and community managed activity should be properly acknowledged in policy documents. It should be incorporated that women and men involve in income generation differently and greater involvement of women in many informal sectors has so far transformed them into formal sectors.
- ❖ Policy documents and plans primarily address women's economic needs (also not precisely as like men's) linked with existing gender division of labor. Their importance and contribution in household and community management is seldom mentioned giving proper importance to society. Only primary needs of women are discussed in policy documents whereas it is the strategic needs that can only ensure gender equality and autonomy. It is important to note that economic empowerment is necessary but can't be taken as a substitute to women empowerment. Only focusing to primary needs and giving a false impression that a woman being empowered is deeply rooted in the perception of gender biased inequities which must be changed. Formulation of a gender policy is thus a prerequisite before advancing to incorporate gender just approach in development initiatives. Based on national gender policy extensive awareness campaign, media operation, message through religious channels and educational institutions, etc need to be carried out which will change traditional view towards women. Both practical and strategic needs of women need to be addressed properly in the formulated policy however, primary focus would be given to strategic needs which will pave the way for active decision making and participation and empowerment.

- ❖ Budgeting for gender equality through gender equity need to be ensured. This will provide the financial support for mainstreaming gender equality in all development works. External support through the means of gender equity should be used to overcome the deeply rooted inequity in the society and improve overall status of women, creating the equilibrium platform which will ultimately ensure the enabling environment.
- ❖ A core group should be established that will lead way for gender mainstreaming in development activity. The group will be responsible for national gender policy formulation and maintain network with other ministries and line organizations, NGOs, civil society, business community and local stakeholders for preparing gender just implementation strategy and action plan, monitor, impact assessment and evaluation. The group will enable environment and mechanism for gender budgeting for the activities. The core group and national planning commission will work parallel for incorporating gender consideration and climate change adaptation in national development initiatives. Poverty reduction and development policies should be gender inclusive and climate proof to withstand climatic adversity in the path of future development
- ❖ A gender disaggregated baseline need to be established which will provide data for assessing practical and strategic needs and provide gender specific objectives for national gender policy and gender budgeting. Gender specific indicators will need to be formulated for monitoring and evaluation. Indicators should be established in a way that, advancement achieved in meeting both practical and strategic needs could be measured. Gender focused monitoring should be ensured which will include all dimensions of gender differentiated triple role and responsibility, access and control over resources and benefit, participation, decision making and overall advancement towards empowerment.
- ❖ Nationwide awareness program on gender equality and gender specific capacity building both horizontally in household and society and vertically in institutional sphere should be initiated. If necessary, quota system to ensure equal participation of women parallel to men should be established. A gender responsive communication strategy needs to be established which will ensure active participation of women even in public sphere. Women seeking their male counterpart's assistance more actively in preparedness program- scope lies for mass scale awareness and motivational program and social and religious encouragement.
- ❖ Women are differently and more severely affected by climate change associated gradual changes and extreme events. However, women are also the key actor in climate proofing and sustainable changes for future development. So, climate change policies must put

women into the central position in adaptation activities. Building their knowledgebase, investing for capacity building, learning from traditional practices and real life experiences, funding their initiatives, ensuring participation in decision making, providing equal access and ownership to land and other resources and upholding their voice in national and international sphere should be strengthened in line with climate change adaptation activities. Extensive piloting and exposure visit, sharing and replication of successful initiatives are also recommended. However, it need to be noted that „limiting adaptation plans to focus only on women without gendering the dominant adaptation plans is not gender transformative. It is gender ghettoisation“ [9]. Only gendering the adaptation strategy will ensure that women do not suffer from increased workload due to climate change adaptation activities. This will also enable environment for proper participation of male community in intervened activities.

- ❖ Academic curriculum need to be modified. Physical dimension, socio-economic implication and gender differentiated impact of climate change should be incorporated in secondary level of education. Educational institutions should be the starting point for gender mainstreaming which will bring mutual respect for opposite sexes and enhance support and assistance. Further, hands on training should be made mandatory for youth age community in higher secondary level. The training should be focused on information dissemination, awareness creation, assistance in warning, participation on emergency rehabilitation, support evacuation, first aid treatment, etc that will build up the capacity of the young community to take the lead role in future climate proofing activity.
- ❖ Linkage should be established among different ministries, organizations, academic and research institutions, NGOs, civil societies, business communities and local stakeholders. Involvement of women in all organizations should be increased. Based on national gender policy, gender just implementation strategy should be practiced in all level of adaptation activities. Organizations involved in specific area of adaptation activity should follow similar intervention strategy just to avoid replication. Gender just governance should be enabled. Govt.'s standing order for emergency response need to be modified. The standing order should also include the service providing organizations and NGOs.
- ❖ Climate change will increase the existing inequalities in the society unless gender just adaptation is implemented. Gender should be mainstreamed in all types of development activity. Focus need to be shifted towards „development plus“ activity where gender should be mainstreamed and climate proofing should be included in order to ensure

sustainable advancement in the context of a gradually changing climate. The study proposes an institutional framework for gender just climate change adaptation that could be termed as „bottom up – top support“ approach.



Figure 4.15: Institutional framework for gender just climate change adaptation in development program

In the „bottom up-top support“ approach women and local stakeholder/ community will be at central position for all types“ climate change adaptation activity. Academics, universities and research organizations will provide support in assessing context specific problem associated with climate change and with proper consultation with local community, will suggest necessary adaptation activities feasible and effective for the area. Then, Govt. ministries and line organizations will finalize the activities making proper consultation with local stakeholders, research organization, donor and NGO organizations active in the specific area. Govt. and donor organizations will work together for arranging necessary budget. The implementation will be carried out by Govt. and NGO organizations where all the stakeholders will be involved as per necessity and requirement. Finally, when community will be empowered and capacitated, the overall monitoring and operation-management will be handed over to the community. Other stakeholders will continue to provide required support for sustainability and continuous betterment of the implemented adaptation initiatives to fight climate change associated future extremities and complexities.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

1. Study findings show that gender community is more vulnerable to gradual changing climate.
2. It is perceived that any climate change associated extreme event in the existing context can result in catastrophic consequences.
3. It is also found that due to gender differentiated roles and responsibilities- gender community is more attuned with nature and has distinct adaptation and mitigation knowledge.
4. In a household sphere, children are found to be most vulnerable due to climate change followed by women and men when the climatic impacts have been assessed against factors of standard of well being.
5. The study explored the gender dimension of vulnerability due to climate change associated events and extremes with developed matrix framework in a scale of 3.0. Vulnerability of the women had been analyzed by assessing the impact of climate change on water resources from user/ gender perspective. The vulnerability score of water resources for Gabura union of Satkhira district was 1.78. It means that water resources are less to moderate vulnerable to climate change considering the user/ gender perspective. Using the matrix framework, vulnerability of gender community i.e. women was found to be 2.53 which predicts moderate to severe vulnerable condition of women due to climate change.
6. The study assessed future gender needs based on generated scenario. Increasing trend in temperature and decreasing trend in precipitation was found in both A2 and A1B SRES scenarios for the period of 2040-2069 and 2070-2099. The study found that large scale migration might result from the study area in absence of immediate adaptation intervention.
7. The study assessed various complexities experienced by only women due to climate change associated events and extremes and summarized key suggestion in line with climate change coping, adaptation and mitigation directly from the climate vulnerable community.
8. The study tried to assess the gender inclusiveness in national climate change policy documents (BCCSAP and NAPA). Findings show that the adaptation policies are more or less gender exclusive. The study provided key recommendations in line with gender just

climate change adaptation and mitigation and proposed an institutional framework ‘bottom up-top support’ approach for gender inclusive climate change adaptation.

9. The study is expected to enhance gender mainstreaming in national climate change adaptation policy, strategy and activity considering country’s sustainable development pathway.

5.2 Recommendations

1. Formulation of a gender policy should be the starting point for gender mainstreaming. Policy documents must address women’s practical and strategic needs and provide distinct pathway for participation and empowerment.
2. Based on national gender policy extensive awareness campaign, media operation, message through religious channels and educational institutions, etc need to be carried out
3. Budgeting for gender equality through gender equity need to be ensured for mainstreaming gender in all development activities.
4. A core group should be established for gender mainstreaming in development activities.
5. Poverty reduction and development policies should be gender inclusive and climate proof to withstand climatic adversity in the path of future development
6. The ‘bottom up-top support’ approach is highly recommended for gender mainstreaming in all types of climate proofing activities in line with country’s development pathway.

5.3 Future scope of the study

1. The study can be used for gender specific vulnerability assessment due to climate change induced events and extremes for other parts of the country.
2. The vulnerability assessment framework developed in the study can be used for assessing vulnerability of any livelihood groups considering different geo-physical context and climate change associated adversities that could lead way for the establishment of a database to provide gender disaggregated information to support improved decision making.
3. The methodology developed in the study can be replicated in future climate change study which will not only empower community but also strengthen different adaptation activity.

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Annex 1

Figures

Figure 1a: Impact of climate change on productive role/ activity

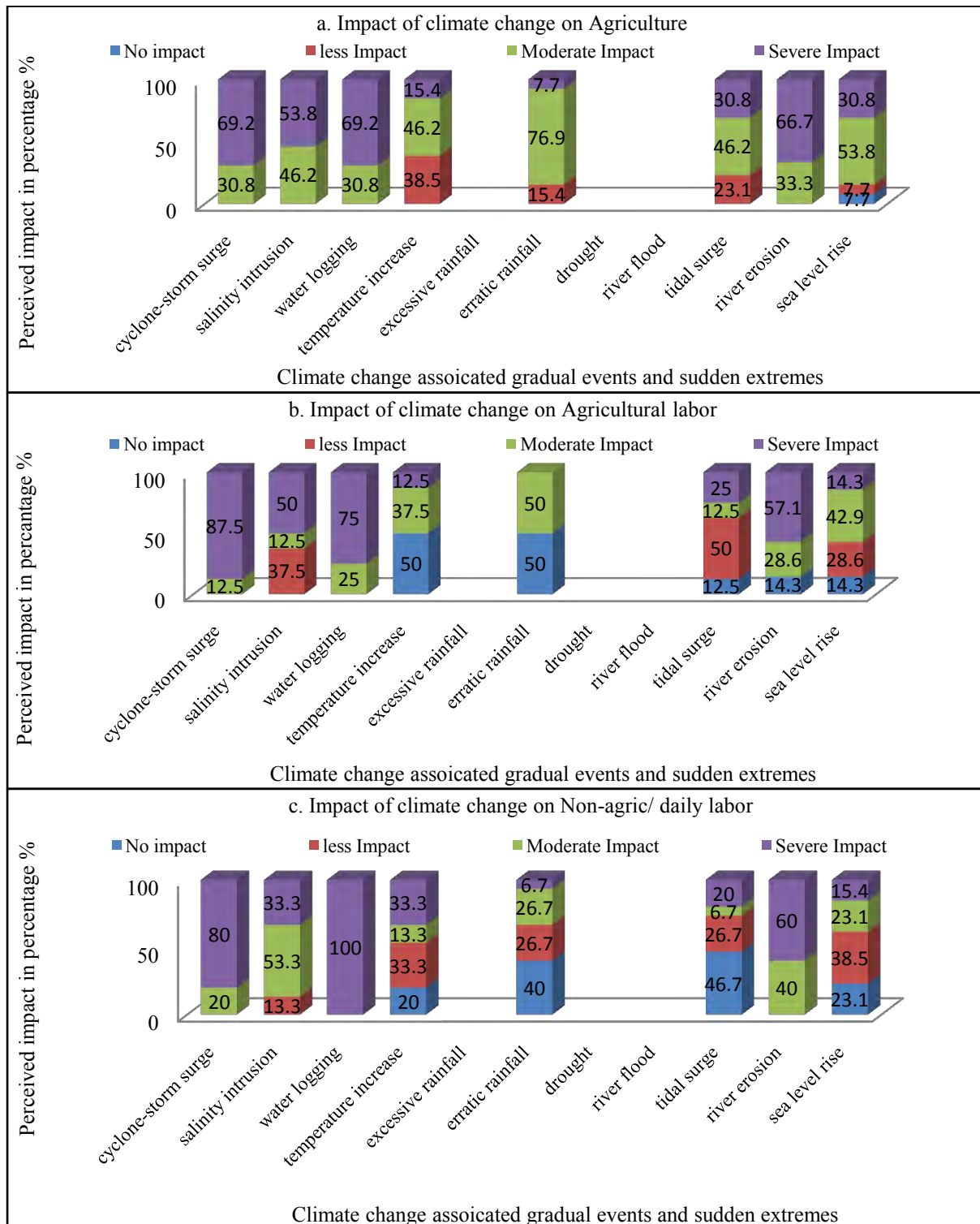


Fig 1a: Perceived response on impact of climate change on productive role/ activity

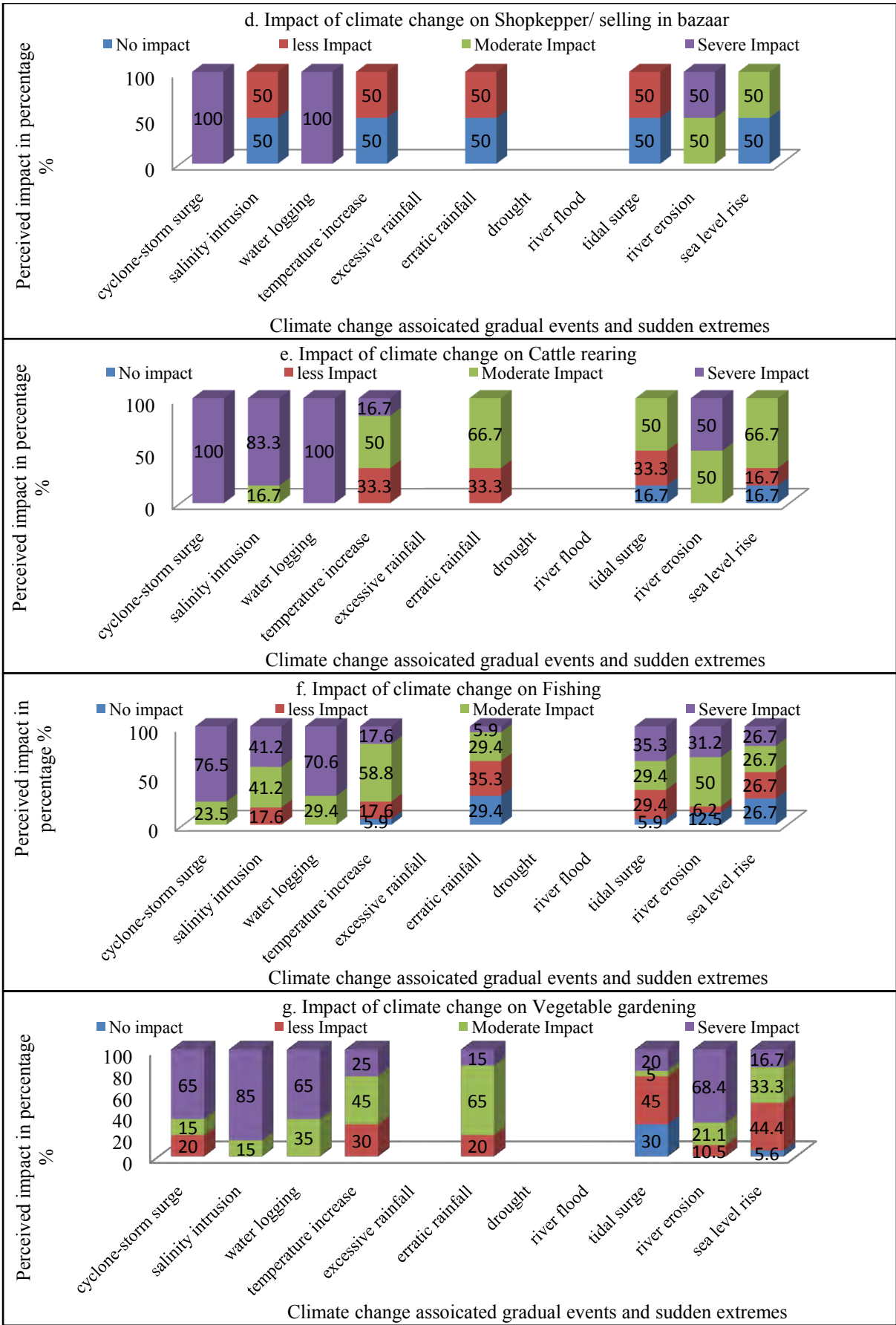


Fig 1a: Perceived response on impact of climate change on productive role/ activity (cont.)

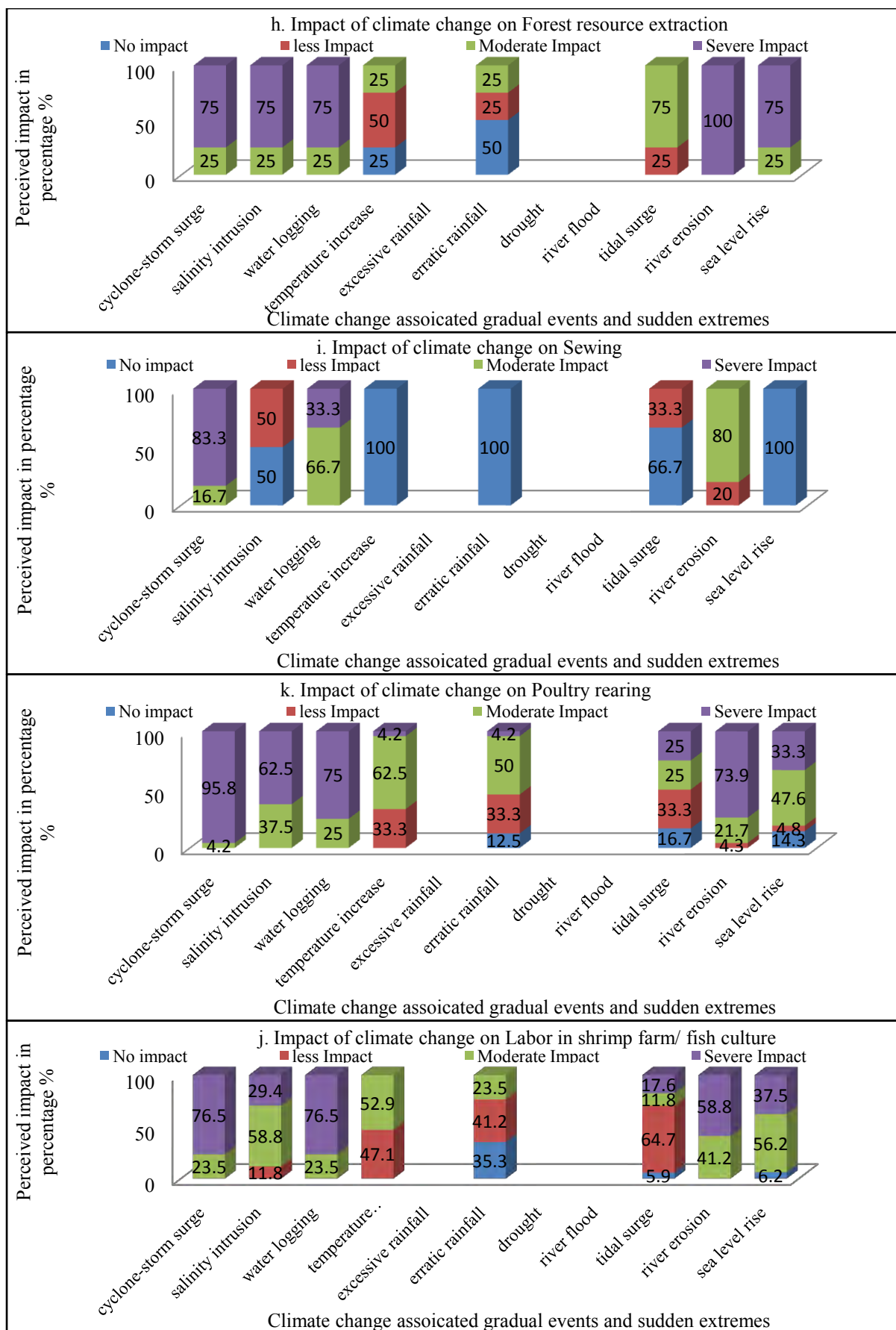


Fig 1a: Perceived response on impact of climate change on productive role/ activity (cont.)

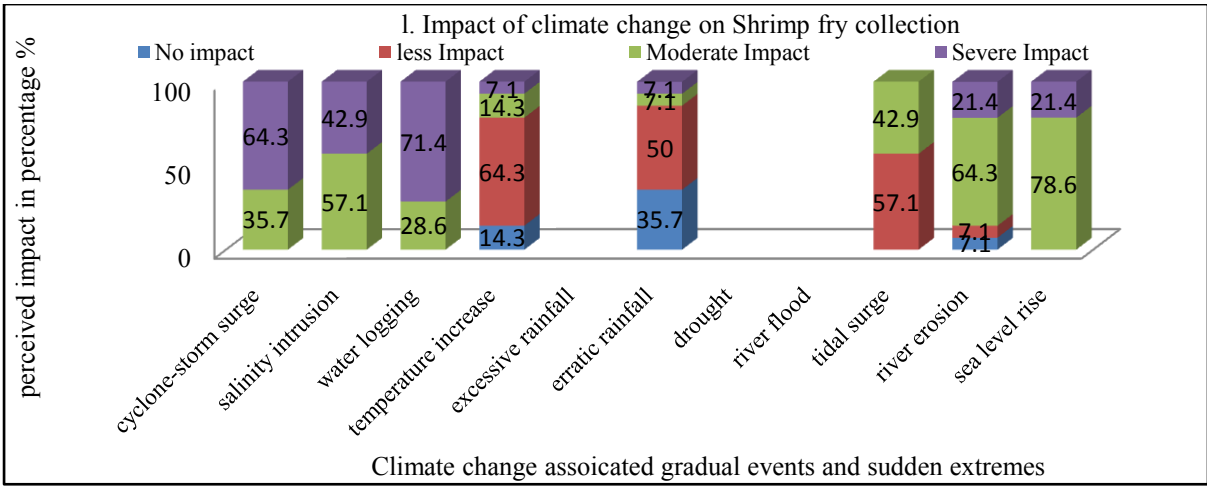


Fig 1a: Perceived response on impact of climate change on productive role/ activity (cont.)

Figure 1b: Impact of climate change on reproductive role/ activity

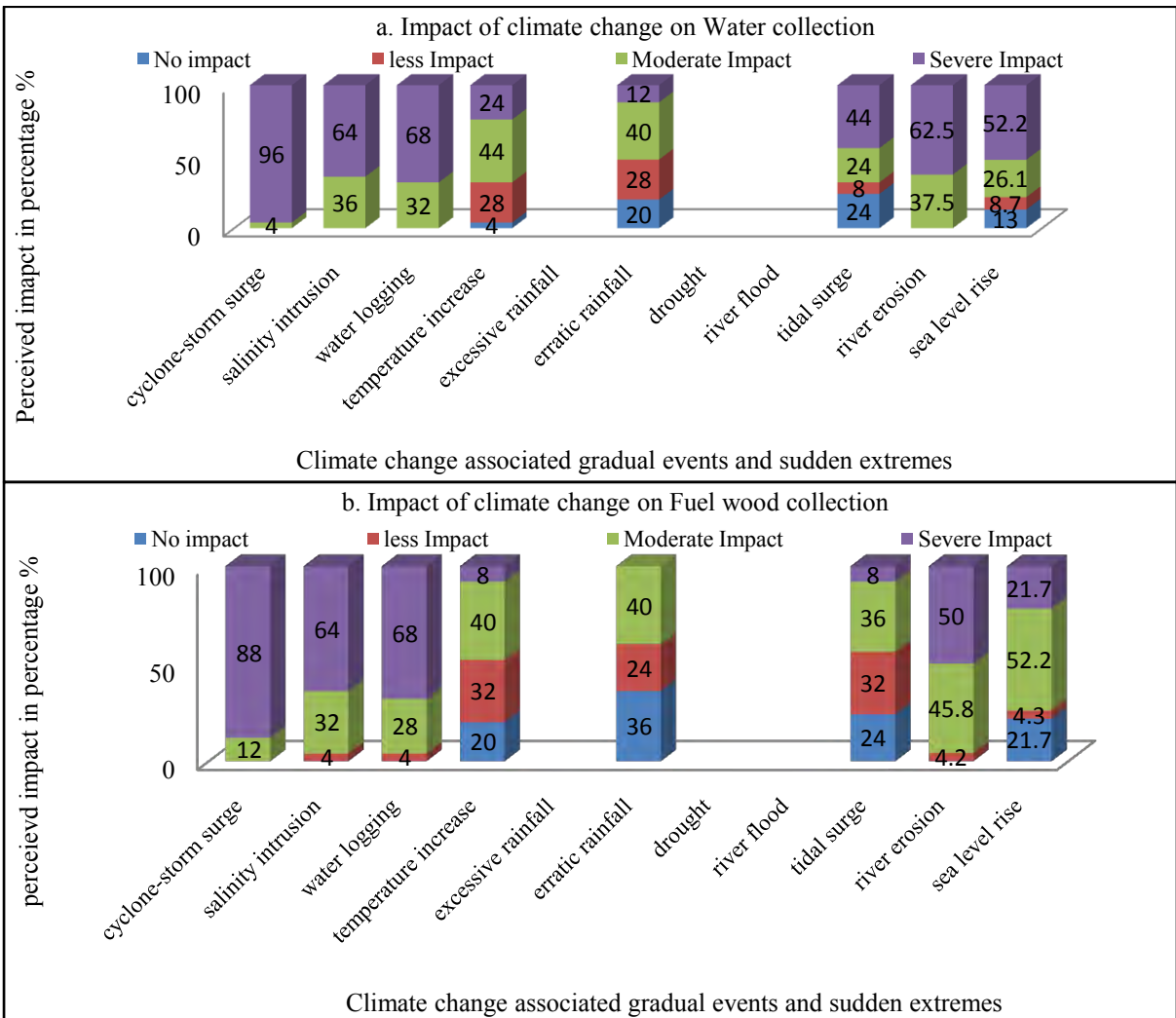


Fig 1b: Perceived response on impact of climate change on reproductive role/ activity

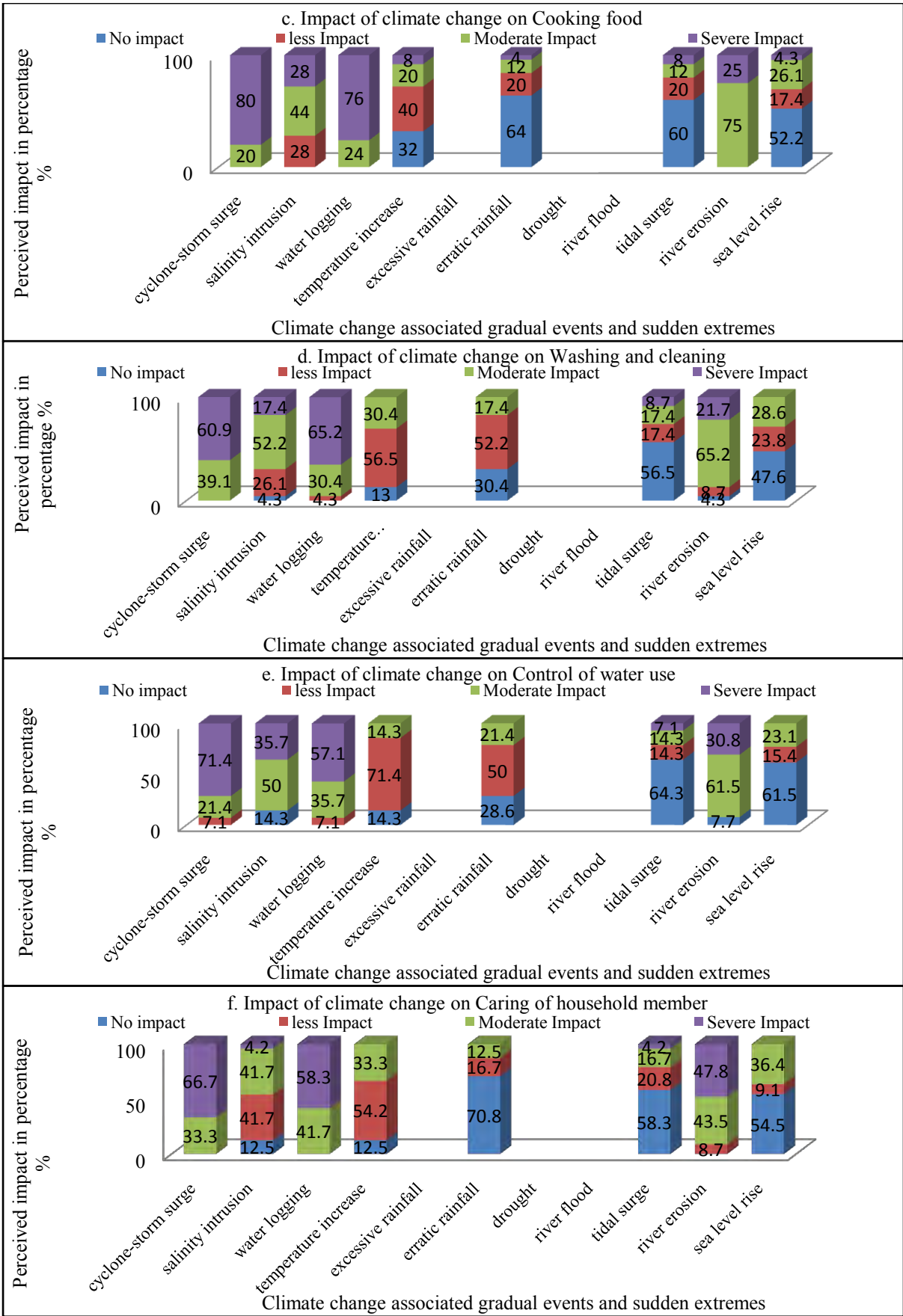


Fig 1b: Perceived response on impact of climate change on reproductive role/ activity (cont.)

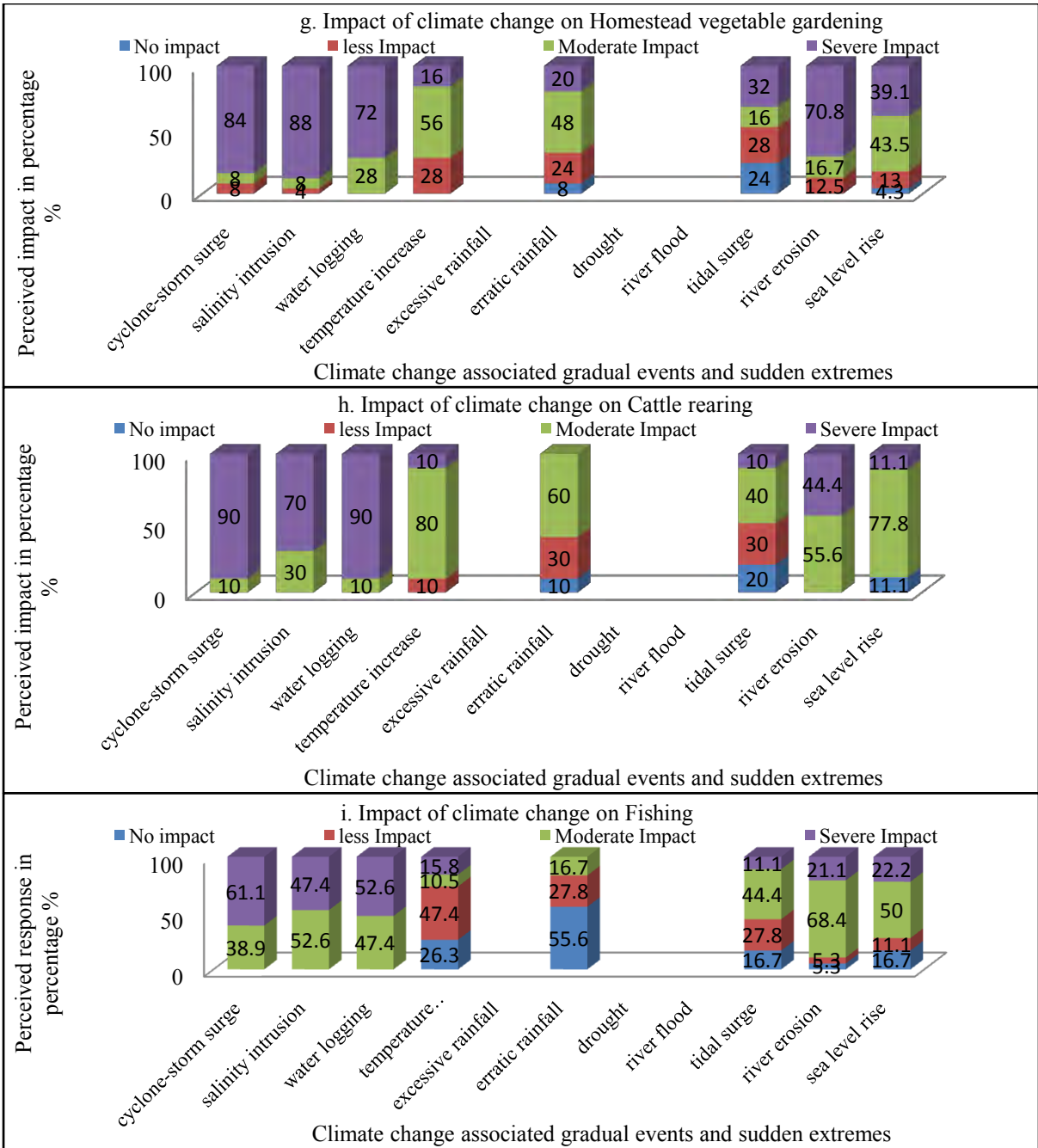


Fig 1b: Perceived response on impact of climate change on reproductive role/ activity (cont.)

Figure 1c: Impact of climate change on community managed activity

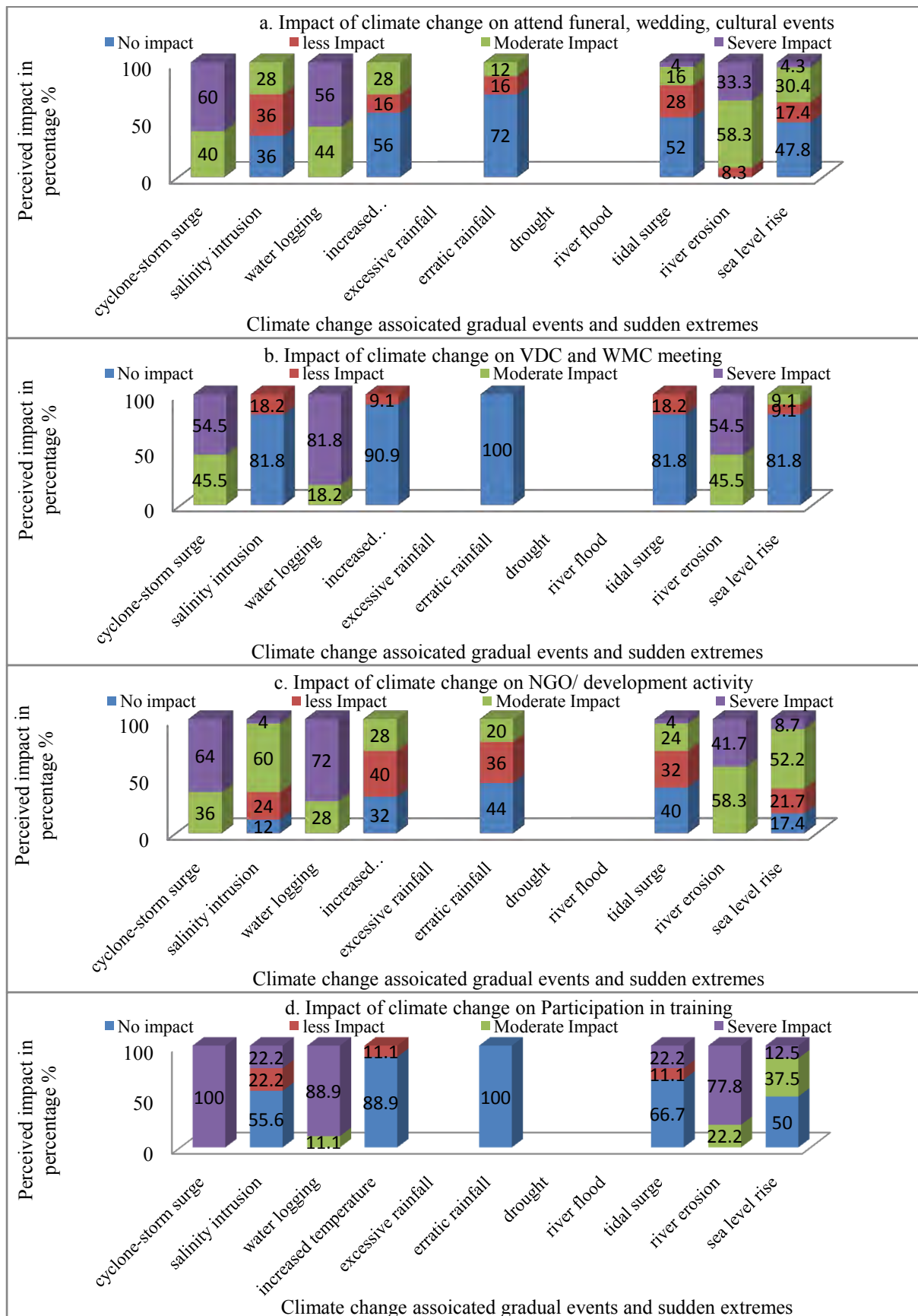


Fig 1c: Perceived response on impact of climate change on community managed activity

Figure 1d: Impact of climate change on access and control over resources

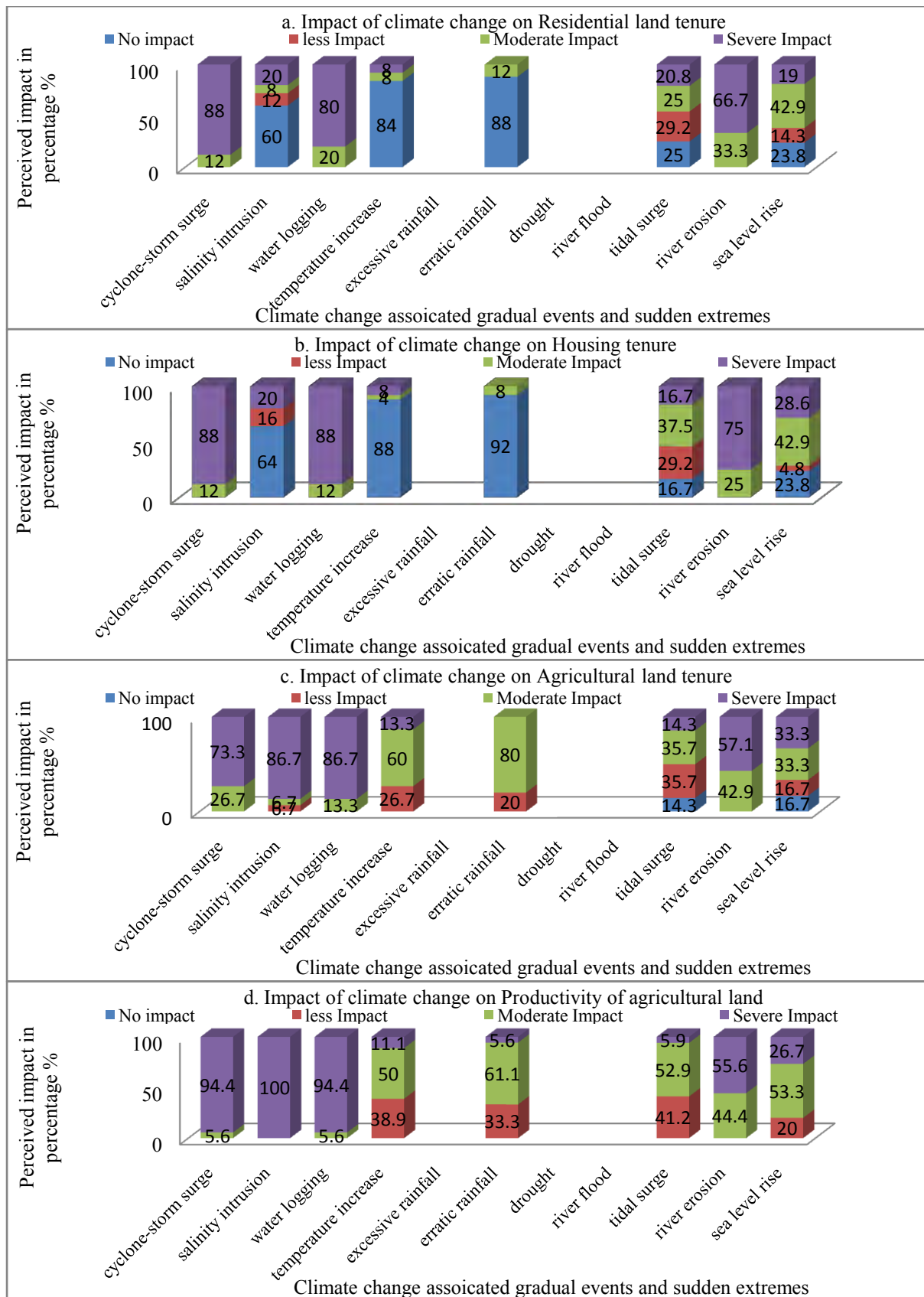


Fig 1d: Perceived response on impact of climate change on access and control over resources

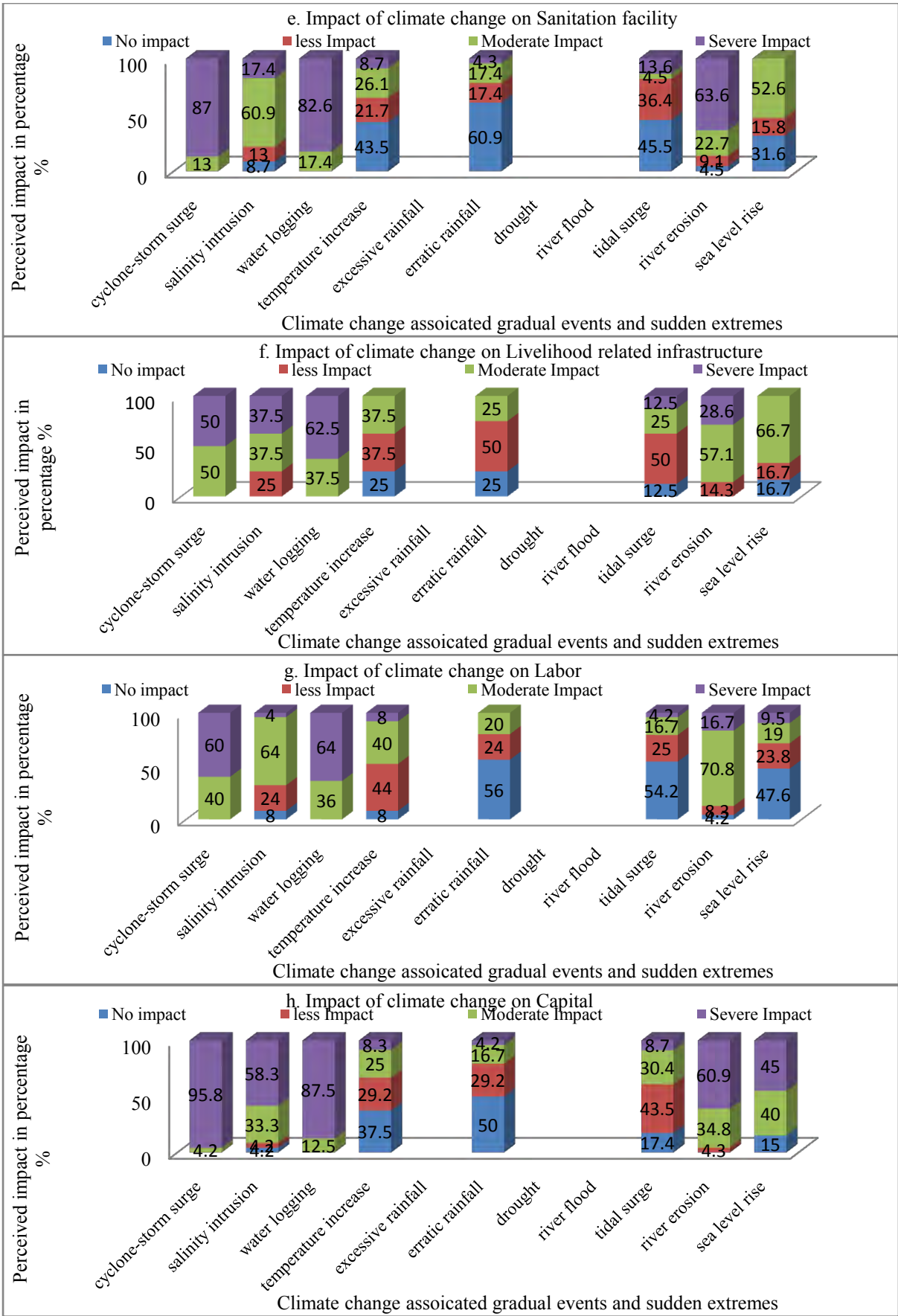


Fig 1d: Perceived response on impact of climate change on access and control over resources (cont.)

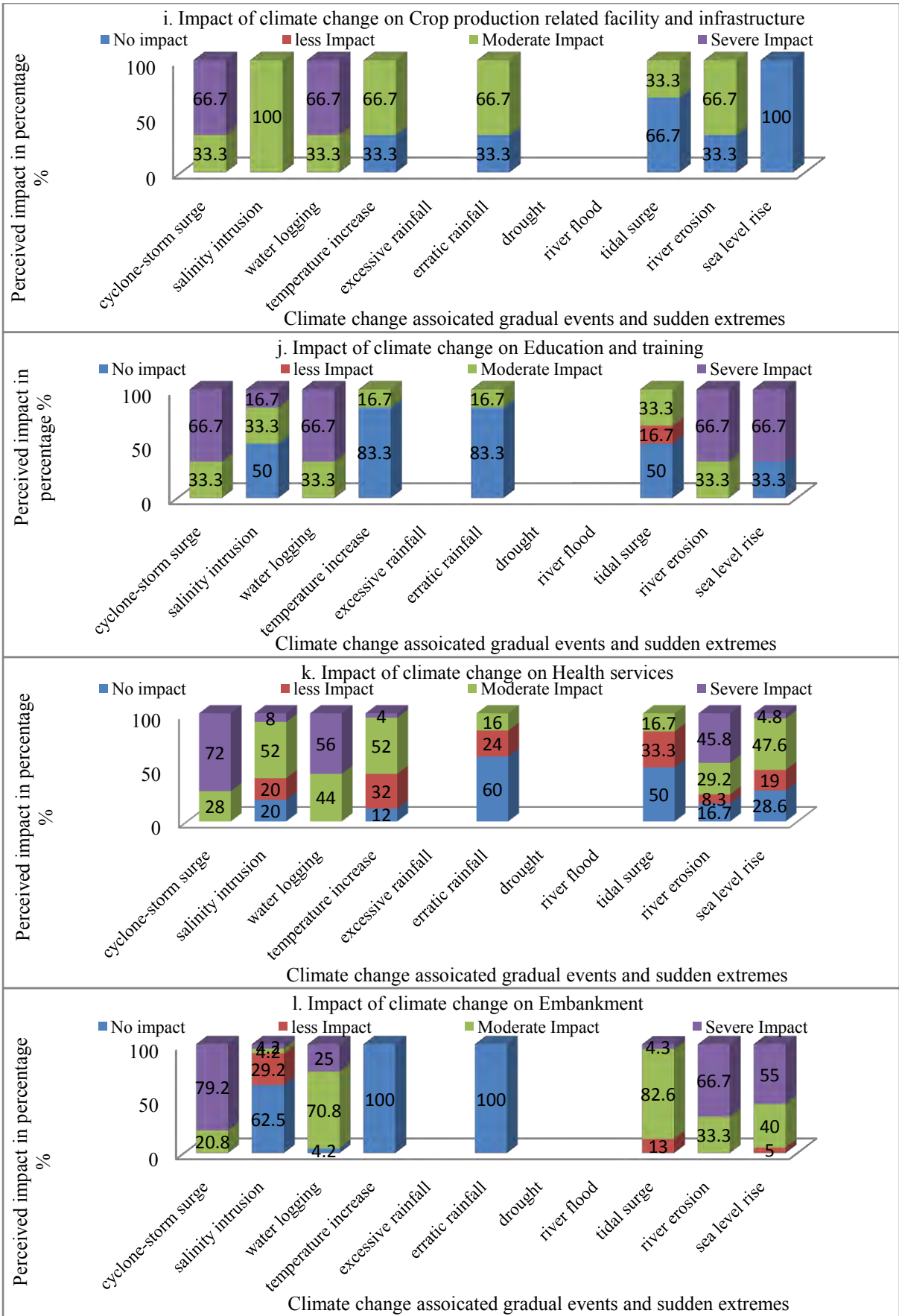


Fig 1d: Perceived response on impact of climate change on access and control over resources (cont.)

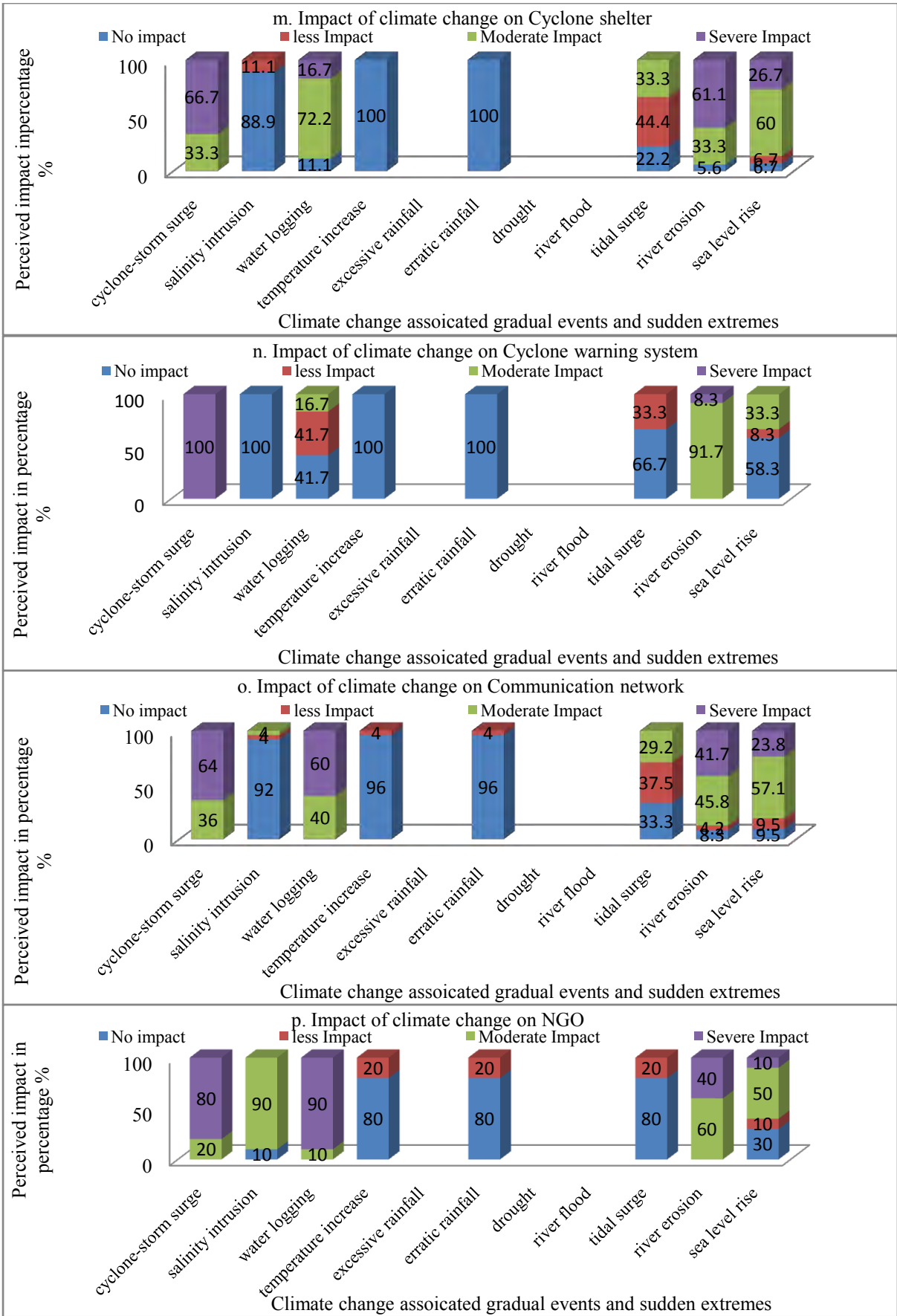


Fig 1d: Perceived response on impact of climate change on access and control over resources (cont.)

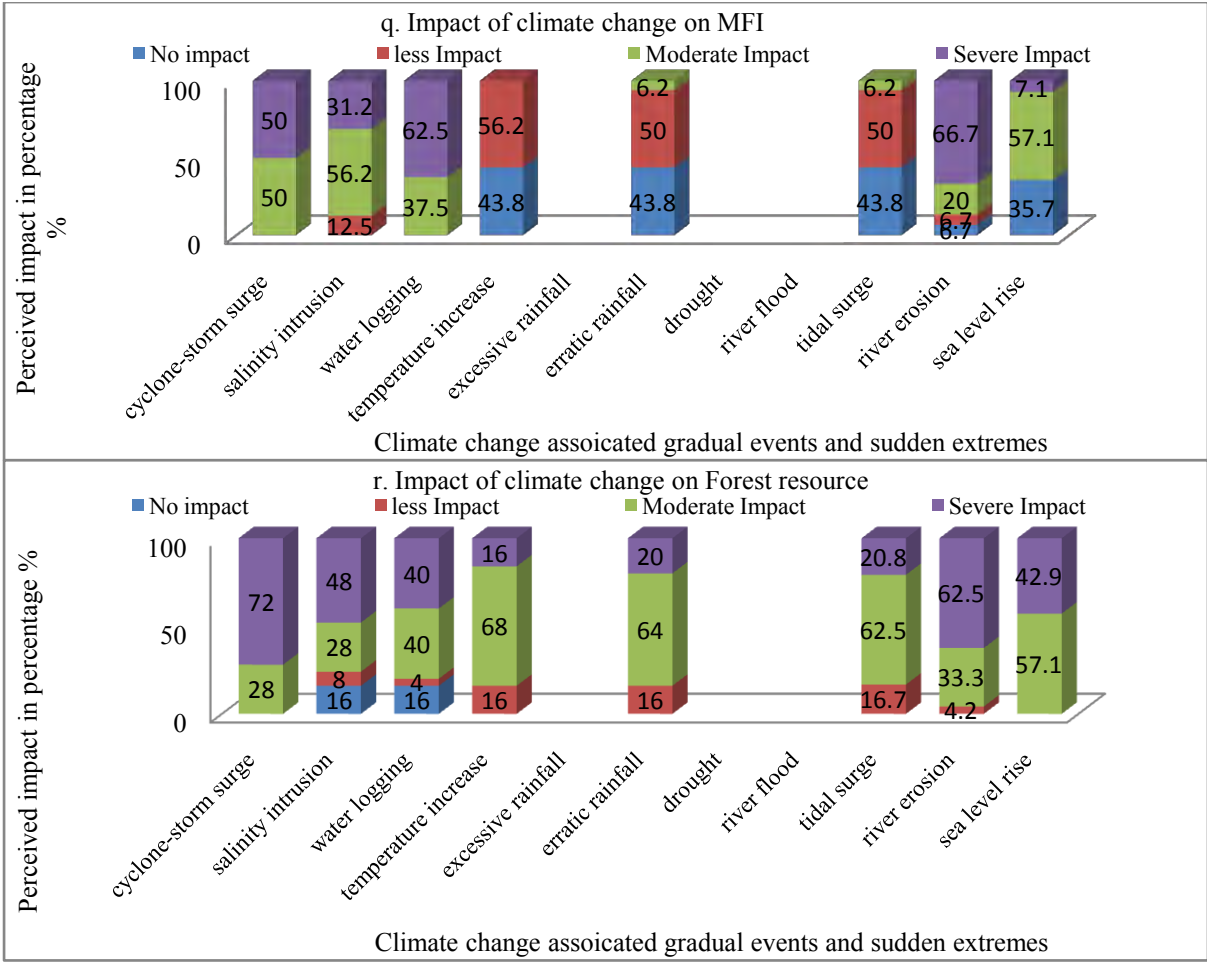


Fig 1d: Perceived response on impact of climate change on access and control over resources (cont.)

Figure 1e: Impact of climate change on access and control over benefits

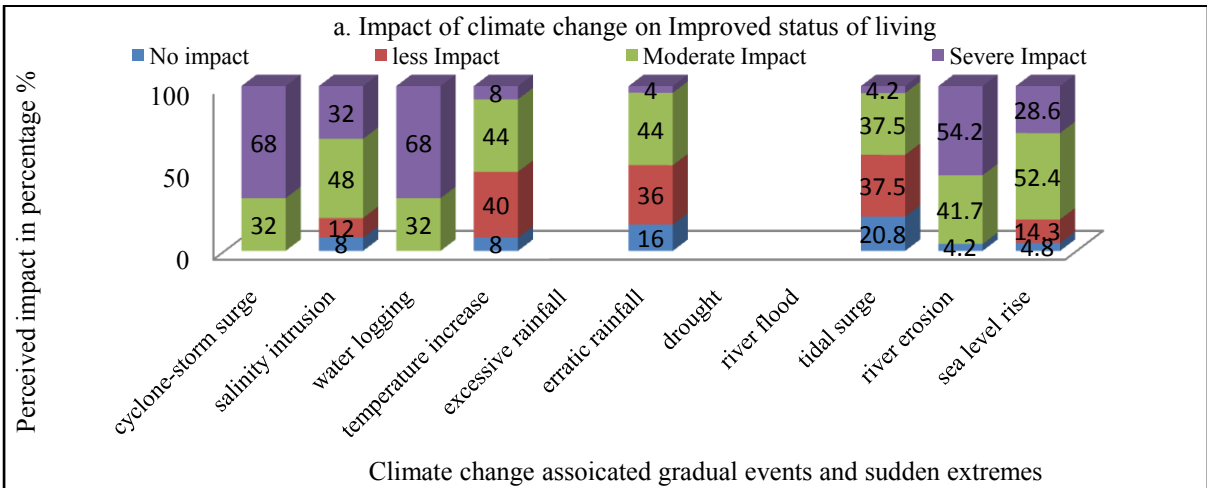


Fig 1e: Perceived response on impact of climate change on access and control over benefits

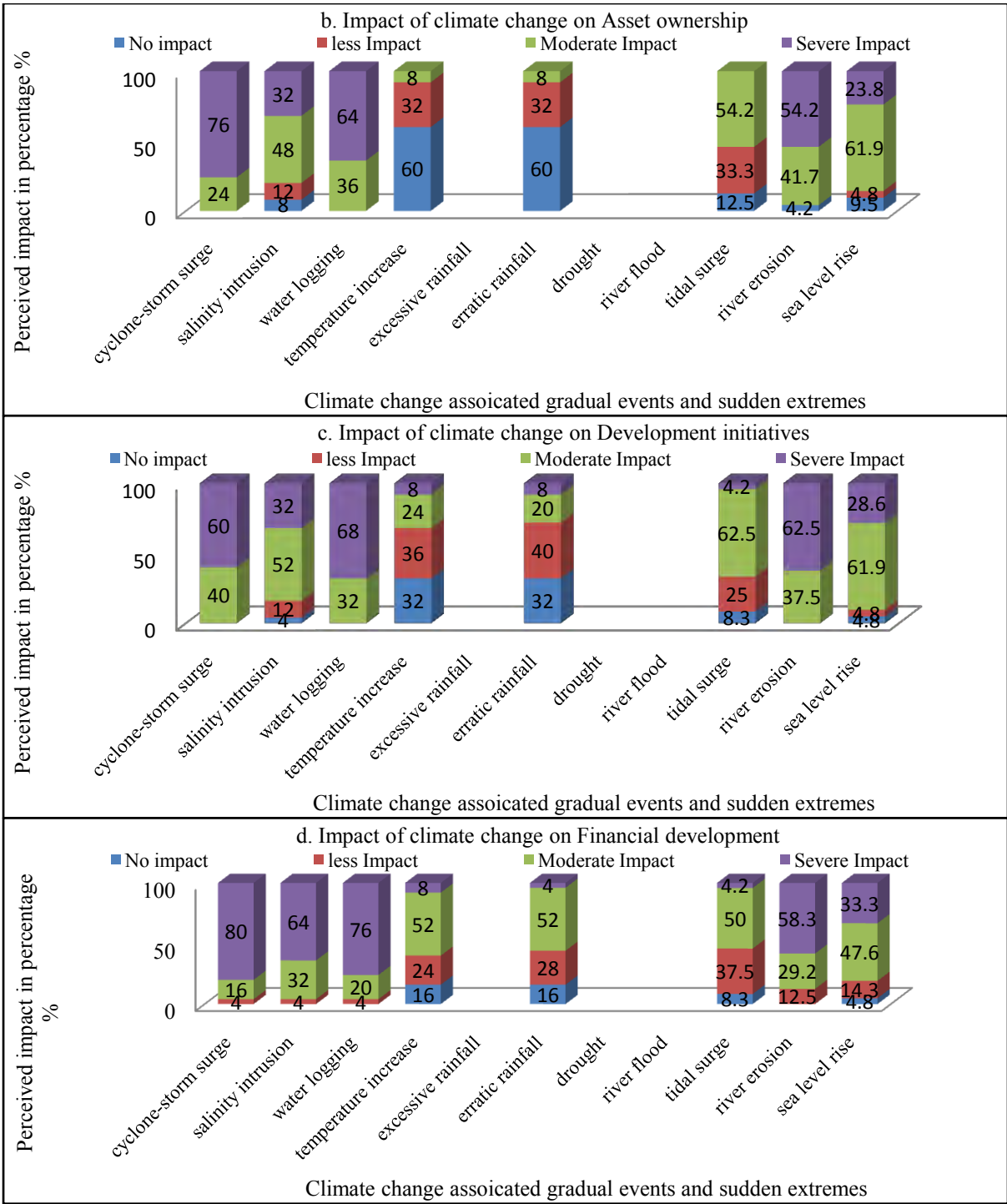


Fig 1e: Perceived response on impact of climate change on access and control over benefits (cont.)

Figure 1f: Model calibration for Statistical Downscaling for future scenario generation

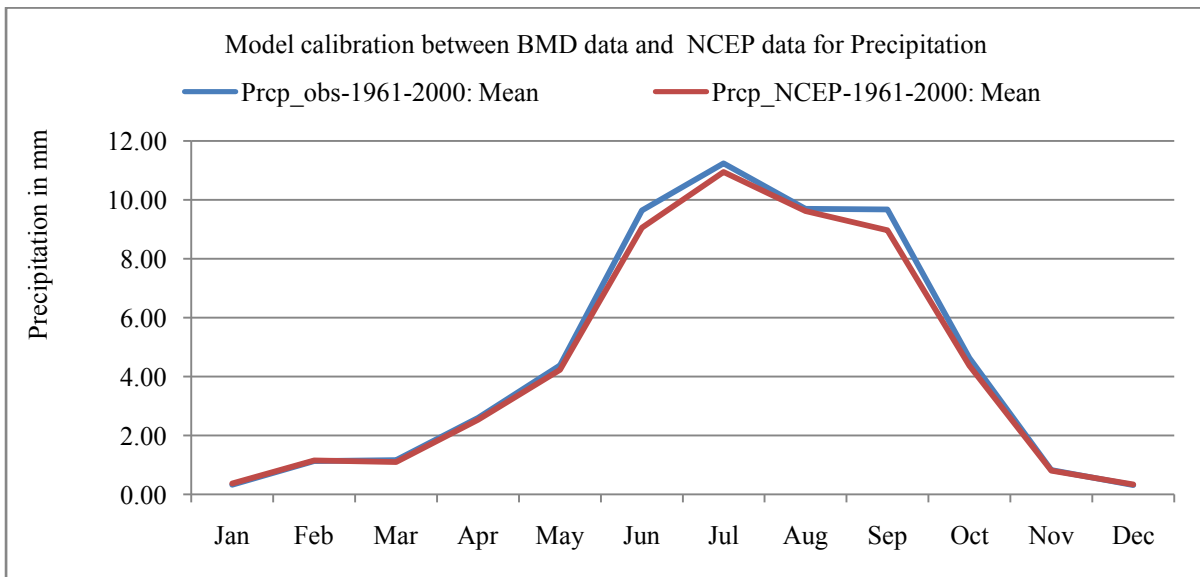
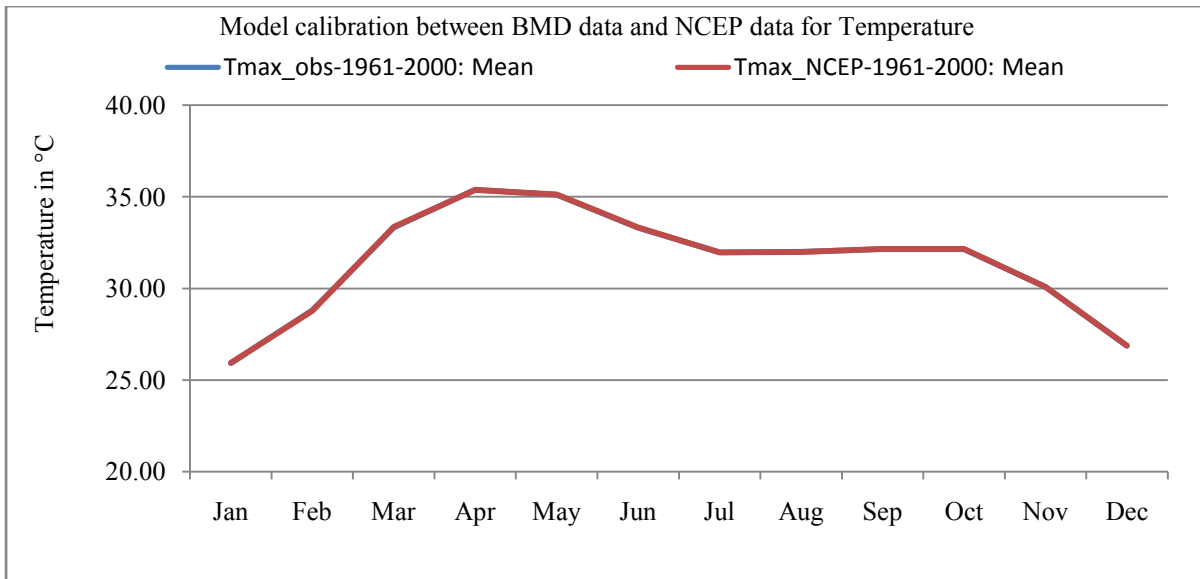


Figure 1g: Future scenario generation for the period of 2040-2069 and 2070-2099 for A2 and A1B SRES scenario for Satkhira district, Bangladesh

g1. Trend in Maximum Temperature (Tmax)

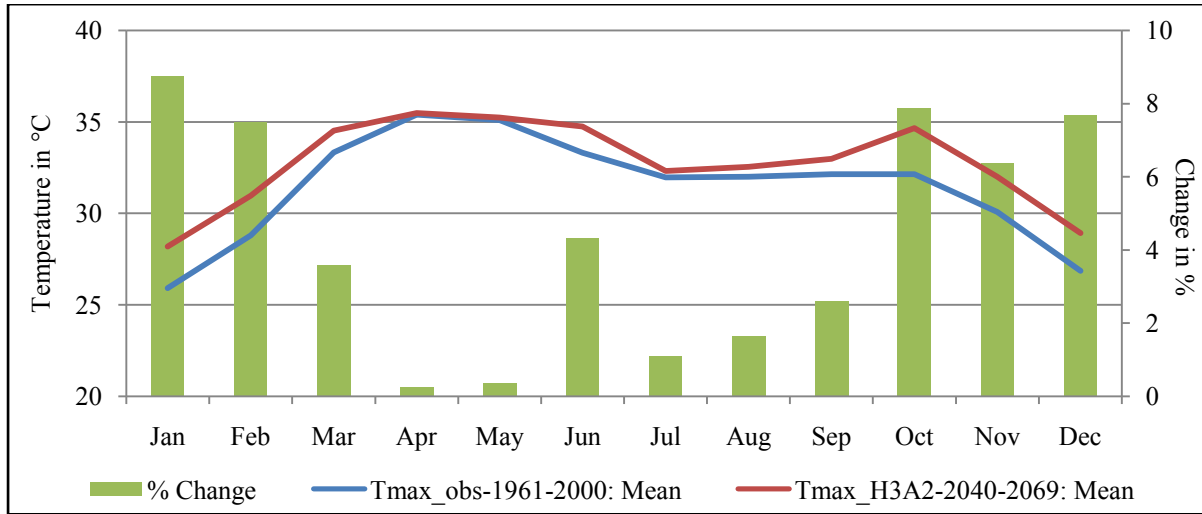


Fig (a): Trend in mean Tmax between 1961-2000 and 2040-2069 (A2 SRES scenario)

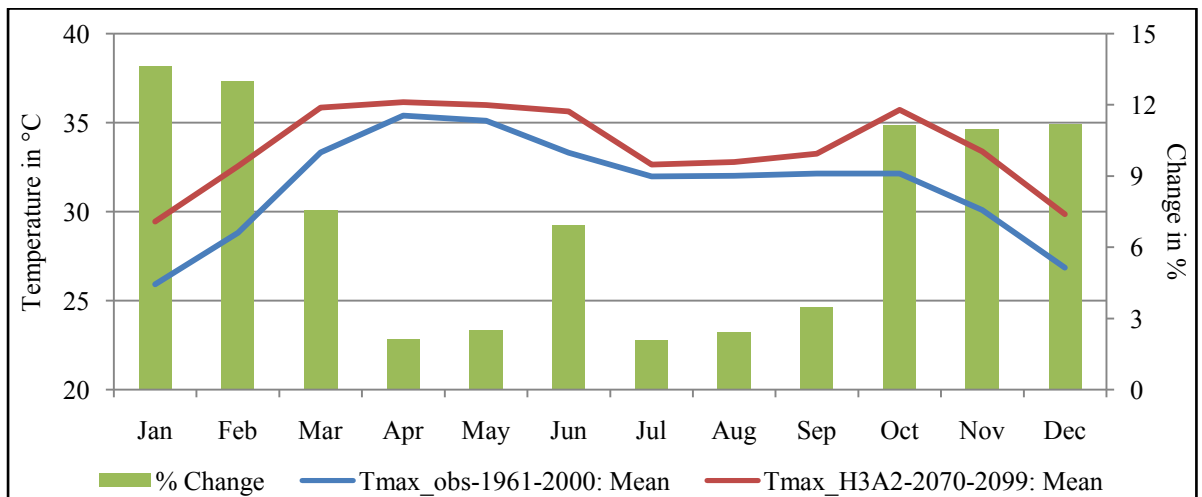


Fig (b): Trend in mean Tmax between 1961-2000 and 2070-2099 (A2 SRES scenario)

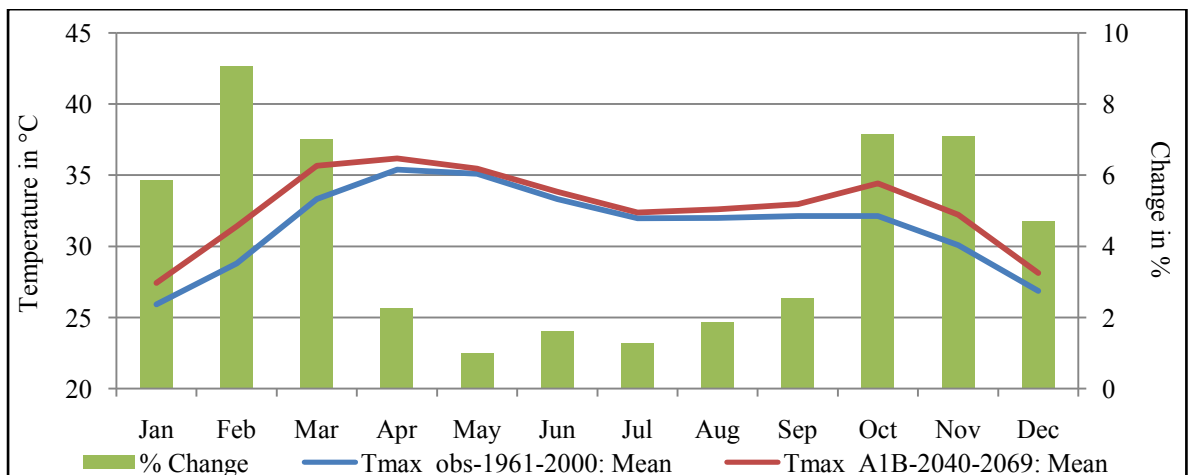


Fig (c): Trend in mean Tmax between 1961-2000 and 2040-2069 (A1B SRES scenario)

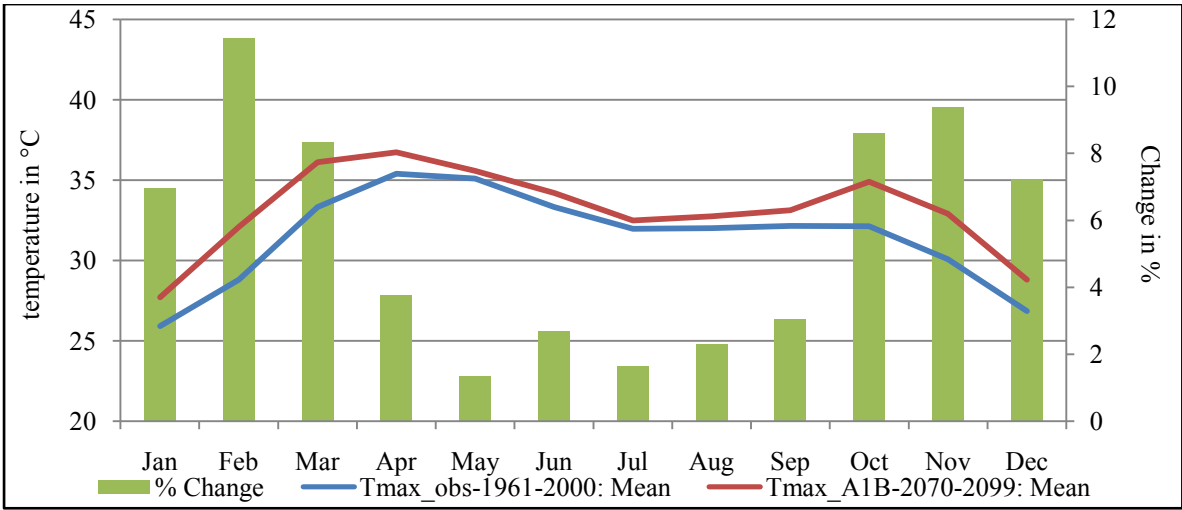


Fig (d): Trend in mean Tmax between 1961-2000 and 2070-2099 (A1B SRES scenario)

g2. Trend in Minimum Temperature (Tmin)

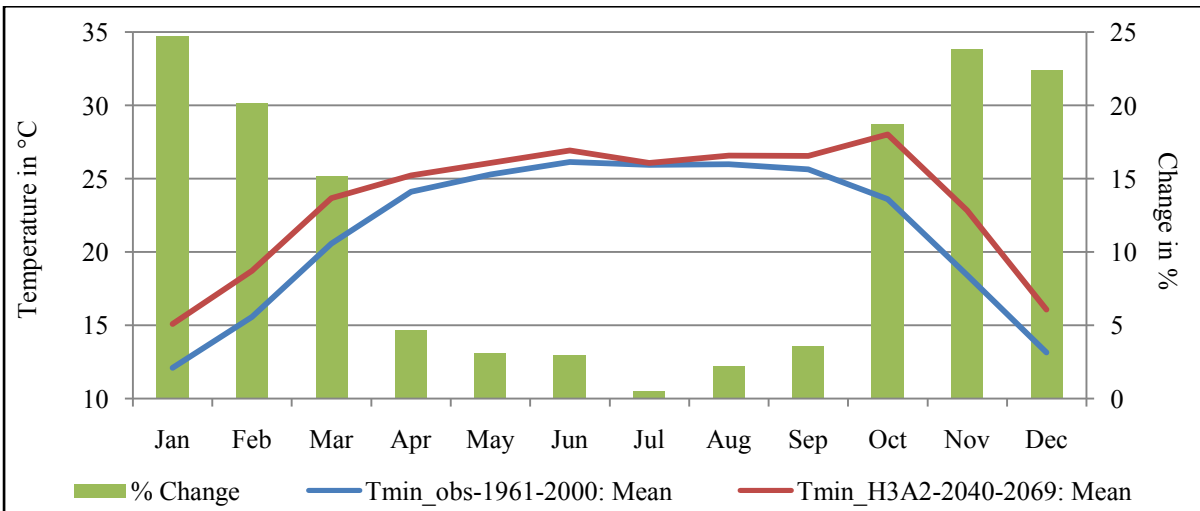


Fig (a): Trend in mean Tmin between 1961-2000 and 2040-2069 (A2 SRES scenario)

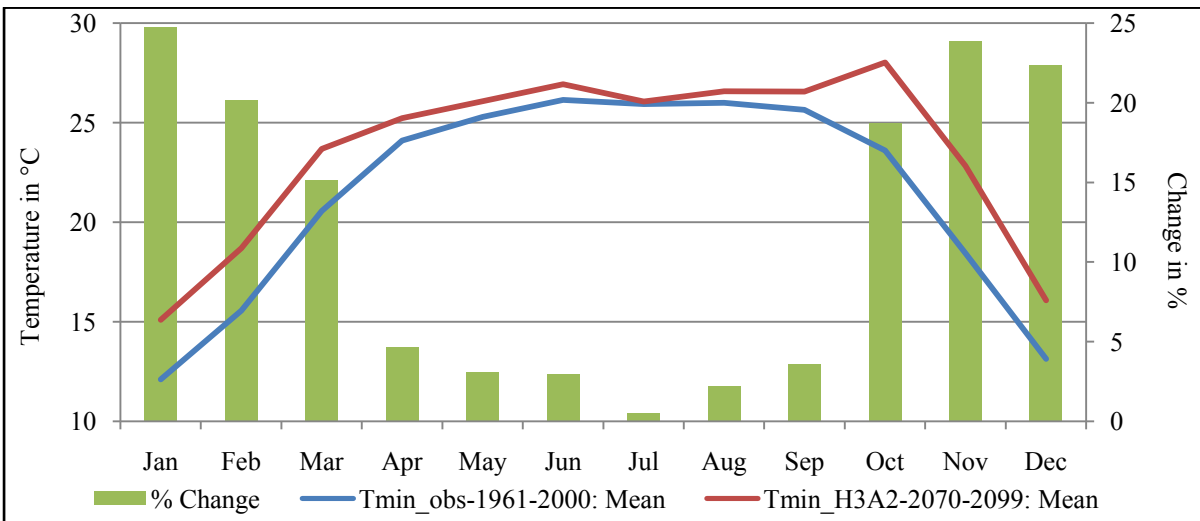


Fig (b): Trend in mean Tmin between 1961-2000 and 2070-2099 (A2 SRES scenario)

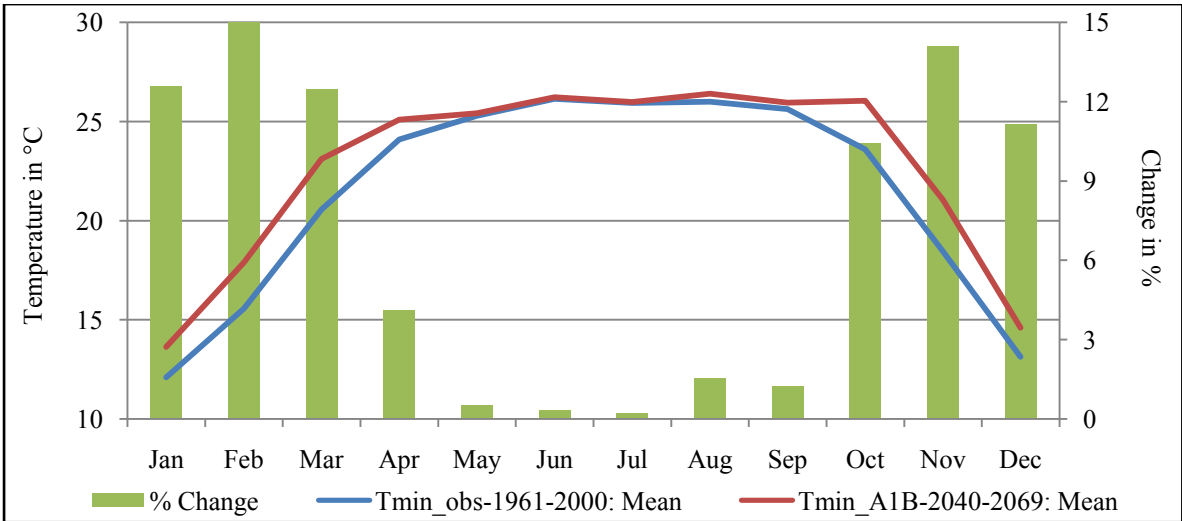


Fig (c): Trend in mean Tmin between 1961-2000 and 2040-2069 (A1B SRES scenario)

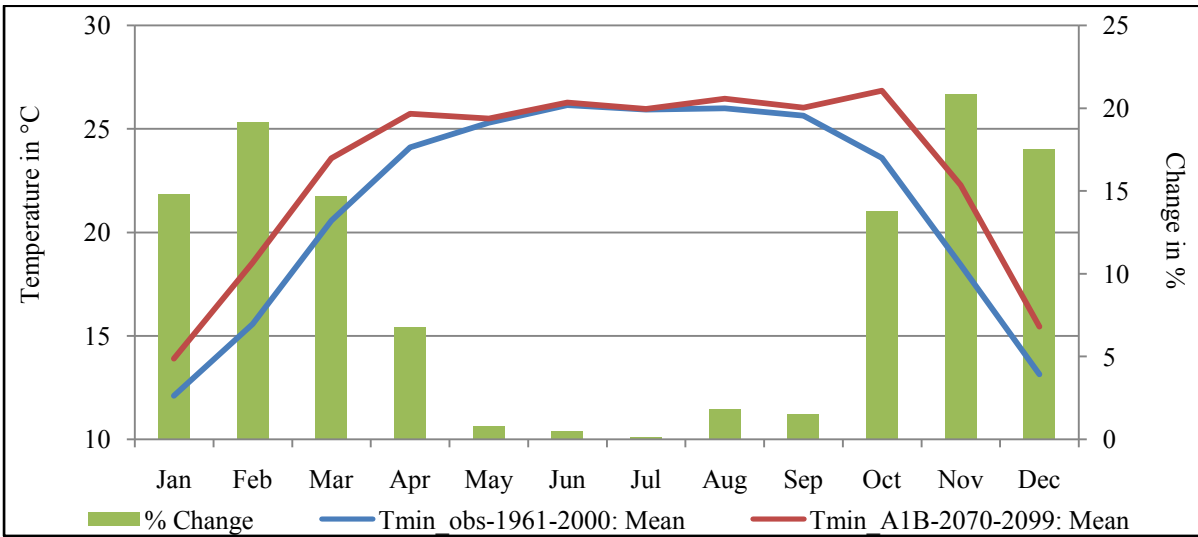


Fig (d): Trend in mean Tmin between 1961-2000 and 2070-2099 (A1B SRES scenario)

g3. Trend in Precipitation (Prp)

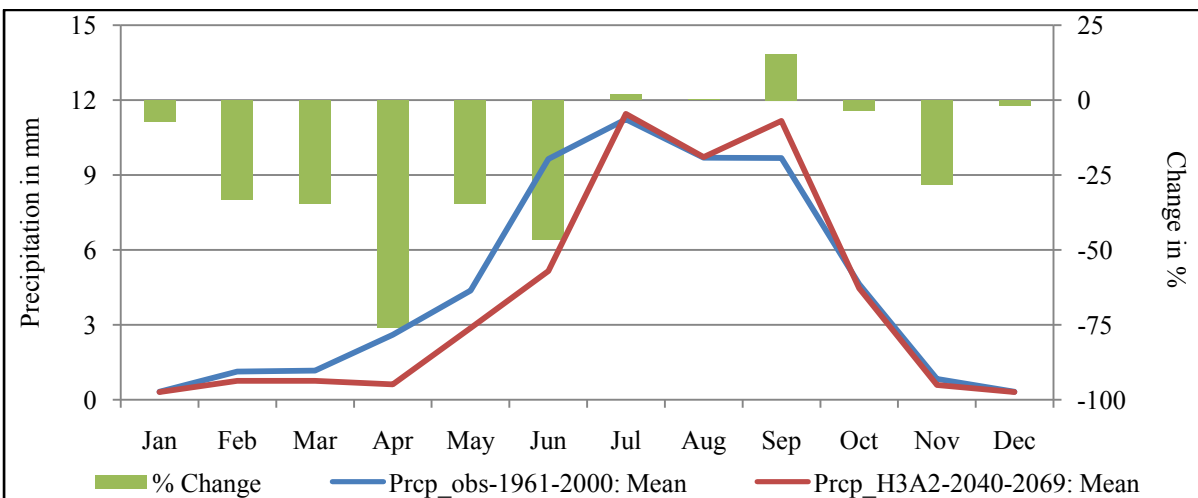


Fig (a): Trend in mean Precipitation between 1961-2000 and 2040-2069 (A2 SRES scenario)

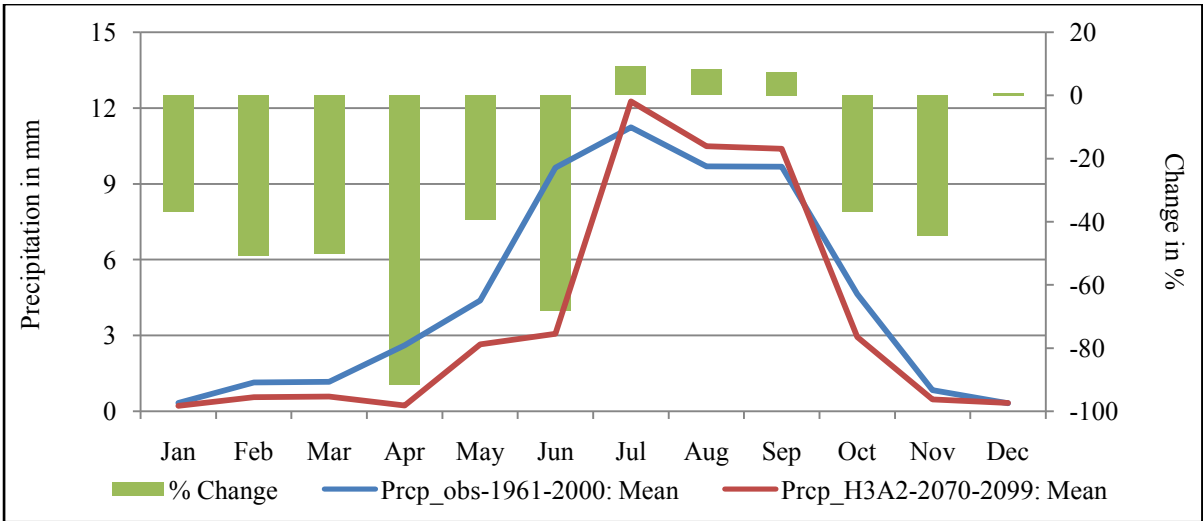


Fig (b): Trend in mean Precipitation between 1961-2000 and 2070-2099 (A2 SRES scenario)

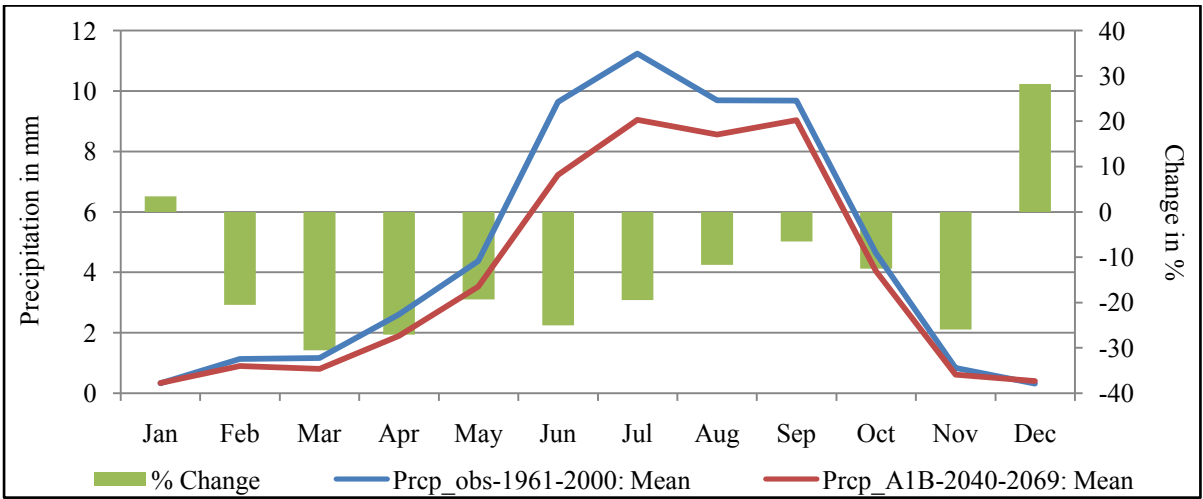


Fig (c): Trend in mean Precipitation between 1961-2000 and 2040-2069 (A1B SRES scenario)

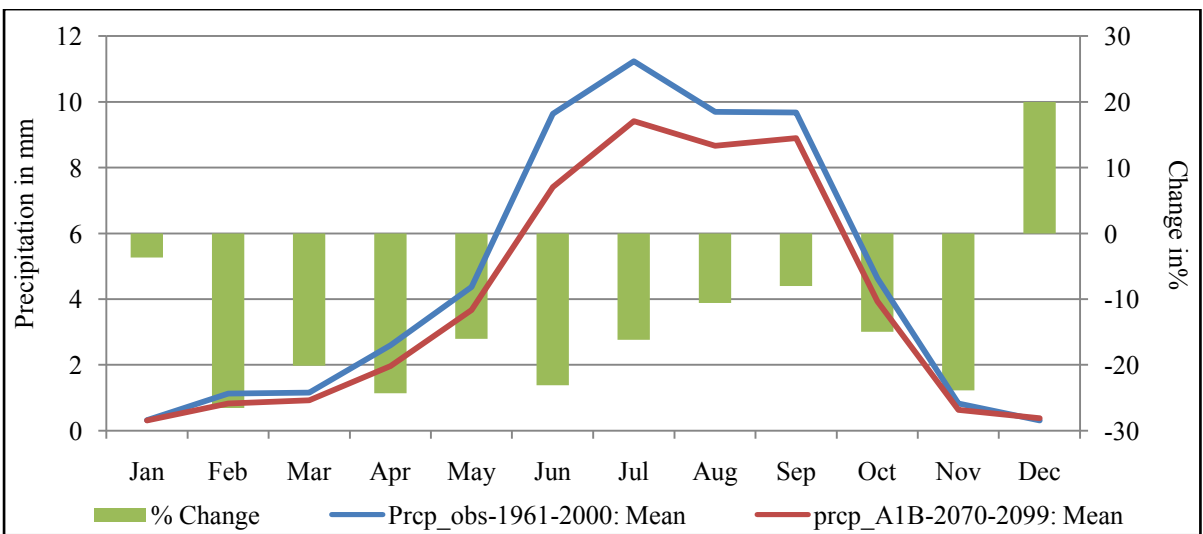


Fig (d): Trend in mean Precipitation between 1961-2000 and 2070-2099 (A1B SRES scenario)

Annex 1

Exploring Gender Vulnerability and Adaptive capacity to Climate Change Associated Extremes

Household Survey Questionnaire

(Circle/ Fill up/ Put the appropriate Answer/ Code as per Question)

1. Household Identification Information:

HH No: ___ Area/ Para: ___ Village: ___ Upazilla: ___ Union: ___ District: ___

2. Name of the respondents: _____

3. Father's/Husband's Name: _____ 4. Religion: _____

5. Age: ----- (yr) 6. Sex: (Male:1, Female: 2)

7. Education level:

(Illiterate: 1, Can sign only: 2, Primary (class 5): 3, Secondary (class 8): 4, SSC: 5)

8. Relationship with Household Head:

(HH head him/herself: 1, Husband: 2, Wife: 3, In laws/ old dependent: 4, Mature children: 5)

9. Marital status: (Married: 1, Unmarried: 2, Divorced: 3, Widow: 4, Abandoned: 5)

10. Type of family: (Nuclear: 1, Joint: 2)

11. Number of dependent: (No. of member less than 15 years and greater than 65 years of age + person physically or mentally disable)

12. Have you been living here since your birth? 1 2 (Yes: 1, No: 2)

[If Yes, go to question Q.16. Otherwise go to Q.13]

13. For how many years you are living here? _____ years.

14. Where did you live before? (Urban: 1, Rural: 2)

15. Reason for living here:

Reason	Code
Due to marriage	1
Family migrated (due to disaster)	2
Own land/house	3
Land bought at lower rates	4
Better livelihood/employment opportunity	5
Low living cost	6
Others (please specify)	88

16. Housing condition:

Condition	Code
CI sheet roof brick made (semi pakka) house	1
Corrugated iron sheet roof house	2
Straw mat roof house	3
Polythin made temporary shelter in own land	4
Polythin made temporary shelter on embankment	5
Living in cyclone shelter	6
Others (please specify)	88

17. Land ownership pattern by Gender (only ✓ mark where appropriate)

Ownership Pattern	Type of land						
	Homestead	Agricultural Land	Sharecropper out land	Shrimp Gher	Pond/Fish Culture Pond	Fallow Land	Other (specify)
Male only							
Female only							
Male and Female Jointly							

18. Wealth wise household class: (Extreme poor: 1, Poor: 2, Middle class: 3, Rich: 4)

19. Occupational details of the respondent:

(Put occupation code and circle appropriate code-multiple codes can be used)

Occupation	Current ¹ (put code)	Previous ¹ (put code)	Reasons for change (Encircle appropriate code)-Multiple responses possible- If the code is 6 or 7, then pls. go to ques. 19a. And 19b.)	
1. Major occupation of the respondent			Not paying well	1
			Lost job	2
			Lost land	3
			Migrated	4
			Health Reasons	5
			Natural disaster	6
			Production loss due to climate variability and associated change	7
			Others (pls. specify)	88
2. Occupation of other major income earner in the HH			Not paying well	1
			Lost job	2
			Lost land	3
			Migrated	4
			Health Reasons	5
			Natural disaster	6
			Production loss due to climate variability and associated change	7
			Others (pls. specify)	88

¹. Occupation code: Cultivator: 1, Agricultural wage laborer: 2, Fisher: 3, Laborer in shrimp farm/ fish culture: 4, Shrimp fry collection: 5, Non-agric/ daily labor: 6, Rickshaw/van puller: 7; Boatman: 8, Carpenter: 9, Sewing work: 10, Livestock rearing: 11, Poultry: 12, Handy craft: 13, Service/NGO worker/Teacher: 14, Shopkeeper/ Small enterprise: 15, Home stead vegetable production: 16, Forest resource extraction and selling: 17, Shrimp Gher owner: 18, Big business-19, Unemployed-20, Other (pls. specify) : 88

19a. Type of natural disaster: (circle the appropriate code- multiple codes can be used)

Type of disaster	Code
Cyclone and storm surge	1
River erosion	2
Tidal Surge and flooding	3
River flooding	4
Water logging	5

Type of disaster	Code
Salinity Intrusion	6
Drought or no rainfall	7
Erratic/ excess rainfall	8
Other (pls. Specify)	88

19b. Type of climate variability and associated change: (circle the appropriate code- multiple codes can be used)

Type of climate variability/ change	Code
Increased temperature	1
Erratic nature of rainfall	2
Increased salinity intrusion	3
Increased height of tidal wave and overtopping of embankment	4
Frequent water logging	5
Drought or no rainfall	6
Increased river bank erosion	7
Increased river flooding	8
Other (pls. Specify)	88

20. Gender division of household income source in normal period and post disaster period
 Gender Code: Male: 1, Female: 2, both: 3 (Insert appropriate gender code)

Income source	Period	
	Normal period	Post disaster period
Cultivation		
Agricultural wage laborer		
Fisher		
Laborer in shrimp farm/ fish culture		
Shrimp fry collection		
Non-agric/ daily labor		
Rickshaw/van puller		
Boatman		
Carpenter		
Sewing work		
Livestock rearing		
Poultry		
Handy craft		
Service/NGO worker/Teacher		
Shopkeeper/ Small enterprise		
Home stead vegetable production		
Forest resource extraction and selling		
Big business		
Shrimp Gher owner		
Other (Pls. specify)		

21. Do you have savings? (Yes: 1, No: 2) (If yes, then answer Q 22 or move to Q 23)

22. Three Major areas where savings money is used: I. -----

II. -----, III. -----

23. Do you take loan? (Yes: 1, No: 2) (If yes, then answer Q 24 or move to Q 25)

24. Major sources of loan with interest rate and purpose:

Source of loan	Interest rate	Purpose

25. What are the sources of water for different uses in your area? (Put appropriate code- Multiple codes can be used if needed)

Sources	Deep tubewell	Shallow tubewell	Pond	Pond Sand Filter	Khal	River	Rain water	Others (Pls. specify)
Drinking	1	2	3	4	5	6	7	88
Cooking	1	2	3	4	5	6	7	88
Bathing	1	2	3	4	5	6	7	88
Washing	1	2	3	4	5	6	7	88
Agriculture	1	2	3	4	5	6	7	88
Fisheries	1	2	3	4	5	6	7	88
Livestock	1	2	3	4	5	6	7	88
Other (Pls. specify)	1	2	3	4	5	6	7	88

26. How would you rate the quality of water from each of these sources? (Insert appropriate code - multiple codes can be used)

Water source	Water use					
	Drinking	Domestic	Agriculture	Fisheries	Livestock	Other (specify)
Deep tubewell						
Shallow tubewell						
Pond						
Pond Sand Filter						
Khal						
River						
Rain water						
Other (Pls. specify)						

Codes for quality- Excellent: 1, Good: 2, Average: 3, Poor: 4, Very poor: 5

27. Who collects water for the household use in normal time and post disaster period? (Insert appropriate code- Multiple codes can be used)

Uses of water	Normal Period	Post Disaster Period
Drinking		
Cooking		
Washing		

28. Distance travelled for collection of drinking water

(Circle appropriate code)

Time	Distance			
In normal period	1	2	3	4
In post disaster period	1	2	3	4

29. What are the major sanitation practices common in the area? (Encircle appropriate codes)

Latrine type	Code
Pacca sanitary latrine	1
Sanitary pit latrine	2
Pit latrine (not sanitary)	3
Hanging	4
Open defecation	5
Others (please specify)	88

30. What are the sources of pollution of water? (Put appropriate codes- multiple codes can be used)

Reasons	Code
Waste water from agricultural field	1
Latrine waste	2
Arsenic	3
Bathing cattle	4
Salinity intrusion	5
Shrimp cultivation	6
Water logging	7
Industrial waste	8
Iron	9
Increased height of tidal wave and overtopping of embankment	10
Others (please specify)	88

31. What might be the possible solutions to prevent water pollution? (Put appropriate codes- multiple codes can be used)

Ways of preventing water pollution	Code
Change irrigation and fertilized use practice	1
Reduce shrimp cultivation	2
Increase height of embankment to prevent overtopping	3
Improve drainage system	4
Making tube wells arsenic free/ ARP installation	5
Installation and use of sanitary latrine	6
Other (Pls. specify)	88
Do not know	99

32. What water borne diseases are common in the area- for normal period and disaster period?
Encircle appropriate codes- multiple codes can be used)

Type of diseases	Normal Period	Post Disaster period
Diarrhea	1	1
Cholera	2	2
Typhoid	3	3
Jaundice	4	4
Skin diseases	5	5
Others (Please specify)	88	88

33. Do you notice any changes in the climate? (Yes: 1, No: 2)

34. If Yes, what are the major changes you have noticed? (Encircle appropriate codes- multiple codes can be used)

Type of changes	Code
Long duration summer	1
Increased temperature in summer	2
Short duration monsoon	3
Monson with heavier rainfall	4
No/less rainfall in Pre-Post monsoon	5
No rainfall in Dry season	6
Erratic nature of rainfall	7
Increasing trend in salinity intrusion	8
Increased height of tidal wave due Sea level rise	9
Increased intensity and frequency of cyclone and storm surge	10
More water logged areas	11
More areas become prone to drought	12
Increased river bank erosion	13
Other (Pls. specify)	88
Do not know	99

35. What is the direct impact of climate change on the water resource in your locality?

(Encircle appropriate codes-Multiple responses possible + rank the impact)

Ranking score: No impact = 0, less Impact = 1, Moderate Impact = 2, Severe Impact = 3

Effects	Code	Ranking of impact
Change in rainfall pattern	1	
Change in water availability	2	
Salinity intrusion	3	
Others (please specify)	88	
Don't know/Can't say	99	

36. What are the major sectors/ activity most sensitive to water stress related vulnerability?

(Encircle appropriate codes-Multiple responses possible + rank the impact)

Ranking score: No Effect = 0, less Effect = 1, Moderate Effect = 2, Severe Effect = 3

Sector/ activity	Code	Ranking of Sensitivity
Impact on underground water recharge	1	
Impact on In stream water demand	2	
Impact on water quality	3	
Impact on water dependent ecosystem	4	
Impact on drinking water supply	5	
Impact on Domestic water use	6	
Standard of living	7	
Irrigation	8	
Navigation	9	
Shrimp culture	10	
Fishing	11	
Women's home stead vegetable gardening	12	
Rearing of livestock and poultry	13	
Industrial demand	14	
Other (Pls. specify)	88	
Do not know	99	

37. What are the major strategy/ activity you are utilizing to cope with the situation as various sectors/ activities been negatively affected/ damaged due to increased stress on water resource (coping)?

(Encircle appropriate codes-Multiple responses possible + rank the impact)

Ranking score: Not Effective = 0, less Effective =1, Moderate Effective = 2, Very Effective = 3

Sector/ activity	Code	Ranking of Effectiveness
Water collection requires more visit	1	
More distance need to be travelled for water collection	2	
Pond water is used for cleaning utensils and washing purpose	3	
Pond-river water is used for bathing purpose in lieu of salinity	4	
Young children had to be sent for water collection though their school going hampers	5	
Stopped rearing of livestock	6	
Stopped home stead gardening	7	
Change of occupation	8	
Purchase drinking water	9	
Rain water harvesting and utilization as alternative source of water	10	
Decrease amount of water used in sanitation purpose	11	
Other (Pls. specify)	88	

38. What might be the possible adaptive measure to reduce/ prevent the negative effect/ damage on various sectors/ activities, resulted from increased stress on water resource (adaptation)?

(Encircle appropriate codes-Multiple responses possible + rank the impact)

Ranking score: Not Effective = 0, less Effective =1, Moderate Effective = 2, Very Effective = 3

Sector/ activity	Code	Ranking of Effectiveness
Rain water harvesting and utilization in domestic activity	1	
Digging of protected pond and PSF installation	2	
Change in traditional irrigation practice	3	
Reduce shrimp cultivation	4	
Increase the height of embankment	5	
Improved drainage system installation to prevent water logging	6	
Plantation of saline tolerant tree species	7	
Other (Pls. specify)	88	
Do not know	99	

39. What is the impact of climate change on your livelihood capital? (Rank the impact)

Ranking score: No impact = 0, less Impact = 1, Moderate Impact = 2, Severe Impact = 3

Livelihood capital	Climate change associated events and extremes											
	Cyclone and Storm surge	Salinity Intrusion	Water Logging	Increased Temperature	Excessive Rainfall	Erratic Rainfall	Drought	River flood	Tidal surge	River erosion	Sea level rise	Other (pls. specify)
Natural capital												
Human capital												
Physical capital												
Financial capital												
Social capital												

40. What is the impact of climate change on your productive role (only income in cash considered)?

(Rank the impact)

Ranking score: No impact = 0, less Impact = 1, Moderate Impact = 2, Severe Impact = 3

Productive activity	Climate change associated events and extremes											
	Cyclone and Storm surge	Salinity Intrusion	Water Logging	Increased Temperature	Excessive Rainfall	Erratic Rainfall	Drought	River flood	Tidal surge	River erosion	Sea level rise	Other (pls. specify)
Agriculture												
Agricultural labor												
Daily labor												
Vegetable gardening												
Shopkeeper/ selling in Hat-bazaar												
Cattle rearing and selling milk												
Fuel wood collection and selling												
Job in NGO/ organization												
Fishing and selling												
Handy craft/ household enterprise												
Care taker of water point												
Poultry												
Sewing												
Forest resource extraction												
Labor in shrimp gher/ fish cultivation												
Shrimp fry collection												
Other (pls. Specify)												

41. What is the impact of climate change on your reproductive role and community management activity? (Rank the impact)

Ranking score: No impact = 0, less Impact = 1, Moderate Impact = 2, Severe Impact = 3

Activity	Climate change associated events and extremes											
	Cyclone and Storm surge	Salinity Intrusion	Water Logging	Increased Temperature	Excessive Rainfall	Erratic Rainfall	Drought	River flood	Tidal surge	River erosion	Sea level rise	Other (pls. specify)
Reproductive activity												
Collection of water												
Collection of fuel wood												
Cooking food												
Washing and cleaning												
Control of water use												
Caring of HH members												
Cattle rearing												
Homestead gardening												
Activities related to post production												
Fishing												
Other (Pls. specify)												
Community managed activity												
Attending funeral, wedding and cultural events												
Participation in VDC and WMC meetings												
Participation in training related to water and sanitation management												
Participation in NGO/ development related activity												
Other (Pls. specify)												

42. Gender division of activity profile in normal time and in disaster period (only Cyclone and storm surge-considered) (Put appropriate gender code) Code: Male: 1, Female: 2, Both: 3.

Activity	Period	
	Normal time	Post disaster period
1. Caring of Children & HH member		
2. Collection of water		
3. Collection of fuel wood		
4. Cooking, washing, cleaning		
5. Livestock rearing and protection		

Activity	Period	
	Normal time	Post disaster period
6. Agricultural work		
7. Agricultural and Daily labor		
8. Fishing		
9. Labor in shrimp gher		
10. Shrimp fry collection		
11. Fish culture		
12. Shop keeper/ small enterprise		
13. Safe guarding HH assets		
14. Ensure HH security		
15. Relief collection		
16. Voluntary rescue and rehabilitation work		
17. House repairing/ Latrine repairing		
18. Paid rehabilitation work		
19. Seasonal Migration		
20. Other (Pls. specify)		

43. How your access to and control over resources and benefits impacted by climate change?

(Rank the impact)

Ranking score: No impact = 0, less Impact = 1, Moderate Impact = 2, Severe Impact = 3

Access to & control over resource	Climate change associated events and extremes											
	Cyclone and Storm surge	Salinity Intrusion	Water Logging	Increased Temperature	Excessive Rainfall	Erratic Rainfall	Drought	River flood	Tidal surge	River erosion	Sea level rise	Other (pls. specify)
Access and control over Resource												
Residential land tenure												
House tenure												
Agricultural land tenure												
Productivity of agricultural land												
Improved sanitation facility												
Livestock infrastructure												
Crop type												
Crop production infrastructure and equipment												
Labor												
Capital												
Technology												
Education and training												
Employment												
Health service												
Embankment												
Irrigation facility												
Cyclone shelter												
Cyclone warning system												

Access to & control over resource	Climate change associated events and extremes											
	Cyclone and Storm surge	Salinity Intrusion	Water Logging	Increased Temperature	Excessive Rainfall	Erratic Rainfall	Drought	River flood	Tidal surge	River erosion	Sea level rise	Other (pls. specify)
Communication network												
MFI												
NGO												
Forest resource												
Other (Pls. specify)												
Access and control over Benefit												
Improved status of living												
Asset ownership												
Financial development												
Knowledge and skill												
Political environment												
Development initiative												
Other (Pls. specify)												

44. Do you think male, female and children are equally vulnerable to climate change induced disasters (disasters noted in previous question)? (Yes: 1, No: 2) (If the answer is No, than go to question no. 45; otherwise go to Q46)

45. If the answer is No. in Q.42, than rank the level of vulnerability of male, female and children to climate change?

Ranking score: Not vulnerable = 0, less vulnerable = 1
Moderate vulnerable = 2 Severe vulnerable = 3

Factors of standard of well being	Male	Female	Children
Income sources			
Homestead			
Food security			
Health			
Education			
Sources of water (Quantity & Quality)			
Sanitation			
Social security			

46. Gender division of activities in Disaster preparedness and post disaster period?

Gender code: Male: 1, Female: 2, both: 3 (Put appropriate gender code)

Coping activity	Disaster preparedness	Post Disaster Activity	
	Pre-disaster period activity	During disaster activity	Post disaster activity
1. Drinking water collection and preservation			
2. Dry food collection and preservation			
3. Starvation for meeting food deficit			
4. Fuel wood, candle, match, etc collection and			

Coping activity	Disaster preparedness	Post Disaster Activity	
	Pre-disaster period activity	During disaster activity	Post disaster activity
preservation			
5. Sell furniture & HH utensils			
6. Sell crop			
7. Sell seeds			
8. Sell agricultural land			
9. Sell livestock			
10. Sell women's ornaments			
11. Take loan			
12. Use deposited savings			
13. Move to relative houses outside the area			
14. Permanent migration			
15. Moving to cyclone shelter			
16. Staying home to look after HH assets sending HH members in safe place			
17. Taking shelter on embankment			
18. Alternative income generating activity			
19. Duck rearing			
20. Shrimp fry collection and selling			
21. Catching crab and selling			
22. Extraction of forest resource and selling			
23. Home stead vegetable gardening			
24. VGD/ VGF			
25. Relief collection			
26. Participation in Govt./ NGO implemented rehabilitation work			
27. Other (pls. specify)			

47. Who play the major role of generational and environmental caregiver/ caretaker in household and community level? (Put appropriate gender code) Gender code: Male: 1, Female: 2, both: 3

Activity as caregiver/ caretaker	Period		
	Normal	During disaster	Post disaster
1. Household sphere			
1.1. Taking care of newborn baby			
1.2. Taking care of children			
1.3. Taking care of old-age/ disable/ sick			
1.4. Self starvation to manage food for other HH members			
1.5. Relief collection			
1.6. Taking care of homestead gardens			
1.7. Taking care of household water point			
1.8. Taking care of household sanitary facility and provision of water			
1.9. Taking care of poultry and livestock			
1.10. Caretaking of common and rare medicinal plant species			
1.11. Caretaking of household and near vicinity trees			
1.12. Collection of water and fuel wood when mentally and physically stressed			

1.13. Moving to shelter during disaster			
1.14. Safe guarding of children and HH members in cyclone shelter			
1.15. Arranging water and food for HH members during and after disaster			
1.16. More willing and motivated to environmental adaptation through conservation of natural resources			
1.17. More willing and motivated to economical development through extraction of natural resources			
1.18. Other (pls. specify)			
2. Community sphere			
2.1. Taking care of newborn baby in neighboring household			
2.2. Taking care of neighboring children and old age/ disable			
2.3. Taking care of old-age/ disable/ sick people			
2.4. Taking care of community water points			
2.5. Participation of relief distribution			
2.6. Voluntary participation in post disaster rehabilitation activity			
2.7. Caretaking of forest resources			
2.8. Caretaking of ponds for continued communal use			
2.9. Caretaking of valuable medicinal plant species for communal benefit			
2.10. More willing in environmental management of natural resources for continued communal use			
2.11. More willing in economic development through extraction of natural resource for communal development			
2.12. Other (Pls. specify)			

48. What major steps have you taken to adjust/ cope with the changes in climate in HH level? Or consider as effective or need to be taken? (Any five)

1.
2.
3.
4.
5.

49. What preventive measures should be taken as climate change induced disasters are increasing in intensity and frequency? (Any five)

1.
2.
3.
4.
5.

50. What are the major implications/ problems, only women face during and after any disaster? (Any three)

- During disaster: 1. -----
2. -----
3. -----

After disaster: 1. -----
2. -----
3. -----

51. What is your opinion on the possible solutions for the problems only experienced by women, during and after disaster? (Any three)

During disaster: 1. -----
2. -----
3. -----

After disaster: 1. -----
2. -----
3. -----

52. What are the major problem women face regarding mobility during cyclone and storm surge? What might be the possible solutions to overcome the problem? (Any three)

Problem regarding mobility:

1. -----
2. -----
3. -----

Solutions to the problems:

1. -----
2. -----
3. -----

53. What are the major problems particularly women face in water logging condition and for salinity intrusion? What might be the possible solution? (Any three)

Problem regarding water logging:

1. -----
2. -----
3. -----

Solutions to the water logging:

1. -----
2. -----
3. -----

Problem regarding salinity intrusion:

1. -----
2. -----
3. -----

Solutions to the salinity intrusion:

1. -----
2. -----
3. -----

54. What is your perception about cyclone warning system? Is there any need to change or modify the warning system? Your suggestion.

1. -----
2. -----
3. -----

55. What is your perception about cyclone shelters? Is there any need to modify the design? Your suggestion.

1. -----
2. -----
3. -----

Thanks for your kind patience, assistance and cooperation

Name of Investigator: -----

Signature: ----- Date: -----

Annex 2

Exploring Gender Vulnerability and Adaptive capacity to Climate Change Associated Extremes

Focus Group Discussion Topics

1. What are the major religious groups in the locality?
2. What types of households are more visible? Nuclear or joint? What is the economic status? Number/ percentage of extreme poor, poor, middle class and rich households? Status of female headed households? Percentage of old age female and male in the community?
3. What is the status of widow and divorced women in the community? Reason for widowhood and divorce?
4. Status of male, female and children without any homestead/ totally destitute? What is the status to the local resources, capitals and benefits?
5. What is the condition of homesteads? Generally in which types of homesteads extreme poor live? How their residency/ homestead hot affected in any types of disasters? How do they repair their homesteads?
6. What are the major sources of water? What are the major sources of drinking and cooking water? Generally which family members are appointed for the water collection task? How many hours get spend for water collection? Usually how many distance travelled for water collection? What are the major complexities arise after any disaster events?
7. Generally in which parts of the areas the extreme poor families are more visible?
8. What are the major income generation options for local community? In which types of options the poor and extreme poor communities are more involved? What are the major occupations of males and females?
9. What is the status of daily earning of male and female? Is there any difference in wage rate in daily labor activity? If so what is the reason and difference?
10. What is the percentage of women involved in income generation outside of household? What are the activities? What are the major income generation activities done staying in homestead? What is the status of earning?
11. What is women's access and control over selling buying land, land ownership, micro credit?
12. Is there any seasonal migration visible for income generation? Usually which members go outside and who take the responsibility of household for the period? Opinion regarding such practice?
13. What is the status of education in the locality? Status between girls and boys? If there is any difference, what is the reason behind that?
14. What is the status of women's participation in educational institution/ NGO driven training activities?
15. What are the major communication options? What is the status of women's access to information?
16. What are the major options of primary and medical treatment in the locality? What is the status of women's access to such facilities?
17. What are the major sources of drinking water? What are the sources of water for different activities? What is the status of poor and extreme poor communities' access to such sources? What are the major sources causing pollution to water resources? How water is collected in normal time and after disaster period? What are the suggestions to prevent water pollution?
18. What are the major types of latrine found in the locality? What are the major complexities women face regarding sanitation after any disasters? What are the suggestions to overcome such problem?
19. What are the major religious rules and obstacles exist in the area? What are the impacts on women especially regarding their mobility, access to information, ownership of resources, income generation option, etc.?
20. Is there any specific beliefs exist in the area which create barrier or conflict among different communities? If so, what complexities arise due to such beliefs after any disaster events? What are the impacts?
21. Does religious rules and social restrictions create barrier in the path of women empowerment?

22. What is the usual age for marriage of a girl? Status of dowry, child mortality, female mortality in the area?
23. Status of domestic and social violence, sexual abuse and harassment? Are there incidents of women and child trafficking? Status in normal time and after disaster period?
24. Does women forced to get involved in prostitution due to poverty after any disaster events? There social position in the aftermath?
25. What is the status of involvement of male and female in domestic activity? Who does what types of activity?
26. What is the status of involvement of male and female in social welfare activity? Who does what types of activity?
27. What is the status of involvement of male and female in community management activity? Who does what types of activity?
28. What are the access, control and ownership of male and female to different income generating activity and resources? In normal time and after disaster period?
29. What are the major activities performed by male and female as disaster preparedness?
30. How income generating activities got affected in post disaster period? What are the major complexities arise in that period?
31. What is the status of migration in post disaster period?
32. Do you notice any change in weather and climate? What are the major noticed changes? From how long the chances became more noticeable?
33. What are the major disasters more prevalent in the area? Is there any change in frequency and intensity? What are the major impact of disasters on life and way of living? What are the impact of disasters on various resources and income generating activities?
34. What are the major impacts of climate change on women? How the women are affected?
35. What are the major suggestions to overcome such problems or complexities?
36. What was the situation during and after cyclone Aila? What was the condition of women? What are the basic needs of women during and post disaster periods?
37. What are the major coping strategy practiced or perceive important in household level and in income generating activity to withstand/ cope the change taking place in climate?
38. What are the major activities related to adaptation and mitigation should be implemented considering the future climatic condition? (with showing generated future scenario based on SRES A2 and A1B emission scenario by Statistical downscaling)
39. Opinion and suggestion regarding cyclone shelter and cyclone warning signal.
40. Opinion and suggestion regarding relief distribution practice/ activity after any disaster events? What are the major facilities they received from Govt. and NGO after disaster events? Or, didn't receive though promised?
41. What are the major complexities faced by women only due to water logging? What are the suggestions to overcome such problems?
42. What are the major complexities faced by women only due to gradual increase in salinity intrusion? What are the suggestions to overcome such problems?
43. General suggestion/ recommendation.

Key Informant Interview Questionnaire

1. What is your name? When got elected/ in which organization did you worked then?
2. Did you stayed here during the time of cyclone Aila? What was the overall situation then?
3. Do you notice any change in climate? Is there any trend visible?
4. What are the major religions in the locality? What are the major income generation options in the locality? Sex disaggregated involvement of male and female in income generation activity?
5. What is the status of women mobility and access and control over information and resources?
6. Do you think males and females are equally impacted/ vulnerable to any disaster events or differently?
7. What are the major problems/ complexities faced by women only during and after any disaster events? Suggestion to overcome such problems.

8. What are the major reasons behind the increase of salinity intrusion in the locality? What could be the possible measures to overcome such problem?
9. What are the major problems/ complexities faced by women only in water logged condition? Suggestions to overcome such problems?
10. What are the major sources of water as per different usages- during disaster and after disaster period?
11. What are the number of cyclone shelters and their overall capacity in the locality? Any suggestion regarding cyclone shelters?
12. What are the major income generation activities/ sectors in the area? Status of shrimp farming? Suggestion for improving the situation.
13. How relief distribution activity carried out after any disaster events? How to poor and extreme poor community get their access? Participation of women in such activity?
14. What is the major Govt. and NGO implemented programs in the area? Was the issue of impact of future climate change and disasters (more prevalent in the locality) been considered during the project design and implementation?
15. What could be the future situation in the locality based on predicted future changes (based on findings from generated future scenario through Statistical downscaling)? Any suggestion to overcome the future predicted adversity?
16. What are the major coping strategies practiced/ assumed important for the locality in household level to cope with the ongoing changes in climate and increase in disaster events?
17. What initiatives should be taken considering the women specific requirements in future climate changed context?
18. Do you think any modification need to be done in traditional disaster risk reduction, preparedness and management activities? Suggestion.
19. General suggestion/ recommendation.