A dissertation submitted for the degree

Doctor of Philosophy

Climate Change Hazards Vulnerability and Resilience Capacity Assessment for *Char* land Women in Bangladesh

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A dissertation submitted to the faculty of the Earth and Environmental Sciences in partial fulfillment of the requirement for the degree Doctor of Philosophy in the Department of Geography and Environment, University of Dhaka, 2015.

Dedication to my parents

Shelina Akter

&

M. A. Hannan

Abstract

The physical and geographical characteristics has exposed Bangladesh to recurrent environmental hazards and vulnerable to natural disasters such as flood, tropical cyclone, tornadoes, storm surges, droughts and river bank and coastal erosion, salinity intrusion etc. The frequent climatic extreme events are adversely affecting the poor, marginal communities and their livelihoods in different climate affected zones in the country. The char people are exposed to multiple forms of vulnerability caused by different types of natural hazards than the people in other parts of the country. The physical characteristics inherent in the ecology of char formation make the char-lands one of the most fragile environments in the world. The frequent hazards in the char lands affect the lives of the dwellers especially the char-women severely. In depth analyses and analytical frameworks to understand the nexus between women disaster and climate change are almost nonexistent. As such an explorative study on the vulnerability of poor char land women and linkages between gender disaster and climate change issues, particularly in relation to enhancing women's resilience capacities to address climate change is of considerable importance. This study attempts to identify the possible impacts and its vulnerability and the resilience capacity of char land women in Bangladesh to the climate hazards like tropical cyclones, storm surges, coastal and riverine erosion and flood water effects etc. Two types of char land areas viz the riverine char lands at Zanjira Upazila under Shariatpur district and coastal char lands at Sonagazi Upazila under Feni district of Bangladesh have been studied for the purpose.

The general objectives of this research was to assess the risks and vulnerabilities of char land women and their livelihoods due to different climate hazards and to explore their coping mechanisms during hazards, their resilience capacity and to find out the similarities and dissimilarities between the two types of char women in vulnerability, coping and resilience capacity. Five specific dimensions- physical, economical, social, natural, and institutional were chosen to assess the disaster resilience capacity of women and a Climate Disaster Resilience Index (CDRI) was developed. Based on the index, the research also examines whether and how the women living in these climate vulnerable areas are impacted by multiple climate hazards and are adapting to and coping with the situation in terms of the five dimensions.

The findings suggest that the women of the study chars have a discrete rural life style. They have their own coping strategy and show their resilience capacity and cope successfully under the climate stressed situation. They show their ability in coping with and adapting to various physical, socio economic, natural and institutional aspects. Women are marginal in all respects both within households and within society and the char land women are no exception from this. Although women are worse off in all five dimensions compared to men, they show their determination and resiliency and are able to cope in any adverse climatic situation with available resources. They are able to improvise methods and find alternatives to deal with adversities and demonstrate their capability to take responsibilities of their households at time of disasters. Women, particularly the poor are open to take up any economic activity and are active economic agents contributing notably to their family's survival. However differences exist between the two char lands with respect to the climate disaster resilience index. Despite their many limitations the char land women's main resources are their confidence, indigenous knowledge and hardworking capacity in harsh situation induced by climatic hazards. As such to support effective coping mechanisms, women inclusive planning and participatory disaster resilient policy are highly recommended to facilitate the sustainable livelihoods for these vulnerable char land women.

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ABBREVIATIONS

ADB	Asian Development Bank
ADPC	Asian Disaster Preparedness Centre
BBS	Bangladesh Bureau of Statistics
BWDB	Bangladesh Water Development Board
BCAS	Bangladesh Center for Advanced Studies
BDT	Bangladeshi currency Taka
BMD	Bangladesh Meteorological Department
BUP	Bangladesh Unnayan Onneshan
CCC	Climate Change Cell
CDMP	Comprehensive Development Management Programme
CDRI	Climate Disaster Resilience Index
CEGIS	Center for Environmental and Geographic Information Services
COP15	Copenhagen summit
CBA	Community Based Assessment
CEGIS	Center for Environmental and Geographical Information Services
DAE	Department of Agriculture Extension
DMB	Disaster Management Bureau
DMIC	Disaster Management Information Centre
DPHE	Department of Public Health and Engineering
DTW	Deep Tube Well
FFWC	Flood Forecasting Warning Center
FGD	Focus Group Discussions
GoB	Government of Bangladesh
HRA	High Risk Area
GBM	Ganges-Brahmaputra-Meghna
H. S. C	Higher Secondary Certificate
IEDM	International Environment and Disaster Management
IPCC	Intergovernmental Panel on Climate Change
ISDR	International Strategy for Disaster Reduction

ISPAN	Irrigation Support Project for Asia and Near East
IUCN	International Union for Conservation of Natures
KABIKHA	*Kajer Binimoye Khadday* (Food for work)
KII	Key Informant Interviews
LGED	Local Government Engineering Department
MFI	Micro Finance Institutions
MOEF	Ministry of Environment and Forest
MNCH	Maternal Neonatal Child Health
MVC	Most Vulnerable Countries
NGO	Non-Government Organization
NSTC	National Science Technology Council
PASW	Predictive Analytics Software
PIO	Project Implementation Officer
PRA	Participatory Rapid Appraisal
PVA	Participatory Vulnerability Assessment
RCC	Reinforced Cement Concrete
SDMC	SAARC Disaster Management Centre
STW	Shallow Tube-Well
S. S. C	Secondary School Certificate
WATSAN	Water and Sanitation
WEDO	Women's Environment and Development Organization
WMI	Weighted Mean Index
UDMC	Union Disaster Management Committee
UNEP	United Nations Environment Programme
UNISDR	United Nations International Strategy for Disaster Risk Reduction
UNDP	United Nations Development Programme
USD	United States Dollar
UzDMC	Upazilla Disaster Management Committee
UNO	Upazilla Nirbahi Officer
UP	Union Parishad
VGF	Vulnerable Group Feeding

CHAPTER ONE

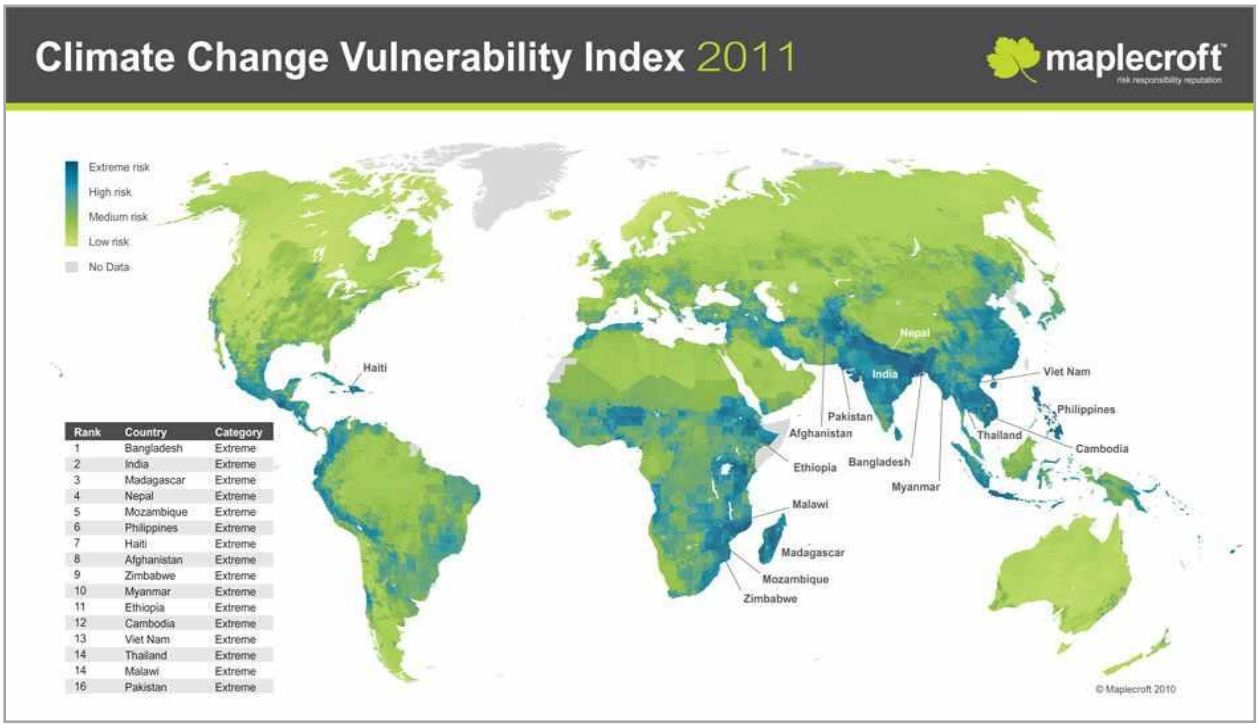
INTRODUCTION

1. 1 Background

Bangladesh is currently ranked as one of the world's most disaster-prone countries, with over 97 percent of its total area and some 98 per cent of the total population is at risk of multiple hazards (World Bank, 2005; ISDR, 2002). The physical and geographical characteristics have exposed the country to recurrent environmental hazards and vulnerable to natural disasters such as flood, tropical cyclone, tornadoes, storm surges, droughts and river bank and coastal erosion, etc. These disasters have become regular phenomenon and almost every year the country experiences disasters of one kind or another. These disasters cause heavy loss of life and property and affect the development activities since many years. The county is beset with many problems like high population density that ranked Bangladesh as the 9th most densely populated country in the world with 1099 persons/km^2 (BBS, 2011), shortage of land to accommodate the people, seasonal food insecurity, illiteracy, ill health, and overall poverty. Regular occurrence of disasters makes the problems even more complicated.

Bangladesh is also one of the most vulnerable countries in the world having severely impacted by the climate change-related risk factors (ADB, 2012). The Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2001) ranked Bangladesh as high in the list of the most vulnerable countries. The impact assessments of the 4th IPCC identified Bangladesh as one of the most 'susceptible countries' of the world to the negative impacts of climate change (IPCC, 2007). Its negative impacts are more severely felt by the poor people and the poorer countries. They are more vulnerable because of their high dependence on natural resources, and their limited capacity to cope and adapt with climate variability and extremes. Low level of economic development combined with other factors such as its geography and climate makes the country vulnerable to climate change. The Johannesburg Declaration on Sustainable Development states, "the adverse effects of climate change are already evident, natural disasters are more frequent and more devastating and developing countries are more vulnerable." The Copenhagen summit (COP15) in 2009 has also identified Bangladesh as one of the most vulnerable countries (MVCs) in the world.

Figure 1.1 Climate change vulnerability index 2011

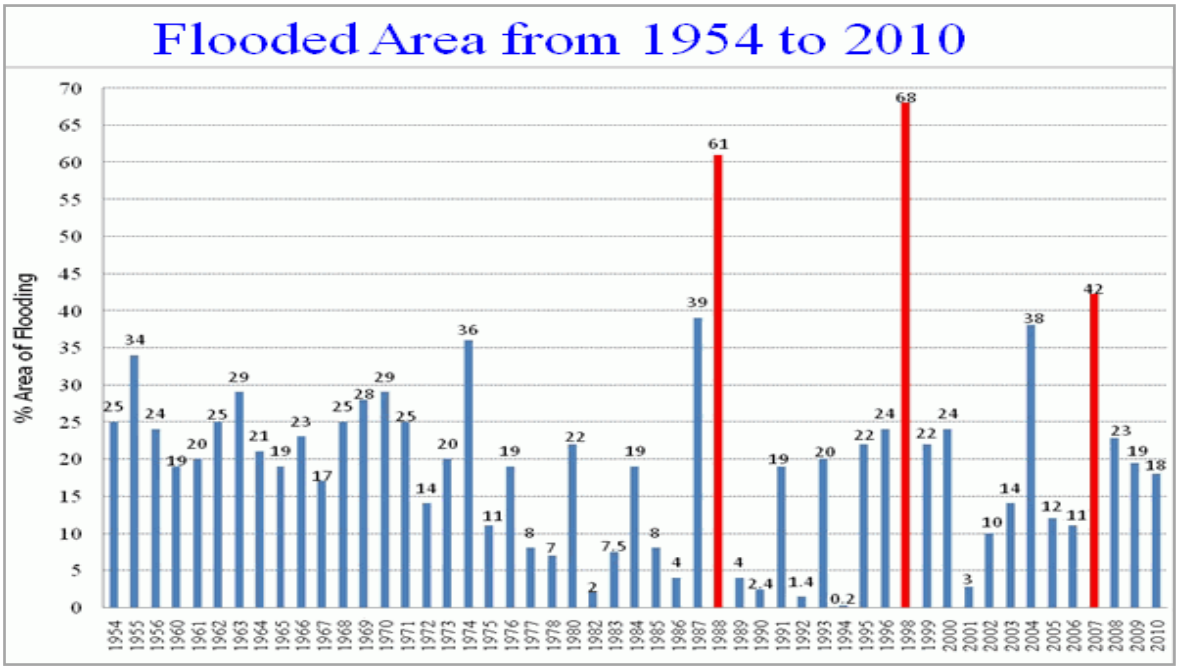


Source: Maple croft, 2011. www.prevention wave.net

A number of studies in the past investigated the causes of vulnerability of Bangladesh due to Climate Change (BCAS, 1994; BUP, 1994; Bangladesh Climate Change Country Study Program 1997, IPCC. 2007, Climate Change Strategy and Action Plan, 2008. About 80 percent of natural hazards in Asia are climate related (ADPC, 2005). The studies indicated that most of the adverse affects of climate change will be in the form of extreme weather events, frequent hydo-meterological hazards such as flood, drought, salinity increase, bank erosion, and tidal surge. These are likely to exacerbated leading to large scale damages to crop, employment, livelihoods, and national economy. The 4th IPCC projected the impact of climate change in Bangladesh and mentioned that 1 meter rise in sea-level will inundate 20 percent of landmass by the year 2100. It also indicated that due to changes in precipitation pattern about 8 percent of rice and 32 percent of wheat production may be lost through enhanced flood and polluted ground water, increased salinity in crop lands by 2050. Temperature increase from 1.4 to 5.8 degree Celsius will induce cyclone, drought etc. Heavy rainfall over short spell would be resulted in landslides. Cold spells will damage crops as well as claim human lives. Droughts will affect even coastal districts of Bangladesh. Bangladesh Water Development Board (BWDB) has calculated the flooded area of Bangladesh regularly from 1954 and until today (Figure 1.2). The floods of 1987, 1988, 1998, 2004, 2007 and

cyclone of 1991 and 2007 and 2009 are treated as a consequence of global warming, sea level rise and other associated problems (BWDB, 2010; Islam and Neelim, 2010).

Figure 1.2 Flooded area (%) in Bangladesh from 1954-2010

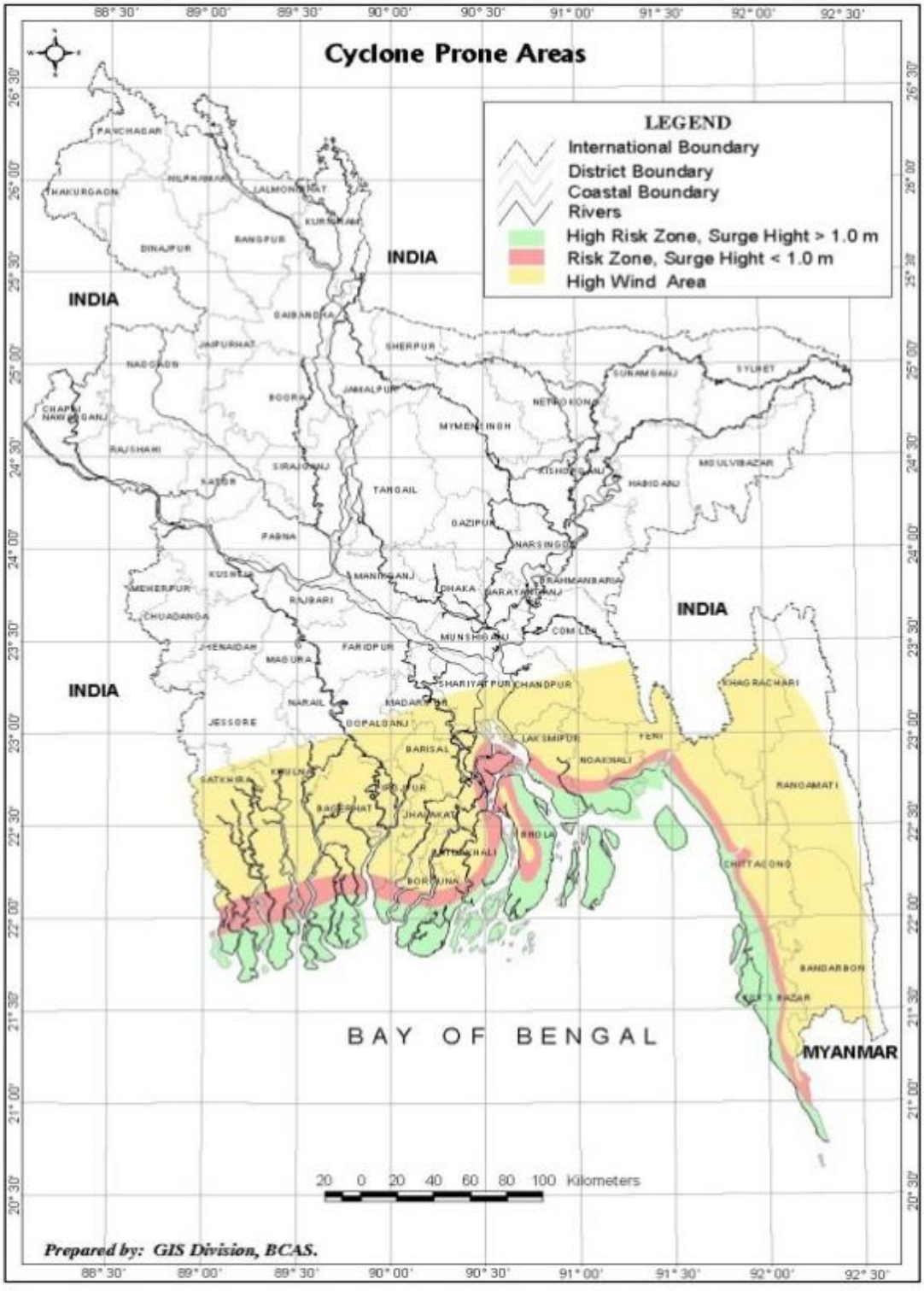


Source: Bangladesh Water Development Board (FFWC, 2010), http://www.ffwc.gov.bd/

Almost every sector of socio-economic life in this country is likely to be affected by climate change. Vulnerability and adaptation to the adverse impacts of climate change are the most crucial concerns for Bangladesh. All communities or all members of an affected community are not equally vulnerable to disasters. Vulnerabilities of the individuals, households and the communities are determined by physical environment, geographical location, type of infrastructures, socio-economic condition, knowledge, awareness and skill. The Intergovernmental Panel on Climate Change (IPCC) also noted that developing countries, particularly those that are the least developed, are more vulnerable to environmental threats, and that this inability is the most extreme among the poorest people and disadvantaged groups such as women and children (IPCC, 2001). In the context of Bangladesh, one example of this is the most disadvantaged people who live in the riverine floodplain areas, locally known as *chaura* (Islam, 2012).

Most of the climate change impacts in Bangladesh are likely to come from the south that is the Bay of Bengal and the adjoining North Indian Ocean. These waters are the sources of tropical cyclones and storm surges, coastal erosion, monsoon wind, evaporation from

Figure 1.3 Cyclone prone areas of Bangladesh



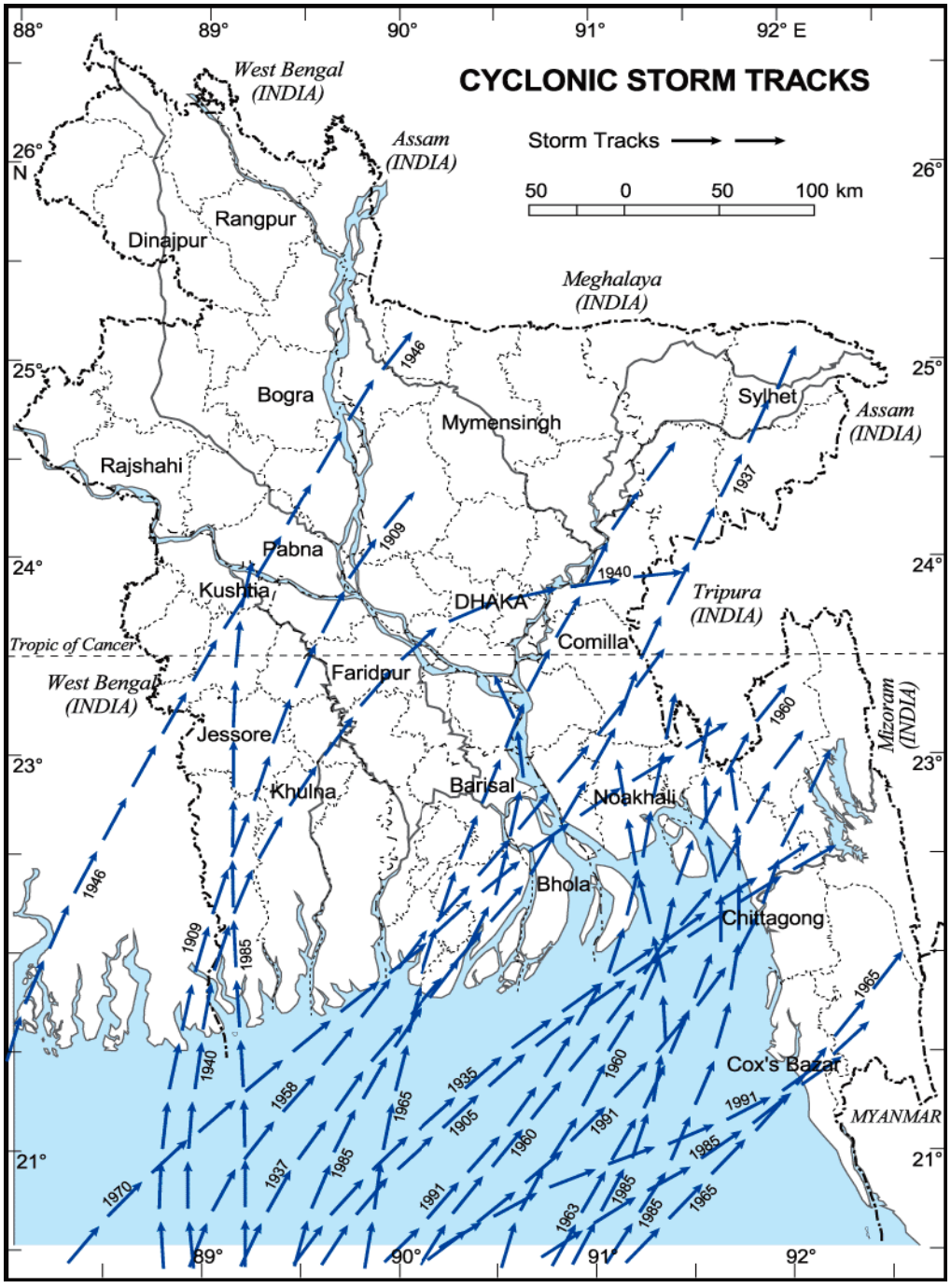
Source: GIS division, Bangladesh Centre for Advance Studies (BCAS)

monsoon rainfall, floods, and droughts. All these have a spatial effect. For example, the increasing hydro-meteorological hazards activated by climate change deteriorate life and livelihood in the most of the coastal regions. The densely populated coastal areas are highly

vulnerable to sea-level rise and storm surge impacts. About 28 percent of the country's population is living in the coastal zones where the density of population is 482 persons in the exposed zones and 1012 persons in the entire coastal areas (Islam, 2004). Figure 1.3 presents the cyclone risk prone coastal region and Figure 1.4 presents the cyclonic storm track in Bangladesh. In these figures, the high risk, risk, high wind risk-prone coastal areas and cyclonic storm tracks of historical cyclones in different years are shown.

Climate change has also increased the salinity problem in many fields which is a common seasonal hazard in many parts of the coastal zone. It has adversely affected the lives and livelihood of coastal people and slowed down the development in these regions. (MoWR, 2005). Sea-level rise also exerts a major impact of on the salinity of coastal zones of Bangladesh. The saline water goes up to 240 kilometers inside the country. When the up-stream flow reduces drastically in dry season, the saline water remains in the fields and increases its salinity (Lokman, 2009). The future sea level rise would inundate more land as well as more salinity intrusion to inlands (Seal and Baten, 2012). The salinity intrusion into fresh water during the low flow condition will reduce fresh water availability that in turn may decrease the economic activities and threaten livelihood severely in coastal areas.

Figure 1.4 Cyclonic Storm Tracks in Bangladesh



Source: Bangladesh Meteorological Department (BMD)

Table 1.1 Major damages by the flood and erosion disasters in Bangladesh (1986-2011)

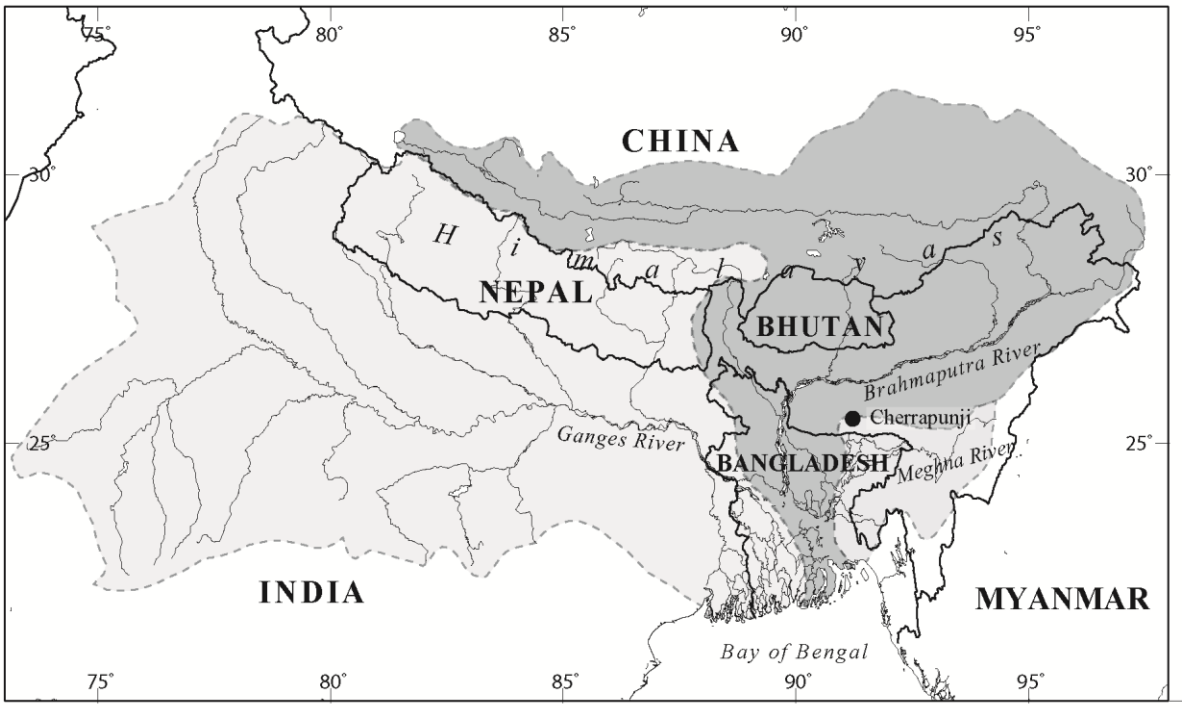
Year	Affected District (Out of 64)	Crops Damaged in Acre (Fully)	No. of House Damaged (Fully)	No. of Damaged Institution (Fully)	No. of Dead Livestock	No. of Dead People
1986	19	990573	196803	302	42374	57
1987	50	2983362	71572	1155	370129	1470
1988	52	755740	1151189	2880	3548018	1621
1991	28	782780	232633	704	46306	818
1993	33	778513	234393	32	29512	162
1995	40	1369358	344276	168	14221	137
1996	48	404456	218275	292	47946	76
1997	37	167586	13252	196	4726	125
1998	52	1423320	980571	1718	26564	918
2002	36	321355	115511	302	25237	26
2004	39	1605958	894954	1295	15143	747
2007	46	890898	81817	563	1459	970

Source: Disaster Management Bureau, Ministry of Food and Disaster Management, Bangladesh (2011).

Almost entire Bangladesh lies within the combined delta of the Ganges, Brahmaputram and Meghna rivers and consists primarily of a low-lying alluvial plain (Figure 1.5). About two hundred and thirty rivers have crisscrossed the country. The riverine and coastal areas of this county are familiar with a landmass called *chars*. The *Char* is a Bengali term for a "mid-channel island that periodically emerges from the river bed as result of accretion" (Elahi et al., 1991).

These *Chars* are the areas of new land formed through the continual process of erosion and deposition of sediments in the rivers and coastal areas. These islands and attached bars have created new opportunities to establish settlements and pursue agricultural activities for the poorest and the most vulnerable communities in Bangladesh. About 600,000 people live on riverine islands and bars or *char lands* (Sarker et. al, 2003). The total area of the main river *char lands* estimated to be 8,444 sq km i.e. about 6 percent of the land area which comprised 33 percent of unprotected mainland of the country (ISPAN, 1993).

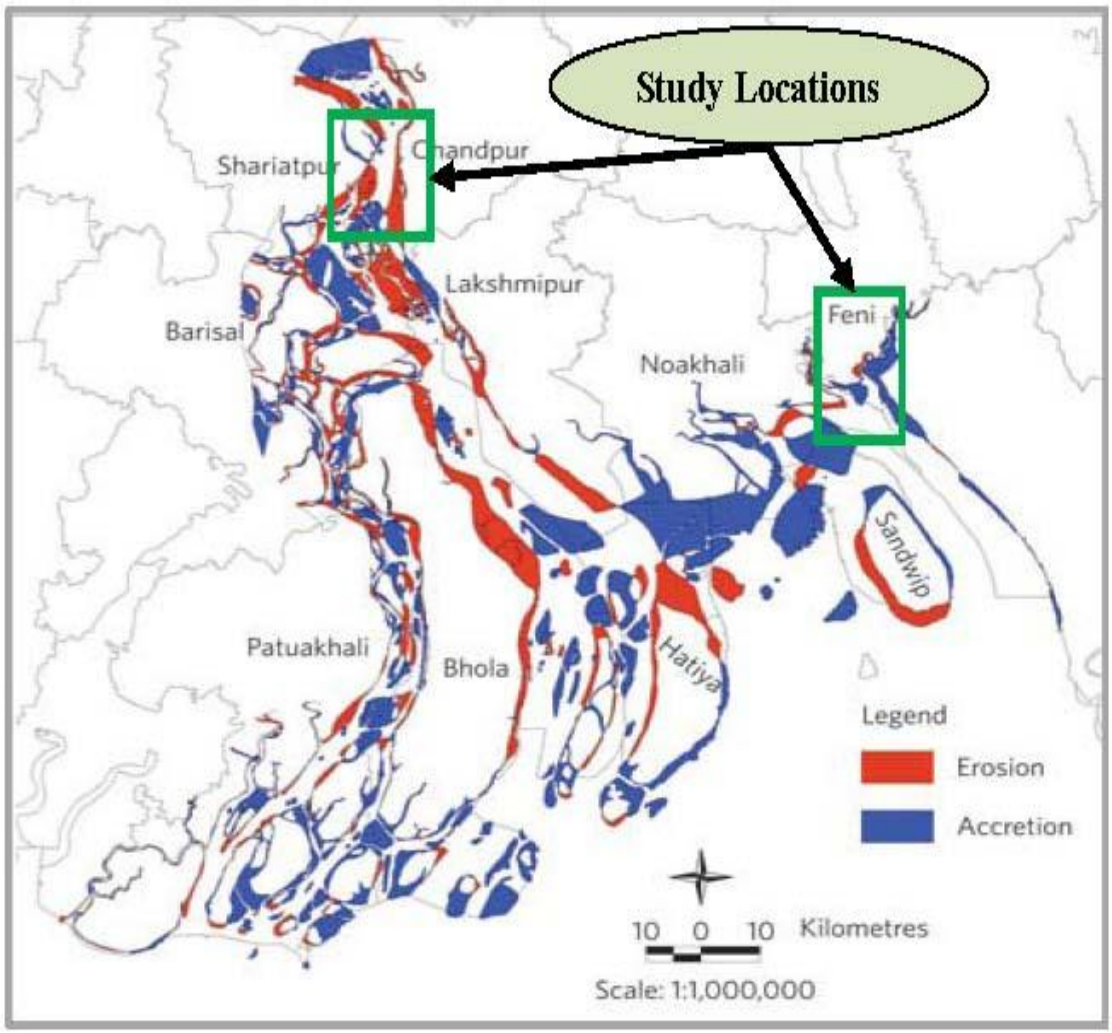
Figure 1.5 Location of the Ganges-Brahmaputra-Meghna (GBM) river basin



Source: Modified by the researcher based on Mirza (2002:128).

The *char* dwellers are the poorest and most vulnerable people in Bangladesh. People living within the life of the *char* land are closely related to variations in the dynamics of river and *char* formation as well as the associated flood and erosion hazards (Figure 1.6). These affect the social and economical lives of the *char* dwellers frequently and intensely than the people in other parts of the country (CEGIS, 2000). The life is not easy in these areas and is full of uncertainty, misery and danger. Even then, people live in the *chars* because of the facts such as to regain the lost land to the river, to get *khas* lands for livelihood, non availability of other livelihood alternatives, adapted to the *char* life, evicted by the land lords etc. (Barkat *etal*., 2007).

Figure 1.6 Erosion and accretion status of the study locations



Source: Modified by the author based on K. Wilde, 2011: 29

The *char* people are exposed to multiple forms of vulnerability caused by different types of natural hazards than the people in other parts of the country. The physical characteristics inherent in the ecology of *char* formation make the *char*-lands one of the most fragile environments in the world. This physical vulnerability makes *chars* very risky and disaster-prone places (Samanta and Dutt, 2007). The hazards affect the lives of the *char* dwellers, especially the *char*-women severely. As such women are the main victims of natural hazards. During disasters like floods and storms, they have been confronting crisis in their daily lives. According to a recent report from the Women's Environment and Development Organization (Araujo and Aguilar 2007), women and children are 14 times

more likely to die than men during disasters. Following the cyclone and flood of 1991 in Bangladesh, the death rate was almost five times higher for women than for men. Women headed households are often impoverished and socially isolated, less able to receive or act on disaster warnings or recovery information (Enarson, 2000).

Although the participation and support of rural women at the household level is very high, the difference between men and women is huge in living life in rural areas of the country. The poverty rate of women headed households is higher than that of men in the agricultural districts. Gender difference also persists in the completion rate of primary and secondary education. With all such limitations women are actively involved with the entire household chores, child care, rearing livestock and homestead gardens (Yoshitani et Al., 2007). During disasters, these women are the main victims facing multifarious problems, difficulties and challenges. The women's sufferings are twofold - first, they have to work hard to save their families from the disasters and second, when men leave for the urban areas for cash earning after disasters, women are left alone for caring the children, elderly and dependent family members. Gender inequality is a major factor contributing to the increased vulnerability for women and girls in disastrous situations.

In the context of the significant attention to climate change at global level, debates regarding identification of gender perspectives and the involvement of women in addressing climate change have arisen. It is believed that men and women will be faced with different vulnerabilities to climate change impacts due to existing inequalities such as, their role and position in society, access to resources and power relations that may affect the ability to respond to the effects of climate change (WEDO, 2007; Commission on Status of Women 2008; Carvajal et al., 2008; BRIDGE, 2008). The impacts and consequences of climate change are not gender-neutral and often affect women and girls in a more direct or severe way in their roles, responsibilities and opportunities. At the same time, experiences of women and men in coping with and adapting to sudden and gradual environmental stress and climatic changes can be valuable contributions to dealing with these problems (Dankelman, 2010). Based on a wide range of practical experiences in the context of climate change, it may be argued that men and women are important agents of change and are distinct counter-forces to cope with and adapt to processes of global and local environmental change, and to mitigate them (Roy and Venema, 2009).

The present study attempts to identify the possible impacts and its vulnerability and the resilience capacity of *char* land women in Bangladesh through climate hazards like tropical cyclones, storm surges, coastal and riverine erosion and flood water effects, etc. As

the scientist forecast a further increase in natural calamities in the future due to climate change, it is important to find out the gaps particularly with respect to riverine and coastal *char* land to build disaster resilient community focusing on *char* land women in Bangladesh. In depth analyses and analytical frameworks to understand the nexus between women disaster and climate change are limited. As such an explorative study on the vulnerability of poor *char* land women and linkages between gender disaster and climate change issues, particularly in relation to enhancing women's resilience capacities to address climate change is of considerable importance.

1.2 Justification of the Study

Char lands are characterized by vulnerable and difficult living conditions and extreme resource constraints. Vulnerability created by climatic hazards plays a dominant role in the livelihoods of inhabitants in *chars*, who are largely excluded from mainland services and infrastructure, as loss of land and other assets completely destroys their survival base. Assessing this vulnerability is important to understand the ways of people's maximum utilization of scarce resources for survival and to cope with the vulnerabilities. In Bangladesh only a few studies have been carried out on the *char* areas and the communities. Most of the studies aimed towards tackling the threats of climate change and focused on scientific and technological aspects of the problem, ignoring the social issues. In at-risk resource-dependent communities, men and women have distinct roles and responsibilities which give rise to differences in vulnerability and ability to cope with climate change. This study attempts to find out the link between *char* land women's vulnerability and climate change induced hazards and their resilience capacity. It is expected that the findings of this study would be useful to undertake future development program and policy formulation for the *char* dwellers and *char* land Bangladeshi women in particular.

1.3 Research questions

This study would seek to answer the following five associated questions:

1. What are the existing socio-economic conditions and livelihood practices of riverine and coastal *char* dwellers?
2. In which extends the *char* women are at risks and vulnerable in different aspects of *char* livelihood due to climate hazards?
3. What are the coping mechanisms of *char* dwellers during hazards with involvement of local knowledge and women participation?

4. How are the resilience capacities o*f char* land women in context of climate hazards in Bangladesh?
5. What are the ways for strengthening gender-sensitive responses, preparedness and decision making capacity of *char* women during disaster?

1.4 Overall objective

The overall objective of this study is to assess the climate change hazards vulnerability and resilience capacity of *char* land women in different aspects of *char* livelihood as well as to explore the coping strategies during climate induced hazards in the riverine and coastal *char* areas in Bangladesh.

1.4.1 Specific objectives

Under the aforementioned overall objectives, the specific objectives are listed as follows:

i. To asses risks and vulnerabilities of *char* land women and their livelihoods due to climate hazards;
ii. To explore the practices of their coping mechanisms during hazards;
iii. To assess the resilience capacity of *char* women with respect to climate hazards in Bangladesh;
iv. To identify the ways for strengthening gender-sensitive responses, preparedness and decision making capacity of *char* women to deal with disasters ;
v. To find out the similarities and dissimilarities between two types of *chars* in vulnerability, coping and resilience capacity of women.

1.5 Methodology and data collection

Human geography has a strong interest in qualitative methods. The strength of qualitative research is its ability to provide complex textual descriptions of how people experience a given research issue. It provides information about the "human" side of an issue - that is, the often contradictory behaviors, beliefs, opinions, emotions, and relationships of individuals. Qualitative methods are also effective in identifying intangible factors, such as social norms, socio-economic status, gender roles, ethnicity, and religion, whose role in the research issue may not be readily apparent. When used along with quantitative methods, qualitative research

can help us to interpret and better understand the complex reality of a given situation and the implications of quantitative data. In qualitative methods, the relationship between the researcher and the participant is often less formal than in quantitative research. Participants have the opportunity to respond more elaborately and in greater detail than is typically the case with quantitative methods. The four most common qualitative methods, explained in detail in their respective modules, are participant observation, in-depth interviews, and focus groups. Each method is particularly suited for obtaining a specific type of data for this present study. *Participant observation* is appropriate for collecting data on naturally occurring behaviors in their usual contexts. *Household survey and in-depth interview* are optimal for collecting data on individuals' personal histories, perspectives, and experiences, particularly when sensitive topics are being explored. *Focus groups* are effective in eliciting data on the cultural norms of a group and in generating broad overviews of issues of concern to the cultural groups or subgroups represented. This study tries to assess the vulnerability and resilience capacity of *char* land women in Bangladesh induced by to climate change hazards primarily by drawing on some empirical experiences and qualitative methods like households survey, Participatory Rapid Appraisal (PRA), Participatory Vulnerability Assessment (PVA), Focus Group Discussions (FGD), Climate Disaster Resilience Index (CDRI), in depth interview from the male and female headed households has also been employed.

1.5.1 Selection of the study area

The present study was conducted on climatic hazard vulnerable riverine and coastal *char* land areas in Bangladesh. For this study two vulnerable unions - Kunderchar (riverine *char* land) from Zanjira upazila of Shariatpur district and Char Chandia (coastal *char* land) from Sonagazi upazila of Feni district in Bangladesh were selected purposively. These study sites have been selected to consider the climate related hazards like flood, tropical cyclone, storm surge, salinity intrusion, drought, river bank erosion and others experiences. For this study, the sample households have been selected from six villages following simple random sampling from the study *char* lands. The study villages are Saralkhar kandi, Eakub matabber kandi and Kalu bepari kandi under Kunder Char union and, Dakkhin-purba Char Chandia, Chhoto Gram Samaj and Haji Jinnat Ali Samaj under Char Chandia union.

Secondary data was collected from authorities of Upazilla Disaster Management Committee (UzDMC). The villages were selected purposively as per the suggestions of Union Parishad (UP) Chairman and Union Disaster Management Committee (UDMC) of

concerned union. A total of 364 households (including all the women headed households) were selected randomly in both study unions as sample for household survey to follow 95% level of confidence and the confidence interval was 4. All the women members of sampled households were considered as the main focus of the study on women vulnerability assessment. For comparison 35 percent sample from total male headed households of the study unions were also considered.

Table 1.2 Determination of sample size

Study area Upazila & Zila	Union Name	Total No. HHs	Female Headed HHs	Male Headed HHs	Sampled Male Headed	Total sample HHs
		(a)	(b)	(c=a-b)	(d= cx35% & above)	(e=b+d)
Zanjira, Shariatpur	Kunder Char,	466	28	438	154	182
Sonagazi, Feni	Char Chandia	455	31	424	149	182
	Total No. of HHs 921				Total sample size= 364	

Here are the formulas used in our Sample Size calculation:

$$ss = \frac{Z^2 * (p) * (1-p)}{c^2}$$

Where:

Z = Z value (e.g. 1.96 for 95% confidence level)

p = percentage picking a choice, expressed as decimal

(0.5 used for sample size needed)

c = confidence interval, expressed as decimal

(e.g., .04 = ±4)

For the equation:

Confidence level = 95%

Confidence Interval = 4

Total Population= 921

Sample size needed = 364

1.5.2 Primary data collection

The study is mainly based on primary data. This data was collected from various sources and in various ways. In order to familiarize with the field condition transact walk were made in the both study sites. This helped to obtain preliminary information about physical structures, natural resources, land use patterns, road network, and physiographic condition of the both study sites to understand the problems of the study area. During these transact walk a number of photographs were taken to keep a record. Field visits and surveys by a semi-structured Interviewed Schedule (Annexure-1) were conducted by the researcher at various time periods during the monsoon season (July to September) and the dry season (January to March) in 2011 and 2012.

The two prime tools of data collection were semi-structured questionnaire and different checklists for Key Informant Interviews (KIIs), Focus Group Discussions (FGDs), and Community meetings were used for the study (Table 1.3). Both the questionnaire and checklists were tested before hand and the necessary corrections were incorporated. KIIs were carried out with various relevant people and professionals such as Upazilla Nirbahi

Officer (UNO), Project Implementation Officer (PIO), Union Parshad (UP) Chairman, UP female members, local NGO activists, concern scientific offices at the study sites and sectoral government officials at local level. Interviews were usually carried out in a 'one to one' mode, "one to many" mode and in many cases with more "elderly informants".

Focus Group Discussion (FGD) is one of tools of PRA which was adopted to collect data and information relating to different types of climatic hazards by which the victims were suffering year after year. A total of six FGDs have been conducted at 6 locations including Dakshin-purba Char Chandia, Hazi Jinnat Ali Shamaj, Chhoto gram Shomaj, Kalu Bepari Kandi, Eakub Matabbor Kandi, Sharal Khar Kandi villages. These areas covered both the riverine and coastal areas with total number of 76 participants. Each FGD were carried out with participants of 12-13 persons. Discussions have been held with major livelihood groups with approximately 12-13 participants. Representatives of the various livelihood groups were present in the FGD sessions. In these sessions, intensive discussions were generated on the pre-devised matrices (Annexure-2). During FGD, locations of vulnerable area were identified and different aspect of climatic hazards and there impacts and coping strategies were discussed with the different types of vulnerable peoples.

The study also employed Participatory Rapid Appraisal (PRA) that included Participatory Vulnerability Assessment(PVA), participatory field observation, and a number of issue-based case studies in order to collect qualitative data and information regarding climate related hazards risks at the household and community level in different aspects like characteristics of hazards, magnitude of damages, preparedness and responses to warning information by *char*-dwellers focusing *cha*r land women in the study sites. Participatory Vulnerability Assessment (PVA) is a tool (Annexure -3) that builds on the principles of Community Based Assessment (CBA) by recognizing that local communities have to be intimately involved. CBA is a bottom up approach by which a community is positioned as the main entity to implement adaptations and is considered to be the subject of projects for competence and technology development to increase adaptive capacity. PVA requires participation of partners and stakeholders in the area where it is being conducted. The success of PVA depends partly on the diversity of stakeholders involved because their actions can exacerbate or reduce vulnerability. Experience has proven that it is rewarding to start at the micro level, with a smaller team, and scale up afterwards. The approach brings the sum of all parts neatly together, i.e. listening to people, hearing people's voices, measuring how effective strategies are in reducing vulnerability and generating people-centered advocacy. There are some studies which have followed PVA method to assess community

vulnerabilities (Adrika, et. al., 2011, Adri, and Islam, 2012). PVA was used for making community Hazard Mapping, Seasonal Hazard Calendar, Seasonal Livelihood calendar for Male and Female, constructing Index of hazard impacts on *char* livelihood and Index of hazards impacts on Female household activities. To assess the climate change vulnerability of *char*-dwellers and particularly *char* women. PVA has been conducted in six study villages.

For collection of household level data and information, survey was conducted in both study sites with the questionnaire on 364 households from six study villages. The questionnaire was developed to collect demographic information of households, their socio-economic status, strategy of health and education, information on household risks and damages from different hazards, preparedness activities and emergency responses at the household level, coping strategies with available resources, role of women in decision making in different stages of disasters.

In addition Climate Disaster Resilience Index (CDRI) tool (Annexure -4) was used to assess the current level of vulnerabilities and resilience capacity of *char* dwellers with main focus on women. It is understood that the vulnerabilities and eventually the resilience level would not be same for all parts of the country especially riverine and coastal *char* areas. CDRI graphically presents information for an area's climate-disaster resilience. The CDRI methodology has been described in detail in the study by Joerin and Shaw (2011) and some studies have employed climate disaster resilience index in different sectors (Razafindrabe et al, 2009; Habiba et. al, 2011; Parvin et. al, 2011). To assess the capacity of climate disaster resilience of *char*-dwellers as well as *char* women, CDRI has been employed in six study villages. Altogether 125 parameters were used under five resilience dimensions with assigned weight from 1 to 5 to the parameters under each dimension according to their importance. Similarly, variables under each parameter were also assigned weight according to their importance. Data has been analyzed using MS Excel software. It has been calculated for each micro level unit of each *char* land. Analysis and formulation of CDRI have been conducted as follows:

- Five specific dimensions (physical, economical, social, natural, and institutional) have been chosen as the most relevant issues of climate disaster risk reduction in the *char l*and areas;
- Each dimension has been divided into five parameters and each parameter was divided into five variables. All together, there were 25 questions and 125 variables ;

- Disaster resilience capacity of each parameter was presented in a question which ranked between 1 (poor/low) to 5 (good/high) in a five point rating scale;
- Parameters and resilience capacity scale of different variables were fixed through Participatory Rural Appraisal (PRA) by the *char* community of three study villages;
- A structured questionnaire was developed consisting of these 25 questions and household survey was conducted on 364 households of six study villages;
- A simple arithmetic function named Weighted Mean Index (WMI) was used to calculate the scores and presented on spider diagram. Finally a CDRI (Annexure-4) was developed.

Table 1.3 Primary data collection methods, tools, and types of data yielded

Methods	Tools	Data Source	Types of data
Questionnaire Survey	Interview Schedule	364 household heads including house wives and all female headed households of six study villages	▪ Demographic information of households ▪ Information on social, economics, health, and education ▪ Information on household risks and damages from different hazards, cyclone, storm surge, tidal flood, riverine, flood river erosion, salinity intrusion and drought ▪ Preparedness activities and emergency responses at the household level ▪ Coping strategies with available resources at the household level ▪ The role of women in decision making in different stages of disasters
FGD	FGD Checklist	*Char* communities (male and female group) 6 FGDs conducted	▪ Major household activities ▪ daily activities ▪ Household income and expenditure ▪ Food security ▪ Education system ▪ Health care system ▪ Vulnerabilities of the char land women ▪ Coping strategies of Char land people ▪ Role of women in hazard preparedness and response

PRA	- Social mapping -Resource mapping -Venn diagram -Problem ranking - Institutional relations through Venn diagram	6 PRAs from two study sites (One PRA has been conducted from each study village consisting 10-12 persons)	▪ Information on social and educational institutions and their management procedure ▪ Catastrophic flood and erosion induced settlement migration risks at community level ▪ Seasonality of their livelihoods, labour demand and agricultural activities ▪ Community based coping strategies with available local resources ▪ Responses and demands of local disaster management
PVA (Participatory Vulnerability Assessment)	- Community Hazard Mapping - Seasonal Hazard Calendar - Seasonal Livelihood calendar for Male/Female - Index of hazard impacts on char livelihood - Index of hazards impacts on Female household activities	6 PVAs from two study areas (One PVA each study village consisting 10-12 persons)	▪ Different types of hazards with seasonality ▪ Different types of livelihood with seasonality ▪ Climatic hazards impacts with severity on different types of char livelihood ▪ Climatic hazards impacts on women activities
CDRI (Climate Disaster Resilience Index)	Structured interview schedule through weighted mean index method	364 households of six study villages	**CDRI Dimensions and Parameters:** ▪ **Physical Dimension:** Housing and land use pattern Accessibility of road Homestead area Water and Sanitation system Cow shed & poultry case ▪ **Social Dimension:** Family & community kinship Health Household demography Education and awareness Community preparedness for disaster ▪ **Economic Dimension:** Household income Household assets Land ownership Employment opportunities (IGA) Savings ▪ **Institutional Dimension:** Access to educational institutions

			Access to health facilities Access to the nearest growth centers Institutional supports from MFIs and NGOs Institutional support from sub-national and local Govt. ▪ **Natural Dimension:** Severity of natural hazards Frequency of hazards Severity of damage Food security Availability of resource
KII (Key Informants Interview)	- Check-list for local managers - Check-list for professionals - Electronic voice recorder	**Participants:** Social elite, local formal and informal leaders, including UP Chairman and members, school teachers and researchers who are involved in this type of activities	▪ Views, opinions, and suggestions of the key informants ▪ Status of community participation in disaster risk reduction ▪ Necessary demands, existing gaps, roles and responses for disaster management at the local level ▪ Coordination and support from national and sub-national level disaster management services
Case Studies	Electronic voice recorder	Select victims from different villages	▪ History and experiences ▪ Responses and modes of coping
Field Observations	-Field book -Transect walk -Digital camera -Global Positioning System (GPS)	Intensively visited the study area including the vulnerable sites	▪ Nature and characteristics of disasters ▪ Household-and community-based coping strategies ▪ Settlement relocation and migration process ▪ Overall socio-environmental condition of the study sites

Source: Prepared by the author based on data collection process and methods for the present study (2011–2012).

1.5.3 Secondary data collection

Secondary data has been collected through a rigorous literature review of relevant published and unpublished materials from different libraries, websites and reports. The study mainly

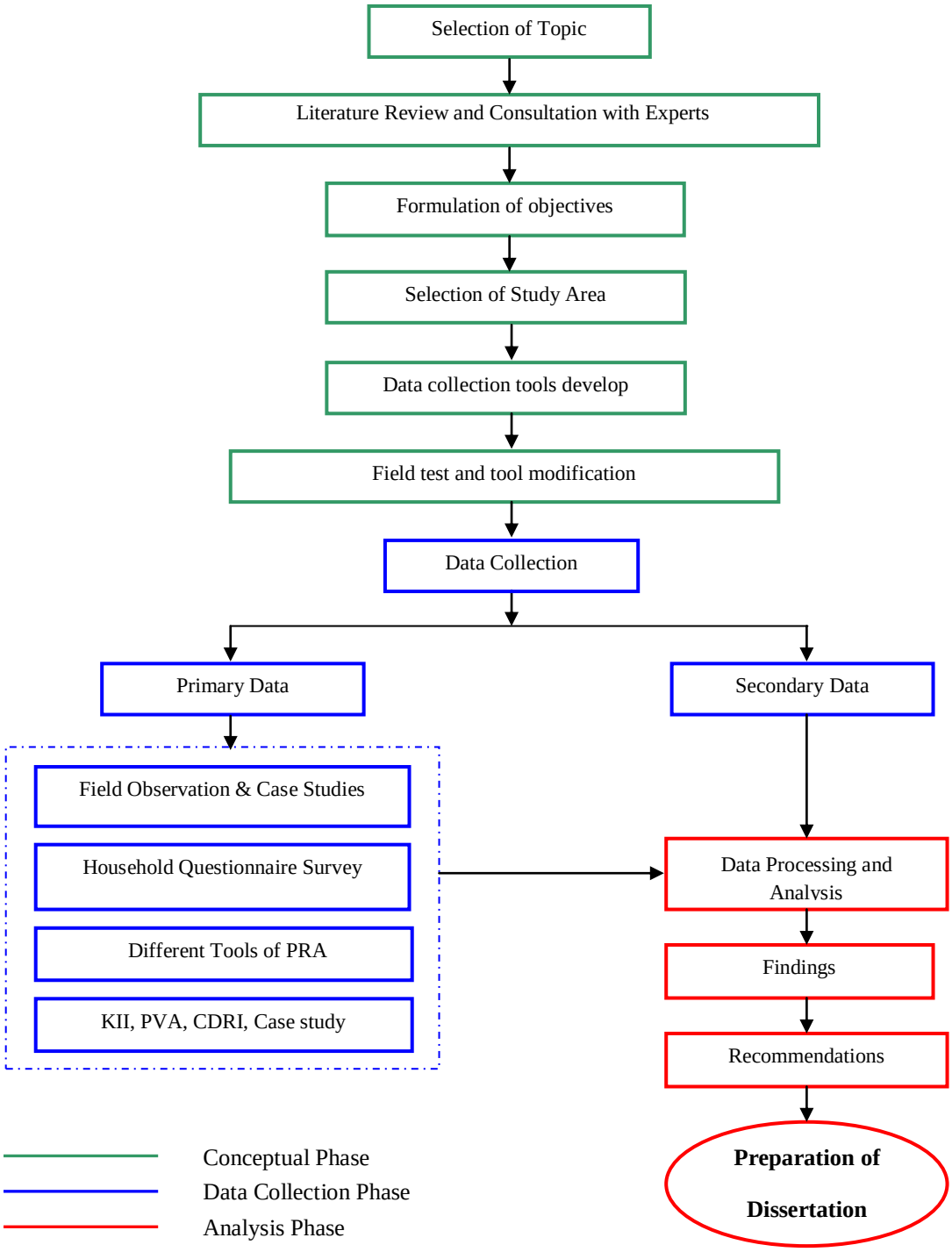
examined the Government of Bangladesh (GoB) report of disaster and climate change adaptation plan and strategy as well as the relevant policy reports. The study has scrutinized the data of Disaster Management Bureau (DMB) and Ministry of Environment and Forest (MOEF).The study examined the global situation and policy on climate change induced human displacement and migration. The study placed especial emphasis on gender related issues of policies and technical report of different organizations dealing with climate change hazards. Secondary data was also collected from different specialized organizations. Flood warning and hydrological data was collected from the Flood Forecasting Warning Center (FFWC) and Bangladesh Water Development Board (BWDB), climate change and disaster related data was collected from SAARC Disaster Management Centre (SDMC), erosion-related data was collected from the Center for Environmental and Geographical Information Services (CEGIS), tropical cyclone, storm surge and such meteorological data was collected from the Bangladesh Meteorological Department (BMD) and SAARC Meteorological Research Center (SMRC). Additional data regarding the socio-demographic and physical features of the study areas were collected from Zanjira Upazila Parishad, Kunderchar Union Parishad, Sonagazi Upazila Parishad and Char Chandia Union Parishad. Information regarding the activities of different government and non-government organizations were collected from the respective local office and officials. Photographs were taken by the researcher during data collection and field visits to present a visual effect of the facts and issues.

1.5.4 Data processing and analyses

For the systematic and fruitful analysis of raw data collected from both primary and secondary sources were coded and cleaned and the final data set has been prepared using PASW (Predictive Analytics Software/SPSS) and Microsoft Excel. Different types of maps, tables, charts, graphs, sketches, photographs, and figures were used to facilitate the analysis.

Analysis of collected data, problems, potentialities, and overall impacts of climate induced hazards; riverine and coastal *char*-people's strategies for coping have been done to develop a comprehensive climate risk reduction framework for the disaster resilient community. Recommendations for strengthening the coping strategies have been made in order to mitigate the risks and vulnerabilities of climate induced hazards in the riverine and coastal *char* lands in Bangladesh. The schematic diagram shows the methodology of the research (Figure 1.7).

Figure 1.7 A schematic diagram of methodology



Source: Prepared by the researcher based on present research design and methods, 2012.

1.6 Organization of the thesis

The thesis is arranged in eight chapters. The introductory chapter provides an overview of the problem. The second chapter presents a review of the literature followed by the operational definition and study justification. The objectives and methodology and study design are also spelled out in this chapter. The third chapter deals with profile of the two study areas along with the riverine and coastal *char* land area in Bangladesh. The socioeconomic characteristics of the *char*-dwellers and the patterns of riverine and coastal *char*-livelihood in perspective of *char* land women following their role and response at household and community level are presented in chapter four. Risk and vulnerabilities of *char* land women due to climate change hazards have been discussed in detail in chapter five. In chapter six, the coping strategies and their underlying causes and the constraints have been discussed. Chapter seven assessed the climate hazards resilience capacity of *char* land women at household level in Bangladesh. The last chapter eight includes the conclusion and recommendations for the riverine and coastal *char* land women to develop a comprehensive climate disaster management framework in context of climate hazards in Bangladesh.

CHAPTER TWO

REVIEW OF LITERATURE

2.1. Review of Literature

Many authors, planners and scholars conducted several studies and analyzed the different aspects of climate hazards and related matters in different parts of the world. Related studies on different issues are discussed in the sections below.

Studies on climate change hazards and its vulnerabilities in Bangladesh

Various studies have been carried out on the impact and vulnerability of climate change in Bangladesh. Warrick et. al. (1996) carried out one of the pioneer works in Bangladesh to address climate change problems. In this study they tried to present the scenarios of greenhouse effect and climate change within the physical, social and legal frameworks of the country. But they put little emphasis on community resilience build up process.

Anwar Ali (1999) discussed the possible impacts of climate change in Bangladesh through tropical cyclones, storm surges, coastal erosion and back water effect. Some remarks were made in his study on the adaptation option for Bangladesh in the event of climate change.

Choudhury et. al (2004) described the socio-economic perspectives of the water related vulnerability to climate change for the selected hydrological unit of Bangladesh. The study has also given a compressive description of the present adaptation policies for adaptation to the climate change induced impacts.

Islam (2005) explained that natural hazards or disasters occur in Bangladesh in many forms, the most devastating ones being coastal cyclones, tidal surges, floods and river bank erosion. The disasters like tornadoes, droughts and mild earthquakes also hit the country from time to time. He has also discussed the perception and impact of hazards and the people's coping strategies with primary focus is on flood hazards but other issues like river-bank erosion and tornado have also received attention. He mentioned that the most ominous warning is that of the probable sea level rise which is indeed becoming a reality would permanently submerge at least one-fourth of the country's landmass and directly affect a similar proportion of the population in the next 30-40 years. He argued that this should not

make us complacent; rather people of Bangladesh should prepare themselves with both mechanisms of coping with hazards and also to combat some of these climate hazards.

Ray-Bennett, Nibedita. S. et. al (2010) in their study described that understanding health in context of disaster vulnerability presents an opportunity to examine how improved health might reduce the effects of environmental disaster and other crises. This study findings show that health related coping strategies and agentive capabilities in the context of impending crises vary from one micro context to the next.

Rawlani and Sovacool, (2011) focused intimately on the benefits to climate change adaptation. They tried to explain why adaptation may be more appropriate and effective than mitigation for least developed countries such as Bangladesh. The study also emphasized on becoming responsive to climate change through community based adaptation in Bangladesh.

Rashid H. and Paul. B. K., (2014) provided a scientific evidence of climate change in Bangladesh through empirical data on its impacts on different types of climatic disasters. In interpreting available data they have attempted to strike a balance between scientific facts on climate change in Bangladesh and public discourse on climate change which often depletes with contested claims on the magnitude and timing of future climate change impacts in Bangladesh. They have also presented necessary information on physical dimension of hazards and disaster in Bangladesh and emphasized on human dimensions of climate change.

But none of these aforementioned studies highlighted the need for assessing climate hazard vulnerability on *char* land women in Bangladesh. Furthermore no study has been carried out so far to identify women's resilience capacity in the context of climate hazards.

Studies on *char* land vulnerabilities in Bangladesh

Dutt, K. L. and Samanta, G. (2013) explored the world of *chars*-part land, part water, low-lying sandy masses that exist within the riverbeds in the floodplains of lower Bengal. They showed how *chars*, both as real-life examples and as metaphor, straddle the convention categories of land and water and how people who live on them fluctuate between legitimacy and illegitimacy. The result is a study of human habitation in the nebulous space between land and water and a new way of thinking about land, people and ways of life. They prompted to reconsider the view that land and water form two different elements of the

physical environment and encouraged the rethinking of ideas of security and vulnerability as absolute, measurable and equally applicant. They also stressed on the adaptation to a changing environment.

Center for Environmental and Geographic Information Services (CEGIS, 2000) conducted a study on river and *char* dynamics emphasizing on the management issues and policy options for better utilization of resources in improving the living conditions on *chars*. The study mentioned that the physical processes involved in the dynamics of the river systems of the country provides information on conditions in the *chars* of the different rivers that relate to establishment of settlement and initiation of agricultural activities and the problems of natural calamities faced by the *char* people. The study makes an attempt to create such an understanding and also suggests certain measures for the betterment of the people living there and for the overall development of the country. This study mentioned that though the people of *chars* try to help themselves under all kinds of odds, there is strong need for institutional support to assist them in tiding over such difficult circumstances and others.

Irrigation Support Project for Asia and the Near-East (ISPAN, 1993) undertook a study of resources and people of *chars* of Brahmaputra-Jamuna, Ganges, Meghna, and Padma rivers. This study estimated the population that was displaced by erosion and also mentioned that the residents of *chars* and the mainland adjacent to the main rivers of Bangladesh have a precarious existence and are subject to erosion and flooding that can destroy crops and homesteads, render land unproductive, and kill livestock. It stated that the *char*-dwellers are among the most hazard-prone people of Bangladesh and the social and economic lives of *char* dwellers are largely determined by the ever-changing nature of the lands upon which they live.

Baqee (1998) illustrated the uncertainties of the lives and livelihoods of the inhabitants of *char*-lands in Bangladesh. The study described the survival strategies of the *char*-people in the face of both natural and man-made crises. The people have experienced constant environmental changes and they had to adjust as a survival strategy on the *chars.* He also focused on the process of occupancy, dislocation and resettlement.

Zaman (1991a, 1991b) explained the social origin, structures and development of the *lathiyal* (private army) political system in the context of *char*-land settlement in floodplain

Bangladesh. He also focused on local-level institutional response and current government policies to riverbank erosion displacement.

Schmuck (2001) examined the coping strategies of the river Jamuna *char*-people and made a comparison of the knowledge and experience in regard to measures against natural forces of the locals vs. that of engineering. She also focused on how the *char*-people perceived the Jamuna river and its behavior and the strategies they followed to cope with the whims of the river.

Thompson and Tod (1998) analyzed the impacts of floods in *char*-lands and the potential use of flood-proofing to reduce the vulnerability of people living in the *char*-lands. They reported that small-scale flood-proofing measures are comparable with investments in larger flood control projects. The vulnerability of *char*-land people could also be reduced by other measures such as improving agricultural returns in the dry season, better flood warning based on upper catchment modeling in India, and implementing government policy for fair distribution of newly accreted land to erosion victims. In adjacent mainland areas there may be scope to diversify incomes and create new opportunities to employ erosion victims and *char*-people by assisting industrial development.

Paul and Routray (2010) explored how floodplain people employ different preventive and mitigation measures through different coping strategies. They also evaluated the different enabling attributes, such as education, income, and occupation, in addition to the overall flood-coping strategy, and how different measures help to minimize the vulnerability to a flood disaster.

Islam et. al (2011) studied the *char* household level responses as coping strategies to reduce their damages from recurrent flood disasters through their local wisdoms and also tried to measure the underline causes and constraints to follow the better practices to cope with these natural calamities.

Aalst (2006) provides an overview of the relation between climate change and weather extremes and examined three specific cases where recent acute events have stimulated debate on the potential role of climate change. He mentioned that the potential increases in extreme events due to climate change come on top of alarming rises in vulnerability and the additional

risks due to climate change should not be analyzed or treated in solution, instead integrating into broader efforts to reduce the risk of natural disaster. He also considered climate change as an additional factor which can be embedded in existing risk reduction strategies.

Haque (1997) focused on the complex human problems caused by riverbank erosion and the associated involuntary migration in the context of *char* land of Brahmaputr-Jamuna floodplain of Bangladesh - one of the most disaster-prone and impoverished environments in the world. The lack of any gender dimensions makes the study out of touch with reality and limits its usefulness. The study provides some valuable insights into the floodplain *char* land environment.

Islam et al (2006) conducted a study on the Padma riverbank erosion hazards, population displacement, and socioeconomic impacts at Zanjira Upazila in the Shariatpur district. The study revealed that the bank erosion and shifting of the Padma right bank was the maximum at the Kunderchar union of the upazila. The study found that over 32.2% of the total displaced households moved as a result of bank erosion of the river Padma at Zanjira Upazila between 1999 and 2003.

Barkat *et al* (2007) reviewed and investigated the applications of present *char* land management laws and regulations. They evaluated different indicators of *char* livelihood and made some suggestions to mitigate the *char* land management problems of *char* people.

Safi Noor Islam *et al* (2010) studied the nature of floods in the river basins and the cause of threat, in order to formulate a long term strategy for the *char*-land settlement relocations. They indicated that the people of *char*-lands are not stable in their land because of monsoon flood hazards.

Chowdhury R. Abrar et al, (2004) looked into the vulnerability and coping mechanisms of the erosion affected peoples in Bangladesh. They examined the pre-displacement, disaster management, rehabilitation and long-term livelihood management issues of the displacees.

Mamun and Amin (1999) presented a development strategy from their research for mitigating the impact of riverbank erosion hazard by densification of people and their settlements to safer zones. The research addressed issues such as erosion impacts, needs and

response, awareness, migration and adjustment behavior of the vulnerable people of disaster prone areas in Bangladesh.

Studies on women vulnerabilities due to climate hazards

Women's status and position in the society and discrimination against them make them more vulnerable in *char* lands but there have been only a few publications in this regard.

Climate Change Cell (CCC, 2009) tried to reveal gender specific vulnerability to climate change in Bangladesh. However given the urgency of the issue and the dimension of the problems in study is rather limited to address all the issues and contexts of vulnerability in relation to climate change and gender.

Dankelman (2010) analyzed the interface between the changing physical environment and human society, with a particular focus on gender aspects of climate change. Changing in the world's climatic conditions, the way these are formed, and how people are affected, cope with and adapt to these and the gender dimensions to these and their interactions have been studied. The study underlines the need for a gender-specific approach in climate change policies, actions, study and research.

Dankelman and Davidson's study (1988) focused on women's diverse reproductive and productive roles in household and community level that are impacted adversely by climatic changes. They observed that floods, droughts, cyclones, cold and heat waves, higher average temperatures, and sea level rise all have major impacts on people's lives and livelihoods, and particularly on those for which women are responsible. In most cases, resources get scarce, production goes down, prices go up and household conflicts develop that heavily affects women.

Samanta and Dutt, (2005) described the livelihood strategies of *char* land inhabitants based on a wider study examining the livelihoods vulnerability of women and men living in the highly dynamic *char* land environments of the *Damodar* River in Southern Bengal, India. In this study it is shown that *char* land inhabitants live difficult lives in eastern India, yet they have adapted to this marginal environment and have developed certain livelihood strategies to ensure their survival.

Baqee (1998) illustrated the nature of activates of the *char* land women and mentioned that depending on the socio-economic status, the *char* women's activities may be categorized under six broad headings like domestic work, childcare, post harvest activities, cash earning activates, rest and recreation and others. He also mentioned that *char* women are equally active in household and earning activities and women belonging to the poor group spend more time in physical labor, while women of well-off households are mostly busy taking care of the family and supervising all sorts of activities in the house. He explained that *char* people have to struggle against heavy odds for mere survival and it is more so for the women headed households.

Roy and Venema (2009) indicated that the ability of women to adapt to climate change pressures will be enhanced by using the 'capabilities approach' to direct development efforts. They mentioned that the survival of women who are vulnerable to climate hazards is dependent on their being able to obtain many essential resources from their immediate environment and gaining these would reduce their vulnerability to their changing environmental circumstances.

Keiko Ikeda (1995) investigated the gender aspects in human loss and vulnerability during quick-onset natural disasters by examining the case of the April 1991 cyclone in Bangladesh. The researcher argued that gender plays a role in victimization during natural disaster, resulting in higher casualty rates for women and there are notable differences in vulnerability to disaster between women and men in preparedness, in terms of getting information and taking decisions in an emergency. She suggested that to reduce gender-related vulnerability in disasters, it is indispensable that both men and women be given equal opportunities, resources and information in all phases of a disaster.

Although many studies have been conducted on climate hazards in Bangladesh, only a few have been carried out on the climate hazards linkage to women aspect of *char* areas and the *char* communities in Bangladesh. The aforementioned studies have not emphasized the vulnerability and sufferings of the riverine and coastal flood plain *char* land communities, especially the *char* land women during climate induced hazards at the household and community level.

2.2 Operational definitions

The operational definitions which have been used in this research are discussed below.

Climate change

Climate is a natural phenomenon that has always been dynamic and varies at a global scale of time and space. Various scholars have defined climate change in different ways (Ribot, et al. 1996). Trewartha and Horn, (1980) defined Climate as '*an average weather condition of an area characterized by its own internal dynamics and by changes in external factors that affect climate'*.

According to the IPCC (2007) *"climate change refers to any change in the state of the climate that can be identified by changes in the mean climate and /or the variability of its properties, and that persists for an extended period, typically decades or longer"*. Current concern for changes in climate have arisen because of the unprecedented human industrial and development activities of the past two centuries that have caused changes over and above natural variation (IPCC, 2001).

The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as *"a change of climate attributed directly or indirectly to human activities that alter the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods*" (IPCC, 2007; UNDP, 2009).

Hazards

Generally 'hazard' refers to a potentially damaging influence on a system of analysis. According to UNISDR (2009), *"Hazard is a dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other heath impact, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage"*.

The Hyogo Framework defined *"hazards of natural origin and related environmental and technological hazards and risks"* (UNISDR, 2005). Such hazards arise from a variety of geological, meteorological, hydrological, oceanic, biological, and technological sources, sometimes acting in combination.

Gilbert White (1974), who pioneered the concept of adjustment to natural hazards, has defined the tem natural hazards as *"an interaction of people and nature governed by the*

coexistence of adjustment in the human use system and the state of nature in natural events system".

The United Nations Disaster Relief Office (UNDRO) defined hazards as *"the probability of occurrence within a specified period of time and within a given area of a potentially damaging phenomenon"* (UNDRO, 1982, cited in Rashid, H and Paul, B 2014, 7).

United Nation (2004) defines a 'hazard' broadly as *"a potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, properly damage, social and economic disruption or environmental degradation".*

In line with the Intergovernmental Panel on Climate Change (IPCC, 2001), the present study defines climate change as *'any change in climate over time, whether due to natural variability or as a result to human activities'*.

This study also attempt to define the term *'Climate change hazard' as an "event or hazard in the built environment, or social life caused by climatic change, that may cause harm to persons, assets, or livelihoods and destroy life, damage properties and degrade environment".*

Disaster

Disasters are often described as a result of the combination of the exposure to a hazard: the conditions of vulnerability that are present and insufficient capacity or measures to reduce or cope with the potential negative consequences. Disaster impacts may include loss of life, injury, disease and other negative effects on human physical, mental and social well-being, together with damage to property, destruction of assets, loss of services, social and economic disruption and environmental degradation.

According to UNISDR (2009) 'disaster' is defined as "*A serious disruption of the function of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources".*

Tobin and Montz, (1997) described that while a natural hazards represents a probability or likelihood of an extreme event to occur, it is not the even itself. Only after an event occurs it is termed as a disaster, provided it has 'a large impact on society'.

This present research use the term 'Disaster' in the context of Bangladesh, as a '*situation of huge destruction in life, property and environment and collapse all functions of a community and minimize their coping capacity to face the difficulty*'.

Risk

The word 'risk' has two distinctive connotations: in popular usage the emphasis is usually placed on the concept of chance or possibility, such as in 'the risk of an accident', whereas in technical settings the emphasis is usually placed on the consequences, in terms of "potential losses" for some particular cause, place and period.

According to UNISDR (2009) *'risk' is described as "the combination of the probability of an event and its negative consequences*". The potential climatic disaster losses, in lives, health status, livelihoods, assets and services, which could occur to a particular community or a society over some specified future time period.

This study defines 'risk' as "*the chance of any hazards and its destructive impacts on life, livelihoods and environments of a society or a community*".

Vulnerability

Various scholars have defined vulnerability in different ways. The ordinary use of the word 'vulnerability' refers to the capacity to be wounded i.e., the degree to which a system is likely to experience harm due to exposure to a hazard (Turner II et al 2003).

The United Nations Development Programme (UNDP, 2004) described vulnerability as *'a human condition or process 'resulting from physical, social and environmental factors, which determines the likelihood and scale of damage from the impact of a given hazard'*.

The UNEP GEO-3 report (2002) defined vulnerability as t*he interface between exposure to physical threats to human well-being and the capacity of people and communities to cope with those threats'*.

The Intergovernmental Panel on Climate Change (IPCC) defined *'vulnerability' as "the extent to which climate change may damage or harm a system"*.

Schjolden (2001) defined *'vulnerability' as the 'degree to which a system is susceptible to or unable to cope with, resist, and recover from the impact of a particular natural hazard'*.

UNDRO, (1991) defines 'vulnerability' as *"the degree of the loss to a given element or set of elements at risk resulting from the occurrence of a natural phenomenon of a given magnitude and expressed on a scale from 0 (no damage) to 1(total loss)"*.

Cutter (1993) described that *"vulnerability is the likelihood that an individual or group will be exposed to and adversely affected by a hazard. It is the interaction of the hazard of place (risk and mitigation) with the social profile of communities*".

Wisner et al. (2004, pp 4 and 11) define vulnerability as '*the characteristics of a person or group and their situation influencing their capacity to anticipate, cope with, resist and recover from the impact of natural hazard'*. He also described vulnerability as the *'likelihood of injury, death, loss, disruption of livelihood or other harm in an extreme event, and/or unusual difficulties in recovering from such effects'*.

The International Strategy for Disaster Reduction (ISDR, 2002) considered vulnerability as *'a set of conditions and processes resulting from physical, social and environmental factors, which increases the susceptibility of a community to the impact of hazards'*. Vulnerability affects a lack of buffers against contingencies such as disasters, exploitation and so forth (Chambers, 1989). Vulnerability can be traced branch to quite remote roots and general causes that entail socio-economic processes and political factors, which are requisite for understanding why hazards affect people in varying ways and why people experience disasters differently (Ray-Bennett, 2009).

Aysan (1993) defined *'vulnerability' as 'disintegration of social patterns can be identified as social vulnerability and lack of access to resources can be considered as economic vulnerability'*.

Liverman (1990), distinguishes between vulnerability as *"a biophysical condition and vulnerability is defined by political, social and economic conditions of society"*. She argues for vulnerability in geographic space (where vulnerable people and places are located) and vulnerability in social space (who in that place is vulnerable).

The concepts of 'vulnerability' used in these studies relates to the natural and climate hazards. This study defines 'vulnerability' as *"a wounded situation of a system or a community causes a lot of destruction and losses to the system or the community resulting from any climatic hazards"*.

Resilience capacity

Resilience is derived from the Latin word '*resilio'*, which refers 'to jump back' (Klein et al,, 2003). Developed as an ecological concept (Holling, 1973), resilience was applied to social systems studies (Adge, 1997) and coupled human-environment systems (Carpenter et al., 2001; Folke, 2006).

According to fourth assessment report of IPCC (2007*), 'Resilience is defined as 'the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of function, the capacity for self-organization, and the capacity to adapt to stress and change'*.

Wildavsky (1991), defines resilience as *'the capacity to cope with unanticipated dangers after they have become manifest, learning to bounce back. Resilience is the buffer capacity or the ability of a system to absorb perturbation, or the magnitude of disturbance that can be absorbed before a system changes its structure by changing the variables'*.

The term 'resilience' is defined by the Fritz Institute as bound from as *"those attributes of an organization that enable it to rebound from the disruption resulting from a disaster so that it is capable of resuming the delivery of services".* (Holling et al., 1995).

The concept of resilience helps us to obtain a complete understanding of risk and vulnerability. It fills a void by addressing the 'soft perspective' of vulnerability and allows us to rethink the prevalent 'risk =hazard× vulnerability' equation (Manyena, 2006). Focusing on resilience directly, rather than vulnerability or poverty reducing, is important for another reason. Disaster resilience activities can 'lead to actions such as enhancing community coping capacity and livelihoods', resilience is rooted in making choices about future losses when development decisions are made. Choosing what is lost in future disasters is absolutely a new way to view those loses since it places 100% responsibility for those losses on people versus nature. There is no specific definition about climate hazard resilience. But 'disaster resilience' means the capacity of hazard-affected bodies to resist loss during disaster and to regenerate and recognize after disaster in a specific area in a given period (Zhou et al., 2010). The present study defines resilience as *"the capacity to adapt the stress and change of any disruption to a system resulting from hazards*".

Adaptation

The term "adaptation" although common in climate discussions is highly problematic. It naturalizes the vulnerable population: it implies that, like plants, they should adjust to stimulate. The term implicitly places the burden of change on the affected unit rather than on those causing vulnerability or bearing responsibility for helping with coping and enabling well-being. Adaptation also suggests "survival of the fittest", which is not a desirable ethics of a society (Mearns and Norton, 2010).

According to UNISDR (2009), adaptation is defined as *'The adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.'*

Cardona, (2001) considered that *"adaptive capacity is a process of adaptation (over time) to structural and/or incidental sources of environmental stress, consisting of distinct social, economic, technological, institutional and cultural adaptive mechanisms"*.

Dankelman, (2010) described that adaptation is a process to cope with the changing environment. When recurrent nature of disaster impact cannot be withstood by the existing coping mechanism and community or individual needs to change their regular life and livelihood strategy for a longer term we call it adaptation. In the context of climate change, adaptation is seen as the adjustment in natural and human systems in response to actual or expected climatic stimuli or effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation are distinguished, including anticipatory, autonomous and planned adaptation

This study considered 'adaptation' as *"a systematic process to adjust with offended situation and changing environment, created by any hazard or disaster".*

Coping

Coping is the temporary form of strategy used by the community until disaster circumstances become normal. It is not always sustainable or the best way to deal with the complex problems, but merely a survival strategy for the short term. As there often is no choice, measures such as adaptations in diets, longer working days, shifting to other fuels and employment under unsafe conditions or even forced migration are all coping strategies that women follow (Delkenman, 2010).

The UNISDR (2009), described 'coping capacity' as *'the ability of people, organizations and systems, using available skills and resources, to face and manage adverse conditions, emergencies or disasters"*. The capacity to cope requires continuing awareness, resources and good management, both in normal times as well as during crises or adverse condition. Coping capacities contribute to the reduction of disaster risks.

Coping is a temporary adjustment during difficult times whereas adaptation is a permanent shift in activities to adjust to permanent change (Davies 1993; Yohe and Tol, 2002). Coping and adaptation studies identify vulnerability reduction strategies used by poor and marginalized populations and the means to support those strategies.

This study defines 'coping' as *"an immediate strategy to manage or handle the hazardous situation which contribute to the reduction of risk and vulnerability caused by a disaster".*

Char land

The *char* lands denotes a piece of land that rises from the just a mixture of land and water, but a uniquely fluid environment where the demarcation between land and water is neither well defined nor permanent. They present *chars* as hybrid environment which exist in the real world, but they are also a metaphor for an ungovernable and borderless state of the environment (Dutt, K. L. and Samanta, G., 2013*).*

The '*char* land' is the Bengali term for a "mid-channel island that periodically emerges from the riverbed as a result of accretion" (Elahi et al., 1991).

The Irrigation Support Project for Asia and the Near East (ISPAN, 1993) described *char* land as *'the active floodplain, which is subject to erosion and accretion" and additionally, some mainland adjoining the main rivers, while not chars in the above sense, is also at risk from bank erosion and is just as flood-prone as the chars'*. The ISPAN (1993) has classified and defined the *char* land in three types: island *Char* (*Duba* Char), Attached *Char* (*Kuler* char) and Unprotected bank line. Island *Char* are defined as the land that can be reached from the mainland by crossing a main channel. Attached *chars* are located adjacent to the bank and are therefore accessible without crossing the main channel by crossing a small channel with shallow water in the dry season. Some mainland that adjoins the main rivers is also at risk of bank erosion and is just as flood-prone as the *chars*.

This study defines '*char* lands' as "a significant areas of hazard prone new rising land between water and land with harsh and hybrid environment".

Char land Women

The women who are living in *char*-land and whose livelihood fully depends on *char* lands are known as *char* land women. The present study considers '*char* land women who are hardworking and more tolerant and painstaking than other rural women in Bangladesh context'.

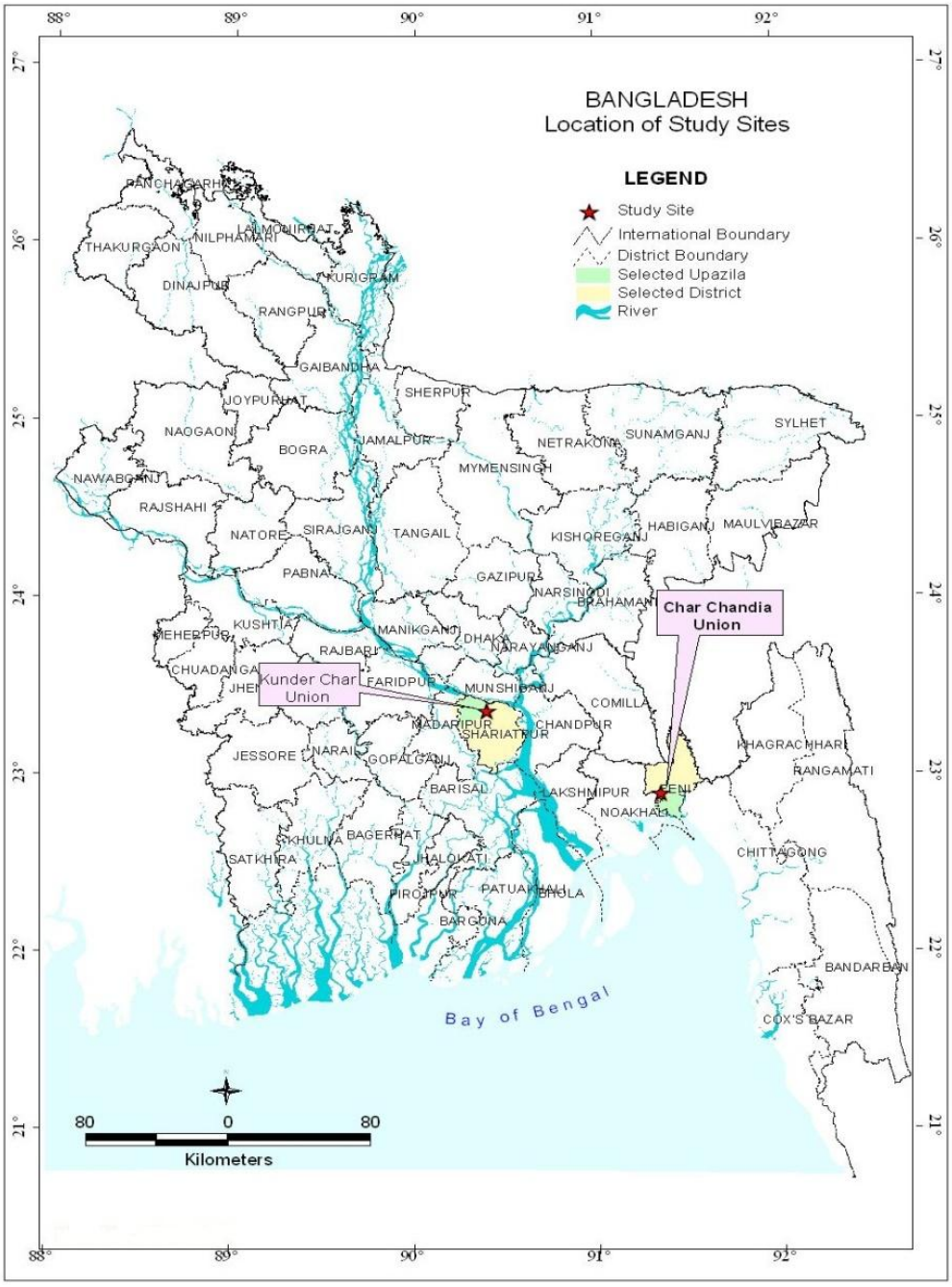
CHAPTER THREE

PROFILE OF THE STUDY AREA

Bangladesh is already experiencing the adverse impacts of climate change and climate variability in the form of variations in temperature, erratic behavior of rainfalls, increased intensity of flood, drought, cyclone and storm surge, salinity intrusion. It is also under the threat of possible sea level rise. These changes are affecting the communities, ecosystems and infrastructure of the country in various ways (Huq and Rabbani, 2011). Rahman et al (2007) indicated that the geophysical location, hydrological influence by monsoon rainfall and regional water flow patterns and low level resilience have made the people of the country more vulnerable to the effects of climate change. The vast majority of the population lives almost exclusively on the natural resource base especially on water and *char* lands which are the areas of new land formed through the continual process of erosion and deposition of sediments in the rivers and coastal areas are even more dependent on it. The coastal areas and off-shore islands of Bangladesh are low lying and very flat. The islands and attached bars known as *chars* are inhabited by some of the most desperate people in the country that created new opportunities to establish settlements and pursue agricultural activities for these poorest and most vulnerable communities in Bangladesh. The physical characteristics inherent in the ecology of *char* formation make the *char*-lands one of the most fragile environments in the world and the vulnerability of the physical environment makes *chars* risky and disaster-prone places (Samanta and Dutt, 2007). As the *char*-lands are highly vulnerable to several climate change induced hazards which affect the lives and livelihoods of the *char* dwellers especially the *char*-women, hence an assessment of the climate change hazards vulnerabilities and resilience capacity on *char* land women in Bangladesh is an important area of research. As mentioned earliear this study has been undertaken in two different types of *char* lands – one in the riverine *char* of the river Padma in *Kunderchar* Union of Zanjira Upazilla under Shariatpur district and the other is the coastal *char* of Little *Feni* River in the young Megna estuary (Figure 3.4) known as the *Char Chandia Union* in Sonagazi Upazilla under Feni district (Figure 3.1). The selected riverine *char* villages are Saral Khar Kandi (island *char* village), Eakub Matbarer Kandi (attached *char* village), and Kalu Beparir Kandi (unprotected bank line village). The word '*kandi*' refers to village in the study area (Figure 3.3).

The selected villages from the coastal *char* lands are *Dakkhin Purba Char Chandia* (unprotected bank line village), *Haji Jinnat Ali Samaj* (attached *char* village) and *Chhoto Gram Samaj* (attached *char* village) were surveyed in depth for this research (Figure 3.4).

Figure 3.1 Location of the study sites



Source: GIS map prepared by the researcher

3.1 Physical and environmental settings of *Char* land areas

The rivers in Bangladesh are characterized by both erosion and deposition. The settlers in the erosion prone areas are constantly on the move in search of new land for settlement. The newly formed virgin lands known as the *chars* are accreted by sediment-laden river flows. Floods are also instrumental in *such* formation. *Chars* can be considered as a 'by-product' of the hydro-morphological dynamics of the rivers. Estimates show that the total area covered by *chars* in Bangladesh was 1722 square kilometers in 1993 (Table 3.1). Riverine floodplain lands in Bangladesh are classified into three types namely *island char*, *attached char* and, unprotected mainland (FAP-16 studies).

Island chars are defined as land that even in the dry season can only be reached by crossing a main river channel. *Attached char* land is accessible from the main land without crossing a main channel during the dry season or sometimes by crossing smaller channels and is inundated or surrounded by water during the peak of a normal monsoon. The maximum elevation of *char*s can be close to the maximum flood levels occurring there. Newer *char*s would thus have lower elevations than older *char*s and the adjacent flood plains. The islands and attached *chars* appear to be less productive than adjacent mainland areas because of the fact that the area is relatively less favorable in terms of soil conditions particularly in some of the newly formed Chars (EGIS, 2000). After a emerging of a new *char*, it continuously goes under new changes. The *char*-dwellers use the *char* land in different ways as they desire to use and develop. The progression takes a *char* from deposition to siltation and then to some kind of vegetation (usually grasses), followed by cultivation after a period of years, and eventually human settlements occur. Typical patterns of physical development and human land use differ from one reach to another. Approximately two-thirds (67%) of the Padma *chars* are cultivated before settlements but 30 percent of the land are cultivated simultaneously in the settlement process (ISPAN, 1993).

The length of time from *char* formation to settlement in the study areas was found to be around 5 to 8 years. The elevation of the areas varied between 1.5 and 4.0 meters above sea level. The total *char*-land area was 62.5 km^2 in 1984 that increased to 152.7 km^2 in10 years time. Table 3.1 presents the types of *char*-land areas in the major rivers in Bangladesh.

Table 3.1 Area of *char*-land by types of *char* in 1984 and 1993 (km^2) in Bangladesh

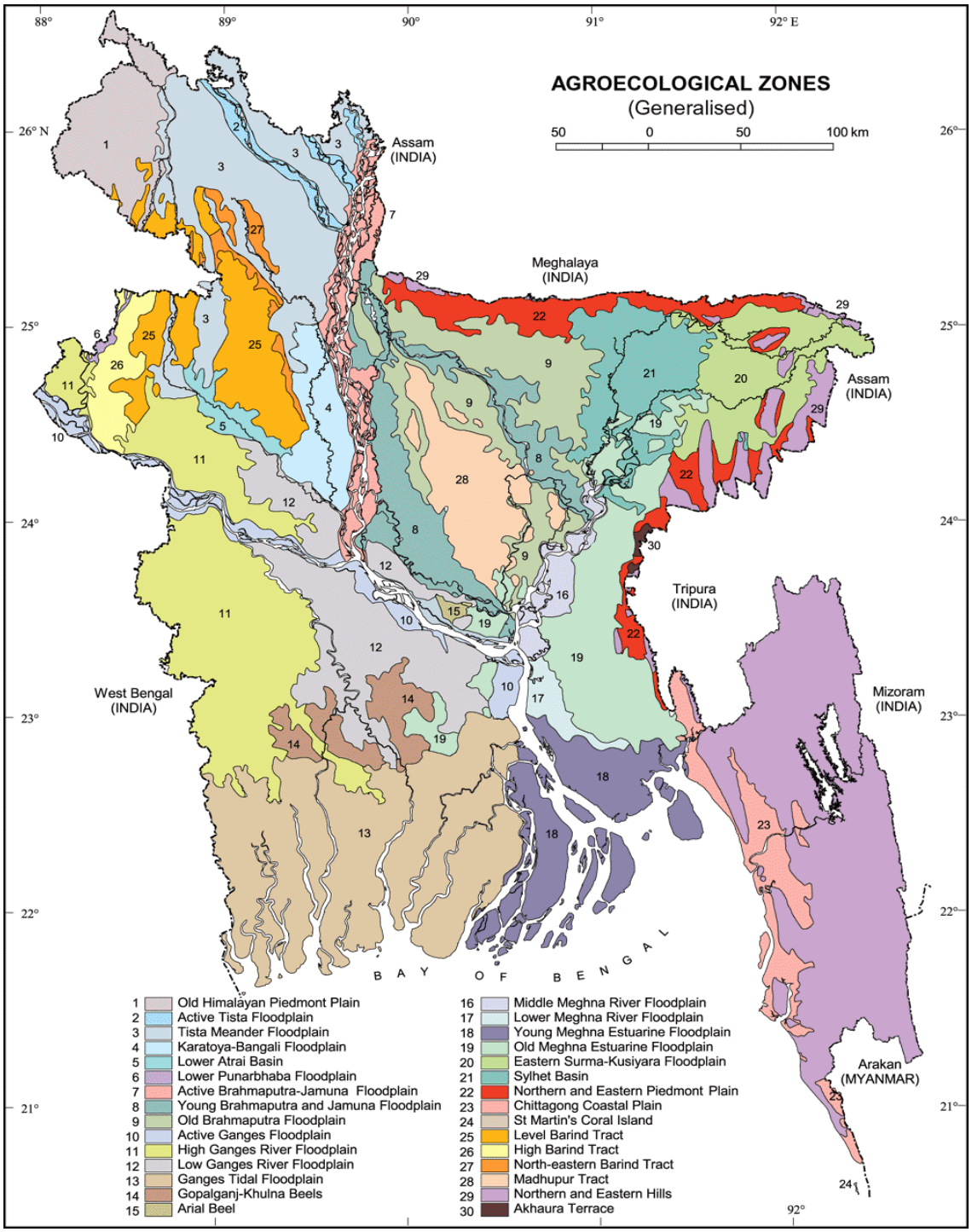
Name of river	Island *char*		Attached *char*		Total *char*	
	1984	1993	1984	1993	1984	1993
Jamuna	447.9	493.8	447.9	493.8	895.8	987.6
Ganges	95.3	138.9	148.4	216.7	243.5	355.6
Padma	28.2	68.8	34.3	83.9	62.5	152.7
Upper Meghna	50.5	46.3	---	---	50.5	46.3
Lower Meghna	110.7	180.8	---	---	110.7	180.8
Total	732.3	928.5	630.7	794.4	1363.0	1722.9

Source: CEGIS, 2000.

3.2 Location of the study area

The district of Shariatpur belongs to the Agro-ecological Zone-10 (AEZ) of the Active Ganges Floodplain of the mighty river Padma. The district of Feni belongs to AEZ-18 at the young Meghna estuary floodplain zone. Figure 3.2 illustrates the different types of agro-ecological zones of Bangladesh.

Figure 3.2 Agro-ecological zone of Bangladesh



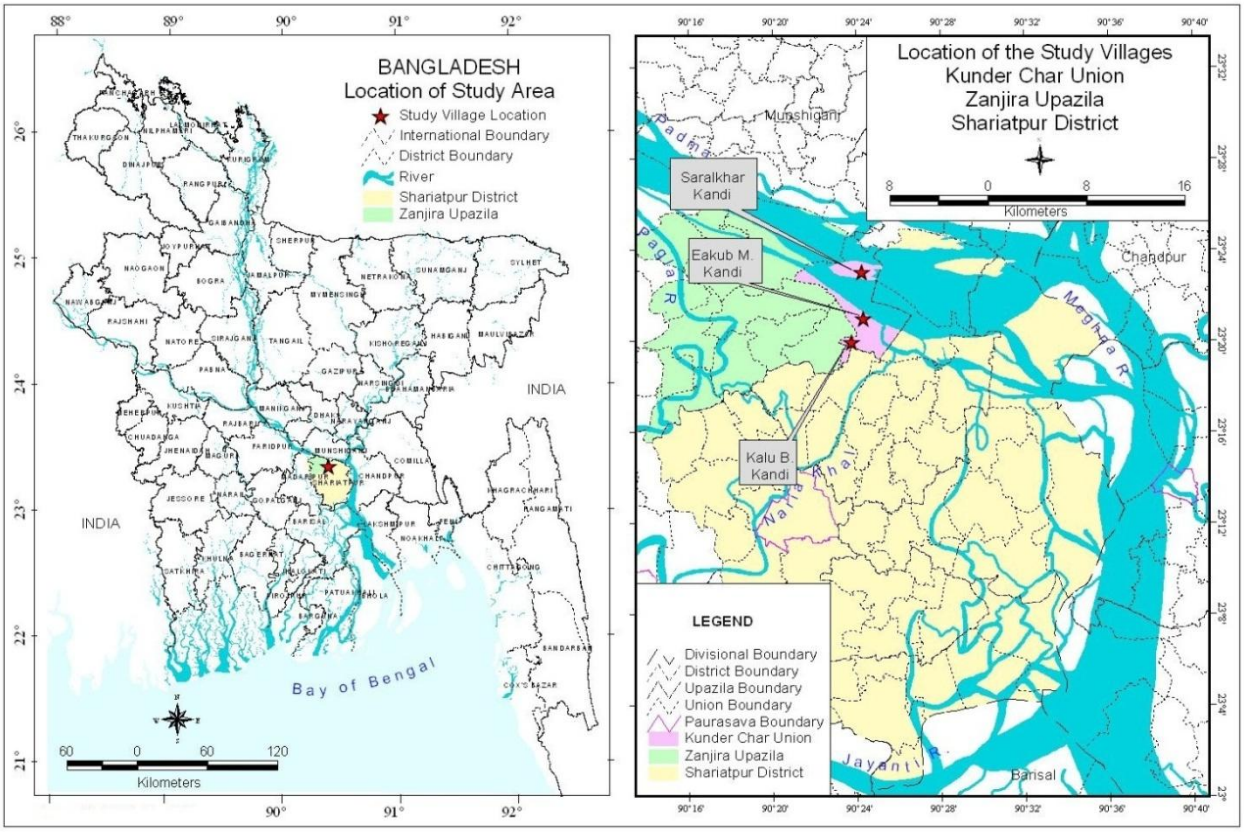
Source: Disaster Management Information Center, CDMP, Bangladesh.

3.2.1 The Riverine Char (Kunder Char)

Kunder Char is located on the right bank of the river *Padma* which is the main distributor of fresh water from the Ganges to the southwest region of Bangladesh. The large discharge and heavy sediment load during monsoon result in high flooding and the river becomes extremely unstable causing river bank erosion every year. Shariatpur is one of the severe flood affected districts in Bangladesh where 60 to 80 percent of area and 40 to 55 percent of the people are affected regularly (Disaster Management Information Centre (DMIC). About 56 percent of this district belongs to medium to deep flooded areas of the country (FFWC 2010).

The Zanjira upazila occupies an area of 239.53 sq km, including 79.93 sq km of river area. The population of the upazila is 1,94,019 (BBS, 2012). It is located between 23°16´ north to 23° 27´ north latitude and 90º 14´ east to 90º 26´ east longitude. Zanjira is bounded on the north by Lohajang Upazila of the Munshiganj district, on the east by Naria Upazila, on the south by the Naria and Shariatpur Sadar Upazilas, and on the west by Shibchar Upazila of the Madaripur district.

Figure 3.3 Location of the study area (Kunder Char riverine *char*)



Source: GIS map prepared by the author

It consists of 12 unions, 126 mouzas, and 179 villages. It is the third-largest upazila of the Shariatpur district in terms of area (Figure 3.3). In the past, the area was famous for growing cumin seeds, which are called *jira* in Bengali. Ships called *zahaj* in Bengali, used to anchor here to carry *jira*. As such the area is said to be called as Zanjira. Other historical evidence has mentioned that the word 'Zanjira' comes from the Arabic word for "island" (BBS, 2012).

Kunder Char Union is an attached bar (adjacent *char*) on the right bank of the river Padma. The study villages are located in the *char*-land of Maowa-Sureswar downstream reach at the confluence of the rivers Ganges and the Brahmaputra (Jamuna) at the central and southern parts of Bangladesh and detached from the main land. This area typically experiences various natural hazards such as severe flood, river bank erosion, cyclone etc. Most of the study area is situated in a low land where seasonal river water stays for four to six months a year. During this time the *char* dwellers are unable to perform their crop farming activities. River erosion is a continuous process in this area and about 3,695 hectares were eroded by the river in 2004 which was 92 percent of the total area of the Kunderchar union (Islam, et.al 2006).

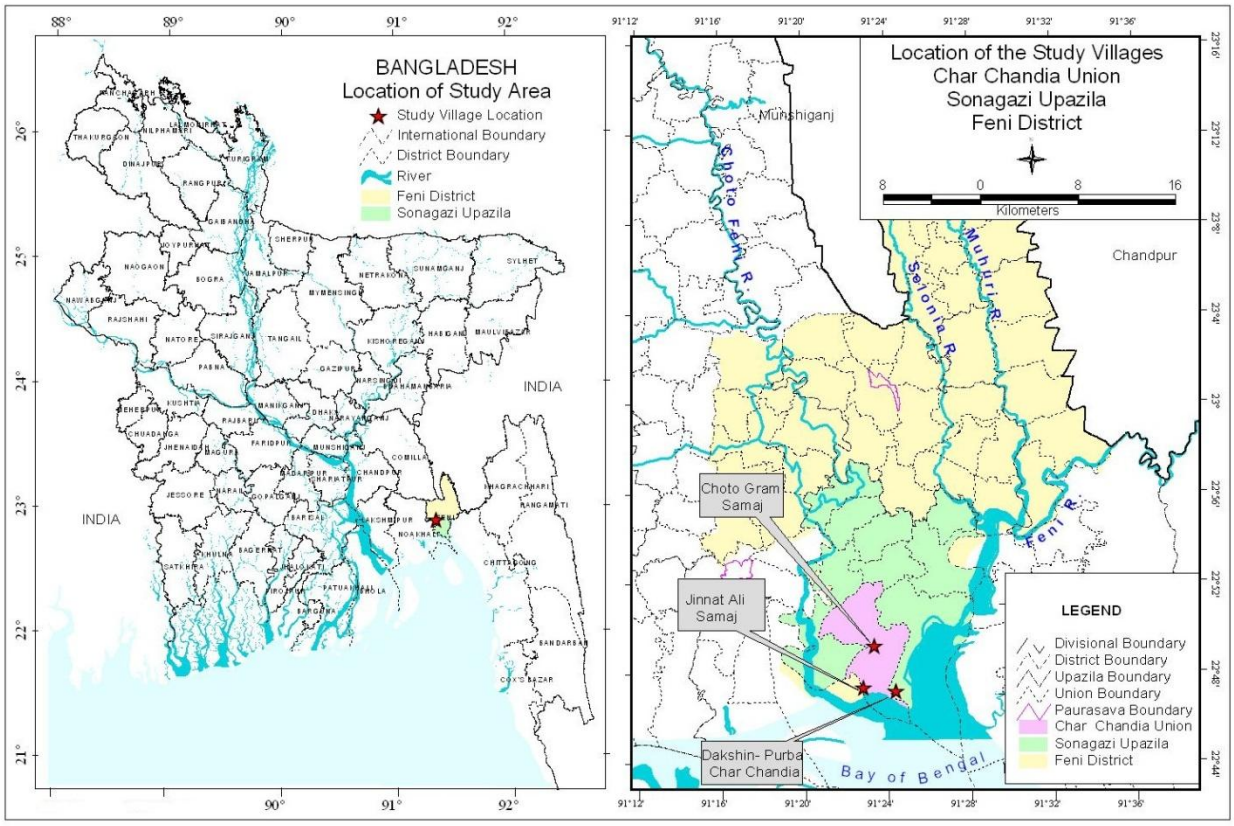
Village Saral Khar Kandi is located in the mid-channel island bar in the middle of the river Padma. The people of the island *chars* have to cross about 8 to 10 kilometers of the main river channel using local motorized boats to communicate with the mainland. The present location of the Saral Khar Kandi settlements were established on a natural levee of the *char*. The Eakub Matbarer Kandi is located on an attached bar (adjacent *char*) on the right bank of the river. During the monsoon season (June to October) the village is submerged by the river water. The people of the attached *char* have to cross around 1 to 2 kilometers of a branch of the main river channel using country boats during April to November and on foot during the dry season (December to March) to reach the mainland. The Kalu Bepari Kandi is located on unprotected floodplain land on the right bank of the Padma river. During the peak period of the monsoon season (July to September), the village farmland is submerged by river water. The Kalu Beparir Kandi was comparatively a newly settled village located on agricultural farmland at negligible elevation. In floodplain land, the homestead area usually stands on elevated mounds.

3.2.2 The Coastal Char (Char Chandia)

The coastal *Char Chandia* belongs to Feni district which was a sub-division of former Noakhali zilla and subsequently upgraded to a zilla in 1984. It is one of the disaster prone coastal districts of

Bangladesh. This zila consists of 6 upazilas including Sonagazi, 43 unions, 552 mauzas, 571 villages. Sonagazi upazila came into existence as a Thana in the year of 1920. Nothing is definitely known about the origin of the upazila name. The upazila occupies an area of 284.89 sq. km which is located between 22°44' and 22°58' north latitudes and between 91°28' east longitudes. The upazila is bounded on the north by Daganbhuiyan and Feni Sadar upazilas, on the east by Mirsharia upazila of Chaittagong zila, on the south and on the west by Companiganj upazila of Noakhali zila. The total length of Char Chandia union is 80 km. and situated in the exposed coast in south-east part of Bangladesh. The area of the union is 14271 acres (Figure 3.4).

Figure 3.4 Location of the study area (*Char Chandia* coastal *char*)



Source: GIS map prepared by the author

There are six unions in Sonagazi upzilla including *Char Chandia* which is the most disaster prone union in this upazilla. The distance of *Char Chandia* from Sonagazi upazila is about 5 km and 22 km from Feni district. This *Char* is highly prone to cyclones associated with storm surges, frequent riverbank erosion and one of the High Risk Area (HRA) in Bangladesh. It is forecasted

that this area will experience increased intensity of cyclone and seasonal inundation due to high tide in future (MoWR, 2005). Increase in salinity threatening the agriculture and health of this area.

The Char Chandia union falls under the AEZ-18 which is at the Young Meghna Estuarine Floodplain. It is located in the unprotected mainland on the right bank of the river Feni. The study villages from this exposed coastal *char* land are - Dakkhin purba Char Chandia (unprotected bank line village), Haji Jinnat Ali Samaj (attached *char* village) and Chhoto Gram Samaj (attached *char* village) (Figure 3.4). The village of coastal *char* land area-the Dakkhin Purba Char Chandia is located in the estuary of river Little Feni and river Feni which is highly exposed to the south-east coast of Bay of Bengal and is an unprotected bank line *char* land. Most part of this village is affected by the tidal surge and severe river bank erosion. The people of this *chars* have to cross around 3 to 4 kilometer to reach the Bay of Bengal for fishing and other activities using local motorized boats. Village *Haji Jinnat Ali Samaj* is located on the left bank of the Little Feni river. During the monsoon season (June to October) the village is submerged under 8 to 12 feet saline water for few hours during high tide. This village is a newly migrated village located on agricultural farmland in negligible elevation. Village *Chhoto Gram Samaj* is located on unprotected floodplain land on the right bank of the river *Feni*. During the peak of the monsoon season (July to September) most of the land of this village is submerged under 8 to10 foot depth saline water for few hours by tidal surge. As such most the homestead area usually stands on elevated mounds to minimize the severity of tidal attack.

3.3 Climate

The riverine *char* land Kunder Char area has a typical monsoon climate with a hot wet summer from May to September and a cooler dry climate in winter from middle of November to end of February. The monsoon season is characterized by high temperature, heavy rainfall, and high humidity. The winter season has cool dry weather with little or no rainfall. The two main seasons are separated by bridging periods- the pre-monsoon and post-monsoon period. The pre-monsoon period is associated with local tornados (northwestern) and sometimes with cyclonic storms due to the low depression in the Bay of Bengal. July to September is the rainy season when the heaviest rainfalls occur (normally 80 to 95 percent). Heavy monsoon rainfall generates excessive flows in the rivers and thereby causes floods almost every year. July to September is the most susceptible for flood and erosion risk in the study areas. The trend of both temperature and rainfall shows the

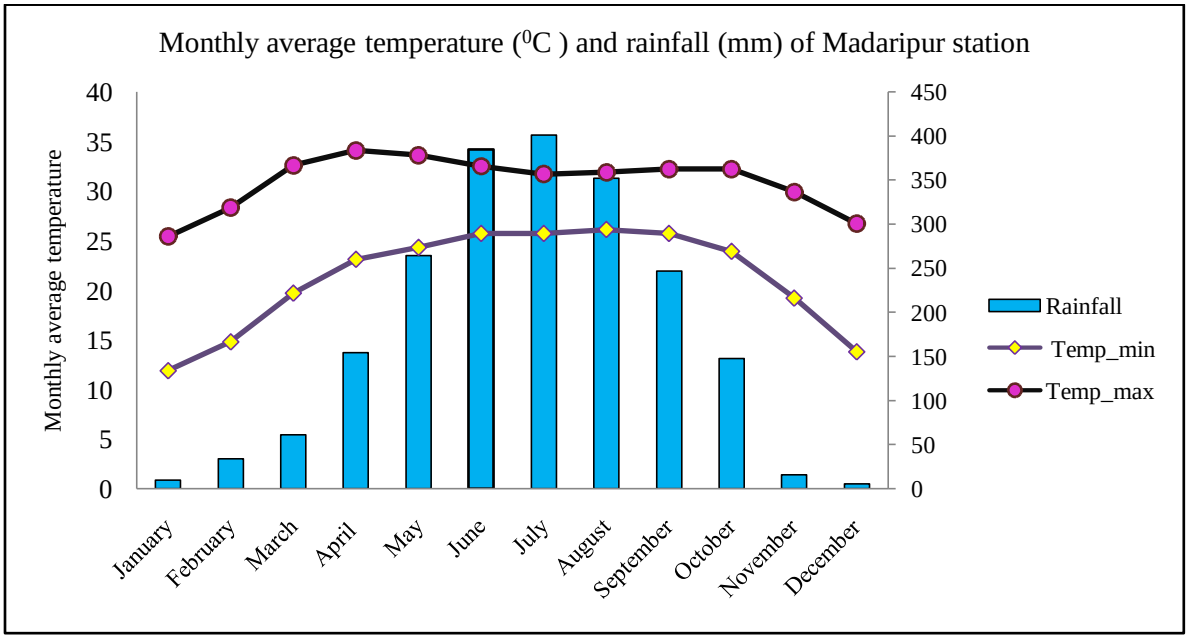
variations with seasonality. The available climatic data (annual average rainfall) for the both study sites from 2006-2011 are shown in Table 3.2 that were collected from Bangladesh Meteorological Department (BMD). Both data were analyzed (simple average) from the nearer available station-Madaripur for *Kunder Char* union and Feni for Char *Chandia* union. The monthly average minimum temperature of Madaripur station is 21.1^0 C and average maximum temperature is 32^0 C while the monthly average rainfall is 175 mm (Figure 3.5).

Table 3.2 Annual average rainfalls of both study sites

Annual average rainfall (mm)						
Year	2006	2007	2008	2009	2010	2011
Madaripur station	2056	3726	2881	2985	3368	3194
Feni station	1489	2020	1659	1580	2095	1613

Source: Bangladesh Meteorological Department (BMD, 2013)

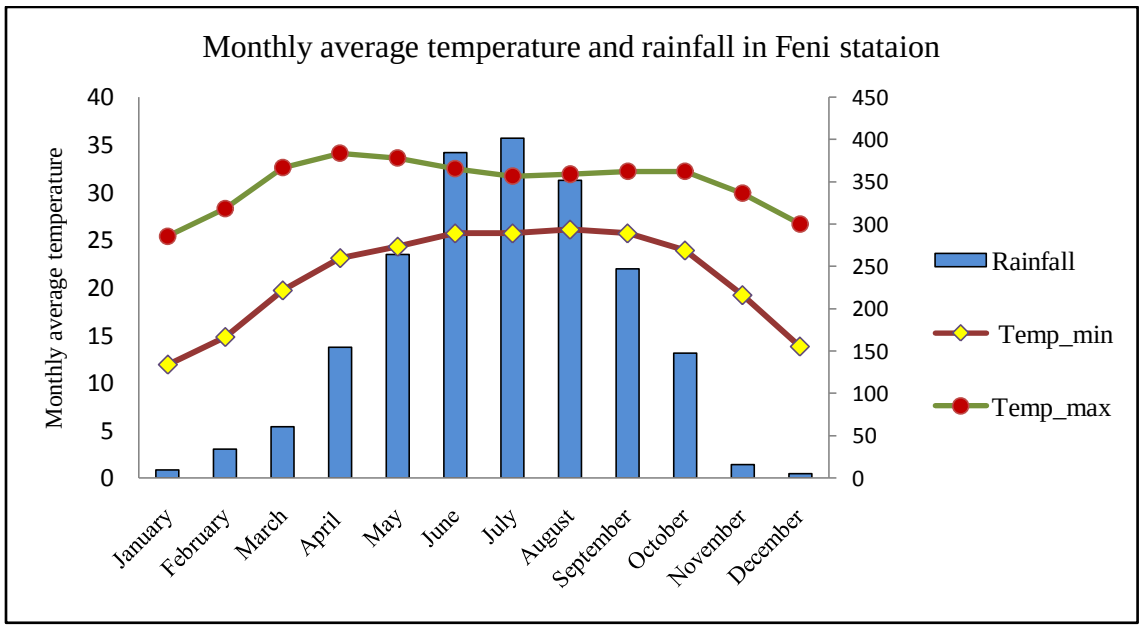
Figure 3.5 Monthly average temperature and rainfall of the Madaripur station



Source: Bangladesh Meteorological Department (BMD, 2013)

The climate of the coastal Char Chandia is also characterized by hot summer, high humidity and well distributed rainfall during the rainy season. The winter season starts about the middle of November and lasts till end of February followed by the summer form March to May. The south-west monsoon season exists from June to September. The month of October to 1st half of November constitute the post-monsoon season. The pre-monsoon period is associated with cyclonic storms due to the low depression in the Bay of Bengal. Average annual rainfall is 2000 mm, of which 75% falls during the monsoon from June to October. The months of July to September are the most susceptible for tidal surge and river bank erosion risk in the study area. The trend of both temperature and rainfall also shows the variations with seasonality in this site. The monthly average minimum temperature of Feni station which is nearest meteorological station of Char Chandia is 21.1^0 C and monthly average maximum temperature is 30^0 C and average rainfall is 257 mm (Figure 3.6). Comparatively temperature is seen less inn Char Chandia than Kunder Char but more rainfall occurs in coastal Char Chandia union.

Figure 3.6 Monthly average temperature and rainfall of the Feni station



Source: Bangladesh Meteorological Department (BMD, 2013)

3.4 Land type

The Water Resources Planning Organization (WARPO) classified Flood plain land based on the depth of inundation of the lands during average floods and divided into four types - high land (F_0-

type width inundation of 0.3 meters for an average flood), medium highland (F_1-type with inundation depth of 0.3 - 0.9 meters for an average flood), medium low land (F_2 type with inundation of 0.9 - 1.8 meters for an average flood), and low land (F_3 type with inundation depth >1.8 meters). Shariatpur district has 38.97 percent of its land under F_2 type and 16.81 percent lands of F_3 type (LGED, 2007). The findings of transect walk of the study villages of the Padma riverine *char* lands indicated that the land belongs to F_2 and F_3 while the villages of the Feni river in the coastal char land area indicated in belongs to F_1 and F_2 types.

3.5 Soil type

Char soil is usually produced partly due to environmental factors. The deposition of sand usually occurs in the peripheral lands having little vegetation. However the sediment source, erosion pattern, river morphology and flow hydraulics may change this general pattern of coarse soil deposition. The *char* land benefits greatly from seasonal flooding through nitrogen-fixation by blue-green algae and bacteria. The flooding also benefits through the addition of organic matter and its nutrients from the decomposed flora and fauna. The organic matter is usually over 1 percent in *char* soils and below 1 percent in mainland soils (DAE officials, Jamalpur). The seasonal fluctuation between aerobic and anaerobic soil conditions also makes phosphorus and possibly potash more readily available to plants (Brammar, 2000). However, the deposition of infertile sandy alluvium being low in organic matter and easily-available plant nutrients on previously productive soils with flood-water decrease the productivity of land. Calcareous dark grey flood plain soils and structured dark grey silty clay loams to heavy clays occurring in basins and on low ridges of the old Ganges river floodplain and locally in the Ganges tidal floodplain. Calcareous, brown silt loams to light silty clays, occurring in the Ganges river floodplain and locally in the young and old Meghna estuarine floodplains (BBS, 2011). Calcareous dark grey and brown silt loams to silty clays soils within a depth of 1.2 meter below the surface are seen in *Kunder Char* union of *Zanjira* upazilla of Shariatpur district. Clays are highly cracking when dry, drought prone and have heavy consistence. Locally they are leached of lime up to a depth of 1 m from the surface. Prismatic and /or blocky structured predominantly grey sandy loams to silty clay loams on young floodplain ridges and silty clay loams to clays in basins, slightly acid neutral soil are exist in Feni district. Non-calcareous grey floodplain soils are also seen in the Feni district including Char Chandia union of Sonagazi upazilla.

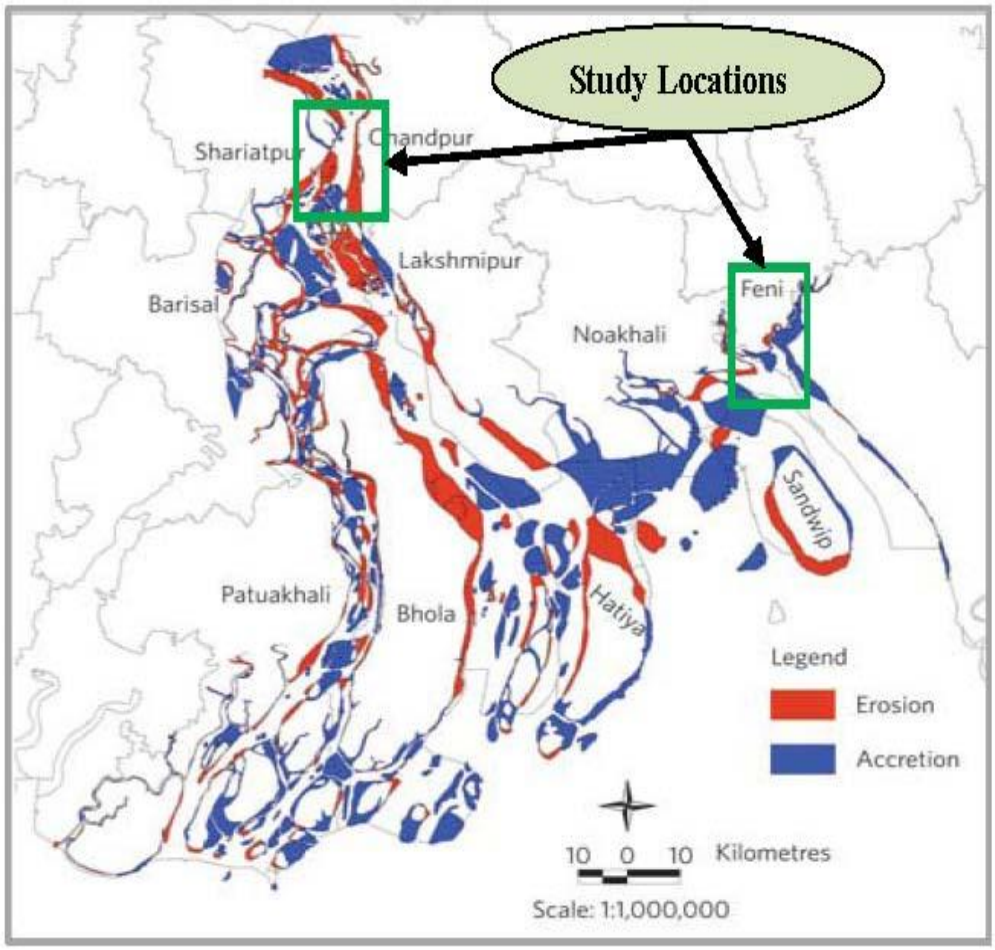
They become saline in dry season in the coastal tidal areas including Char Chandia union (BBS, 2011).

3.6 Hydrology

Shariatpur district has several important rivers, including the Padma, the Meghna, the Kirtinasha, the Palong, Padma-branch river- *Choto* Padma, etc. In addition, there are numerous water bodies like *khals, beels, baors*, and ponds in the district that render high-potential water availability. The river Padma receives the combined flow of the two main rivers of the country- the Ganges and the Jamuna. The river Meghna meets the river Padma near Chandpur town and then flows downstream by the name of the Lower Meghna. These rivers are major contributors to the annual medium to deep floods in the district. The major causes of floods in the study site of riverine char are upland floods coming through the rivers Ganges and the Brahmaputra, internal rainfall, rainfall run-off from cross-boundary catchments, impeded drainage, overbank spills from rivers that are not embanked and tidal influence. Submergence duration is prolonged if the rivers continue to remain high above the danger level for a long period of time. The major causes of prolonged floods are prolonged rainfall of high intensity at the upper catchments of the rivers, synchronization of the flood peaks of the rivers Ganges-Padma and the Meghna and their tributaries and distributaries, drainage impediments due to tidal effects in the Padma and the Meghna rivers and their distributaries, siltation of river beds, and public encroachment (LGED, 2007).

In Feni district (Figure 3.7) there are three main rivers- the Feni, the Little Feni and the Muhuri (BBS, 2012). There are also numerous *khals*, *beels*, *baors* and ponds in this district that render water availability. The present area of the Feni zilla was once under marshy land meaning *Feni* and the continuous silting process made it suitable for human habitation as a result of which people from far and near called the area as Feni (BBS, 2012).

Figure 3.7 Meghna estuary floodplain area



Source: Modified by the author based on Koen de Wilde (2011:29).

3.7 Demography

The demographic information of the study sites are shown in Table 3.3. The total population of Kunder char union is 11,263 and 40,592 in Char Chandia; population densities in the study sites are 268 and 703 per square km respectively. The overall average household size is 4.4 persons in Kunder Char union and 5.5 persons/households in Char Chandia union while national household size was 4.4 persons (BBS, 2012).

Table 3.3 Demographic status of study sites

Items		National	Shariatpur zila	Kunder Char	Feni zila	Char Chandia
Total population		149772364	1155824	11263	1437371	40592
Annual population growth rate		1.47	0.65	-	1.46	-
Sex ratio		100.3	94	100	93	89
Avg. household size		4.4	4.66	4.4	5.1	5.5
Density in sq. km.		976	984	268	1451	703
Literacy rate (Percent)	Both sex	51.8	47.3	35.7	59.6	47.8
	Male	54.1	48.0	36.2	61.1	50.7
	Female	49.4	46.6	35.3	58.3	45.2

Source: Bangladesh Bureau of Statistics (BBS), 2012

The mean household size in coastal *char* site was found higher than riverine *char* land site. The literacy rate of Kunder Char union and Char Chandia union is found 35.7 percent and 47.8 percent respectively where as it is 51.8 percent for the country (Table 3.3). This gives evidence that literary rate in both *char* sites are low but it is more severe in riverine *char* site.

CHAPTER FOUR

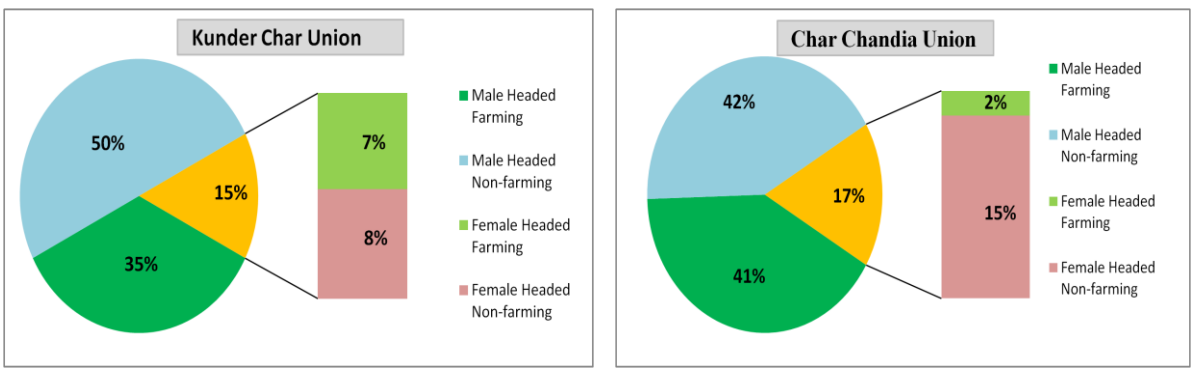
SOCIO-ECONOMIC CHARACTERISTICS OF *CHAR*-DWELLERS OF THE STUDY AREAS

The people living in the *chars* of riverine and coastal environment have a distinct style of rural life. This distinction is noticeable because of the tough and uncertain life they lead and the high risks involved in residing in such hazard-prone lands where human - nature interaction is highly significant. The environment of the *char*-lands although highly uncertain due to the looming threats of flood and erosion, provides the residents with the most productive agricultural soil in the country (Baqee, 1998). The general socio-economic characteristics of the two study areas have been presented in this chapter. It includes information on household type, demographic characteristics, households' physical structures, sources of households' income and expenditure, male and characteristics of female headed households, role of women at household and community level, livelihood patterns, communication systems, education, health and sanitation facilities and their performances, women's household activities etc.

4.1 Types of households

To get a comprehensive idea and information regarding the different household groups and their characteristics, all households in the two study areas were classified according to their sex of household's head - male headed and female headed and major sources of income that supported their livelihood into farming and non-farming households. The overall situation of the different types of households in the study areas are presented in Figure 4.1.

Figure 4.1 Household classifications in the study area



Source: Household survey 2012-13.

The study revealed that 85 percent households of Kunder Char union is male headed having 35 percent farming households and 50 percent non-farming households. The households those are involved in farming activities directly or work on others farm lands are considered as farming households in this research. Rest of the 15 percent households are female headed including 7 percent involved in farming activities and 8 percent in non-farming activities. The survey found that women became household heads either by their husband's death or have been deserted after their husbands or abandoned when the husband went for a second or third marriage. Apart from these, women became the household head because their husbands or sons are living abroad. The overall livelihood pattern of Kunder Char union shows that 42 percent households are involved in farming and 58 percent households are non-farming groups. In Char Chandia 83 percent households of are male headed with 41 percent involved in farming activities and 42 percent belonged to the non-farming household group. Rest of the 17 percent households are female headed where only 2 percent are involved in farming activities and the remaining 15 percent involved in non-farming activities.

Among the farming households some are working on their own land and some take lease or share cropping lands in different styles. The other livelihood activities which are considered as non-farming activities those include small and petty business, non-farm wage labor, living abroad and do service etc. This study noted that some women headed households are involved in farming activities because they have no other options to earn or they are habituated in farming activities. It also noted that it was difficult for some women to carry on with agricultural activities without help from male in the harsh environment. In both study sites the number of women headed farm households are almost same; 42 percent in Kunder Char and 43 percent in Char Chandia. Fifty eight percent of women headed households of Kunder Char and 57 percent of Char Chandia possess no farmland and dependent on different sources of income.

4.2 Demographic characteristics

4.2.1 Age and sex

A total of 2015 population were enumerated in 364 households in the two study areas (1,032 males and 957 females). The sex ratio of the Kunder Char union is 110 males per 100 females and 106 males per 100 females in Char Chandia union; which is slightly higher than national average (Bangladesh national sex ratio is 100.3 males per 100 females, BBS, 2011). Of the 364

total surveyed households, 182 households were from Kunder Char union with 1014 people (530 male and 448 female). The remaining 182 households were from Char Chandia having 975 people (503 male and 472 female). The average household labor force is 2.5 persons in Kunder Char and 2.2 persons in Char Chandia union. Among the two study sites, the average age of household head was lower (45 years) in Char Chandia union compared to 55 years in Kunder Char union. The average year of schooling of the household head in the Char Chandia union is only 2 years and 2.2 years in Kunder Char union giving evidence of backwardness in literacy status of both study areas. The demographic profile of the two study areas is presented in Table 4.1.

Table 4.1 Demographic profile of surveyed households

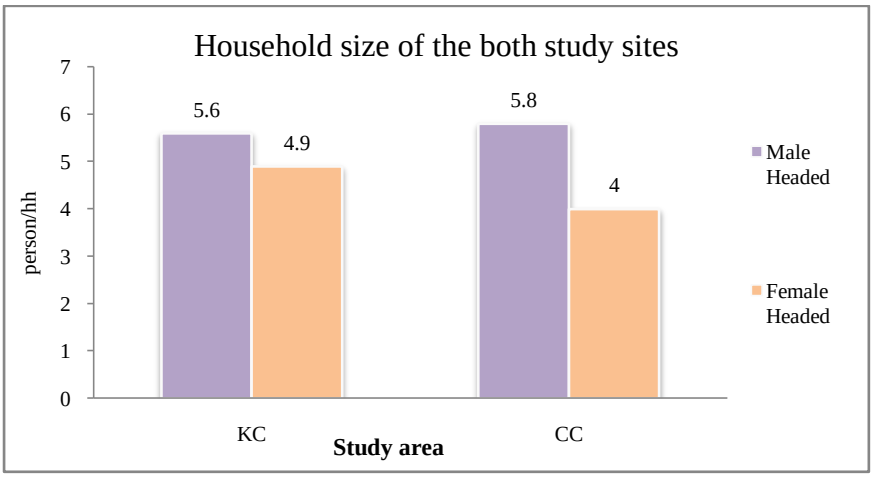
Types of HHs		No. of HHs	House hold size	Labor force (Male)	Labor force (Female)	Total Labor Force	Average age of HHs Head
Kunder Char	Male headed farming	64	6	1.6	1.1	2.7	46
	Male headed non-farming	90	5.6	1.34	1	2.9	47
	Female headed farming	13	5.6	1.4	1.1	2.5	58
	Female headed non-farming	15	4.7	0.9	1.1	1.9	52
Kunder Char union total		182	5.8	1.4	1	2.5	55
Char Chandia	Male headed farming	74	5.8	1.7	0.7	2.9	45
	Male headed non-farming	77	5.4	1.5	0.7	2.2	45
	Female headed farming	4	4.5	1	1	2	49
	Female headed non-farming	27	3.94	0.9	0.9	1.8	44
Char Chandia union total		182	5.5	0.9	0.9	1.8	45

Source: Prepared based on household survey in 2012-13.

4.2.2 Household size

Household was defined as the total number of persons living together in a family and taking their meals from same kitchen and the family functions mean as a unit for income generation, working, reproduction and social interaction. Most of the households are composed of 5-6 members in both the areas. The highest percentage (22%) was found with 6 family members in Char Chandia union whereas 21 percent households with 5 family members were found in Kunder Char union. Households with 12 persons (0.5%) are found in Kunder Char union and household of 11 persons (1%) in Char Chandia union. The Average household size in male headed households was found to be 5.6 in Kunder Char and 5.8 in Char Chandia compared to 4.9 in Kunder Char and 4 in Char Chandia of the female headed households (Table 4.1). Figure 4.2 shows the average family size of households head on sex basis.

Figure 4.2 Households average size of the study area



Source: Household survey 2012

Photo 4.1 A typical family in *char* lands

Photo 4.2 Child members in a typical *chaura* family

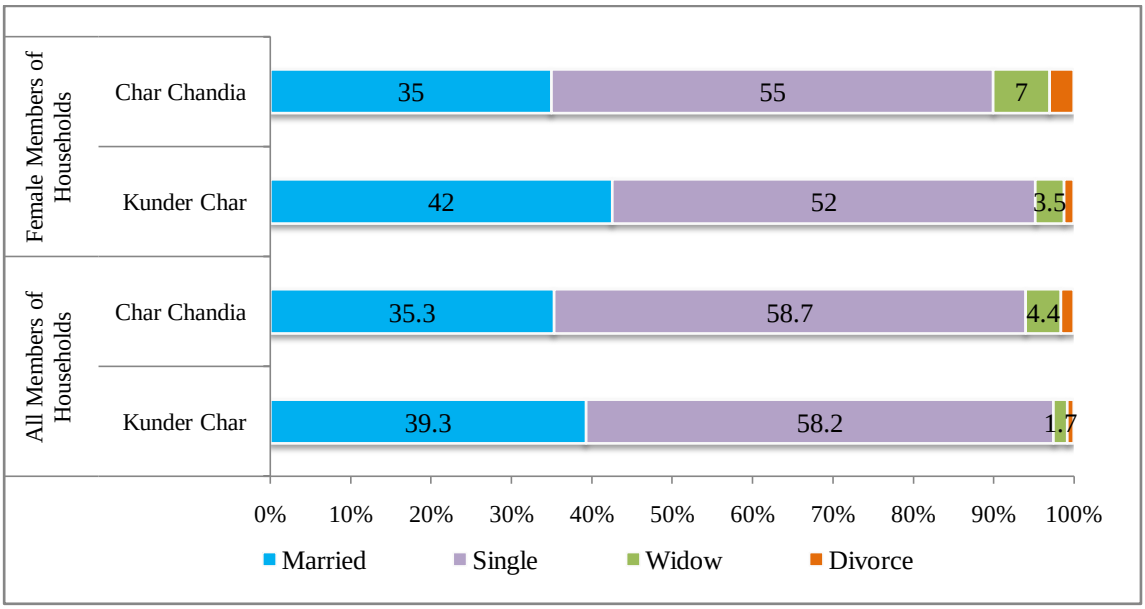
(Photographs were taken in 2012 during field survey)

4.2.3 Marital status

The marital status of the household members show that only 39 percent in Kunder Char union and 35 percent in Char Chandia union were married where as single members (including children) compiled 58.2 % in Char Chandia union and 59 % in Kunder Char union. Widows constituted 1.7% and 0.8% were divorced in Kunder Char union while 4.4% were widows and 1.6 % were divorced in Char Chandia union. The household survey revealed that 42% female members are married, 52% are single (including children), 3.5% are widow and 1.2% is divorced in Kunder Char union. On the other hand, 35% members were found married, 55% were single, 7% widow and 3% were divorced in Char Chandia (Figure 4.2).

This study revealed that early marriage is more prominent in Char Chandia than in Kunder Char due to more strict religious and cultural reasons. The study also noted that culturally *char* people are less preferred as bride or bridegroom in comparison to other areas of the region because of their weak economic condition. The prejudice is more pronounced for women as their skin becomes rough and dark because of their exposure to strong sunshine and saline water to carry out their daily activities in these *char* lands.

Figure 4.3 Marital statuses (%) of household members in the study area



Source: Household survey, 2013

4.3 Household physical structures

4.3.1 Homestead area and plinth height

The average homestead area of Char Chandia union was 15 decimals which is higher than Kunder Char (8.1 decimals) area. In the later areas, female headed households have an average homestead land of 7.8 decimals compared 7.7 decimals in Char Chandia union. It was also found that women headed households have small homestead area in both study areas which is significantly lower than that of male headed households.

The nature of physical structures indicated the social status of the people in community. The housing status and strength is also very much important for security from flood in riverine *char* and cyclone and storm surges in coastal *char*. Attempts were made to find out the condition of physical structures. It was found that most of the *char* dwellers constructed their houses in their own land. Some of the poor landless dwellers who lost their land to massive riverbank erosion and are not capable to construct their house on their own lands lived in neighbors or relative's house or took lease from others to construct a structure.

Homestead land usually stands on elevated mounds in Bangladesh except for some flood-free areas and Kunder Char is no exception from this. The houses are located on a natural levee of a mid-channel island bar of the river Padma. The plinth height generally refers to the height of the ground floor of houses vis-à-vis agricultural land but the actual degree of safety of houses from flood differs according to local conditions considering factors such as farmland level, monsoon water level, normal and catastrophic flood level etc. The study found that the elevation of homestead area varied between 1.5 to 2.0 meters from agricultural field and average plinth height for housing structures varies from 2.5 to 3.0 meters from agricultural land in riverine Kunder Char union. Every homestead looks like a small hill in the dry season and like a small island in monsoon. On the other hand, the elevation of the homestead area varied between 0.5-1.0 meters from agricultural field and average plinth height for housing structures is 1.0-1.5 in coastal Char Chandia union. This study measured the plinth height index on a scale 1 to 5 for every household where 1 indicates the most dangerous and 5 is the safest. Table 4.2 shows the number of households, homestead area, plinth height of the two study sites.

Table 4.2 Physical Structures

Study sites	Types of HHs	No. of HH (%)	Status of households physical structure			
			Homestead area in decimal			Plinth height (in scale of 5)
			Total land	Own	Leased	
Kunder Char	Male headed total	85	8.1	3.2	5	3.5
	Female headed total	15	7.8	3.2	5	2.3
Kunder Char Total		100	8.1	3.2	5	3.2
Char Chandia	Male headed total	83	16.7	16.7	0.5	2.9
	Female headed total	17	7.7	5.4	2.4	2
Char Chandia Total		100	15	14.2	0.84	2.7

Photo 4.3 Homestead area of a *char* land houses

Photo 4.4 Plinth height of a *char* land houses

(Photograph by the researcher 2012)

4.3.2 Main dwelling houses

The typical house structures and the different types of construction materials which are commonly used by the *char*-dwellers are similar to that used in rural Bangladesh. In this study three types of dwelling houses were found (Photo 4.5-4.7). Tin (CI) house indicating the house which has tin made roof and wall and wooden platform with RCC pillar or log timber pillar. Bamboo house refers to the houses consist of tin/straw made roof, bamboo made wall, earthen floor with bamboo poles. Thatch houses refer to the houses made of thatch/straw roof, bamboo or thatch made wall with earthen floor and bamboo poles Table 4.3.

Table 4.3 Types of main dwelling houses and construction materials of both study sites

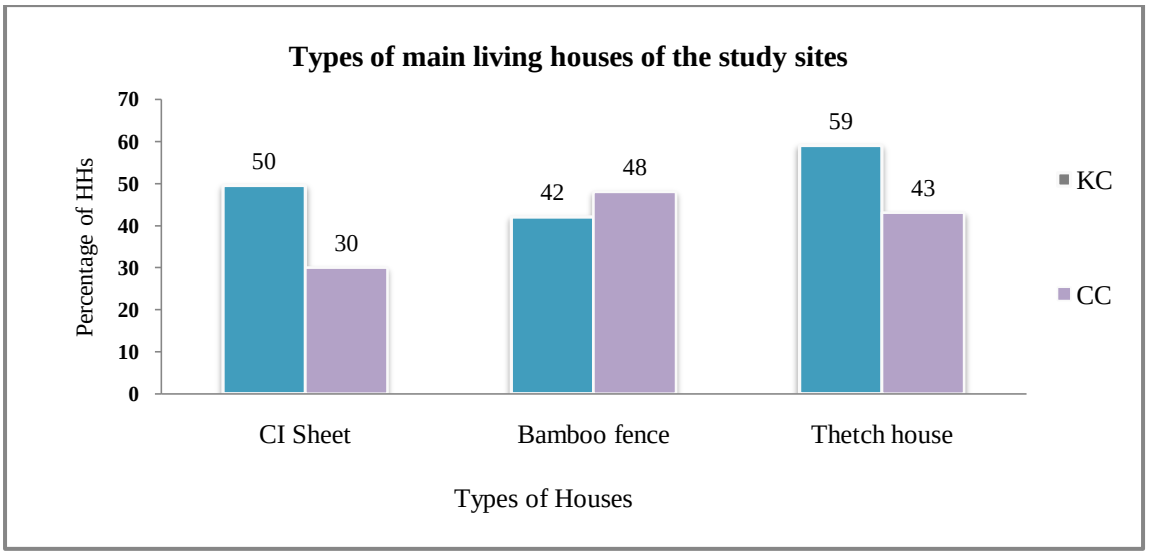
Types of House	Roof	Wall/Fence	Floor	Pole
Tin-sheet (CI) House	Tin sheet	Tin sheet	Wooden platform Earthen	RCC pillar/ Log timber
Bamboo Fence House	Tin sheet	Bamboo fence	Wooden platform Earthen	Log timber Bamboo
Thatch House	Thatch	Thatch Jute stick	Earthen	Bamboo

Source: Field survey 2013.

Note: RCC stands for reinforced cement concrete

It has been seen that 50 percent of main dwelling houses are of tin structures, 42 percent bamboo of structures, and 59 percent of thatch houses in Kunder Char union. In Char Chandia union, 30 percent of main living houses are of tin structures houses, 48 percent of bamboo structures, and 43 percent of thatch made houses. The physical structures of *char* dwellers of both study area are predominantly *kuncha*. The floors of some houses of Kunder Char were found to be wooden platform (*pataton*) which is usually flood protected as flood proofing strategy. The study revealed that almost 50 percent houses in Kunder Char were of tin made houses while only 30 percent in Char Chandia union. It indicates that the coastal *char* Chandia union is more vulnerable than Kunder Char as CI sheet houses are more protective than Bamboo and thatch houses.

Figure 4.4 Physical structures of the study sites



Source: Household survey 2013

In coastal area of Char Chandia union the house roofs are mostly sloping downward to protect the main structure from high wind during tropical cyclone hazards. However this depends on the financial condition of the owner of the houses. It should be noted that in the villages udndr study reinforced cement concrete (RCC) pillars were not used so much as poles even in the tin houses because for its weight and it is difficult to carry from main land of construction of RCC pillars are not possible because of lack of the materials locally. A large number of the houses had earthen floors in both tin and bamboo houses. The alternate drying and wetting of houses due to frequent floods of Kunder Char and saline water intrusion of tidal surge in Char Chandia creates

Table 4.4 Average status of main dwelling houses

Study Area	Types of house holds	No. of HHs (%)	Type of main dwelling houses (average no.)		
			Tin	Bamboo	Thatch
Kunder Char	Male headed total	85	0.7	0.5	0.7
	Female headed total	15	0.6	0.6	0.7
Kunder Char total (mean)		100	0.6	0.5	0.7
Char Chandia	Male headed total	83	0.5	0.4	0.4
	Female headed total	17	0.2	0.3	0.8
Char Chandia total (mean)		100	0.5	0.4	0.5

Source: Household survey 2013

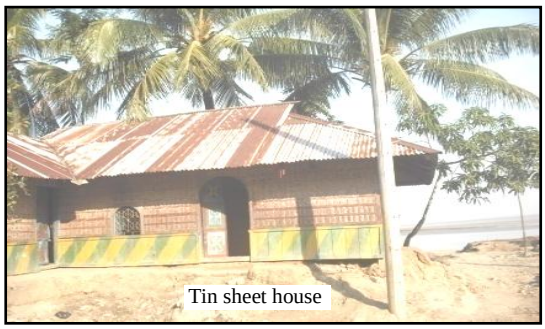


Photo 4.5 A typical earthen floor - tin sheet house

Photo 4.6 Earthen floor jutestick made wall house

cracks in earthen structures. As such women remain busy in repairing of polishing, the mud floors, plinths and the walls. The study revealed that houses with wooden platform floors were most suitable in the riverine *char* areas (Photo 4.7) although wood and bamboo are not easily

available in *char* areas. They are in constant need of repair and maintenance and the people usually cannot afford it which makes it vulnerable to all kinds of hazards throughout the year.

Photo 4.7 Wooden platform (*pataton*) tin sheet houses

Photo 4.8 A typical thatch house

(Photographs taken in 2012-13 during field survey)

Table 4.4 shows that the average number of main tin-sheet made dwelling houses of male headed and female headed households in Kunder Char union are 0.7 and 0.6 and where as it is 0.5 and 0.2 in Char Chandia union. The average index however did not differ much in Kunder Char and in Char Chandia sites. However poor female headed houses are in this category is far less than male headed households and are more vulnerable in this regard. It was observed that the wealthier households had safer houses located in safer places in both types of *char* sites.

4.3.3 Kitchen type and fuel usage

Structure of kitchen is one of the important aspects of women vulnerability. Usually the kitchens of both *char* areas were very close to the main dwelling house in the homestead area. The walls of the kitchens are made of bamboo, jute stick or straw and the floors of kitchen are *kuncha* i.e. made of mud. Some households do not have a well structured kitchen and in such cases the *char* women cook in a bamboo, jute stick or straw walled shed or in open courtyard. They usually used earthen oven made in the kitchen area also have portable earthen oven to use it during disaster period (Photo 4.9 & 4.10). Women remains highly threatened for collapse of weak structured kitchens during disaster. Their cooking activates becomes highly disrupted during hazards and disasters. As such they remain prepared with alternate cooking arrangements like portable ovens.

Photo 4.9 Women use a fixed earthen oven in the kitchen of Char Chandia

Photo 4.10 A portable earthen oven used for disaster situation in the study sites

(Photograph taken in 2013 during field visit)

Collecting cooking fuel is almost entirely a women's job. *Char* women fully depend on chopped wood, dry branches of trees, jute stick, dry cow dung, straw and crop leftovers for cooking fuel (Photo 4.12). But during monsoon it is tough to collect from nature and during a disaster situation like flood or tidal surge attack, the *char* women face extreme difficulties in getting fuel for cooking and use stored fuel like jute stalk, tree branches or cow-dung from their surroundings earlier to be necessary during emergency situation. They hung jute stick bundle on the big trees to meet the needs during floods period (Photo 4.11). Sometimes they store fuel material on the rack (*hapar*) of kitchen and livestock shed.

Photo 4.11 Fuel collection system in Kunder Char

Photo 4.12 prepared cow dung fuel in Char Chandia

(Photographs were taken in 2012-13 during field survey)

4.3.4 Livestock shed

Cattle and poultry are the very common sources of income of *char* dwellers. Most of the households in both study sites have some cattle or some poultry (Photo 4.13 & 4.14). The study revealed that the most of the livestock sheds are made of straw, bamboo, jute sticks etc. Floors of the sheds are *kancha* i.e. made of mud. Poultry sheds in riverine *chars* stand on pillars for safety from flood. The livestock sheds in *char* land areas are not strongly constructed to withstand hazardous situation for their poor economic condition. As such causality of livestock is a regular feature during hazards in the study areas.

Photo 4.13 Livestock shed in the study sites

Photo 4.14 Poultry shed

(Photograph by the researcher 2012-13)

4.3.5 Sources of water

Tube well is the main source of drinking water in the *char* lands. The Department of Public Health and Engineering (DPHE) and NGO Forum are involved in installation of tube wells for drinking purpose in rural areas of Bangladesh. Though some NGO's with the support of foreign donors are working in water and sanitation (WATSAN) sector in the rural part of Bangladesh, but such type of services are not common in these climate vulnerable *char* lands. With the help of NGOs like Water Aid and Sariatpur Development Society (Local NGO*),* some tube wells have been installed in Kunder Char union. The study found that 59 percent respondents of Kunder Char union and 63 percent of Char Chandia union are dependent on shallow tube wells. Seventy two percent households of Kunder Char and 35 percent of Char Chandia are fully dependant on common Deep Tube Wells (DTW) which are located in public place like in front of the village school or flood/cyclone shelters and village mosque or schools. Collection of water is mainly done by the women and children in the study areas. So the location of tube wells is also very important from women's perspective. As such some of the village women cannot collect drinking water from these DTW due to their conservativeness and social stigma. In such

ccases, the children and male members of the family are involved in water collection activities (Photo 4.15 & 4.16 and Table 4.5).

Photo 4.15 Common deep tube well at Kunder Char union

Photo 4.16 Sharing of shallow tube well

(Photographs were taken in 2012-13)

Table 4.5 Distribution of dwelling households by the sources of drinking water (% of HHs)

Sources of Drinking Water	Kunder Char (Dependent HHs in percentage)	Char Chandia (Dependent HHs in percentage)
Deep tube-well(Own)	2	14
Deep tube-well (Share)	40	23
Shallow tube-well (own)	17	5
Shallow tube-well (share)	41	58

Water from open sources such as rivers, ponds or ditches are the major alternatives to tube well water that is used for different household purposes. During dry season, river water is used for household purposes as some of the village ponds become dry (Table 4.6).

Table 4.6 Distribution of households by source of domestic water usage (% of HHs)

Sources of Domestic Water	Kunder Char in (%)	Char Chandia in (%)
Deep tube-well (Own)	2.2	12
Deep tube-well (Share)	1.1	17
Shallow tube-well Own	2.2	12
Pond/Ditch	19	31
River	75	20

It is revealed in the study that 94 percent women of Kunder Char used pond and river water for daily domestic uses while 31 percent respondent in Char Chandia did so (Photo 4.17 & 4.18). It

was seen that water from open sources are used for cooking, bathing, washing utensils, cleaning after defecation; livestock are also bathed and cleaned in the same water in the both study sites. Use of drinking water from pond is decreasing almost in both study sites and no households used river water for drinking purposes. Eighty percent respondents of Kunder Char and 90 percent respondents of Char Chandia stated using DTW and STW for cooking purposes. But 15 percent respondents in Kunder Char and 10 percent respondent in Char Chandia still use pond water 5 percent respondents use river water which is highly vulnerable to health and hygiene. Twenty percent respondents in Kunder Char and 10 percent in Char Chandia informed using tube well water for cooking is not good as iron content turns curry and rice blackish in color (Figure 4.5).

Figure 4.5 Usage and sources of domestic water in the study sites

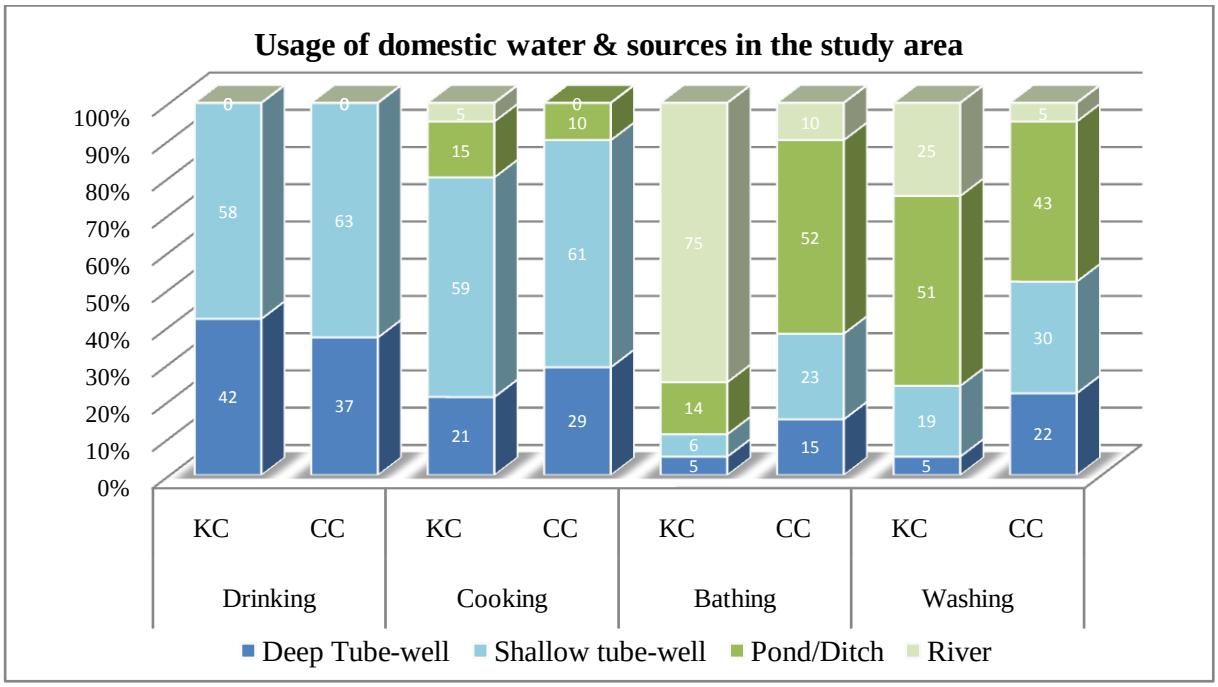


Photo: 4.17 Domestic water uses from river in the *char*

Photo: 4.18 Domestic water uses from pond in Char Chandia

(Photographs were taken in 2012-13)

4.3.6 Sanitation systems

Knowledge, awareness and financial ability are closely related to create hygienic sanitation environment. The study revealed that semi-pucca, pucca, ring-slab and open toilets are commonly used in Kunder Char and in Char Chandia union. The household survey revealed that 5 percent HHs in Kunder Char and 1 percent HHs of Char Chandia have no toilet in their households and although 18 percent households of Kunder Char and 20 percent of Char Chandia have open latrine but it is unhygienic for environment and health (Photo 4.19 & 4.20). By the support of foreign donors, some local NGOs and DPHE provided significant number of latrine slabs, 71 percent dwellers of Kunder Char and 66 percent of Char Chandia union use ring slab toilets. The sanitation system of the study sites is not good compare to other rural areas because of lack of knowledge and low socio-economic status or livelihood patterns. This is more pronounced in poor women headed households.

Figure 4.6 Distribution of dwelling households by sanitation system (HHs in %)

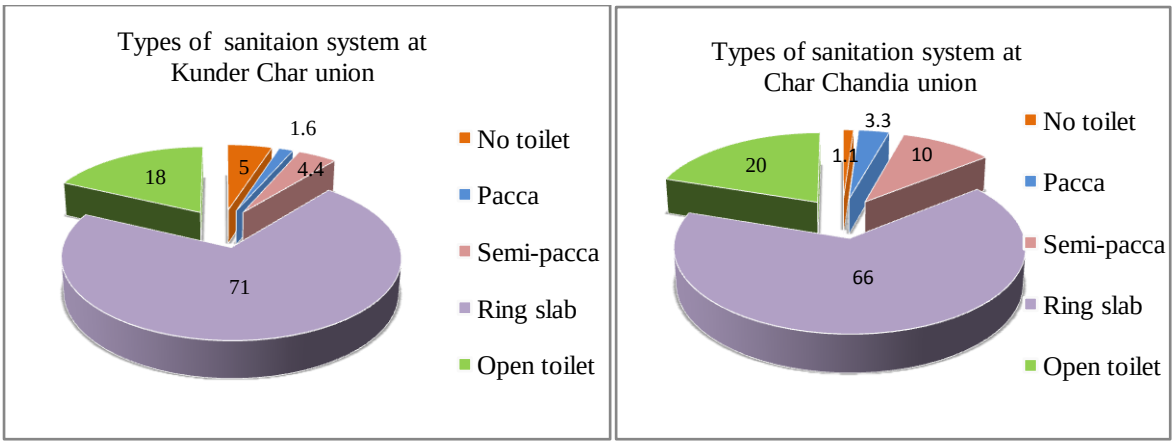


Photo 4.19 A safe sanitary toilet set by a NGO

Photo 4.20 A weak structured ring slab toilet in Char Chandia

(Photograph by the researcher 2012-13)

4.3.7 Sources of lighting

Availability and use of lighting is a useful indicator of development. The survey found that Char Chandia union has been brought under Rural Electrification Programme of the government but the most of the coastal villages including the study areas of Char Chandia have no electricity. Kunder Char union is still out of the government Programme and no electricity connection is there in any household of the study villages of this union. The survey findings show that 19 percent of dwelling households of Char Chandia union have electricity where as 81 percent households still have no electricity. The working hour of these households are fully dependent on sun-light at day time. At night oil burner lamps are usually used which was found in 88 percent households in Kunder Char and 92 percent households in Char Chandia. But it is quite costly for them to use it for long time. In riverine site of Kunder Char, some well to do households are using solar energy (12.2 percent) for their lightening (Photo 4.21 & 4.22). Recently an NGO (*Grameen Shakti*) is providing solar energy technology at the cost of 13000-50000 BDT which have to be paid by installment. But it is not affordable by the common poor *char*-dwellers.

Table: 4.7 Distribution of dwelling households by lighting system

Study sites	Types of lightening	No. of Households	% of total House holds
Kunder Char	Oil lamp	22	88
	Solar	160	12
	Total	182	100
Char Chandia	Oil lamp	147	81
	Electricity	35	19
	Total	182	100

Photo 4.21 Solar energy

Photo 4.22 Roof top solar panel of a house of Kunder Char union

(Photographs taken in 2012-13)

4.3.8 Agricultural land holding

The Agricultural land holding in the villages under study shows that the majority of farmland (62 percent) was leased in Kunder Char due to the loss of lands resulting from catastrophic river bank erosion in 2005 and 2007 (Photo 4.23 & 4.24). In Kunder Char, 35% male headed households have average farmland of 166 decimal and average ponds / ditch area of 2.3 decimal. The average own land size is 77 decimal while average leased land size is 89 decimal. The female headed households have far less average operated land size than male headed households having 70 decimals while only 1 decimal pond/ditch. In Char Chandia union the average operated land size is 16 decimal for male headed households of which average own land size is 37 decimal. Most of the lands are unusable for crop production due to salinity. The average operated land size is 31 decimal for female headed households while the pond/ditch size is 2 decimal only.

Women headed farming households in both study sites have less land size than male headed farming households. Most of the *char* dwellers in the study sites are owners or tenants who may or may not lease out their own land to others but lease in some land from others on a sharecropping basis on different terms. There were three types of land tenancy systems in the study areas - land mortgage, yearly leasing, and sharecropping. Table 4.3 shows the holding status of farmland and ponds/ditches in the study villages.

Photo 4.23 Land holding of Kunder Char union

Photo 4.24 Land holding of Char Chandia union

(Photographs taken in 2012 during field survey)

Table 4.8 Holding of farmland and ponds/ditches

Study area	Types of HHs	No. of HHs (%)	Farmland (decimal)			Pond/ditch (decimals)
			Own	Leased	Operated	
Kunder Char	Male headed Farming	35	77	89	166	2.3
	Male headed non-farming	50	0	0	0	0.3
	Female Headed Farming	7	33	38	70	1
	Female headed non-farming	8	0	0	0	0.7
	Kunder Char Total	100	33	38	70	1.1
Char Chandia	Male headed farming	41	37	2	16	3.3
	Male headed non-farming	42	11	0.3	3	3
	Female headed farming	2	31	0	31	2
	Female headed non-farming	15	4	0	4	1
	Char Chandia Total	100	32	2	34	2.9

Source: Household survey 2013.

4.4 Diversified livelihoods with seasonality

Based on assets and access to resources and opportunities householders decide what activities to be pursued for living. Livelihoods differ widely in different environmental, social and institutional settings of a community. Rural livelihoods of Bangladesh are highly dependent on natural resources which are againdependent on the environmental and climatic condition. Poor women in Bangladesh with lack of education and financial assets are forced to involve with household activities to support their families.

4.4.1 Diversified livelihood with seasonality in the flood-prone areas

The *char* land communities have diversified livelihood strategies. The riverine *char* dwellers of Kunder Char union are engaged with different types of primary and secondary livelihoods like: farm-based wage labour, non-farm wage labour, cattle and poultry rearing, fishing, homestead gardening, small and petty business, working in mainland as garments workers etc. The most of the *char* dweller including poor women are however involved mainly in agriculture,

sharecroppers or wage laborers. The seasonal livelihood calendar for riverine *char* dwellers in the flood-prone area is shown in Figure 4.7.

Figure 4.7 Seasonal livelihood calendar for riverine *char* dwellers in the flood-prone area of Kunder Char union

SEASONAL LIVELIHOOD CALENDAR FOR THE RIVERINE *CHAR* LAND COMMUNITIES IN THE STUDY AREA

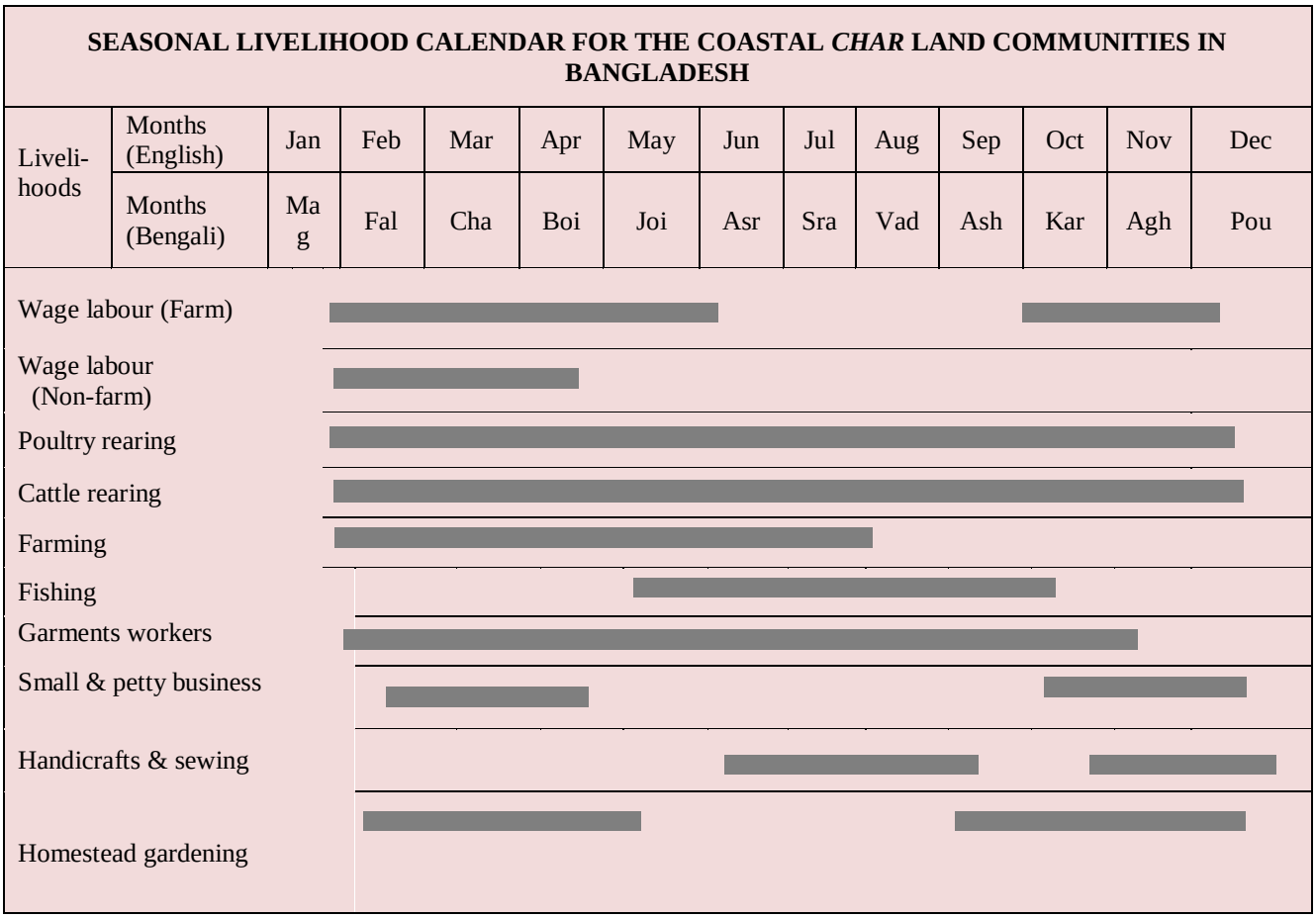
Livelihoods	Months (English)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Months (Bengali)	Mag	Fal	Cha	Boi	Joi	Asr	Sra	Vad	Ash	Kar	Agh	Pou
Wage labour (Farm)													
Wage labour (Non-farm)													
Poultry rearing													
Cattle rearing													
Fishing													
Tailoring & Handicrafts swing													
Homestead gardening													

Cattle and poultry raring are an important source of income and source of nutrition for the flood-prone communities in Bangladesh. Livestock rearing is an important alternative livelihood. The seasonal livelihood calendar (Figure 4.7) shows that cattle and poultry rearing are practiced throughout the year. Fishing, horticulture, homestead gardening, working in garments industries in urban areas, are the seasonal livelihood options for the flood-prone *char* communities especially for women at different times of a year. Apart from these many marginal male and female headed household members are involved as farm-based wage labourers in *Rabi* and *Kharif-1* crop production during November to May. Some ultra poor male and female headed household members are involved in wage labourers in the garments industries in urban areas sending small remittances and some work in local non-government development works like Work for Food (*KABIKHA*) program in the flood-prone riverine study site. In Kunder Char union river bank erosion has increased the percentage of landless people and contributed to the excess supply of agricultural wage laborers, which caused severe unemployment and resulted in further impoverishment.

4.4.2 Diversified livelihoods with seasonality in the coastal area

The livelihoods of rural coastal Bangladesh vary from each other in terms of production and marketing. Some people work independently (fish fry collector), some work as lessee or share cropper (crop and fuel wood collector) some are wage laborers while some live on skill-based natural resources as timber collector, fishermen, honey collector. Skill-based activities were also found (boat-building carpentry, fishing net making). The dwellers of coastal site Char Chandia are engaged with different types of primary and secondary livelihoods like farm-based wage labourers, non-farm wage labourers, cattle and poultry rearing, fishing, homestead gardening, tailoring, auto rickshaw drivers, handicrafts, sewing etc. The seasonal livelihood calendar for *char* communities in the coastal land of Char Chandia is shown in Figure 4.8. The figure shows that many *char* household members are also involved as farm-based wage labourers in *Rabi* and *Kharif-1* crop production during October to May in the coastal study areas. Cattle and poultry rearing and tailoring are practiced in all round the year. Apart from this fishing is a seasonal livelihood option for the coastal people in different times of the year.

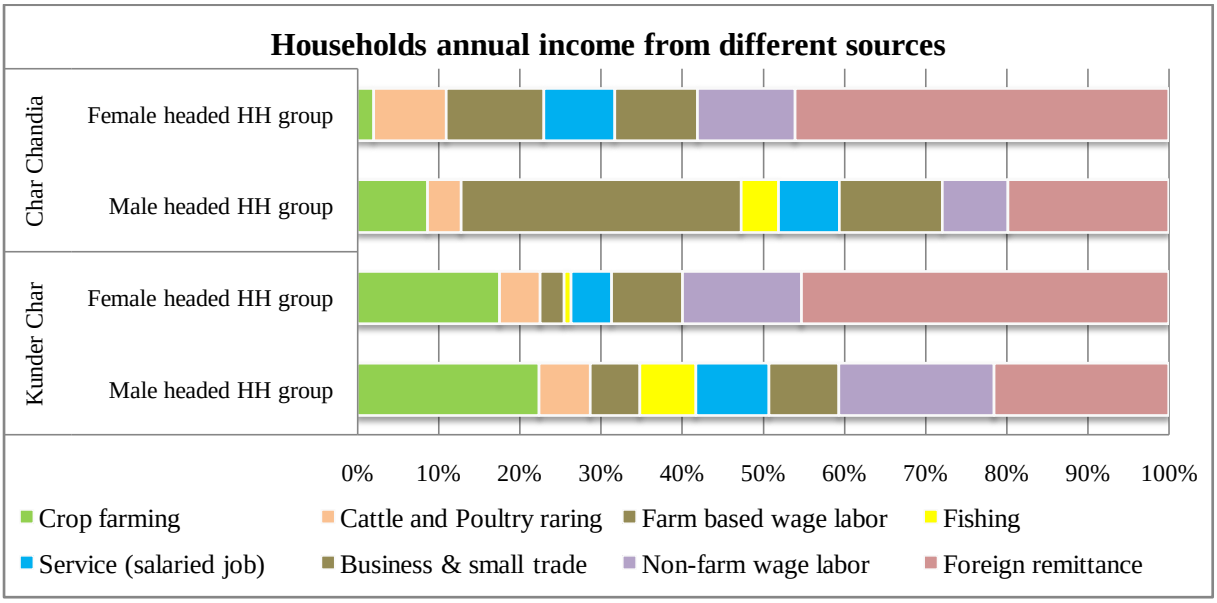
Figure 4.8 Seasonal livelihood calendars for dwellers of Char Chandia union in the coastal area



4.5 Sources of households annual income

Household annual income is an important indicator of household status. With scarcity of farmland and natural hazards associated with seasonality, the climate vulnerable communities are not able to depend on single sources of income. So, the rural householders of both the study *char* sites are involved in different livelihood activities. They are dependent on multiple sources of income according to the season and their ability. The household sources of income available in the study areas are - crop production, farm based wage labor, non-farm wage labor, business and small trading, salary from job, foreign remittance and others. Women are usually engaged in home based works like homestead gardening, poultry and livestock farming, small business, tailoring etc. The study found that average annual household income in Kunder Char and Char Chandia is 81,300 BDT and 74000 BDT respectively. The average male headed households income in Kunder Char is 81200 BDT and female headed households is 69,600 BDT while in Char Chandia union, the annual income of male headed household is 79,900 BDT and female headed is 52,200 BDT. It is apparent that the income of female households in both study sites is lower than the male headed households. Figure 4.9 presents the percentage of household annual income by different sources.

Figure 4.9 Distribution of dwelling household income from different sources



4.5.1 Income from farming

The inhabitants of the sample villages of both the study sites are primarily engaged in agricultural activities which is the main source of income (Photo 4.25 & 4.26). The riverine study site of Kunder Char is located in the fertile Ganges deltaic area. But many low lands here

remains flooded from June to October. There are three agricultural seasons in Bangladesh- *Kharif-1, Kharif-2,* and *Rabi*. The major crops which are grown in the riverine Kunder Char are jute, *aus* rice (broadcast) in the *kharif-1* season and *boro* rice, mustard, chili, coriander, and different pulses in the *Rabi* season. However in the *kharif-2* season, the water depth becomes too deep in the riverine Kunder Char area which is located in the *Padma* river basin and remains flooded at a depth of 1.5 to 2.5 meters from June to October. As such no crops can be grown, except in a limited area where deep *aman* rice is grown. Homestead gardening by female member in both study sites is very common and most of the householders have vegetable garden in their houses.

The study revealed that average income (Table 4.9) of male headed household in Kunder Char from crop farming is 18200 BDT which provides 38.5% of their total average household annual income. The annual average income from crop farming is 14300 BDT for female headed household which contributes 21 % of their total annual income in Kunder Char union. It is evident from this that the income from crop farming of female headed households of Kunder Char union was lower than male headed households.

Photo 4.25 Farming in the riverine Kunder Char

Photo 4.26 Farming in Char Chandia union

(Photographs were taken in 2012-13)

In case of coastal Char Chandia union, most of the households are also farm based. Almost three-quarters of the land are used for farming- mainly rice. But salinity intrusion by tidal surge in monsoon season causes the agricultural land more saline which damaged the agricultural production as well as homestead garden production. So only few crops are grown in this tidal surge prone area. paddy, chili, coriander, potato, onion, garlic etc are grown in the *rabi* season (Photo 4.27 & 4.28). Other crops include vegetables, pulses, oil seeds etc. Due to salinity many agricultural farms were unsuitable for cultivation which deterred people's interest to invest in labor and money for agricultural cultivation.

Table 4.9 Average household annual income and their sources

Study area	Types of HH		Total income agriculture)	Total Income (Non-agricultural sector)	House hold's total Income
Kunder Char	Male Headed	Farming	51500	36000	87600
		Non-farming	10900	69600	80500
		Sub-total	29000	52300	81200
	Female Headed	Farming	27400	53900	81300
		Non-farming	2667	51500	54200
		Sub-total	19100	58500	69600
	Total		27400	53900	81300
Char Chandia	Male Headed	Farming	14200	32700	46900
		Non-farming	5500	47500	53000
		Sub-total	14200	32700	79900
	Female Headed	Farming	9000	25500	34500
		Non-farming	6400	20600	27000
		Sub-total	6800	21300	52200
	Total		13000	30800	74000

Data source: Field survey in 2012-2013.

The household survey found that male and female headed household's annual income from crop farming is extremely 11800 BDT and 800 BDT respectively which contribute 14% and 1.5% respectively in their household's total annual income in Char Chandia union. It gives evidence that female headed household's income from crop farming in Char Chandia union was much lower than male headed household's income. The total income from agriculture sector in Char Chandia union was lower (9900 BDT) than Kunder Char union (17600 BDT).

Photo 4.27 Vegetable plant (gourd) in a house of Kunder Char union

Photo 4.28 Homestead gardening in Char Chandia union

(Photograph by the researcher 2012-13)

4.5.2 Cattle and poultry rearing

Cattle and poultry are the integral part of the rural household assets. The rural people raise cow, goat and poultry etc for multiple purposes like plowing, threshing and transportation of agriculture crop, supplying manure and dung for household fuel, supply of protein and a source of cash income (Photo 4.29 & 4.30). Livestock is especially an important asset for the *char*-dwellers who have no farmland to cultivate or capital to conduct small business. It is also an important movable assets in time of river bank erosion hazards. The *chars* have large areas of grasslands which are used for cattle rearing by the people in both the study sites.

Photo 4.29 Cows in households of Char Chandia

Photo 4.30 Cattle rearing in a household of Kunder Char

(Photographs were taken in 2012-13)

Cattle and goats are the common types of livestock in the riverine *chars* and buffaloes were rare in the riverine *char*. Being more tolerant to salinity grazing buffaloes are preferred in the coastal *char* of Char Chandia union. On an average ownership of the cow is 1 per household in both Kunder Char and in Char Chandia. Many households in both study sites lease contracts for cows in both the study sites for cash earning. The small farm households in Kunder Char union mostly practice this type of cow tenancy. Ownership of livestock varied between households and between areas; it depends on household's needs and economic condition. It is evident from Table 4.9 that male headed households were more involved in livestock rearing than female headed houses in both study sites. Cattle and poultry rearing (Photo 4.31 and Photo 4.32) contribute 6.3% and 5% to total income of male headed and female headed households respectively in Kunder Char union.

Livestock rearing contribute 6.4% and 6.7% in male and female headed households respectively in Char Chandia. As this activity involves strong labor for its bathing, fodder collection, cleaning sheds etc which sometimes makes it difficult for female headed household to be involved along with their other household chores.

Photo 4.31 Poultry rearing in Kunder Char union

Photo 4.32 Goat rearing in Char Chandia union

(Photographs were taken 2011-12)

The ownership pattern indicates that the farming households have more number of livestock compared to non-farm households in both study sites. The survey revealed that the farming households also have more homestead area and fodder availability from crops residuals. It has been also found that goats are relatively more important for female.

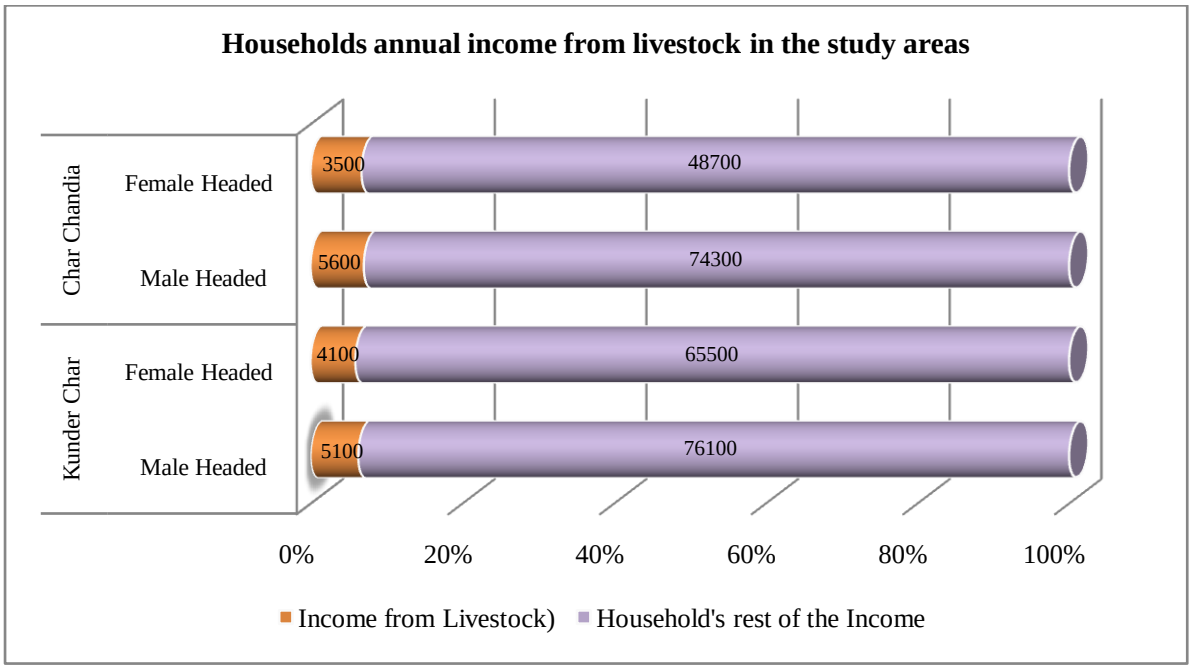
Table 4.10 Livestock holding in the study sites

Union Name	Types of HH	Types of HHs occupation	No. of Cow (Own)	No. of Cow (Leased)	Total No. of cow	No. of goat	No. of duck	No. of hen
Kunder Char	Male Headed	Farming	1	0.1	1.2	0.7	1.4	5
		Non-farming	0.6	0.2	0.8	0.5	0.6	3.7
	Female Headed	Farming	0.8	0.1	0.9	0.6	1	4.4
		Non-farming	0.4	0	0.4	0.6	1.1	5.1
	Sub-total		0.9	0.1	0.9	0.6	1	4.4
Char Chandia	Male Headed	Farming	0.9	0.2	1.1	0.7	1.7	3
		Non-farming	0.6	0.2	0.8	0.4	1.3	2.9
	Female Headed	Farming	0.5	0.5	1	1.3	2.3	2.8
		Non-farming	0.3	0.5	0.8	1	1.8	2.6
	Sub-total		0.8	0.2	1.1	0.7	1.7	2.9

Source: Household survey 2011 -2012.

The average annual income from livestock rearing is 4900 BDT (5100 BDT/year in male headed HHs and 4100 BDT in female headed HHs) in Kunder Char and 5100 BDT (5600 BDT/year in male headed HHs and 3500 BDT in female headed HHs) in Char Chandia union (Figure 4.10).

Figure 4.10 Households annual income from livestock rearing in both study sites



4.5.3 Fishing

Fishing is an important component of the livelihood of the *char* dwellers. But it is not a major occupation for both the study areas because of their geographical location and land inundation of 1 to 3 meter for 4 to 6 months during the monsoon. The low lands turnes into open water fishing source and become an additional source of income for the riverine *char* dwellers. So, the dwellers of riverine *char* areas are more dependent on open water fishing in monsoon season. But some poor *char*-dwellers of coastal areas can not engage in fishing due to lack of fishing equipments such as non-motorized small country boats, different types of nets, and fish cages. From November to March these low lands dry up and fish culture in the dry season is not possible to pursue livelihood in the riverine study sites becomes difficult. During this time fishermen depend on other livelihood activities like farm based and non-farm wage labor or others. The study revealed that only 2 percent *char* dwellers are involved in fishing at Kunder Char union and most of them are male headed households. The average annual income from fishing in male headed households in Kunder Char union was 5600 BDT and in female headed households was only 700 BDT. The low income of women headed households may be explained

by the fact that fishing is a male dominated activity (Photo 4.33 & 4.34) in Bangladesh. Women are involved in post fishing activities like drying.

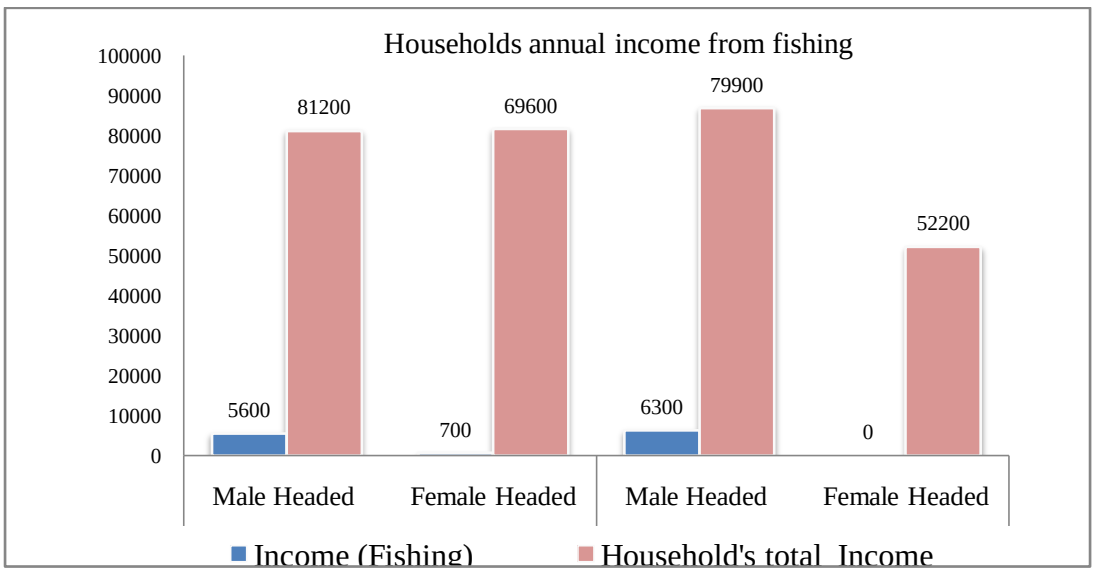
Photo 4.33 Open water fishing as a livelihood in Kunder Char

Photo 4.34 Fisher men of Char Chandia are sharing their coastal fishing experiences

(Photograph by the researcher 2011-12)

Many creeks and canals are found in the coastal site of Char Chandia which is utilized for fishing. But due to tidal surge attack, the most of the ponds and ditches become unusable for fish culture due to salinity intrusion. A large number of fishermen are involved in catching *Hilsha* fish or other sea fish from estuary area of Char Chandia. But the fishermen are often robbed by marine robbers. The survey found that only 3 percent people are directly involved in fishing in Char Chandia union. Though the *char* dwellers have ample scope for fishing, but shortage of capital and deed money, many HHs cannot do this. The average annual income of male headed households in Char Chandia union from fishing was 6300 BDT. No female headed households were practicing fishing in the harsh fishing environment that but a few of them is engaged in fish drying activities.

Figure 4.11 Households annual income from fishing in study sites



4. 5.4 Farm based wage labour

All income generating activities that contribute directly to physical capital formation of the households in this study have been identified as wage labor. The study found that the *char* dwellers that have no land, no livestock or fishing capital, they are fully dependent on wage labour. The major source of income for the significant number of *char*-dwellers in both the study sites was wage labor (Photo 4.35) which is 10 percent in both Kunder Char and Char Chandia unions. In the dry season (November to May) the landless wage laborers work as agricultural laborers in their own village as well as in the surrounding villages. They also work as day laborers in the nearby village markets, and as rickshaw/van pullers. As noted earlier the *char*-dwellers in Kunder Char and Char Chandia are seriously affected by river bank erosion in last few years and is the main reason of availability of abundance wage laborers in the two study sites. Some women of both the study sites are also involved as day labors (Photo 4.36). Women from poor households are actively engaged in wage labor in agricultural field in Kunder Char union. Women in Char Chandia do not work in the agricultural fields. A landless woman particularly from Muslim families may pick chillies or collect fuel litter form others fields but does not like to be employed as wage

Photo 4.35 Farm based wage laborer in Kunder Char

Photo 4.36 Woman as wage laborer in Char Chandia

(Photograph by the researcher 2011-12)

labor in agricultural fields because of their cultural values. The women of Hindu families in Char Chandia union work in the agricultural fields for cleaning weeds. Some poor women work as day laborerers in government programmes such as ‘Goat rearing’, ‘Thirty days programme for village development’ etc.

4.5.5 Non-farm wage labour

The people of both the *char* lands practice subsistence agriculture for their livelihood which is continuously disrupted by frequent natural hazards. The river bank erosion is a common hazard in both sites; Kunder Char inhabitants are more affected by this hazard. Some people of this *char* however regained their own accreted land few years later by new formation after riverbank erosion. Char Chandia union has not yet regained any accreted land after facing their last riverbank erosions which is progressing slowly since the year 2007. The soil of Char Chandia is less suitable for farming because of the tidal surge induced salinity which damages agricultural crop production. As a result, these farmers and the landless people have no option but to be involved as non-farming wage laborers in both *char* sites or elsewhere.

Since there is almost no farm work in the riverine Kunder Char area in the *kharif*-2 season from July to October (during monsoon season), many agricultural wage laborers and other laborers especially from small farm households migrate to urban areas to engage in multiple non-farm activities. During the monsoon season some agricultural wage laborers engage themselves as boatman, fisherman, and rickshaw/van pullers in their local area or in different surrounding places such as village markets, the nearest upland villages, urban areas even in the capital city Dhaka. A sizeable number of *char* dwellers migrated to urban areas to work as wage laborers in brick fields, market places, bus and launch terminals, construction sites and factories, rickshaw pullers, van pullers, day laborers, industrial laborers etc. In the dry season these people return home and engage as farm-based laborers in their limited own lands or in other land in their village. Among the non-farm groups land less wage labor households constituting 51% in Kunder Char and 34% in Char Chandia union were the most vulnerable group due to lack of land, capital, and job sources in the both study areas. Women are worse victims in this regard. The dwellers of Kunder Char are more involved in wage labor than Char Chandia. They work not only in their own village but also in other nearby villages, unions as well as in urban areas especially in Dhaka city.

Some women of Char Chandia work as day labor for their livelihood and few of them are involved as day labor in some government programme such as ‘Food for Work’ (village development program). Several women are involved in rural road construction work of earth digging as well. The families with adult male members have better earnings compared to those having no adult males. Various NGOs are working for capacity building of the women and creating awareness among the women and involving them in some income generating activities

in order to empower them. Different types of initiatives have been taken by the GOs such as Food for Work (*KABIKHA*), widow allowance, vulnerable group feeding (VGF) programmme etc. The NGO's have also taken up development activities to ensure other services such as asset building (goat or cattle), financial assistance to older people, and technical support to the lame and autistic women to lessen their vulnerability.

Table 4.11 shows the average annual income from different types of livelihoods options and their contribution. Table 4.11 reveled that in Kunder Char 25 percent income of male headed households and 21 percent income of female headed households are earned by non-farm based wage labor. In case of Char Chandi, 21 percent of male headed households and 9 percent women headed household income is earned by non-farm wage labour. The study also noted that the non-farming wage laborers groups are the most vulnerable group in both the *char* land sites with respect to all kinds of vulnerability.

Table 4.11 Contribution of various non-farming incomes to total annual income (in BDT) in the study sites

Study sites	Types of house holds	Total HH income	Total HH income (non-farm sources)	Income from service/salaried job	Income from business & trade	Income from non-farm wage labor	Income foreign remittance
Kunder Char	Male headed	81200	52300	7300 (9)	7000 (8.7)	20500 (25)	17500(22)
	Female headed	69600	58500	4100 (5)	7100(8.6)	14400 (21)	36900(45)
	Total (KC)	53900	53900	6800 (8.4)	7000 (8.6)	19600 (36)	20500(25)
Char Chandia	Male headed	52700	32700	10200 (12)	17200(20)	11000 (21)	27000(31)
	Female headed	52200	21300	3400 (6.5)	4000(7.7)	4700 (9)	18000(34)
	Total (CC)	75200	30800	9000 (11)	15000(18.5)	11800 (16)	25300(31)

N.B. Parenthesis shows the percentage value of total income

Source: Household survey 2012 -2013.

4.5.6 Salaried Job/Service

All types of salaried jobs were considered as 'service' by household groups. These individuals hold jobs in government and non-government organizations. Some hold jobs in different types of industries such group of people have regular income. Failing to find employment in and around the village, some males from landless households of both *char* sites were find work in the mills and factories or do informal jobs in nearer urban areas or in capital city Dhaka. In case of salaried jobs, it was found that education was an essential condition for getting such jobs. Some people are involved in the teaching within or outside the area. Only 2.5 percent household members in Kunder Char union and 2 percent household member in Char Chandia are engaged in salaried jobs/services. Only 9 percent annual income in male headed households and 5 percent income in female headed households are earned by salaried job in Kunder Char. In Char Chandia, 12 percent annual income in male headed households and 6.5 percent income in female headed households are earned from salaried job in different sectors. The overall annual average income from salaried job in Char Chandia union is found higher (9000 BDT) than in Kunder Char union (6800 BDT). The study revealed that the participation of women in service is rare which may be explained by the fact of their hosehold responsititie, education status and cultural norm (Table 4.10).

4.5.7 Small and petty business

Due to prolonged inundation during flood in monsoon and lack of job opportunities in the riverine and coastal *char* villages, many households get involved in business in Kunder Char. Two types of business groups were observed- the first group conducted business throughout the year at the local village markets or in the nearby urban vegetable and fish markets. The second group get migrated from the village during the monsoon season for as they have no income during this time and engaged in petty business such as selling plastic toys, vegetables, cookeries etc. in different places. Only 2 percent households in Kunder Char and 3.6 percent households in Char Chandia are involved in such business (Photo 4.37, 4.38 & 4.39). The average annual income from business in Kunder Char union is 7000 BDT which covers 8 percent of total annual income (Table 4.11).

Photo 4.37 Small business in Kunder Char

Photo 4.38 Small business in Char Chandia

Photo 4.39 Embroidery as a small business in Char Chandia union

(Photograph by the researcher 2011-12)

4.5.8 Remittance from abroad

Many households that mainly depend on foreign remittance send by their household members. Among both the study areas Char Chandia has the higher number of households (26 percent) in the remittance receiving against group 16 percent households belonging to such category in Kunder Char. It was found that education was an essential condition for getting work abroad. Networks placed an important role in international migration. The study revealed that in Kunder Char, female headed household's income from remittance was higher (26900 BDT) than male headed households (17500 BDT). This is because more male members from the female headed household groups working in abroad and send remittance. Women headed households of Char Chandia union receive less remittance (18000 BDT) than male headed household (27000 BDT) from this source. The survey indicated that households' earning from remittance is gradually increasing from last decade in both study sites. The households that receive on remittance from abroad enjoy high income that is much higher than that for the other types of households. Table 4.11 presents the sources of household annual income of coastal and flood prone areas from foreign remittance.

4.6 Household expenditures

Table 4.12 shows the annual average household income and expenditure in food, health, education and in other items in the two study areas. Kuder Char union has the higher annual average income (81300 BDT) compare to Char Chandia union that have household average income of 74000 BDT which is 9% less than the average household income than in Kuder Char union.

Table 4.12 Average household income and expenditure

HH Incomes and expenditures	Kunder Char	Char Chandia
Average yearly Household 's annual Income (Tk)	81300	74000
Average Daily income available per HH (Tk/Per day)	220	200
Average expenditure in food per HH (Tk/per day)	155	180
Average expenditure in other items (in percentage)	52 %	23%
Sum of the average expenditure for food and other items expressed as percentages of the total income	93 %	100 %

Food, health treatment, child education are found major sources of expenditure and house repair and maintenance, fuel, oil, clothing for family members, communication, festival costs etc are classified as 'other' expenditures (Table 4.13). The study found that major portion of 'others items' is expenditures for house repair and maintenance due to regular attack of monsoon flood and cyclone in riverine Kunder Char union and due to cyclone and storm-surge attack in coastal Char Chandia union.

4.6.1 Expenditure on food

The percentage of expenditure on food is an indicator of poverty. It has been found that the expenditure on food is higher in climate vulnerable *char* areas - 89 percent in Char Chandia compared to 75 percent of the total annual budget in Kunder Char union. So, it is difficult spend on other needs. The study revealed that average annual expenditure (Table 4.13) for food is less (56700 BDT) in Kunder Char union, than that of Char Chandia (65700 BDT). The study also found that in Kunder Char the total annual average expenditure of male and female headed households is very close (76500 BDT and 7600 BDT respectively). On the other hand it is slightly differs in Char Chandia union - 78600 BDT in male and 74200 BDT in female headed households.

Table 4.13 Households annual expenditures in the study sites

Union Name	Types of HH	House hold annual expenditure					
		Category of HHs occupation	Expenditure_ food	Expenditure_ Health	Expenditure_education	Expenditure_others	Total expenditure of HH
Kunder Char	Male Headed	Farming	61200 (72%)	5900 (7%)	2700 (3%)	14600 (18%)	84600
		Non-farming	54800 (76%)	3500 (5%)	3200 (4%)	11100 (15%)	72500
		Sub-total	57300 (75%)	4000 (5%)	3100 (4%)	12100 (16%)	76500
	Female Headed	Farming	56700 (75%)	4400 (6%)	2800 (4)	12400 (14)	75600
		Non-farming	45400 (86%)	2300 (4%)	900 (2)	8400 (16)	52900
		Sub-total	53600 (73%)	6600 (9%)	1200 (2%)	14100 (16)	73400
	Sub-total		56700 (75%)	4400 (6%)	2800 (4%)	12400 (16 %)	76000
Char Chandia (CC)	Male Headed	Farming	58900 (75%)	3100 (4%)	6500 (8%)	13300 (17 %)	78600
		Non-farming	53700 (75%)	3300 (5%)	5500 (8%)	13600 (19%)	71400
		Sub-total	58900 (75%)	3100 (4%)	6500 (8%)	13300 (17%)	78600
	Female Headed	Farming	43300 (81%)	1200 (2%)	2000 (4%)	6800 (13%)	53300
		Non-farming	36900 (70%)	1300 (3%)	6400 (12%)	7140 (15%)	52400
		Sub-total	37700 (72%)	1300 (2%)	5900 (11%)	7080 (13%)	52500
	Sub-total		65700 (89%)	2800 (4%)	6500 (9%)	16200 (22%)	74200

* BDT-Bangladeshi currency Taka

4.6.2 Expenditure on health

The average household annual expenditures for health and medicine in Kunder Char union is 4400 BDT which is 6 % of their total expenditure compared to 6500 BDT in Char Chandia which is 4 % of their total expenditure (Table 4.13). In Kunder Char union the average annual expenditure for medical treatment and medicine in male headed households are 4000 BDT compared to 6600 BDT in female headed households. In case of Char Chandia union it is 6500 BDT and 5900 BDT respectively. This gives evidence that female headed households of Char Chandia spend more for health and medicine than in Kunder Char union.

4.6.3 Expenditure on education

The average household annual expenditures for childrens' education in Kunder Char union is 2800 BDT which is 4% of their total expenditure against 6500 BDT Char Chandia which is 9 % of their total expenditure (table 4.13). The average annual expenditure for children's' education in male headed households are 3100 BDT against 1200 BDT of women headed households. In Char Chandia are 6500 BDT and 5900 BDT respectively for male and female headed households. It is therefore evident that female headed households of both study sites spend less than male headed households for children's' education due to their weak economic condition or lack of proper awareness and remain more backward in educational attainments.

4.6.4 Expenditure on other items

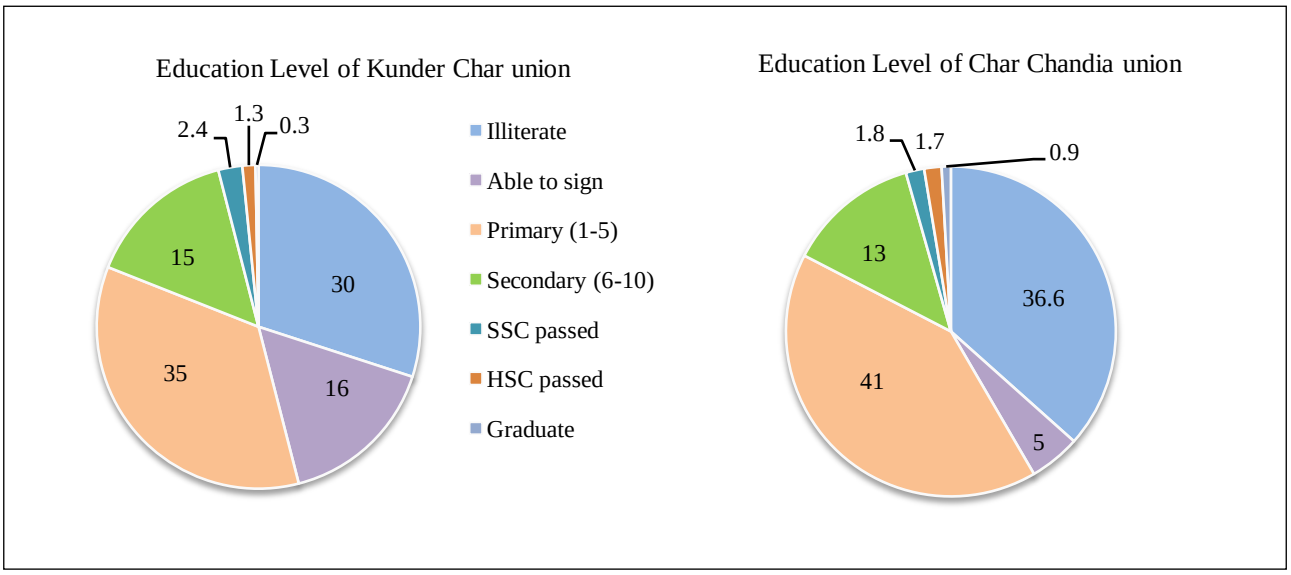
The study revealed that expenditure ***on*** **"**other" items is almost 16 percent in Kunder Char and 22 percent in Char Chandia union. It was also found that major portion of 'other items' is the repair cost for house and its maintenance due to regular monsoon flood and cyclone and storm-surge in the study villages. The remittance recovering on spends more on others items.

4.7 Status of basic services

4.7.1 Educational facilities

Education plays a vital role to make people more conscious about their status in terms of deferent socio-economic perspectives. A household with more educated members can ensure their security in different sectors of life and properties

Figure 4.12 Education status of the study population



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The literacy rate of the surveyed population is comparatively better in the *char* communities of Char Chandia union than Kunder Char union. In Kunder Char union 29.8 percent people are illiterates with 16.3 percent are able to sign, 35.3 percent have primary education, 14.6 percent have secondary education (SSC) and only 1.6 percent has higher secondary (HSC) education. On the other hand 36.7 percent people of Char Chandia Union are illiterates, with 5.2 percent are able to sign, 41.2 percent have primary education, 12.4 percent have secondary education, and only 2.6 percent had higher secondary education (figure 4.12). There were very few people who passed S. S. C or H. S. C (average 2 percent in both study sites) and 4 percent people have higher than HSC level education. A large percentage of respondents possess no education in both study areas and most of them are women. According to Table 4.14 literacy rate of women in riverine Zanjira upazilla of Shariatpur district is 46.6 percent. In coastal Sonagazi upazilla of Feni district it is 35.3 and 45.2 percent respectively. The survey findings indicate that 48 percent of total literate members are female in Kunder Char union where as it is 45 percent in Char Chandia union which is lower than national average literacy rate (63 percent) (Table 4.14). It indicates the backwardness of female educational status in both *char* sites.

Table 4.14 Literacy rate (in percentage) in the study area

Different Level		Both	Male	Female
National		51.8	54.1	49.4
District	Shariatpur	47.3	48	46.6
	Feni	59.6	61.1	58.3
Upazilla	Zanjira	35.7	36.2	35.3
	Sonagazi	47.8	50.7	45.2
Union	Kunder Char	35.7	36.2	35.3
	Char Chandia	47.8	50.7	45.2

Source: Zilla Community Series, BBS (2011)

The average year of schooling of house hold heads is slightly higher in Kunder Char than Char Chandia (2.23 and 2.01 years respectably) though the communication system of Char Chandia is better. The survey however revealed that literacy rates for the population as a whole have steadily increased in both study sites over the decades. The study found that women are less educated in both study area than men because of the social barriers, household work load, transport and communication problem etc.

The literacy status depends also on the social and economic condition of the village (Photo 4.40-4.43). In the study villages of Kunder Char union, there are five primary schools and three high schools within are of 10 sq. km. while in Char Chandia uinon, four primary schools, and two high schools within are of 10 sq. km. (Table 4.15) but this number of educational institutions is not enough for the growing population.

Table 4.15 Access to educational institution and their mode of transport in study sites

Study areas	Name of the institutes	Distance from the study village (km)	Mode of transport
Kunder Char Union	Saral Khar Kandi Govt. Primary School	0.7 km	Walking
	RDC NGO Primary School	1.0 km	Walking
	Mannan Mallik Kandi High School	3.0 km	Walking-boating-walking
	Eakub Mataberer Kandi Govt. Primary School	1.0 km	Walking-boating-walking
	Kalu Bepari Kandi High School	1.0 km	Walking-boating-walking
	Alhaz Islamie Memorial Girls' School	3.0 km	Walking-boating-walking
	Kalu Bepari Kandi Primary School	0.5 km	Walking
Char Chandia Union	Al Jamia Dakhil Madrasa	0.25 km	Walking
	Char Chandi Govt. Primary School	0.5 km	Walking
	Char Chandia Junion High School.	1 km	Walking
	Purba Char Chandia primary School	1 km	Walking

Source: Household survey, 2012-2013.

Photo 4.40 Children in a school of Kunder Char Union

Photo 4.41: Educational Institutes of Kunder Char Union

Photo 4.42 Children in a *Madrash* of Char Chandia Union

Photo 4.43 Educational Institutes of Char ChandiaUnion

The educational institutions are not much equipped with proper facilities for lacking of fund, proper management and teachers for the large number of students. Besides, the geographical location is one of the major factors which hinder attendance. Other factors such as unstable land, vulnerable location, frequent alteration of char land, and increasing educational expenses are the major causes for low literacy rate in both the *char* land areas. During monsoon or rainy season, children of both *chars* have to suffer a lot because of extreme bad road condition. That is why most of the children especially the girls do not go to school. An inquiry was made to find out the cause of school dropouts of children. It was revealed that poor economic condition was the main reason for their dropouts. Involvement in income generation activities of the children to enhance family income was the main cause of dropout. The economic condition of the most of the households was so poor that they could not afford education expenses of their children. It has been observed that there is no training school and college in both the study unions for which people of these areas are deprived of higher and technical education.

Table 4.16 Students status of the study area

Study sites	Total surveyed population	Percentage of students		Percentage students of total surveyed population
		Male	Female	
Kunder Char	1014	12%	13%	23%
Char Chandia	1003	12%	14%	27%

Source: Household survey 2011.

4.7.2 Health-care services

The status of medical services in the *char* land area can be defined by the availability and type of doctor, technological facilities and the quality of treatment. *Char*-dwellers are vulnerable to diseases and sickness for frequent natural hazards. Low-quality of living environment, poor housing conditions and communication system etc. indicate that they are more exposed to climate related health hazards (Photo 4.44-4.46). The people of both study areas frequently suffer from various seasonal diseases throughout the year. Water-borne diseases such as diarrhea, dysentery, fever, jaundice, eye infections, and skin infections are very common health problems during flood. The study findings show that both the *char* dwellers suffered from various types of disease including fever, gastric ulcer, diarrhoea, skin disease, headache and malnutrition. They also reported to suffer from some contagious diseases like chicken pox, measles etc. It was found that 39% members suffered from fever, 23% member suffered from skin disease, 14% suffered from gastric pain, 17% suffered from diarrhea, 23% suffered from headache and 13% people suffered from malnutrition during last one year prior to survey.

Table 4.17 Status of health services in study sites

Study area	**Informal Treatment**						**Formal Treatment**								
	Local Pharmacy			Local Village Doctor (Quack)			MNCH Clinic			Community Clinic			Upazila Health complex		
	No. of Service points	Avg. distances in km	Treatment quality	No. of Service points	Avg. distances in km	Treatment quality	No. of Service points	Avg. distances in km	Treatment quality	No. of Service points	Avg. distances in km	Treatment quality	No. of Service points	Avg. distances in km	Treatment quality
Kunder Char Union, Zanjira	3	5 Km.	Poor	2	7 Km.	Poor	0	0	0	1	3	Moderate	1	10	Good
Char Chandia Union, Sonagazi	2	0.5Km.	Poor	1	2 Km.	Poor	0	0	0	2	2	Poor	1	5	Good

Source: Based on field survey, 2012

Visit to health care centers is the indicator of the accessibility to health facilities and the performance of medical services of the study sites is defined by the quality of treatment. The access to healthcare services in Kunder Char and Char Chandia union is extremely poor which are explained in Table 4.17. There is no good health care center and certified doctors in both the *Char* areas. This study found that skilled doctors and staffs are unavailable in both the multiple hazards prone *char* lands. As many of the dwellers of the both *char* belong to bellow poverty

line so they are not capable to bear the health expenses. So they are dependent on local medicine shop or non certified doctors or quacks within the locality.

For better treatment, they go to Nearest Upazila Health complex either in Naria Upazila or in Zanjira Upazilla. The average distance of Health complex is 8 km and 10 km respectably from these unions. There are two nearest health centres in Char Chandia union namely *Gano Shayastha Kendro* and *Char Chandia Shastha Kendra*. But there is no certified doctor or good facilities in these centres. There are some medicinal shops (pharmacies) in some villages where doctors visit privately for one or two days a week for a few hours. These are the only health care support for the people of the coastal study areas. For serious health problems patients are taken to Sonagazi Upazilla Health Complex and get medium quality health facility. There is no proper transport to move seriously ill patients. The *char* dwellers usually use their wooden platform (make shift stature) to move the patient from their house to hospital. In terms of population control and family planning, awareness program is not much effectively in the study area. Field workers are not interested to visit some villages of Kunder Char for fough communication system.

Photo 4.44 A local community clinic of Kunder Char

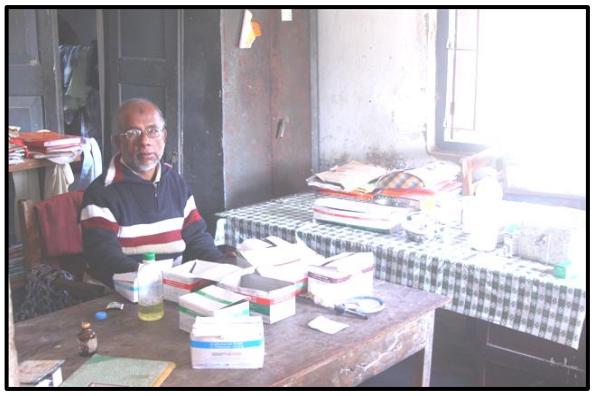


Photo 4.45 A medical staff instead of a doctor are working at a local community clinic of Char Chandia

The major causes of poor health-care service for *char*-dwellers are- their inability to afford treatment due to unemployment and poor income, non availability of physicians, and communication difficulties. Most *char*-dwellers do not store any type of emergency medicine, even oral saline to handle initial stage of diarrhea during the flood period. The first aid knowledge is found to be very poor in the study households.

Photo 4.46 A poor patient suffering from brain stroke, but no treatment except quacks support

It was found that 74% people took treatment from the quack, 23% received treatment from homeopath, 22% received treatment from qualified doctor and 19% received treatment from Unani or herbal physicians. There are no skilled and responsible medical teams for emergency treatment. In case of health needs, personal or household awareness would be more significant especially in crisis situation. During the tidal surge period in Char Chandia union, the risk is mainly from physical injury and epidemic disease. It is also difficult to contact a doctor or move to a hospital because of disastrous situation and transportation and communication problems. At time of flood it has been repeated by the respondent that many women die in their pregnancy period, and many people die due to snack biting. As a result of lack of medical care and many children die by drowning in water.

4.7.3 Transportation and communication facilities

Usually the *char* dwellers of both study area move on foot to nearby places or within the village. In Kunder Char union there are some island *char* villages like Sharalkha Kandi, which are accessible by country boat (*Khewa*). Hundreds of people from surrounding *char* villages communicate by *Khewa* every day and particularly on market days to the mainland, (Photo 4.45) which is available from sunrise to sunset. The attached *char* or unprotected bank line *char* dwellers of Kunder Char and Char Chandia usually use country boat only in monsoon season. During monsoon, the students of Kunder Char have to cross 1 or 2 km. river to go to school, market, or for other purpose. Inter-village communication within *char* villages and contact with the mainland become difficult during the monsoon period (mid-June to mid-October). They use Country boat or engine boat becomes the only means to cross the big river to go to the mainland.

Students of Kunder Char cannot maintain regularity and proper timing to school for scarcity of boat for lacking the river. During rough and hazardous weather, parents do not send their children to school as crossing river becomes dangerous. In general there is no good road and communication network in riverine Kunder Char union.

Photo 4.47 A common view of transportation in the Coastal Char Chandia

Photo 4.48 Moving on foot in a narrow bridge *(shako)* in Char Chandia union

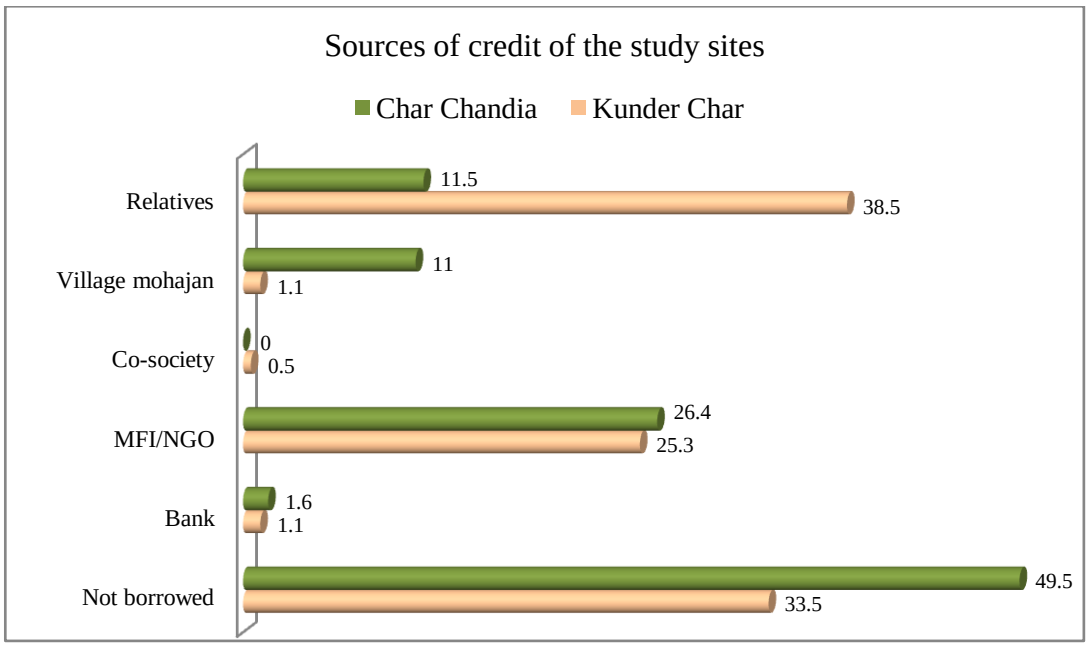
There is a narrow road inside the village in Char Chandia (Photo 4.46). Some auto-rickshaws runs on rental basis. Manual transports such as rickshaw van, bicycle, and motor bikes ply from one place to another in both the study sites. Apart this, the number of transports is low and their fitness are not good and insufficient. During storm surge in coastal study sites, people can not use transport because of inundation of the road. Lack of modern transport and poor road structure affect the tidal surge prone coastal area of Char Chandia union. Sufferings of movement especially for pregnant or weaker women and elderly escalate and journeys become very risky to boats particularly during hazardous conditions.

4.7.4 Credit facilities

Economic condition of the both Char lands is not so good. Though majority of the people of these *char* sites have the ability to take three meals a day, but their daily household income is below US$ 3 (1 US$ is about 78 BDT). The study revealed that 66% households of Kunder Char and 50% households of Char Chandia need to borrow money to meet their basic demands. The study indicates that the people of the study sites invest their borrowed money in crop production, pre or post disaster house repair and maintenance, small business (petty shop) lending, dairy and poultry farming, treatment and other purposes. Both institutional and non-institutional sources of credit were operational in the study sites. The sources of borrowing are banks, NGOs, money lenders (*mahajons),* co-operative bank and relatives (Figure 4.13). High rates of interest are changed for borrowing by NGO's and *mahajons*. Though NGOs charge high interest for loan,

still people prefer to borrow money from this source because their office are located nearby. Loans in general are taken to meet either some immediate financial crisis in the family or to provide working capital for agriculture and other self-employed businesses. Non-institutional sources were prominent but charged even a higher rate of interest than the aforementioned sources. Due to poor communication and recurrent hazards, institutional sources were insufficient in the Kunder Char and Char Chandia unions (Figure 4.13). During the monsoon season, credit is needed to purchase fishing tools and rice for family consumption. In the post-monsoon season, credit is highly demanded for the *rabi* crop seed to purchase. The better off groups have multiple sources of income like foreign remittance or businesses money lending lending (*mohajons*) business in the *char*-land and charge very high interest. Among the money lenders some live within the village and some stay in the neighboring villages or in the mainland. Micro Finance Institution's (MFI's) play a significant role and 26.4 percent households in Kunder Char and 25.3 percent in Char Chandia union are dependent on MFIs. Many women borrow from MFIs as their target is women.

Figure 4.13 Sources of credit of the study sites



Source: Household survey 2011.

4.7.5 Local Markets

There are two weekly *Hats* and three *Bazaars* (markets) in Kunder Char union are only one *Hat* and two *Bazars* in Char Chandia union. These *Hats* and *Bazaas* provide opportunities for trading of local agricultural products as well as items of daily needs. Usually women are rarely seen in shopping and trading activities as religious and cultural norms profit them. The majority of the

shop structure but few women were seen as petty shopkeepers in the bazaars. Majority of the shop structures of Kunder Char and Char Chandia union are made of bamboo or tin and are not strong enough from protecting of high wind of cyclone or tidal surge. The most of the markets of both study sites are located near the rivers which are vulnerable to river erosion, flooding in riverine *char* and storm surge or tidal surge in coastal Char Chandia. One Hat site (namely Khejur Tola hat) had already been eroded away in 2007.

Photo 4.49 A local market (*Hat*) in Kunder Char union

Photo 4.50 Woman operated shop in Char Chandia

4.7.6 Flood and cyclone shelters

Condition of flood and cyclone shelters and embankments mainly depends on management and maintenance. It has been found that that some 30 percent of the areas were protected by the coastal embankment of LGED, Bangladesh. Forty structures found to be good in performance considering their present height and capacity. Cyclone shelters are considered as one of the six cyclone mitigation measures along with embankments, afforestration, early warning systems, awareness raising and communication. The coastal *char* dwellers of Char Chandia usually take shelter in different shelters during severe attack of cyclone or tidal surge. The traditional and improved shelter options in Bangladesh coast are given in Table 4.17. River erosion is high in the study area and a cyclone shelter with capacity of 300 persons nearer Al Jamia mosque was eroded in 2009 while another flood shelter cum primary school namely Dashin Purba Char chandia with capacity 500 persons eroded in 2011. The following table also shows the uses of the shelters in normal period distance from the study villages and carrying capacity of those shelters according the size of population in the both the study sites.

Table 4.18 Profile of usable multi-purpose flood/cyclone shelters in the study area

Study area	Location of flood/ cyclone shelter	Normal time uses	Distance from the study village (km)	Capacity (population)
Kunder Char Union	Kalu Bapari Kandi	Education Centre	1	500
	Eakub Mattabbar Kandi	Education Centre	0.5	400
Char Chandia Union	Char chandia govt. primary school	Education Centre	0.5	500
	Purba Baradholi primary school	Education Centre	3	600

Source: Field survey 2012.

cyclone shelter (with capacity was 300 persons) near to Al Jamia mosque Eroded in 2009 and another flood shelter cum primary school namely Dakshin purba char chandia primary school with the capacity of 500 persons eroded in 2011. Table 4.18 also shows the uses of the shelters in normal period, distance from the study villages and carrying capacity of these shelters.

With respect to flood/cyclone shelters, 52 percent respondents stated that the location of flood/cyclone shelters in terms of accessibility is poor in Kunder Char union. While 44 percent respondents in Char Chandia union stated so. In terms of capacity, only 8 percent dwellers each of Kunder Char and Char Chandia said it is good while real of the respondents stated it to be moderate or poor to accommodate the dwellers. Some 65 percent respondents of Kunder Char and 54 percent of Char Chandia said that basic services of flood/ cyclone shelter are in poor condition. In case of safety, only 12 percent and 8 percent respondents respectively in Kunder Char and Char Chandia stated it to be good (Table 4.19).

Table 4.19 People's perceptions (household head) on local flood/cyclone shelters performance in the both study sites

	Kunder Char Union			Char Chandia Union		
	Poor	Moderate	Good	Poor	Moderate	Good
Accessibility	52 %	42 %	6 %	44 %	51 %	15 %
Capacity	45 %	34%	8%	35 %	23%	8%
Basic services	65 %	32%	5%	54 %	12%	6%
Safety	19 %	76%	12%	36%	55%	8%

The shelters are not sufficient to accommodate the huge number of dwellers of these unions. So much the *char* dwellers are forced to take shelter at educational institutes in the nearby Sonagazi upazilla when needed.

Photo 4.51 A newly constructed flood shelter in Kunder Char union

Photo 4.52 A cyclone shelter in Char Chandia union

Analysis of this chapter reveals that the socioeconomic characteristics and *char*-livelihood in the Padma riverine *char* and south-east coastal *char* lands play a significant role in helping these people to reduce their vulnerability and enhance their capacity. This study revealed that farming is practiced in Kunder Char union though significant proposition of its land have been eroded by riverbank erosion hazards. On the other hand, farming activity is less in Char Chandia due to regular attack of salinity intrusion. In case of women's involvement in farming, it was found that the women were more involved in Kunder Char union. Compared to Char Chandia union due to the cultural constrains and low production of crops in the later area. It was also revealed that the women headed households have small amount of homestead area in both *char* sites which was significantly lower than male headed households. Many educated households in Kunder Char tended to settle in the safe zone and involved in non-farm activities. It is also clear that households with some education and networking skills cope well and can even improve their economic condition by switching to non-farming occupations. There are very few schools in both study sites which face transport and communication problems during hazards. The appointed teaching staff does not stay for long duration due to bad communication systems and poor basic services in these fragile areas. For this, they always intend to move away from these *char*-lands to a better place. The children of *char*-lands are deprived of minimum education services due to inadequate number of teaching staff, other logistics, flood-free classrooms, teaching equipments etc. The Upazilla Health Workers and Veterinary field officers usually do not visit these remote places especially during the monsoon season. Lack of proper treatment

and medicine, many children, pregnant women, and valuable livestock often die during disasters. Due to the increasing pressure on the land and recurrent natural hazards, farming alone cannot provide sufficient employment for *char*-livelihood in the Padma riverine area of Bangladesh. Though both the study sites have flood and cyclone shelters, but these are not enough for large number of *char* dweller. Besides this, most of the women especially young women do not prefer to go to the flood or cyclone shelters in order to avoid staying with males (strangers) and in anticipation of sexual violence and lack of basic services. The study also revealed that the poor communication, challenging transportation system, and geographic isolation are the major reasons of these communities deprivation of many of the citizen services from the central and local governments. Unfortunately such deprivation forces them to remain as the most vulnerable communities in Bangladesh.

CHAPTER FIVE

CLIMATE CHANGEHAZARDS INDUCED VULNERABILITIESON*CHAR*LAND WOMEN

Bangladesh comprises of unique geographic, physiographic and climatic settings with dynamic hydrological and morphological landscape and ecological characteristics governed by the Ganges-Brahmmaputra-Meghna (GBM) delta.Itis also one of the most vulnerable regions the earth in context ofhydro-metrological and other climate change related hazards. Variousliteratures, it has been recognized that the geographical location of the country, location of Himalayas in the north and the Bay of Bengal/ the Indian Ocean in the south, make this deltaic country even more vulnerable to the climatic hazards. Historically Bangladesh has been subject to a variety of water related and climatic hazards namely flood, cyclone, storm surge, river bank erosion, drought, and salinity intrusion (Ahmed and Mirza 2000, Ali 1999).Millions of people are under these threats not only for their livelihood but to face natural eviction from their land.In distant futurethe coastal *char* dwellers may lose their land due to sea level rise. The international donors of Bangladesh have estimated that out of its 150 million people, more than 30 million are likely to be affected directly by global warming in the next 30 years (SMRC2007). Global warming effects may be feltby severe and erratic behavior of climatic hazards that deteriorates the normal functioning of life, affecting homesteads, agricultural land, household's income, water supply and sanitation condition and economic structures and numerous other vulnerabilities. Such challenges of climate change are not gender neutral. Women and men have different vulnerability and capacity to adapt to climate impacts due to differing roles, opportunities, and access to resources. Women are hindered by discriminatory social practices, diverse work responsibilities that may augmenttheir exposure to climate hazards, and less access or rights to financial and productive resources, information and services that may help them to cope with impacts. Poor people are even in worse situation in this regard asChambers (1989) pointed out that the poor are often the least resilient to absorb external shocks and risks and the poorest are also those who have the fewest immediate entitlements and assets making them the most vulnerable (Swift, 1989).

Many of the poorest communities in Bangladesh are obliged to live in the climatic hazards vulnerable areas such as riverine and coastal *char* lands. Valdivia and Gilles (2001) noted that water, crops, livestock, and knowledge- all play significant roles in the livelihoods of most of the world's rural households. The vulnerabilities are mainly because of the most of

the livelihood support sectors are climate sensitive or they donot have the capabilities to support the impacts of climate change. The participation and support of rural *char* women in their livelihood is very high. But the effect of natural disaster is much more severe on women than it is on men because of biological and psychological factorsand their responsibilities as well as in built societal norms. The present study areasare located in severe climate hazard prone zones and the both *char* land communities face recurrent hazards and vulnerabilitieson their livelihood. One of the objectives of this present research is to assess the vulnerabilities of climate hazards of*char* land women in terms of *char* livelihoods. The present chapter analyzes how the *char* womenface the vulnerabilitiesin terms of their social and economic status, extent, magnitude and duration of hazards etc. The study also focused onwomen's level of vulnerabilities on issues which are closely related to their livelihoods and daily activities such as their vulnerabilities tophysical structures,household chores, water-sanitation facilities, school attendance,availing health care services, community kinship, mobility etc.

5.1 Major climatic hazards in the study sites

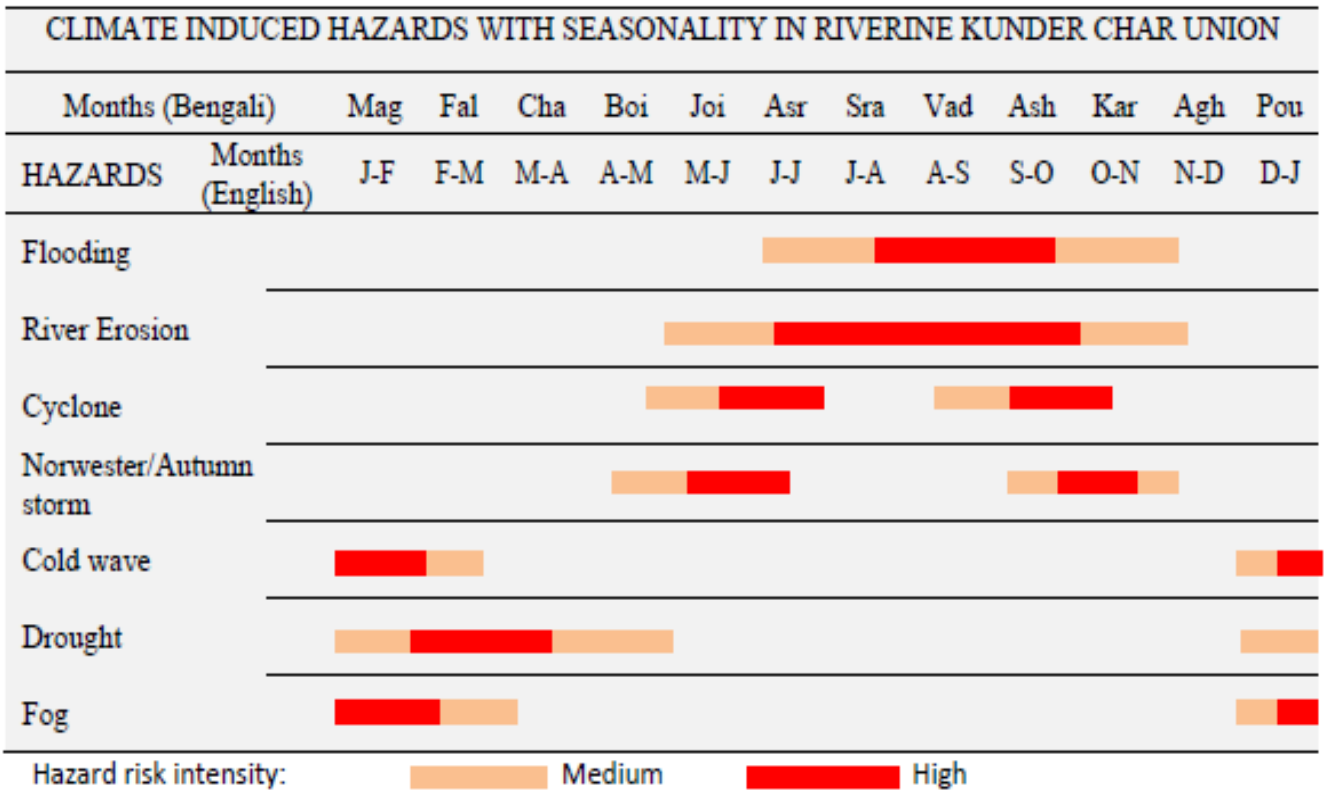
It is already mentioned that the two study sites are located in climatic hazards prone areas. Their vulnerability is due to their geographical location in a low laying land and at the edge ofthe Bay of Bengal.All the study villages are experiencing problems of temperature rise, erratic rainfall, drought, floods, cyclone and tidal surges. Other environmental problems like ground water depletion, increase of salinity, arsenic and high iron content in ground water etc, were also mentioned by the local people during the PRA sessions. For this, ecosystems have become more fragile and natural resources arepartially or totally lost or are out of reach to the poor *char* community. These people are dependent on the local natural resources for their survival and scarcity of these resources and their limited capacity to cope with extreme hazardous situation causes sufferings to these dwellers particularly women, the elderly and the children. The less privileged women are exposed to greater risk than their malecounterparts. Common disasters of Kunder Char and Char Chandiaunion were identified using participatory methods namely PVA and FGD.

5.1.1 Climatic hazards in the riverine char landarea

Floodplains occupythe majority (about 80 percent) of the total land of Bangladesh. The riverine Kunder Charbelongs to thelow-lying active Ganges flood plain.The major threats of the people living in this active Ganges Flood-plain zone are riverbank erosion, river flood, drought,cyclone, early summer/ nonwestern's and autumn storm, cold wave, fog etc. The

multiple hazards are more varied and more intensive than those faced by others ruralcommunities of the main land. The vulnerable poor *char*dwellers often suffer repeated and multiple shocks in their lives, their settlements, and their livelihoods. According to Islam et al. (2006)the bank erosion and shifting of the river Padma reached the maximum at the Kunder Char union of ZanjiraUpazila between the years 1998 to 2003 where 92 percent of the landmass was disappeared and 2,238 households were displaced through continuous process of erosion. The hazard calendar in this area is depicted in Figure 5.1.

Figure 5.1 Climatic hazards with seasonality in the riverine *char* land of Kunder Char



Source: Prepared based on PRA sessions in 2014.

The PRA sessions on hazards with seasonality revealed that severe floods occurred due to excessive rainfall in the catchments almost every year within the month of July to October. When water levels in the three major rivers rise simultaneously and cross the danger marks in monsoon, severe floods usually occur all over the villages. The impacts of flood damage (Photo 5.1) have both socio-economic and spatial dimensions. Floods cause considerable damage to standing crops, livestock, houses, transportation and communication systemsand educational and other social facilities. In addition to flood disaster, the dwellers of Kunder

Char also face recurring riverbank erosion hazards. Many households in the study area are forced to move away from their homesteads due to riverbank erosion and flood. The month of August, September and October are the high time for severe floods in the study area. When flood and erosion disaster strikes, houses, trees and homesteads are washed within a short period of time (Photo 5.2).Apart these hazards, the survey also revealed that the early summer storm, drought, cold wave and fog have severe destructive damages in this riverine *char* land hitting most the agricultural sector. Themonths of March-May are the high time for pre-monsoon period and October-November is the high time inpost monsoon period as well asfor norwester's and autumn storms. In Bangladesh, this norwester'sstorm locally known as *Kalboishakhi*bring heavy showers with strong wind and occasionally hail and tornadoes (Brammer,2012). The respondentsof the study mentioned that this hazard causes heavy loss of their production as well as their physical structures. On the other hand, December and January are the highly prone to cold wave and fog which create a lot of destructive damages to agricultural production.

Photo 5.1 Flooded homestead area in Kunder Char union

Photo 5.2 Damaged homestead vita from riverbank erosion in Kunder Char

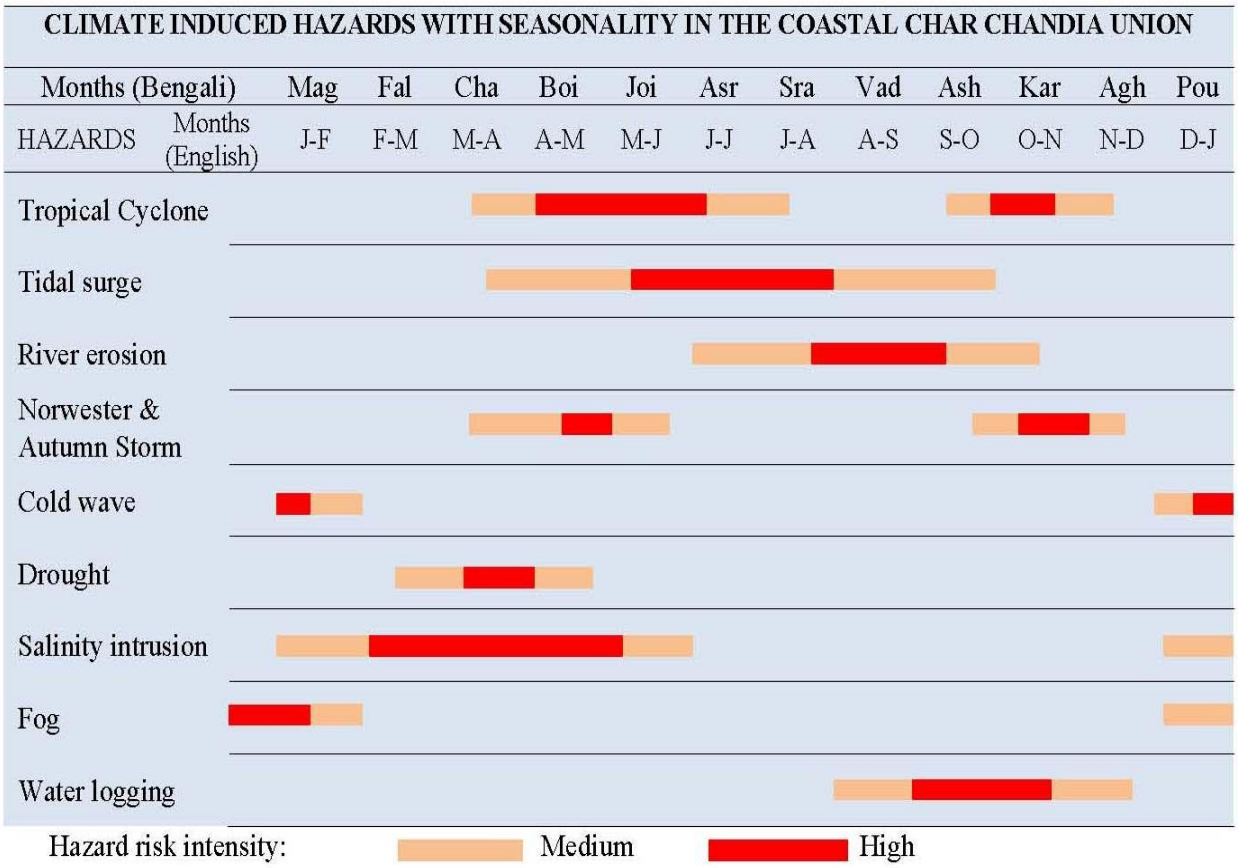
Source: Photographs were taken in 2012 during field survey

5.1.2 Climatic hazards in the coastal char land area

Major threats to the people living in the coastal *chars* are cyclones and storm surges, water logging, droughts,salinity intrusions, coastal erosion and deteriorating ecosystems. These uncertainties are exacerbated by the inevitable consequences of climate change and climatic variability. Greater probability of cyclones and storm surges, increased rainfall during the monsoon season, less precipitation in winter, higher temperatures and sea level rise as predicted by IPCC will have an adverse impact on livelihoods of people in the coastal zone

(Ahmed and Wilde, 2010). The coastal study area of Char Chadia union is extremely vulnerable to cyclonic storm surges and tidal floods, saline water intrusion, riverbank erosion, water logging etc.There are more varied and intensive than those faced by the most of the inland communities. Figure 5.2 shows the status of climate induced hazards with seasonality in the coastal study sites of Char Chandia. The PRA sessions on climatic hazards with seasonality revealed that tidal surge intensity is very high in the month of June, July and August in the Char Chandia union (Photo 5.3). In addition, the dwellers of Char Chandia are also severely affected by tornadoes and drought in April and by tidal flooding and riverbank erosion hazardsseverely in the month of August and September.

Figure 5.2 Climatic hazards with seasonality in the coastal *char* land of Char Chandia



Source: Prepared based on PRA sessions in 2014.

Photo 5.3A low land after tidal surge attack in Char Chandia

Photo 5.4 Tidal surge attack causes river bank erosion in Char Chandia

Salinity intrusion in Char Chandia is dominated by the coastal saline water inflow of the Feni and the Little Feni rive under the Lower Meghna estuary. As a result, major parts of the south west union remain severely affected by salinity intrusion.Actually it is highly seasonal. During dry season, deep landwards salinity intrusion occurs through the tidal Feni river of the lower Meghna estuary in November to May when the discharge in the Feni river reduces significantly and during January to February the channel spill. Norwesterand autumn storm often attack in the month of March-May in pre-monsoon period and October-November in post monsoon period which causes heavy showers with strong wind and occasionally hail and tornadoes.

5.2Impacts of climate change hazards on *char* land women's livelihoods

The people living in Char land areaare isolated and impoverished areas of Bangladesh. They regularly faceconsiderable climate and weather related hazards (Ahmed, 2012; Ahmed et al. 2012; Arawala et al, 2003; World Bank, 2000). These have been impacting the lives and livelihoods of the people, physical infrastructure,regular shifting ofhouses and livelihood assets. The effects of climatic hazards are not equally feltby all the people of Bangladesh. Some groups of people are more vulnerable than others. Usually the most vulnerable people earn very low and suffer mostly from the damages of climatic hazards. The continuing experience of living with climatic hazards of *char* dwellers indicates that women are the most vulnerable segments of thecommunity due to their high degrees of baseline vulnerabilities and some additional impacts of different climatic hazards.Discrimination against women also varies from one area to another with differential impacts. Thefollowing sections presentclimate change impacts on women's livelihoods found in the present research.

5.2.1 Impacts of climatic changehazards on women's livelihood of riverine char land

The study areas are located within and alongside the main rivers with large catchment areas.The Kunder Char is partially or sometimes completely submerged during the annual flood that extends from few weeks to few months making the area a very insecure place to live. Significant damages in terms of crop losses, distraction of roads and other infrastructure, disruption of business, trade and injuries and losses of human lives from inland monsoon floods and sever riverbank erosion hazard occur almost every year. It seriously affects the livelihoodsin these flood-pronecommunities andcreates unending misery to many. The persons were once rich farmers or landlords of this *char* sitehavebecome paupers as a result of bank erosion. Women headed householdsin particular have to face huge loss of valuable assets and theyhave no alternatives but to move to a new place for resettlement or for temporary shelter. The livelihood of the *char* dwellers is predominantly agriculture based.So, theyrely on floods to replenish soil fertility. Figure 5.3 shows the pattern of the climatic hazards impacts on women livelihood patterns in the climate vulnerable riverine sites. By using PRA tools, the local community mentioned the climatic impacts on their livelihoods which have been quantified in a scale (+++++ = very high, ++++ = high, +++ = moderate, ++ = low and + = very low). Very high indicates the highest negative impacts on women livelihood on the respective climatic natural events. In contrary very low indicates the lowest impacts.

Figure 5.3 Ranking of climatic hazards impacts on women's livelihood at KunderChar

Activities of women for livelihoods	CLIMATIC HAZARDS IMPACTS ON WOMEN'S LIVELIHOOD AT RIVERINE KUNDER CHAR UNION							
	Flooding	River erosion	Cyclone	Norwester & Autumn Storm	Drought	Fog	Cold wave	Impact Rank
Farming	+++++	++++	++++	++++	++++	++++	+++	1
Wage labour (Farm)	+++++	+++++	+++	+++	++++	+++	+++	2
Homestead gardening	+++++	+++	++++	++++	++++	+++	+++	2
Petty business	+++++	++++	++++	+++++	+++++	---	+++	3
Cattle raring	+++++	+++	+++	+++	++++	+	++	4
Poultry rearing	+++++	+++	+++	+++	++	++	+++	4
Wage labour (Non-farm)	+++++	++	++	++	+	++	+++	5
Handicrafts & swing	++	++	---	++	---	---	++	7
Tailoring	++	+++	---	+	---	---	+	8
Impact scale: (+++++ = Very high; ++++ = High; +++ = Moderate ; ++ = Low; + = Very Low; --- = Insignificant)								

Source: Based on PRA sessions in 2014.

In this figureWomen's livelihood particularlyfarming activities and farm-based wage labor livelihoods are severely affected by flood, cyclone, riverbank erosion, drought, fog, norwester/autumn storm, cold wave.These livelihoods are ranked asthe first and second respectively in the level of vulnerability. Among the hydro-climatic risk factors, riverine sites have direct bearingon its crops and cropping system. During the months of July to October there is no work opportunity in agriculture for women. For this reason agricultural wage laborers migrate to the urban and industrial areas. On the other hand, November to June is the busy season for agriculture when they return to their native places for work. Damage to crops can also take place due to high floods, rapid water level rise, late floods etc. Serious damage can be caused by river erosion when the land is lost to the river which has severe implication on women headed households. Since there is basically no farm work in the study area in the *Kharif*-2 season (from July to October), many laborers including women, especially the small farmers and agricultural wagelaborers, migrate to urban areas to engage in multiple non-farm activitiesalong with their household members.Most of the women are

also directly involved in cattle and poultry raring with their male members that arehigh to moderately vulnerable to hazardous situation and ranks fourth in their livelihood vulnerabilities scale. Some of the women are involved as non-farm wage labor and soildigging in the Government sponsoredFood for Work (*KABIKHA*) project which are ranked as third and fifth livelihood activities.Compare to other activities, handicraft and tailoring have beenmentioned as less impacted by climatic hazards like tropical cyclone, tidal surge and flooding and are ranked as seventh and eighth livelihood activitiesrespectively.

5.2.2 Impacts of climate hazards on women's livelihood of coastal char land

The topography Two-thirds of Bangladesh is less than 5 meters above mean sea level.It is susceptible to river and rain water flooding and in low-lying coastal areas to tidal flooding during cyclonic storms (MoEF, 2009). The coastal region of Bangladesh bordering the Bay of Bengal and its *char* lands suffers the worst for its high vulnerability to cyclonic storm surges and salinity intrusion which eventually damages infrastructures, agriculture and aquaculture. In this scenario the coastal *char* land community always remains on the frontline of any impact of climatic hazards and the coastal communities depend on multiple sources of income according to the seasonality and their ability. This section presents the impacts and duration of different hazards on women's livelihoods in multiple climatic hazard-prone coastal Char Chandia union of Bangladesh. The findings suggest that women of this*char* land are engaged in different types of primary and secondary livelihoods like farm-based wage labour, non-farm wage labour, cattle and poultry rearing, fishing, homestead gardening, tailoring, handicrafts and sewing etc. The seasonal livelihood calendar for women in the coastal study area is shown in Figure 5.4. It shows that cattle and poultry rearing and tailoring are practiced throughout the year. Fishing, crab and prawn collection, wood and honey collection are seasonal livelihood practices for the coastal women at different timesof year. Apart from these, many female household members are also involved in farm-based wage labour in *Rabi* and *Kharif-1* crop production during October to May.

Figure 5.4: Ranking of climatic hazards impacts on women's livelihood at Char Chandia

LIVELIHOODS OF CHAR LAND WOMEN	CLIMATIC HAZARDS IMPACTS ON WOMEN'S LIVELIHOOD AT COASTAL CHAR CHANDIA UNION								
	Tropical Cyclone	Tidal surge	River erosion	Norwester & Autumn Storm	Cold wave	Salinity intrusion	Drought	Water logging	Rank of Impact
Wage labour (Farm)	+++++	++++	+++++	+++	+++	+++++	++++	++++	1
Farming	+++++	+++++	++++	++++	+++	+++++	++++	+++	2
Cattle rearing	+++++	++++	+++	+++	++	++++	++++	++++	3
Poultry rearing	+++++	++++	+++	+++	+++	+++	++	++++	4
Homestead gardening	++++	++++	+++	+++	+	++++	+++	+++	5
Wage labor (Non-farm)	+++	++++	++	++	+++	+++	+	+++	6
Handicrafts & swing	+++++	++++	++	++	++	---	---	+++	7
Open fishing	+++	++++	+++	+++	---	++	---	+++	8
Tailoring	++++	++++	+++	+	+	---	---	+++	9
Fuel wood collection	++++	+++++	++	++	+	---	+	+	10

Source: Prepared based on PRA sessions in 2014.

Figure 5.4 depicts the climatic hazards impact on different livelihood groups of women in the climate vulnerable coastal Char Chandia. The study noted that among the livelihood activities, farm-based wage labour and farming livelihoods are severely affected by all kinds of coastal hazards and ranked in the first and the second respectively in the context of level of vulnerability. Some women are engaged in cattle and poultry rearing with their family members and face high level of vulnerability totropical cyclone, tidal surge, drought, water logging hazards and moderate vulnerability to cold wave. Salinity intrusion heavily impacts fodder collectionand pasture making trouble to cattle, increased salinity hampers irrigation, agriculture and domestic work.Severe water and sanitation problems are also faced by women. Tidal surge, salinity, tropical cyclone and water logging hazards pose high level of vulnerability to homestead gardening activities ofwomen. Compared to other livelihood practices, fuel wood collection and tailoring are lessimpacted by climatic hazards. Cold wave creates a lot of sufferings to the poor *char* labor and farmers. Fog also causes a huge damage to the agricultural product and related livelihoods in the winter season (December to February).

5.3 Climate hazards induced vulnerabilities of women of*Char* land

The *char* women of the study areas are engaged in a number of activities depending on their financial conditionalong with their household responsibilities. Usually women in both the study sites devote most oftheir time for household activities like cooking, food processing (preparing food for cooking, grinding spices etc), gathering fuel, collecting water, washing clothes and dishes, cleaning/sweeping rooms, looking after children and other family members. They are alsoengagedindifferent kinds of farming activities especially the post harvest activities, homestead gardening, livestock and poultry rearing. Women also take care of their household properties and support their male members in homestead repair and maintenance like thatching,polishing the mud floor of their houses, plastering etc. as part of their domestic work. Some women of both the study sites are also found to be engagedin wage labor and petty business. Women have to encountervarious climatic hazardsduring their regular activities and cause great sufferings to their life bringing a lot of misery.

5.3.1 Vulnerability of women at household level

5.3.1.1. Household physical structures

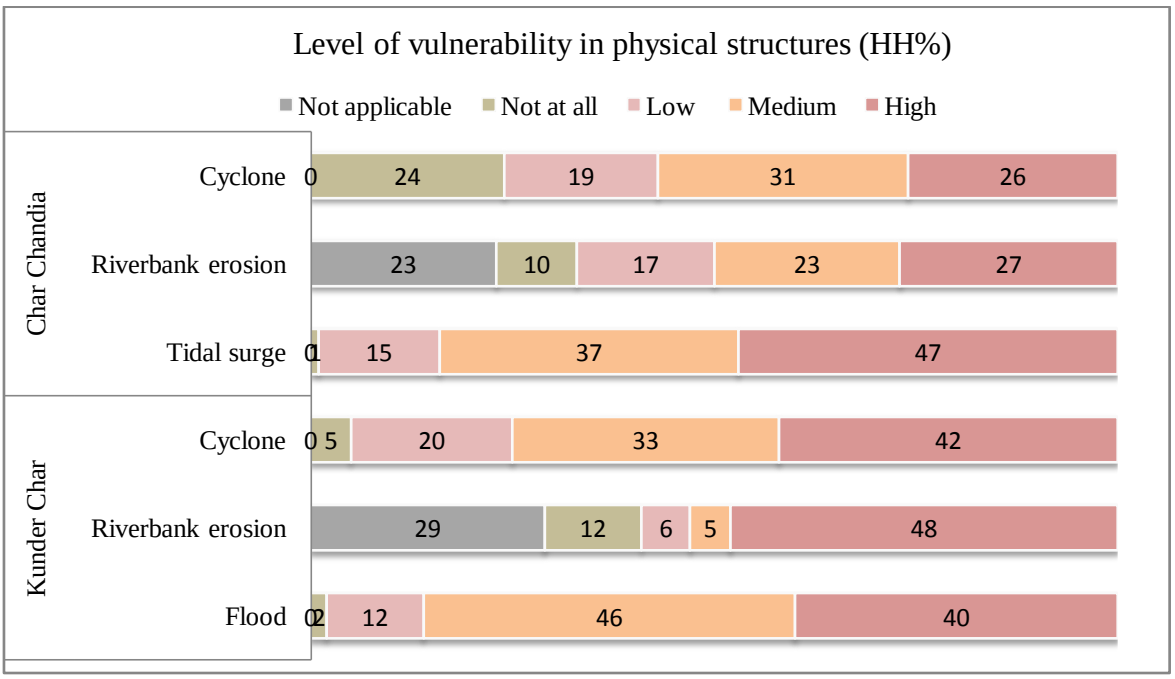
The housetype, quality and standard arevery important from the security point of climatic hazards like flood, cyclone, storm surges,etc in*char* land areas. The security of life and household properties depends on the strength of physical structuresof houses during hazards. This study found that climatic disastersare a severe threat to the dwelling houses of the both study sites. Most of the people in such sites live in traditional but fragile houses made of mud, bamboo, thatch and wood. Very few people live in corrugated iron (CI) sheet built housesof these sites. Weak structured houses are an important aspect of vulnerability in*char* land settlements. Buildings with durable materials (pucca) are more resistant to cyclone, tidal surge and flooding but no one in these areas is able to afford to live in a brick build/ pucca houses. Despite the high risk to cycloneand storm surges,the houses in the study areas can be classified as temporary type with predominantly*jupri*and *Kutcha*.*Jupris* are mostly constructed with thatch, jute stick and bamboo. Joints and anchorages are the most vulnerable to withstand high and sudden cyclonic storm and tidal surges (Mowla, 1998). The homesteads stand on raised mounds in Kunder Char and Char Chandia like other flood or tidal surge prone areas in Bangladesh. All the homesteads get fully submerged during catastrophic floods in Kunder Char when waves batter the foundation of their houses. Some parts of Kunder Char and Char Chandia unions are to face riverbank erosion and cyclone almost in every year. As a result,womenare in constant threat to losstheir homestead towash

away.Inmanyeventserosion of top soil of their homestead areaoccurred as soil becomes loose and is easy to be washed away by high current from tidal surgewhich make the homestead even more vulnerable.Women of these areas are thus burdened by reconstruction work regularly.

Photo5. 5 A flooded physical structure in Kunder Char

Photo 5.6 A house collapsed by cyclone Mohasen attack (05 May, 2013) in Char Chandia union

Figure 5.5 Level of vulnerability in physical structuresof the study sites



Thehousehold survey findings indicate thatthe level of vulnerability of the physical structures is highfrom riverbank erosion. Forty eight, percentmentioned that their physical structures are highly vulnerable to riverbank erosion, highly vulnerable from flood (40%) and cyclone (42%) hazards. Forty seven percent of the respondents of Char Chandiareported that tidal hazards caused inundation of and they are highly vulnerable from tidal surge (Figure 5.5). Apart from this, the structures are highly vulnerable from cyclone was mentioned by 27%and erosion hazards by 26%.There is also high risk of development of cracks and high possibility ofother damages by strong winds with the cyclones. Houses are built with low height to avoid the violent cyclone that frequently sweeps through the *Char* lands. Trees act as protection against storms and cyclonic wind.It generalobservation that the poor *char* dwellers does not have good quality houses. A large discrepancy was observed among the male and female headed households in terms of physical structures in each union. The structure of houses belonging to women headed households were much more vulnerable than male headed households for weak construction.

5.3.1.2 Meal preparation and cooking

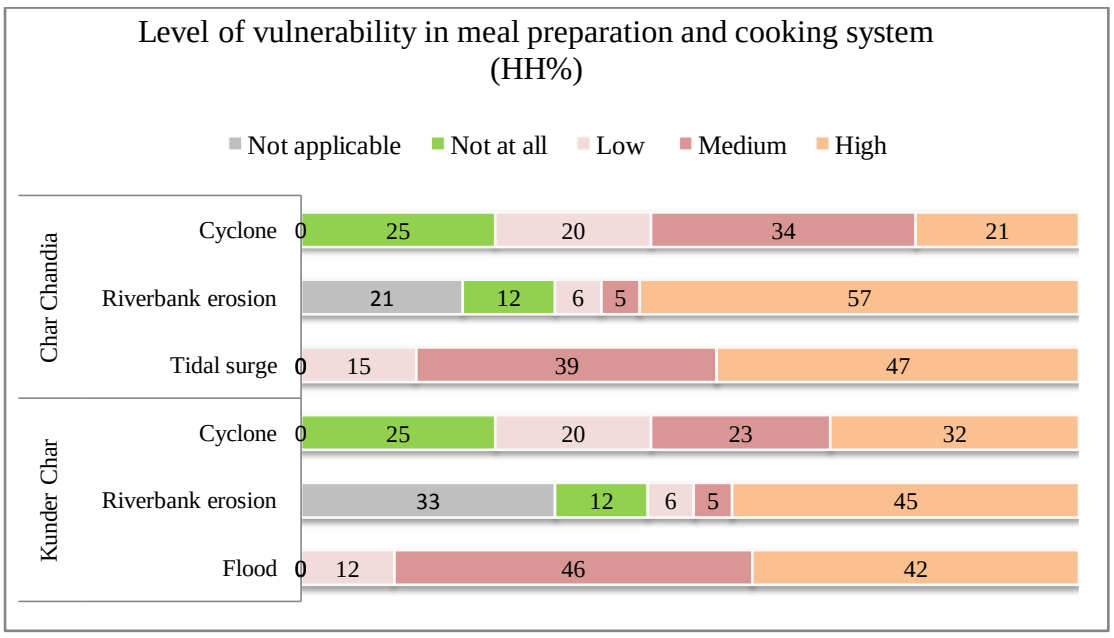
The *char* women are engaged in a number of household activities and fall in vulnerable situation during climatic hazards like cyclone, floods and storm surge.They regularly confront crisis in their cooking activitiesduringmeal preparation and related task. Such hazards always pose a serious threat to the food security of *char*-dwellers. The most of the households suffer from adequate food supplyduring floodor tidal surge attack.In case of flood prone Kunder Char area homesteadsare surrounded by flood water for 2-4 months a year. On the other hand tidal surge water in Char Chandia remains in homestead area for 6 to 7 hours or more in a day after any sudden attack. Cooking place or kitchen getsubmerged or damaged during this period (Photo 5.9) and theyneed to cook defying the risk involved. Usually cooking ovens and kitchen houses become unusableduring flood (Photo 5.8) or tidal surge in both study sites.As suchmobile earthen oven or tin sheet made movable burners are the only means to cook minimum food for the family members. Figure 5.6 depict the vulnerability level of *char* women in meal preparation during climatic hazards.

Photo 5.7 Women are preparing meal in a house of Kunder Char

Figure 5.8 A*Char* women is cooking in a vulnerable situation during flood hazard in Kunder Char union

Figure 5.9 A vulnerable structure of kitchen at Char Chandia union

Figure 5.6 Level of vulnerability of women in meal preparation and cooking system



percent and 42 percent respondentsin Kunder Char mentioned riverbank erosion and flood hazards respectively to cause high level of vulnerability in meal preparation activities as well as cooking.On the otherhand, 57 percent in Char Chandia respondentsstated that meal prepartion and cooking fall in highly vulnerable situation from riverbank erosion. Forty percent mentionedthat meal preparation and cooking are highly vulnerable fromtidal surge attack.

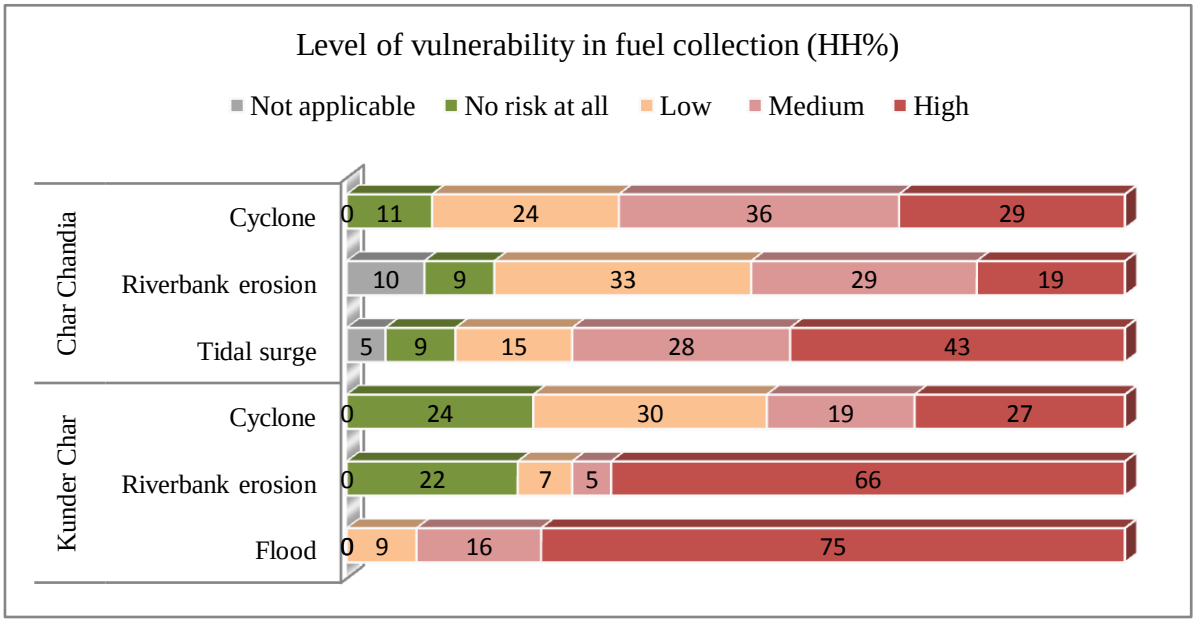
5.3.1.3Fuel collection

*Char*women fully depend on chopped wood, dry branches of trees, jute stick, dry cow dung, straw etc as fuel for cooking their food. It is tough to collect them from natural sources during disasters. So,many*char* women store fuel woods in kitchen ceilings, corridors or *verand*ato use them during crisis situation. Usually,the most of the *char*-dwellers do not have enough space or extra room to preserve fuel for 4-5 months during monsoon or flood time. Womenoften suffer from fuel crisis in disaster situationsfor inundatedfrom flood or tidal water and very difficult to dry these fuels quickly. So, women use kerosene stoves for this purpose which is quite expensive for thesepoor *char* households.The riverine *char* dwellers mentioned fuel collection (Photo 5.10) as high level of vulnerability (Figure 5.7) during different types of climatic hazards; 75 percent of the respondentsmentionedflood (Photo 5.11), 66 percent statedriverbank erosion and 27 percent other hazards like storms and excessive rainfallas climatic hazards. On the other hand, 43 percent of women respondentsof coastal *char* mentioned cooking fuel like highly vulnerable to tidal surge, while29 percent and 19 percent mentioned cyclone attack and riverbank erosion hazards as high level of vulnerability respectively.

Photo 5.10 Fuel storage in a *Chaura*household

Photo 5.11 Collection of fuel in Kunder Char

Figure 5.7 Level of vulnerability of women in cooking system



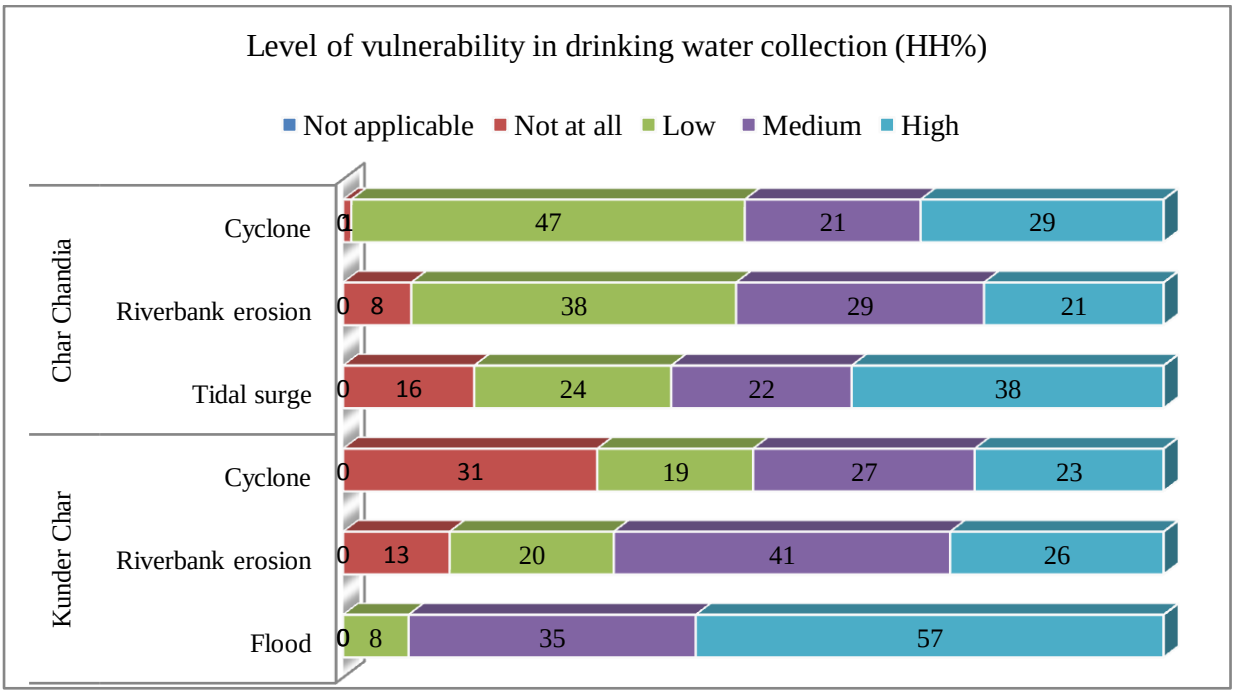
5.3.1.4Drinking water collection

Collection of drinking water is one of the major crises for the *char* dwellers. It increases the vulnerability of their health.Hand tube-well is the only source of drinking water in bothKunder Char and Char Chandia, as the homestead area of *char* lands goes under waterduring flood in riverine *char* or tidal floodsin coastal *char* sites women fall in diffculty to arrange drinking water as tube-wells and other safe water sources getsubmerged in flood water. According to the field survey (Figure 5.8), 57 percent women respondents ofKunder Char rankeddrinking water collectionas highly vulnerable to flood hazard whereas26 percent and 23 percentdweller find riverbank erosion and cyclone hazards respectively as high level of vulnerability. As a mitigating measure,the households raise their tube well heights and suffer from additional cost to purchase extra pipe and necessary tools. The most of the dwellers suffer from financial and technical capacity to raise tube-wells. In such situation they have to travel long distances to collect drinking water from others houses who have high tube well. Women also use flood water for most of the household chores but collect tube well water for drinking purpose. It has been observed in many places of the study area the top part of the tube wells is tied up with thin plastic paper during floods to keep it safe from pollution and drinkable after floods.

Photo 5.12A tube-well is surrounded by flood water in Kunder Char union

Photo 5.13 Salinity intrusion in shallow tube well after tidal surge attack

Figure 5.8 Vulnerability of women in drinking water collection



Thirty eight percent and 29 percent respondents of coastal *char*of tidal surge and cyclone prone areas respectively, - find it highly vulnerable as they face scarcity of safe drinking water during this time. Asstorm surge affects frequently and the women in Char Chandia union sometimes women collect and store water from nearby tube well before disasters or if they get warning. But in most cases they donot get enough to store water. The sudden storms blow away their utensils including water Jar or bottles etc that are used for water storage. In such cases many householdsremain in drinking water crisisand are forced to drink impure water. The *char* people become sick from water born diseases during flood and storm surge attack. This put extra caring loadonthe women for their sick family members. Most of the ponds on which the local communities especially the women dependfor domestic

water requirementsand homestead vegetable farming are also flooded and polluted and becomes unusable due to salinityintrusion in the coastal zone.As such women have to work hard after disaster for recovering their homestead gardens.

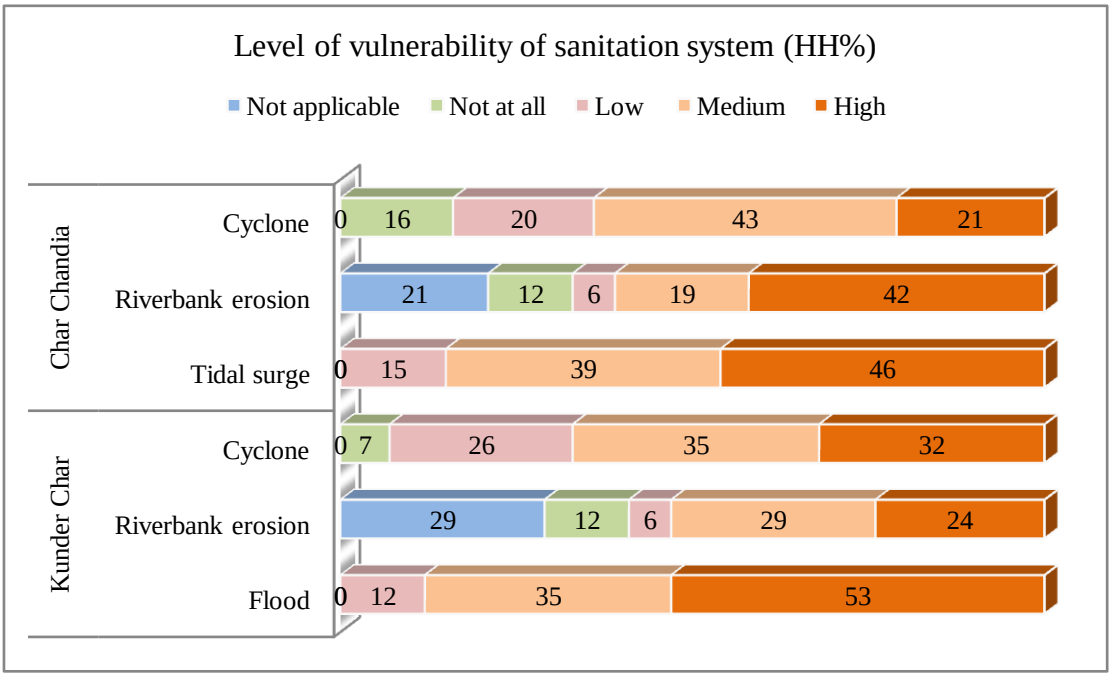
5.3.1.5Sanitary system

The sanitary system collapses during climatic hazardsandserves as one of the prime contributing factors to health and environmental degradation (Kazi and Rahman, 1999). In the study areas, the toilet of householdsareusually detached from the main house and located in a corner or lower ground then the ground level of homestead. As a result, the latrines are flooded during flood waters or tidal surges.The*char* land dwellers use any available open space for defecation under such circumstances. Malescanuse any open place like embankments, road side, tree branch or on boatfor defecation during submergence of toilets. But it extremely difficult for women to use open space during daytimeand is especiallydifficult for the pregnant or elderly women for their physical, cultural and religious constrain and values. Sometimes women areforced to defecate in the flooded toiletstaking many risks.Latrine waste usually get mixed with waterin the locality. In such sanitation, The health and sanitary conditions of the locality becomescritical causingvarious water borne diseasesamong char dwellersand get sick during and after floods. Financial constraints are one of the major impediments for construction and maintenance of proper sanitation in these sites. Two main causes are identified by the survey forsufferingsof women during disaster period. They have to take care of other members of the family ignoring their own health needsand to hold fefecation for a long period in such situations. As a result, women develop different kinds of health complications. This is more acute in case of pregnant and elderly women and those who gave birth during disaster times and menstruating women.Use of contaminated and salinewater is also responsible for various female diseases. Fifty three percent respondents of the study mentioned that sanitary system is highly vulnerable to flood and 24 percent stated it is highly vulnerable river bank erosion in their*char* area. On the other hand 46 percent, 42 percent and21 percent respondent respectively replied that they fall in highly vulnerable situation in terms of sanitation system during tidal surge, riverbank erosion and cyclone attack (Figure 5.9).

Photo 5.14Vulnerable situation of sanitary system in Kunder Char

Photo 5.15Vulnerable structure of sanitation system in a Char Chandia

Figure 5.9 Vulnerability in sanitation system



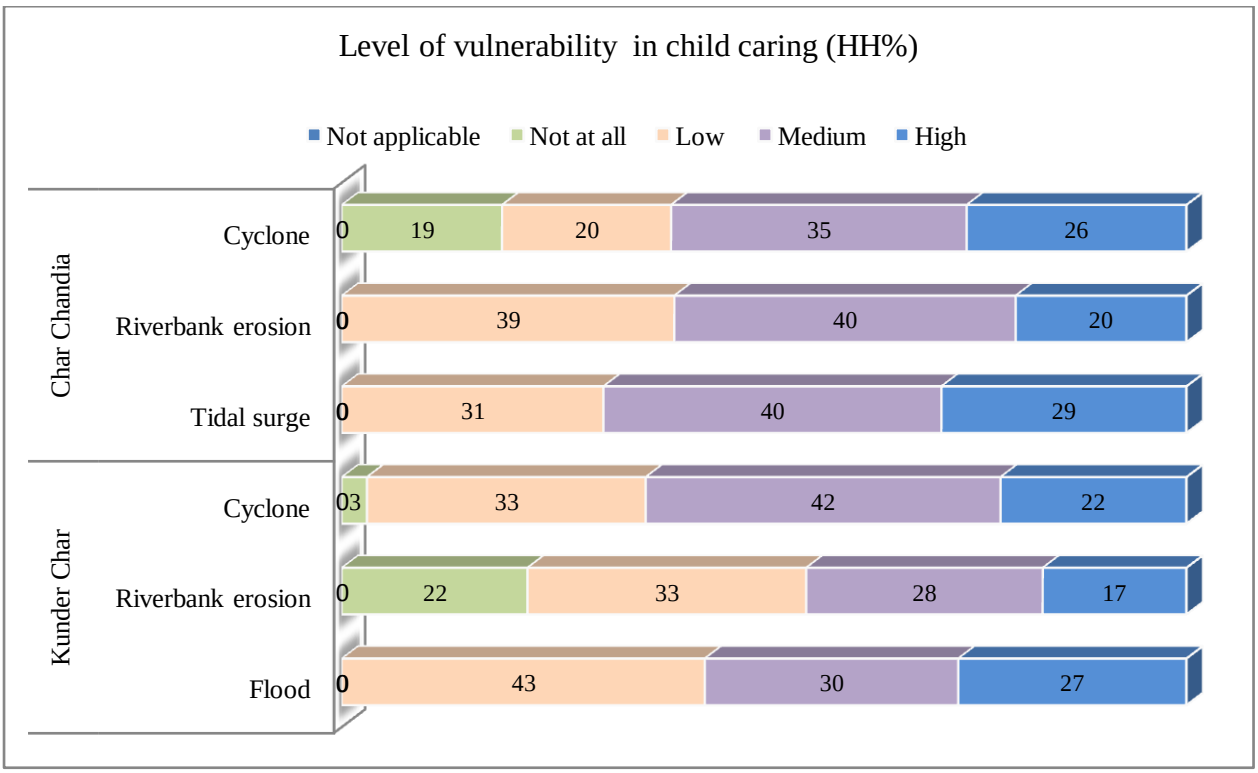
5.3.1.6Washing and cleaning

Washing and cleaning are regular household activities for every woman in rural areas. And it is not exceptionincase of *char* land women. During hazardous situation like flood, cyclone, tidal surge women are facedwithdifficultyforhousehold washingand cleaning. They are to wash their clothes, utensils and dishes in flood water due to non availability of tube well water.Under such situation women face danger like snake biteand fall injuries in Kunder Char. The high salinity intrusion in coastal Char Chandia also hinder women's household activities and women have to use saline water for washing and cleaning. They develop various skin diseases like allergy, scabies, and irritation etc using saline water. They also mentioned that their clothes become unusable and tear veryquickly due to high percentage of salinity.

5.3.1.7Child caring

Child caringfor every woman becomes challenging during disasters in both the *char*sites. The respondent women reported that they remain busy for their survivalin the hazardous situation and cannot fully concentrate on child caring. As a result children suffer more fromhealth complicationslike fever, coughand cold, diarrhoea, dysentery, skin diseaseetc. Many children die from snake bite, drowning or are injured from falling trees etc. In some cases the males become unemployed after natural hazards andmigrate to urban areasfor a job for cash earning.In such situation women are left alone at home and have to bear

Figure 5.10 Level of vulnerability in child caring for *char* land women in study sites



all household activities and caring for the children as well as the family solely. The survey findings shows (Figure 5.10) that in Kunder Char 27 percent and 17 percent women mentioned high level of difficulty due to flood and riverbank erosion hazard respectively in carrying out child care activity (Photo 5.16 & 5.17). In case of Char Chandia 29 percent and 26 percent respondent mentioned so during tidal surge and cyclone attack hazards respectively.

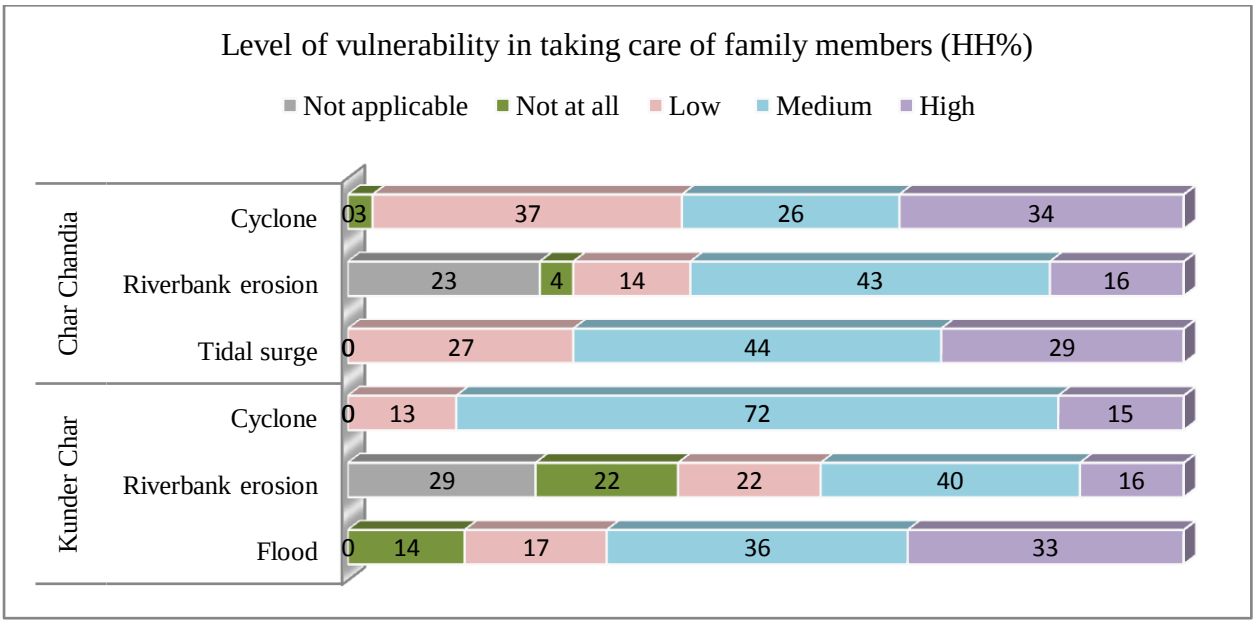
Photo 5.16 Children are playing in an eroded riverbank at Char Chandia union risking their lives

Photo 5.17 Child caring challenge of a *char* land women in a very vulnerable condition

5.3.1.8Caring of family members

The women have to work hard to protect their family and belongings from the disasters and afterwards especially when men migrate for cash earning.During this period,household activity of women load increases particularly caring activities. The poor *char* women have less access to get evacuation warnings and are bound to stay in their house at high risk. Though sometime they go to shelter or any other neighbors or relative's house to save themselves, but they have to face a lots of difficulties, sufferings and challenges in this regard. The survey revealed that the family health care activities are more or less vulnerable in regular climatic hazards. In Kunder Char 33 percent respondents stated that taking care of family members bywomen becomesvery difficult due to riverbank erosion while16 and 15percent respondentsmentioned it as highly complicated due to flood and cyclone hazards. Some 34 percent respondent replied that cyclones have severe impact on them compared to tidal flood and riverbank erosion (Figure 5.11). Such difficulty is faced as women take equal responsibility with men and spend more time in various household safety activities along with regular activities.

Figure 5.11 Level of vulnerability in taking care of family members



5.3.1.8 Homestead gardeningvulnerability

Usually the *char* dwellers do not buy vegetables or fruits to provide nutritionto the family members as the supply come from their home garden. The *char*-women plant various types of vegetables in a corner/back yard of their homestead (*vita)*bordered by bamboo fence. In Kunder Char, some women plant vegetable by rising earth higher than the homestead vita level so that they can prevent vegetable plant from inundation in monsoon flooding. But when the entire homestead village is submerged by flood or tidal water these home gardens are damaged and causes food crises for the family.

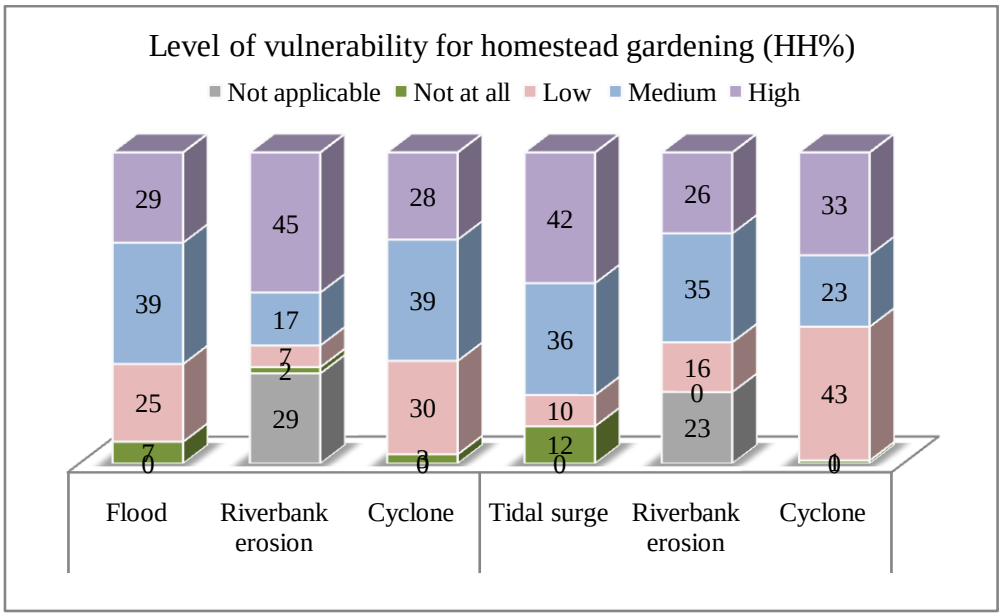
Photo 5.18 Flood affected homestead gardening in Kunder Char union

Photo 5.19 Coconut plant are dying due to salinity intrusion in Char Chandia union

In case of Char Chandia salinity intrusion by storm surge causes a great damage in homestead gardening as plants suffer from increased salinity. During hazard time the *char*-women fall in

difficultsituation to provide sufficient nutritionto their family members. The family members suffer from malnutrition that makes the women worried and put them in psychological pressure. The survey revealed that 39 percentof respondentsfeel that homestead gardening are

Figure 5.12 Level of vulnerability in homestead gardening in the study areas



moderately vulnerable to flood hazard in Kunder Char area where as 45 percent and 28 percent of respondents also mentioned that homestead gardening are highly vulnerable to riverbank erosion and cyclone hazard respectively (Figure 5.12). Forty two percent and 33 percent of respondentsof Char Chandia, stated about high level of vulnerability to tidal flood and cyclone attack for maintaining home gardens. The food insecurity from condition of the households fall in critical situation as a result of natural disasters particularly in poor women headed households.

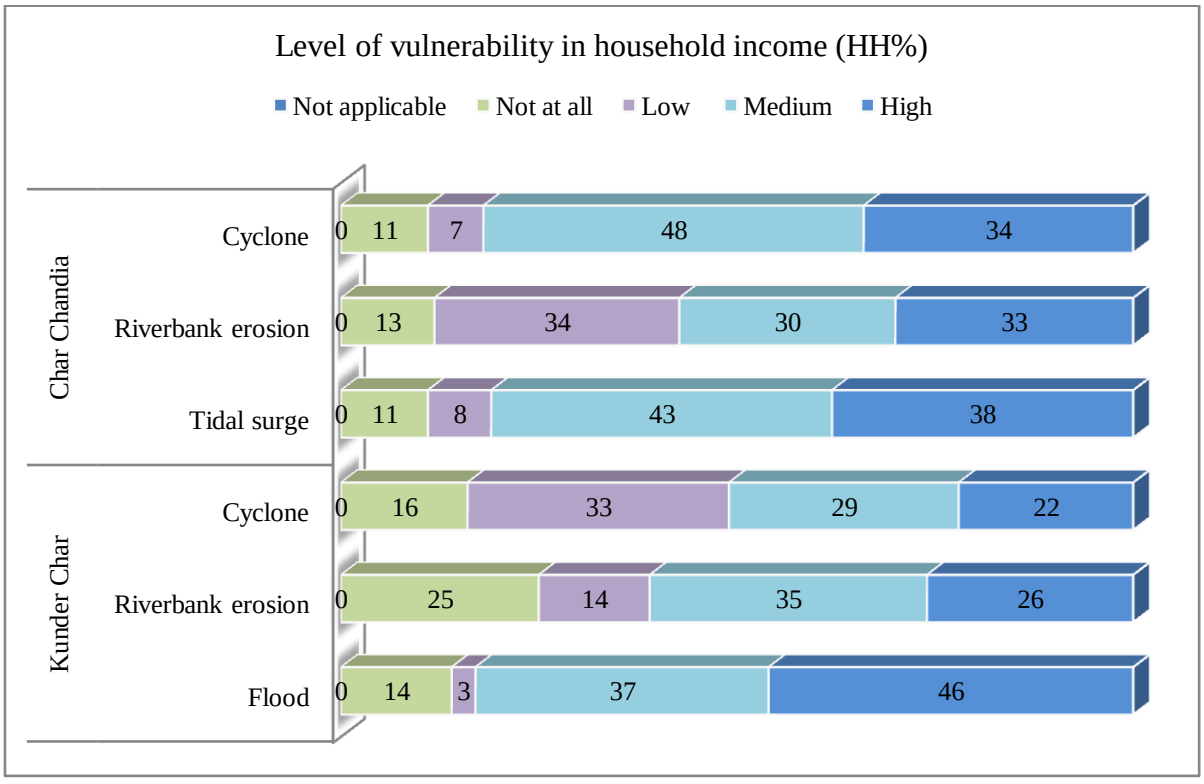
5.3.1.9 Household income vulnerability

As climate change will have significant influence on water-related hazards and disasters, so peoples' livelihoods will also be severely affected (RVCC 2003, Ahmed and Schaere, 2004,Asaduzzaman et al., 2005).Due to the difference in geographic location, the magnitude of hazards and availability of resources, the vulnerability of households differs from area to area. Employment in the *char* land is completely a seasonal attribute. C*har* dweller are highly vulnerable to unemployment as they do not have regular work because of its vulnerable environment and location and women are the worse sufferes. Most of the males of Kunder

Char and Char Chandia lead their livelihood as day labor, agricultural labor, livestock rearing, fishing etc. In spite of being a regular event every year, life and livelihood of the dwellers of Kunder Char is severely disrupted due to flood.Along with the damages and losses of their homestead, loss of income and occupation is a regular feature. Some farm based households lose their crops and their source of income. Not only their subsistence agriculture is affected, the food securities of the poor households are also at risk. One of the significant findings that came out of the survey is that, for continuing livelihoods and safe guard their income, people in the coastal land of Char Chandia are also involved inmultiple livelihood activities as alternate source of income.

The study revealed that many of the households have changed their livelihood from farming and farm-based wage labor to non-farm wage labor, rickshaw-van puller, fishing and boatman.

Figure 5.13 Level of vulnerability in household income



During the flood peaks, household income of many farm-based and wage labor households were drastically reduced and they endure hardship. One of the major vulnerability factors in coastal Char Chandia is their income which creates extreme level of income crisis in the study sites. The survey found that in monsoon season, most of the *char* dweller become

unemployed and are forced to spend idle time. As such they try to cover up and wage rate become high- almost by three timesfor rest of the period. The study revealed that 46 percent 26 percent the respondent feel that their household income is highly to moderately vulnerable due to frequent attack of flood and riverbank erosion. On the other hand, 33 and 38 percent respondent of coastal Char Chandistated that they are highly to moderately vulnerable to income loss during frequent and regular happening oftidal flood, cyclone and riverbank hazard (Figure 5.13).

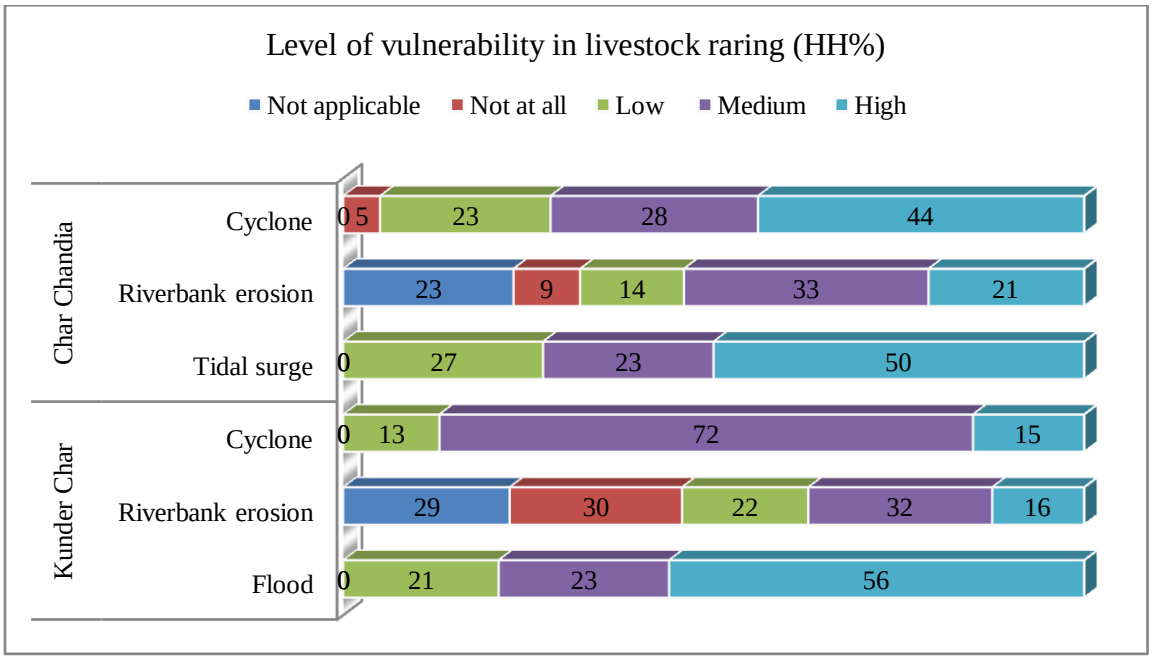
5.3.1.10Livestock rearing vulnerability

In addition to affecting human beings, climatic hazards cause tremendous sufferings for the livestock population of Bangladesh. Livestock suffer huge deaths in cyclonic storm surge (Haider et al, 1991). Prolonged flood can also cause death of livestock through a number of direct and indirect ways (Ahamad et al 2000, Choudhury et al 2003). During other disaster like droughts, livestock in Bangladesh do not suffer death but lack of water increases their vulnerability to diseases. Since climate change would increase susceptibility to climatic hazards, the anticipated toll on livestock sector would be quite high (Ahamed 2005a,GoB 2005). Livestock rearing is an important subsidiary livelihood activity of the *char*-dwellers. The study revealed that households of Kunder Char and Char Chandia raise cattle, goat and poultry etc.Both *chars* have extensive areas of grasslands and these areas are used for the cattle rearing by men and women of Kunder Char and Char Chandia. However lack of grazing land during flood or tidal surge attack, are also identified as potential reasons for decreasing livestock population. The sufferings of livestock in the coastal sites are much higher than in river char sites. During the interview session, the local elderly informed that gradual increase in salinity also increased the vulnerability of cattle. As the animals have less access to fresh water sources during the dry season, these animals often develop diseasesas a result of drinking poor quality/polluted water which also reduce their milk production. In many occasions the owners sell these ill health animals.

Figure 5.20 Vulnerable condition of livestock shed in Kunder Char union

Figure5. 21 Livestock raring in flooded household of char land

Figure 5.14 Level of vulnerability in livestock raring



The household survey indicated that 56 percent respondents of Kunder Char and 50 percent respondent of Char Chandia motioned that they fall in highly vulnerable situation for their livestock raring during flood and tidal surge attack (Figure 5.16). The riverbank erosion and cyclone attack also causes considerable vulnerability. Lack of grazing lands and fodder and animal health care facilities have forced many farmers to sell livestock or give up such activity. For all thesereasonsthe *char* dwellers often lose their interest or avoid livestock raring. It may therefore be stated that the livestock rearing sector is vulnerable to adverse impacts of climate change in the study char areas which in turn affects the family income. .

5.3.1.11 Poultry rearing

Almost all of the households of the *chars* tend to raise poultry as a supplementary source of income by almost all households. However lack of suitableplace and animal healthcare facilities have forced many farmers not to raisepoultry.This study revealed that the vulnerability of poultry is highest among the livestock as most of the respondents reported that their poultry die during the period of floods or storm attacks in both the sites.During these periodschar people often try to keep their livestock to safeneighborhoods places or on high roads. Sometimes they are forced to sell their poultryat low price to meet the economic crisis after or during the hazards. Women usually raisepoultry to support their family in these char households and they are hit hard by these disasters. They fall in more vulnerable situation and lose their income due to poultry deaths. Since women are the providers of food on the table, loss of poultry also reduce the protein supply of the family income.Most of the responds expressed that poultry raring becomes extremely difficult during climatic hazards in these char land sites and the poor *char* women have to pay a huge toll due to loss of their poultry stock. Poor women who depend on cattle and poultry raising for cash income from sell of eggs and milk suffers hugely due to lack of income and also lack of protein sauces.

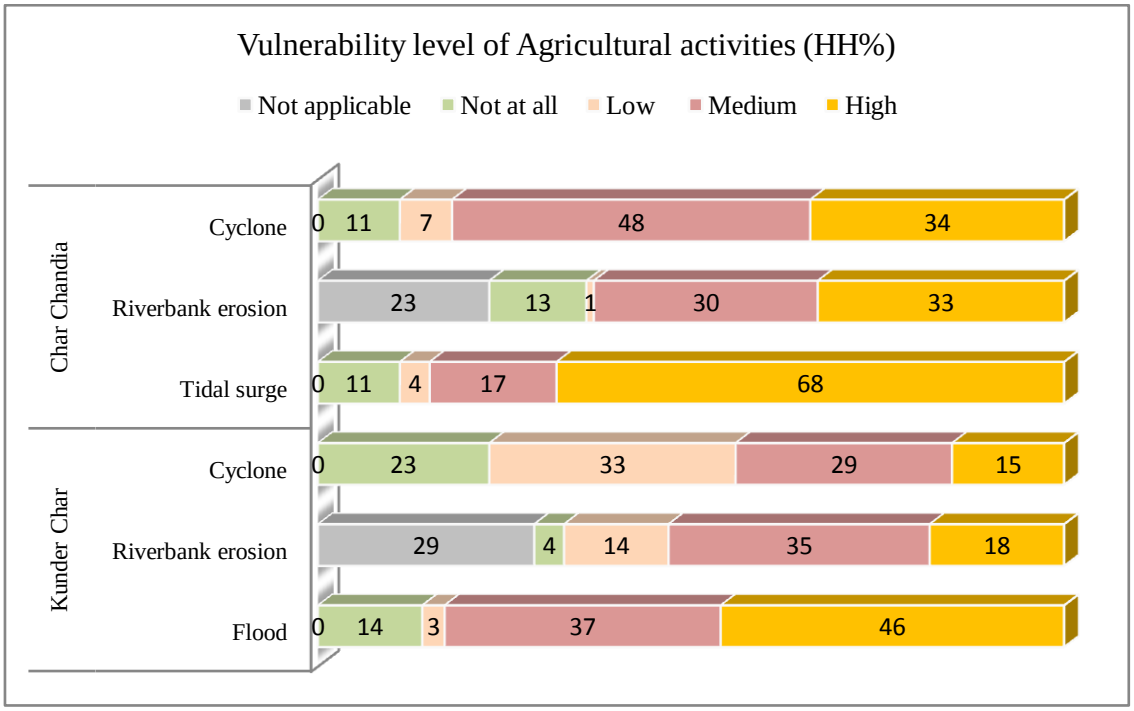
5.3.2 Vulnerability of women at community level

5.3.2.1 Agricultural activities

The *char* land people face various kinds of environmental uncertainty for which their subsistence agriculture is affected adversely (Figure 5.15). The early monsoon floods in Kunder Char and saline water intrusion by tidal surge in Char Chandia damage the aquaculture ponds/ditches causing financial loss. As a result food security of the poor *char* people falls at risk. Besides these the economic factors are also creating vulnerability of farmers to carry out their agricultural activities. Economic factors like lack of cash, unemployment, high production cost etc. causes vulnerabilities for the poor farmers in the study areas. The survey found that 46 percent respondents in Kunder Char mentioned their high level of vulnerability in agricultural activities due to riverbank erosion hazard while 68 percent mentioned that their agricultural activities falls in highly vulnerable condition due to tidal surge attack (Photo 5.22). Besides, thecyclone and other climatic hazards causeconsiderable vulnerability in their agricultural activity. Women who are engaged in such activities are the worst sufferers in terms of employment and cash earning.

Photo 5.22 Salinity intrusion damage the agricultural field in Char Chandia

Figure 5.15 Level of vulnerability in agricultural activity.



5.3.2.2 Children's education

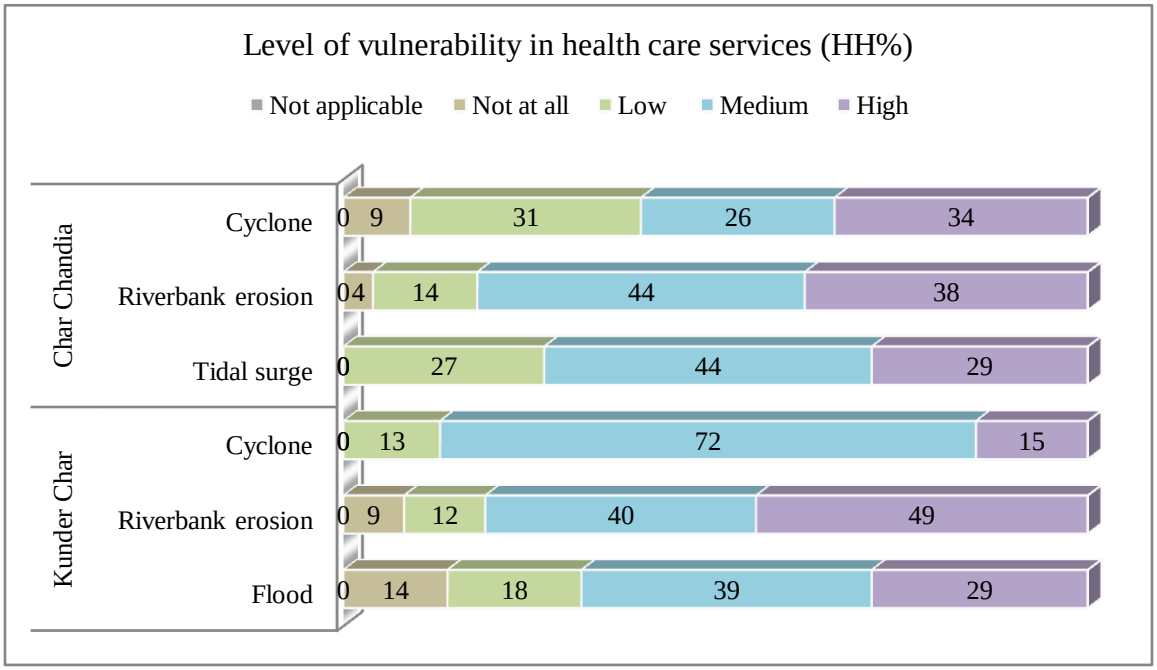
A household with educated members can ensure their security in different sectors of life and properties. Education is also an important factor for the women to make them more awake and capable to cope with disaster. In monsoon or rainy season, children of Kunder Char and Char Chandia have to suffer noticeably for muddy road communication and it is very difficult for them to attend school. As such most of the children do not go to the schools especially the girlsstay at home to avoid such difficulty. In the long runmany of themlose interest in education. It should be noted hear that it is difficult to maintain school infrastructures in a

char land area due to regular flood and erosion.Lack of good teaching staff in difficult geographical locations is also a vital factor. For teachers there is no extra incentive to for their duties hence they are unwilling to serve in *char* land schools. During monsoon, country boat is the only means of transport but poor *char* families do not have a boatman and hiring a boat for each school going child is not supported by their economic condition. That is whyschool dropout particularly for the girls is a regular feature in these areas. The quality of education deteriorates with the limited number of school days and the academiccalendar is severely interrupted. Education therefore remains confined to only the rich families.

5.3.2.3 Health care services

The *char* dwellers are vulnerable in variety of ways in terms of health and health care facilities. Health care supportfor chronically ill or disabled *char* dwellers is nonexistent. There is little or no access to services such as basic healthcare. The people of both the study areas frequently suffer from various seasonal diseases throughout in all the year round. The most common diseases are diarrhea, dysentery, jaundice, typhoid and scabies etc. There is no good health care center or certified doctor in both *Char* areas. Most of the people go to the local chemist/medicine shop or non certified doctors of the locality. Water born diseases are more prevalent in the riveine*char* sites than the coastal *char* site. Lack of awareness regarding risks to water born diseases and high dependence of using river or flooded water for domestic purposes are the major causes of illness in these areas. Due to disruption of transport and communication system during and after hazardsthe dwellers are not able to move for better treatment in upazilla health complex or to main land. Women, particularly the pregnant women are the most vulnerable group. For lack of medical services many women die for their pregnancy related complications indisasterperiod. In an emergency time, pregnant women are assisted by traditional birth attendants which poses a life treat when complicacies arise.

Figure 5.16 Level of vulnerability in health care services



Women also suffer from various health related problems during and after disaster due to lack of adequate food and nutrition and awareness about personal hygiene. Many of them die by snack bite or by sinking during flood. The survey revealed (Figure 5.16) that one third of the respondent of Char Chandia and between 15 to 50 percent respondents of Kunder Char union stated their high vulnerability in health care services in different climatic hazards.

5.3.2.4 Vulnerabilities ofwomen's mobility

Climate change induced high intensity events pose huge threats to existing physical infrastructure. Inter-village communication within *char*-land or with the mainland is often disrupted due to monsoon flood in KunderChar. Apart these, there is no other means to travel even within the areas or the neighboring houses without using a boat in monsoon season in Kunder Char. During storm surge, people can not avail proper transport and lack of modern transport facilities and poor road condition affect the surge prone areas of Char Chandia union. Sometimes due to strong wind, high wave and strong river current,it is highly difficult to communicate to the main land. As a result, people face difficulties to go to their workplaces and markets because the local road becomes unusable. In these hazardous situation women of this fragile areas suffers more than man. Pregnant and older women can not move one place to another place for their treatment or others emergency purpose due to bad road condition and scarcity of treatment. As a result they fall in a vulnerable condition.

5.3.2.5 Warning responses

The cyclone preparedness program (CPP) operates an extensive network of radio communication facilities in coastal Char Chandia union.The radio stations and telecommunication system are always active to deliver the news and warning about cyclone or surge risk. Apart that the Cyclone Preparedness Program (CPP) field staffs deliverwarning information to the local community of Char Chandia union. On the other hand, Flood Forecasting Warning Center (FFWC) also produces and broadcast their flood information through print and electronic media. But the problem is that most of the *char* dwellers of Kunder Char unionremain out of this forecasting and warning information due to remote location, unavailability of telecommunication devices, lack of electricity and lack of education to understand technical terms of the signals. For such reason they are not capable enough to handlehazard situation and many of them donot know what to do after getting such types of information.

The findings of the study reveal that the effect of natural disaster is much harsher on women than men and may be explained in the context of their biological and psychological factors and heavy family responsibilities. All these factors increase women's vulnerability to hazards. Weak physical structure of the houses particularly the cooking place and latrines increase the vulnerability of *char* land women. As a consequence they pay special attention in taking care of their houses by involving in repair and maintenance work like thatching, polishing the mud floor of their houses, plastering, etc alongside the males. However women's contribution in this regard remains invisible and unrecognized. It has been seen that women have to come across different climatic hazards in different time of the year that hinders their regular activities. Such environmental condition often poses extra sufferings to their life. Many households are forced to move away from their homes as a result of riverbank erosion and floods. Women have to modify her activates to fit into such difficult situations. The study also noted that farm-based wage labour and farming livelihoods are severely affected by all kinds of coastal hazards and ranked high the context of level of vulnerability. Women's multifarious activities, particularly the outdoor activities are highly disrupted in such conditions. As such they have to take special measures to perform their activities in facing such challenges.

A case of Jamila Khatun (Age: 42)

Jamila Khatun became a widow 11 years back when her husband died by diarrhoea. He left behind three daughters and a joint family headed by his father. Jamila narrated that 'since I was dependent on the family, they always treated us as a burden and dominated me in every step of my life. I became fed up with family restrictions and after two years I decided to lead independent life with my daughters. Initially I had a struggling life with my three daughters. I was totally landless and I had to depend on multiple livelihoods for income generation like wage labor, petty business (vegetable seller in local market), producer of cane made product like basket, mat, fish cage, poultry cage, etc. My daughters also helped me to produce these products so that I could earn more.The household income was not sufficient to cope with the hazard situation with four members. That's why I often needed to borrow money from MFIs. She uses this loan as capital of her petty business, or to repair her house before or after any hazards. She is now trying to give marriage her daughter, but facing lots of social difficulties like demand for huge amount of money as dowry. Some of the bride's guardians don't like to choose a bride groom from *char* lands in fear of seasonal unemployment and irregular income due to multiple climatic hazards. Jamila also mentioned that usually *char* land girls are not fair complexioned due to movement in direct sunshine and rough weather. She is trying hard to save some money to arrange her daughter's marriage. But she fears that any sudden and severe attack of hazard may turn her saving money for various needs and be disappointed of her dream to marry off her daughters.

CHAPTER SIX

COPING STRATEGIES TO CLIMATIC HAZARDS OF *CHAR* LAND WOMEN

Climate change is a crucial challenge and it is posingdeterioratingeffects on communities (IPCC 2007). The impacts are cumulative and the effects are magnified at the local level. Bangladesh is projected to be severely affected by climatic hazards in terms of the frequency and magnitude of damage.The*char* communities are more vulnerable to various kinds of climatic hazards than main land communities. As such most of the *char* dwellers survive in emergencies with their own coping strategies rather than outside interventions to deal with their vulnerable conditions during or after any hazard. Their coping strategies are enacted to respond to shocks, trends and seasonality in the *char* land sites. Thepoor *char* women have limited access to resources, restricted rights, limited mobility and voice in community and household decision-making which make them even more vulnerable than men to the effects of disasters and climate change. Theregular natural disasters and gradual environmental change affects women and men differently because of their ascribed traditional and social roles and responsibilities (CCC, 2008). But women are not just victims of adverse climate effects; they are also the key active agents of coping. Women play a unique role in managingavailable resources and support to households and communities. They not only act as caregiver and nurturers of their households members but also maintain strong social networks within their communitiesfor collective mitigation of the climate imposed vulnerability. Women are willing and able to take active role in what are traditionally considered 'male' tasks in responding to disasters and local coping strategies. However,lack of access to and control over basic resources and entitlements,magnify women'svulnerability and weaken their ability to cope with effects of disasters (Action Aid, 2008). Female headed householdsare likely to have fewer options available to them due to the absence of adult or able bodied men on whose labor they can depend.

In the absence of technological choices and government support and their subsistence economy, the vulnerabilities, impacts and the coping strategies vary by gender as well as by class, age, and status within the family.The coping mechanism also varies with their knowledge, ability, available resources and from area to area. Many factors make them different from each other in regard to the practice of coping strategies. Among them, factors like the geographical

location of an area, the type and magnitude of hazards, duration and period of hazards, homesteadlocation, vegetation coverage, size and elevation of the homestead areas, type of housing structures, financial abilities, agro-based livelihoods, availability of local resources,educational and social institutions, level of education and awareness of the household members, communication systems of the locality, frequency of movement to the nearest growth centre, health-care facilities, etc. play vital role in the coping capacity at the household and community level. This chapter presents the coping strategies by the riverine and coastal *char*women of the study areas before, during and after climatic hazards.

6.1 Coping strategies of *char* land women at household level

Due to the recurrent climatic hazards and their devastating impacts, women in *char* areas have adaptedto live with hazards through their own coping mechanism that enabled them to survive with hazards. The Kunder Char union is one of the most adversely affected by several climatic hazards viz.flood and river bank erosion, storms, cold wave, drought,etc. and Char Chandiaas the exposed coast of the Bay of Bengaland is also subject to multiple hazards every year. The continuous effort of coping with hazards has made the lifestyle of the char women very different than that in other areas of Bangladesh. The coping strategies of both typesof *char* land women are influenced by their activities, knowledge, skills, resources as well as their experiences. Among the diverse coping strategies, this study investigated what kind of measures the *char* dwellers usually take to protect their houses, homesteads areas, other physical structures and their livestock and crops and manage their financial need, how the *char* land women manage their household activities like drinking water collection, sanitation, meal preparation and cooking, caring ofchild and family members and other daily activitiesto live with disasters. The *char*-dwellers have multiple perceptions that lead to multiple responses at household-level approach.

6.1.1 Protection of homestead area

The homestead protection is very important for ensuring safe housing, accessible drinking water, sanitation systems, livestock rearing and homestead gardening. Tree plantation is a very common practice of homestead protection in these areas. The*char*-dwellers planted vegetation like cane plant and catkin grass in and around their homestead area to prevent soil erosion by wave

battering and river erosion (Photo 6.1). Some *char* people also made temporary fences with bamboo, jute-stick, and water hyacinth to protect soil being eroded away from their homesteads (Photo 6.2). There are no other alternatives to protect the plinth in order to save the households physical structures from collapsing except for building a fence made of jute-stick, water hyacinth and crop residue around the mud plinth in the study households.

Photo 6.1 Homestead area protection by cane plant at Char Chandia union

Photo 6.2 Homestead area protection by bamboo fence at Kunder Char

Sources: Photographs taken 2012-2013 during field survey

6.1.2 Earth rising of homestead area

House position is a vital issue in the context of coping strategies. The *char* villagers usually build their settlement on alluvial natural levees to get the extra benefit of natural elevation from the agricultural land.Most of the homesteads in both the study sites were made of mud which are collected from the borrow pit or the nearest farmland (Photo 6.3 and 6.4).As mud plinth is severely affected by flooding in riverine site and tidal surge water in coastal *char* land site, plinth raising work is urgently needed to ensure the safe life of the *char*-dwellers. The most common measure that have been under taken for homestead protection was to raise their height using a borrow-pit for digging mud and raise it above annual flood levels to make flood resilient houses. While men are responsible for digging mud, women are responsible for plinth raising and polishing work. Table 6.1 shows the average plinth height, average homestead area and inundation period of both study sites.

Table 6.1 Average plinth height and homestead area of the study area

Name of the study area	Average plinth height from farmland level	Average homestead area	Inundation period in monsoon
Kunder Char union	2.0–2.5 meters	8.1 decimals	4 months- 5 months
Char Chandi union	0.5–1.0 meters	15.0 decimals	During storm and tidal surge

Source: Household survey in 2011-2012.

It may be seen from the above table that the average heights of the riverine homesteads are higher than coastal *char* land homesteads but the average homestead area is lesserin riverine *char* sites. Compared to coastal study sites, the riverine sites remain under monsoon water for 4 to 5 months a year. This limited piece of homestead land is very important for women'sdaily livelihood activities but such inundation disrupts their life severely.

Photo 6.3 Homestead rising before monsoon

Photo 6.4 Building a tidal surge proofing house

Sources: Photographs taken 2012-2013 during field survey

6.1.3Meal preparation and cookingstrategies during hazards

Char land women in both the study sites spend long hours inhouseholdchores. Such work includes meal preparation and food processing which comprise grinding spices, preparing vegetable/fish for cooking, collecting vegetables from the homestead garden, preserving food items, serving meals to the members of the family, etc. During hazards, meal preparation and cooking become very challenging for women as the kitchen becomes inundated or damaged by water. Purchase of fooditems on credit is common in both the study sites in hazard times. Modification of food habits and management of daily necessities at minimum expense become one of the important coping strategies of the households. It alsoincludes reduction in meal frequency. The variety of food items is also reduced and many people only eat rice with water and salt. Women cook food once a day to minimize the problem of cooking in critical situation.Washingutensils in safe water scarce situation is also a great problem. The common practice of*char* land women is to sacrifice and reduceself consumptionand save food for other members of the family. The households also suffer from income loss and do not get enough credit to purchase food items during such time and food security situation becomes critical. Storage of food, particularly the dry food like puffed and pounded rice (*chira, muri),* potato, oil,spicesand dried fishis also a common practice by the women.

Making of traditional mobile clay burners/stoves (*Chula)* is a very common practice for monsoon flood season in Bangladesh.Ithas been seen that the households have one or more than one movable *Chula* in both the study sites.The *char*women usually make fixed mud ovensattached to theirkitchens and in the courtyard. As the homestead kitchens become submerged during floods and tidal surges the portable mud ovensare the only means of cooking(Photo 6.5 & 6.6). These ovens are stored in the hanging false ceiling or in a safe place as a hazard preparedness measure. When the regular kitchen becomes inundated during floods in riverine *char* site, womenhave to cook on a temporary raised platform or on a floating country boat using such portable mud ovens.As a make shift arrangement a temporary bamboo, rope and wooden platform or a wooden bed (*Chouki*) is used as cooking place in both *char* areas. During flood hazards many households consume their productive assets like poultry to fulfill their protein intake. The quantity of fish and vegetables consumption may decrease depending on the availability. Meat, milk, eggs, and fruits are rarely consumed during such situation.

Photo 6.5 Tin made portable burner forcooking

Photo 6.6 Mud ovensstored for flood season

Sources: Photographs taken 2012-2013 during field survey

6.1.4Fuel collection and storing strategies

Almost all *char* dwellers use stock fuel, such as dry wood, jute sticks, husks, cow-dung sticks, straws, dry leaves, tree branches, crop residue or kerosene oil. The households often face acute fuel crises during floods. Women of the family are mainly responsible for arranging cooking fuel and preserving them for the emergency period. As a coping strategywomen store different kinds of fuel in their house and kitchen ceiling which purposively built tokeepsuch things. Some *char*-dwellers build a raised bamboo platform and store their fuelcovering with the polyethylene paper.Women gather branches of plants, chopped wood pieces, jute stick and make dry cow dung sticks to be usedas fuelpurposively during hazard periods.

Photo 6.7 Fuel stock in a wooden shelf inside

Photo 6.8 *Char* land women prepare cow dung stick to use as fuel

Sources: Photographs were taken 2012-2013 during field survey

6.1.5Drinking water collection

Drinking and domestic water supply infrastructure particularly in the *char* land areas of Bangladesh is hardly found. As such household members are mainly responsible for the arrangement of water for their needs. Drinking water collection which is mainly a woman's task becomes a critical during all types ofhazards. The survey findingssuggestthat most of the tube-wells are submerged during floods or tidal surge and very few hand tube-wells function during these hazards. Char dwellerstake some measures to protect and keep the tube-wells fully or partially usable according to their ability. Women, during this period try to collect water for drinking from tube-wellslocated onhigh ground or from distant places. Most of the respondents mentioned that they try to store drinking water before cyclone or tidal surgeand collect enough containers to carry and save water for emergency use. Womenusually use flood water for cooking and washing purposes. As a coping strategy, the riverine char dwellerstemporarily raise their tube-well height using a 1.0-meter-long pipeduringflood which is removed when flood water retreats. The households that do not have this capacitycollect drinking water from neighbours and store in plastic containers. The indigenous knowledge of *char* dwellers helps them to survive and cope with the adverse situation of floods, tidal surge, cyclone, salinity intrusion etc. Age old practices like use of alum (*fitkiri*-Al_2SO_4) areapplied to purify flood water for drinking purposes. The study revealed that to safe guard the tube wells some of the *char* dwellers tie up the top part of the tube wells with thin polyethylene paper to prevent entry of filthy water during floods, cyclone, and tidal surge attacks that remain usable after the hazards. The NGO workers and the radio and television played important role in disseminating this knowledge. During hazards like flood, rain water harvesting is also practiced in the study areas. Earthen pitchers (*Motki*)are used for collecting rain water and for storage.Ponds are also protected from salinity intrusion by raising the sides in the coastal sites,

Photo 6.9 A raised hand tube well in Kunder Char union

Photo 6.10 Rain water harvesting pitchers

Sources: Photographs taken 2012-2013 during field survey

Photo 6.11 Earth rising for protecting the pond from salinity

Sources: Photographs taken 2012-2013 during field survey

6.1.6 Sanitation system

InKunder Char and Char Chandiavillagesmost of the households use ring-slab type sanitary latrines. These latrines become inundated during the flood and tidal surge attacks. Some of the capable households build temporary latrine especially for the female members during disaster time. The *char* dwellers take protective measures to keep the latrines fully or partially usable by raising the toilet pan. Sometime temporary bamboo bridges are sometimes made to reach the flooded latrines. When toilets become totally unusable temporary hanging latrines are constructed by raising the base of toilets supported by bamboo or a tree where the filth is directly dropped into water. Poor households use other people's latrines or defecate from the open boats or floats.Using hanging latrines or a boat latrine or defecating directly into water make the

surrounding as well as the water bodies polluted and filthy. As a result,majority of the *char* dwellers suffer from different kinds of water borne diseases.Noalternate strategies have been noted in this regard in both the study areas.With respect to health and disease very few people store any emergency medicine before cyclone and flood hazards. In the absence of a physician in hazard times, households seek treatment from local quacks or local medicine shops for sickness.

Photo 6.12 Temporary latrine especially for the female members during disaster

Photo 6.13 Constructed temporary hanging latrines by bamboo or a tree

Sources: Photographs taken 2012-2013 during field survey

6.1.7 Care of children and family members

Women in Bangladesh are the keepers of her family and house and characteristically her concern and responsibilities towards her family is a part of her daily life. The houses particularly of the poor are highly vulnerable due to their poor quality structurewhich remains under threat ofcollapse during hazards. In such situation caring activities of women become difficult. Child caring activities of women includes feeding,bathing, carryingchildren and even playing with them and these activities become problematicwhen hazards strike. Usually mothers having infants have to devoteconsiderable time for child carebut they are unable toallocate enough time during hazards because they have to be involved with extra different kinds of tasks for preparedness and coping with the situation.Women's work load escalates and they remain under continuous stress during this time.They have to be very cautious and have to pay extra attention to protect their children from disasters and post disasterperiod especially when their men leave the house for cash earning and women are left alone to look after their children and elderly. Caring activities are also shared by elderly men and womenor young girls andboys in the

household. However, it has been reported by the respondents that many children diefrom snake bite ordrowning in flood water or suffer which injuresby falling from trees, etc. In the revarine*char*villages, death of young children by drowningin flood water is very common. As such women have to pay enough attention in this regard. They putbarriersaroundtheir cot or in front of the door to protect their babies from drowning (Photo 6.13).

Photo 6.14 Child caring by young elder sister

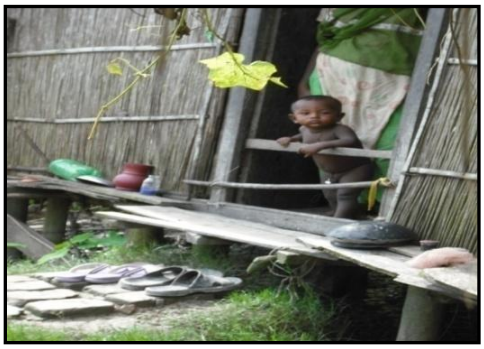


Photo 6.15 A child is protected by a bamboo barrier

Sources: Photographs taken 2012-2013 during field survey

Womenof both the *char* land are mostly poor. Hence, they have to work hard to protect their family members and belongings from the disasters and afterwards, especially when men leave the house for cash earning. The women who are left alone to look after their family becomeburdenedto deal with poverty and household works.As a result,sometimes they have difficult lives in which very simple tasks such as cooking, caring for the family and meeting the household demand becomes hard. Female-headed households in particularpass throughmore difficult timein performing caring activities along with their other activities that increase theirmental stress.But they are able to cope and manage this responsibility by their own knowledge and capacity or simply overlook such taskswhen tired.

6.1.8 Coping strategies in Homestead gardening

Char land women spend considerable time in homesteadgardening. Year round homestead gardening is the coping initiative in *char* land for their food security and family income. Besides home consumption, the most of the fruits, vegetables and spices grown by women are sold to

meet household expenditure.Theyhave to spendconsiderable time and energy for nursing of homestead gardens along with the houshold activites. During the monsoon season, the homestead garden product is an important source of household food and nutrition in Kunder Char. A flood-free land is suitable for homestead gardening but it is very difficult to get such land as many homesteads in Kunder Char are subject to seasonal flooding. In such situation, the women usuallydo vegetable gardening on raised ground up to one meter height by earth filling for flood water (Photo 6.14) protection. Creeper vegetables are also planted on pots that grow on roof tops or trees in both the study sites. Artificial platforms made by bamboo are made to grow as fast growing plants during the flood season.

In Char Chandia,homestead gardening is difficult for women as the soil of the homestead area becomes unusable by salinity intrusion. The poor households cannot produce enough vegetables, spices and fruits for their own consumption as well as for selling in such time. Some familiesescape this situation by putting anearthen fence surrounding their homestead garden to protect from saline intrusion. To cope with the hazardsituation,fast-growing leafy vegetables are grown to meet their household food demand. They also prefer to grow year round crops in their homestead garden to meet the family's food and economic needs. Rearing poultry and duck by women is a very common practice along with home gardening in these areas.

Photo 6.16 Flood-proofing vegetable garden

Photo 6.17 Creeping Vegetables & poultry rearing in a hanging bamboo platform in homestead area

Source: Photos were taken during field survey in 2011-2012.

6.1.9Alternative sources of household income as a coping strategy

Source of income and dependable occupation play an important role in maintaining household wellbeing of*char*-dwellers. It is evident from the seasonal livelihood calendar (chapter 4, section 4.4.1 and 4.4.2), that the people of riverine and coastal *char* lands are dependent on diverse livelihoods in different seasonsof the year. These include farming, fishing, wage labor in towns, small petty business, boatmanship, handicrafts making,etc.Despite their difficulties posed by frequent climatic hazards, people always look for alternative occupations for their livelihood. The study revealed that though males are mostly responsible for earning household income,there are some women from poor female headed households who have to be involved in crop cultivation and other income generating activities to maintain their families. As the male members migrate out of their villages in search of employment during monsoon, the female members remain responsible to maintain their families. To prevent loss of income from climate change induced hazards, some women and men of these areas cultivatesaline and drought tolerant fisheries and agricultural crops. Women from poor households actively engage themselves as wage labor during post harvest periods (threshing, drying, cleaning, parboiling paddy and husking work), village road development work, etc. Some landless women pick chilies or collect fuel litter from 'other' fields to earn cash. But these activities are seasonal. Failing to find employment within the village, some women from landless households temporarily move to work in mills and factories of the capital city of Dhaka or near by urban centers like Shariatpur and Feni. The respondents reported that during disaster, adult and older women and few men who have no or irregular income try to earn money by selling their assets like trees, furniture, ornaments, and stored crops to meet their basic needs for survival. Poor women have to struggle with their disruption of livelihoods by changes in the climate. This give evidence of the fact that climate change induced hazards affects women's livelihoods severely because many of them depend on natural resources and the local environment for most of their activities. The study areas are no exception from this. The findings of the study indicate that men and women farmers of Kunder Char and Char Chandia face multiple challenges to deal with their chronic food insecurity.

Photo 6.18A woman making cane product

Photo 6.19 Fishermen are bound for

Photo 6.20 Wage labors are coming back to *char* land from nearby agriculture field

Sources: Photographs taken 2012-2013 during field survey

6.1.10Coping strategies in livestock and poultryrearing

The multifarious domestic work of Bangladeshi rural women also includes maintenance of the poultry and cattle and *chars* land women are no exception. Women are the manager of food and fodder for cattle and poultry. But consequences of climate change areleading to weaker and increasingly poorer fodder gathering in the study areas.Women,in Kunder Char and Char Chandia, as a part of their livestock and poultry rearing activity, usually store and preservedry poultry and animal feeds in advance for emergency purpose. They collect and preserve rice straw and dry rice husk(*bhushee*) for the livestock as grass is not available during flood. The women member also remains prepared with baskets to keep and carry the poultry and ducksin hazardous situation like cyclone, tidal surge, etc. Poultry cages are usually kept onraised bamboo platforms (*machan,*Photo 6.19)or on rooftops during high floodsin riverine Kunder Char.They also prepare raft with banana stalks as a floating home for the livestock during flood. The*char* dwellers also keep livestock on floating *machan*s made of layers of straw and water hyacinth placed over a horizontal structure made of bamboo with banana trunk underneath. Since the structure is made of straw and other leafy materials, it provides animals fodder as well. In Kunder Char a popular coping strategy is construction of a *Jakon*in which the floor and the roof of the cow-shed are raised along with the water level. The*Jakon*is made by water hyacinth,grass, bamboo poles and jute ropes. When the water level becomes too highin riverine and coastal sites, the *char*-dwellers shift their animals to a flood freehigher ground such as on roads, embankments or inrelatives houses (Photo 6.20).The survey findings show that 59 percent of respondents safeguard their livestock and poultryduring hazards,whereas 64 percent of respondentssaid that they shift their livestock to safer places in nearby neighbors/ relatives house and 79 percent of respondents sift them to road side embankment. Due to non availability of flood shelters and flood-free land and poor communication and transportation systems in both the study sites,*char*-dwellershave no means to shift their livestock during peak flood and tidal surge attacks. They are forced to sell their livestock at a cheap price to cope up such situation.

Photo6.21 Flood-proof poultry cage

Photo 6.22Sifting cattle on a embankment of aerosion-affected households in Kunder Char

Sources: Photographs were taken 2012-2013 during field survey

6.2 Coping strategies at community level

Communities develop strategies to handle the hazard problems according to their own knowledge and skills. Besides the different household coping strategies, community level coping method is also appliedto ensure the smooth functioning of the socio-economic and livelihood cycle of the *char*-dwellers during and after any climatic hazards.

6.2.1 Community labour sharing

The *char* dwellers mainly depend on agriculture and agriculture related activities. Both men and women headed households in these areas are largely involved in crop cultivation. The impact of climate change hazards is already affecting the agricultural production in both the study areas.The study revealed that women of thestudy areas know how to preserve seeds of crops and vegetables and prepare seedlings of various typesof crops. Adequate labor isneeded during pre and post-flood situations in *char* areas especially in the months of April-June in Kharif-1 crop season and January-February in Rabi crop season in the *char* sites. Most of the standing crops get submerged by the rapid rising of river water particularly during jute harvesting in the monsoon season (Photo 6.22). Community labour sharing is a common practice in this regard. The*char*-dwellers help each other by taking turns in harvesting, processing, and sowing which is one kind of emergency response employed by them to meet the labor demands and to reduce the amount of damage from flood or excessive rainfall hazards.Women in particular also get

organized in labor sharing. They work together in the field or in the collection of crops. They share the problems with each other and find a common solution. Landless women of Kunder

Photo 6.23women labor sharing in post harvest activities in Char Chandia

Photo 6.24 Labor sharing in jute harvest activities with others female neighbors in Kunder Char

Sources: Photographs taken 2012-2013 during field survey

Char pick chilies or collect fuel litter from others' fields to meet their financial needs. Sometimes it is necessary to harvest premature standing crops if there is a risk of being inundated and the entire community comes forward to help each other. Along with men, women take early measures in seed preservation in order to expedite agricultural activities following the recession of the floodwaters in the riverine site.

6.2.2 Community measures in child education

With respect to education, girls have little time to pursue education due to their involvement in household activities with their mothers during hazard time.As such girlsdrop out from schools at an early stage is a regular feature in these areas. As the entire area of riverine Kunder Char remains submerged during flood and the earthen local roadsbecome unusable,the school going childrenhas to cross a 1 kilometerwide river using country boats to go to school. It is difficult to arrange a boatfor every student from different households. As a mitigating measure, the *Char* community usually arrange a common boat for all school goingchildren where one boatman crosses the village from the starting point to the endpoint and collects all studentsfrom the households and carriesthem to their school. The same process is followed to bring them back after schools. The payment for the boatmen is also unique in this area. The farm-based households give 20 kg of paddy per season (June-October) and non-farm-based households pay

100 BDT monthly per student which is usually paid after crop harvesting to the boat man.In coastal Char Chandia,there is no such system to send children to schools during hazard periods.

6.2.3 Transportation and communication

Char land people face difficult situation for disruption of road and communication system during flood or excessive rainfall hazard. The study revealed that during and after any climatic hazardmobility of *char* dwellers especially of women decrease largely in both the study sites. All the *char*-dwellers of Kunder Char union have to use country boats or floats to travel from one place to another even for a short distance as most of thearea remains submerged (Photo 6.23). The poor householdsmake afloat withbanana plant to make short trips as they cannot afford boats or manage boat fare. But solvent *char* dwellers always keep a personal boat tied up in front of their homestead.

Photo 6.25 Boat is tied up in front of homestead of riverine *char*

Photo 6.26 Floating boat made by banana tree using for nearer movement in flooded situation

Sources: Photographs taken 2012-2013 during field survey

During monsoon season it is very common to makea walk pathby putting a short bamboo bridge(*sanko)*constructed by bamboo poles between the village mosques and nearest houses in Kunder Char (Photo 6.25). The construction materials like bamboo and jute stickwhich are usually availableand affordable for the *char*-dwellers as low-cost. The households who would be benefited by this bamboo bridge contribute to this coping initiative by donating bamboo, labor or money. Usually young village volunteers prepare thesestructures according to the*char* dwellers demand. This is also a measure to maintain the social network with the households of a

village.For intra-house movements, the *char* dwellers also use *sankos if needed*. For distant mobility and visit toupazila growth centers, country boats or engine boats are used as amode of transport. They also use rickshaws, auto-rickshaws or vans if situation permits and have to pay high fare.

Photo 6.27 A short bamboo bridge (*sanko)* constructed by local people

Sources: Photographs taken 2012-2013 during field survey

The study noted that the *char*-communities are engaged in a constant fight for coping against recurrent climatic hazards and possess a good deal of knowledge in regard to how to manage and control their hostile environment.The study also found that women play a crucial role in local coping strategies in both the char lands. However,poor women have fewer assets than male headed households and donot own any remarkable assets that can be sold to secure income in an emergency situation. As such their sufferings are endless. Their coping strategies such as skipping meals, using inferior energy sources or dependence on money lenderare not always sustainable and healthy (Christ, 2008). It has been seen that women play a key role in increasing human security by protecting, managing and recovering their household and assets during and after climatic hazards. They take preparedness measures at the household and community level and have knowledge and capacities to contribute towards coping with and adapting to climatic change. The women of the sites have different types of capacity and experiences to cope with the different types of hazards to reduce their vulnerability.

CHAPTER SEVEN

CLIMATE CHANGE HAZARDS RESILIENCE CAPACITY ASSESSMENT FOR *CHAR* LAND WOMEN

Climate hazards induced vulnerabilities are common in *chars* and these have serious impacts on life and livelihood of *char* land community including loss of land, assets and people. The population of a *char* land and the condition under which they live are diverse and vary from place to place. Therefore, it can be the assumed that the vulnerabilities and eventually the resilience capacity would not be the same for all parts of a *char* land due to the variation of its physical condition, land use and settlement pattern, population density, economic activities of *char* dwellers and characteristics of the living communities, etc. All these diversities contribute to disaster risk and vulnerability which in turn affect human development and resilience capacity in different parts of the *char* land.

Resilience capacity of the social systems can anticipate and plan for the future. 'Resilience capacity is the buffer capacity or the ability of a system to absorb perturbation or the magnitude of disturbance that can be absorbed before a system changes its structure by changing the variables' (Wildavsky, 1991 and Holling et al, 1995). It is the capacity to cope with unanticipated dangers after they have experienced and leading to bounce back or bounce forward capacity. According to IPCC (2007) it is 'the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of function, the capacity for self-organization, and the capacity to adapt to stress and change'. UNISDR (2005) explained it as the capacity of a system, community or society potentially exposed to hazards to adapt by resisting or changing in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organizing itself to increase this capacity for learning from past disasters for better future protection and to improve risk reduction measures. Building a climate resilient community requires detail and careful assessment on its current level of vulnerabilities and resilience. It is important to understand these linkages and their impacts from a gender perspective. An assessment of the vulnerabilities and resilience capacity of *char* land women is very important to understand the ways of utilization of scarce resources for survival and to cope with the vulnerabilities brought by climatic hazards.

According to Pelling (2003), "vulnerability of settlement is measured on the scale of nature and severity of the event or issue, the physical and socio-economic factors that determine the degree of community resilience; how they are affected and capacity of component or community to recover". Sivell et al. (2008) used a set of indicators to measure climate resilience and proposed physical, social, economic, institutional and natural indicators that will be impacted by climate change induced hazards and will demonstrate greater or lesser resilience. Recognizing the research gap and considering the importance of *char* land resilience assessment, this study attempts to assess the *char* land women's vulnerability and their resilience capacity due to climate change hazards. This chapter presents the existing level of resilience capacity using climate disaster resilience index (CDRI) approach based on Joerin and Shaw (2011) by different (physical, social, economic, institutional and natural) dimensions. It also compares resilience capacity between the male headed and female headed households in riverine and coastal *char* land sites. Information about socio-spatial profile of both the study sites including pattern and condition of social structures, different aspects of climatic hazards and their vulnerabilities, coping measures to survive with these vulnerabilities have been collected by several field surveys in the *char* land study sites of riverine Shariatpur district and coastal Feni district to get an appropriate scenario of these areas (union) on current climate hazards situation.

To consider the active floodplain communities and its ecosystem physical, social, economic, institutional and natural dimensions have been taken and all the resilience issues are verified by the local communities through PRA in the study sites. All these diversified dimensions and parameters are closely related to resilience capacity of *char* dwellers in context of climate change hazards and each of these five dimensions consists of five parameters which are selected and ranked by the experienced *char*-dwellers. Each parameter consists of five related variables which are influenced their ability to cope with upcoming natural hazards. Altogether 25 parameters and 125 variables were used to assess the resilience capacity of the study population. Data on each of these parameters and variables were collected through a comprehensive set of questionnaire (Table 7.1). Each question was ranked between 1 and 5 (1=very low, 2=low, 3= moderate, 4= high, 5= very high) in a five-point rating scale. The survey respondents were requested to assign weights for the indicators in terms of dimensions in order to reflect the relevance of the indicators to local situation. The researchers self observation was also considered in assigning weights for the indicators. Simple arithmetic functions such as weighted

mean index and aggregate weighted mean index were used to calculate the scores for indicator and dimension respectively.

Table 7.1 Dimensions, parameters and variables used in the CDRI approach

Dimensions	**Parameters**	**Variables**
Physical	P1: Household structures	Main living house, homestead area, plinth height, Kitchen functions, livestock sheds
	P2: Road and communications	Road inside the village ,Village road to the growth centers, Usages of Country boat/Rickshaw/Van/Cycle, Usages of TV/Radio, Usages of cell phone
	P3: Water and sanitation system	Quality of drinking water (salinity/arsenic), availability of water in dry season, Climate context technologies for water, Existing sanitation facilities (types), Easy access to toilet for women and children, Available sources of fuel in normal period
	P4: Fuel and Electrifications	Available sources of fuel during disaster, Fuel storing capacity, Lightening facilities/electrification facilities, Alternative options of lightening (SHS/Generator)
	P5: Accessibility of Flood/ Cyclone shelters	Distance from house to shelter, Road communication system, Water and sanitation facilities in shelter, Population capacity of shelter, Safety net of women, children and elderly people
Social	S1: Demography	Household size , Earning member, Population under 14 years, Population above 64 years, Population density
	S2: WATSAN during disaster	Sources of drinking water during disaster, Quality of drinking water (salinity/arsenic), Sources of domestic water during disaster, Types of toilet, Functionality of toilet during disaster,
	S3: Health and Education	Availability & distance of the nearest health centre, Access to health care centre's during disaster, Emergency MNCH services during disaster, HH head year of schooling, Functionality of schools during disaster
	S4: Social Kinship	Relationship among the family members, Relationship between HH and neigh, Acceptance in the community, Women participation in HH decision making, Women participation in community decision making,
	S5: Awareness and Preparedness	Aware of forecasting of hazards, Adequate preparedness at HH level, Response after getting forecast, Move in safe place with movable assets, Family members evacuating voluntarily

Economic	E1: Income	Major sources of income, Adequate income for the HH, Alternate sources of HH Income, Income with seasonality, Degree of impact on major livelihood of HH
	E2: Expenditure	HH food expenditure (%),HH health expenditure (%),Expenditure (%) of disaster preparedness, Expenditure (%)for education, Expenditure (%) for other consumption
	E3: Household assets	House hold have livestock, HH have television,mobile phone, HH have transportation vehicles (boat, cycle), HH have agricultural and fishing tools, Household having flood free homestead
	E4: Employment	No. of earning Members in HH, No. of Women involved in IGA, No. of youth unemployed, Seasonal employment opportunities, Seasonal migration for alternate livelihoods,
	E5: Credit and Savings	Availability of Credit sources (MFI/Bank/Money lender), Accessibility of credit facilities, Availability of credit facility to prevent disaster, Saving practices of HH,
Institutional	I1: Community responses in disaster risk reduction	Understanding level of forecasting information, Receiving mode of forecasting information (TV/radio/mobile), No. of labor force, No. of children/elderly/disable people, Location of the nearest shelter
	I2: Household based coping practices and CCA	Coping in physical structures, Coping in livelihood options, Coping in water & sanitation, Coping in transportation
	I3: Effectiveness of Local government (UP) to respond to a disaster	Disseminate hazard warning, Response to evacuation, Response to emergency relief, Response to medical support, Response to rehabilitation
	I4: Institutional support at post disaster situation by GOs in sub-national level	Support in MNCH sector , Support in agricultural sector, Support in livestock treatment, Support in WATSAN sector, Support in education sector
	I5: Institutional collaboration and participation in local	Participation in village contingency plan development, Accessibility in UDMC, Participation in village DRR decision making, Involvement of UP member & VDP in DRR, Institutional supports from GOs-NGOs and MFIs in DRR

	DRR	
Natural	N1: Changes of climate variability	Changes in temperature, Changes in rainfall pattern, Intensity and duration of rainfall pattern, Severity of cold wave (winter), Duration of monsoon
	N2: Frequency / Severity of Natural Hazards	Frequency of flood in the last one decade, Frequency of cyclone in the last one decade, Frequency of riverbank/coastal erosion in the last one decade, Severity of drought in the last one decade, Severity of salinity intrusion in the last one decade
	N3: Ecosystem service	Access to surface water, Access to ground water, Vegetation opportunities, Quality of air, Quality of soil
	N4: Land use in natural terms	Homestead area vulnerable to flood hazards, Agricultural production are vulnerable to flood/storm surge, Vulnerable location of settlement, Vulnerable location of fishing pond/shrimp, Morphological vulnerability of char-land soil
	N5: Food security	Operated farmland, Serial production with rice, Rice purchase from market/year, Food and seed storing capacity, Fuel stock and cooking capacity

7.1 Resilience capacity: physical dimension

The resilience capacity of a settlement depends on its available infrastructural facilities providing shelter and necessary basic services required at pre-and post disaster period. Weak structure of houses and accessibility to road network are other aspect of vulnerability of *char* land settlements. Building with durable materials (*pacca*) is more resistant to cyclonic wind, tidal surge and flooding hazards. In this study, physical dimension considers variables such as household structures, road and communications, water and sanitation system, fuel and electrifications, accessibility to flood/cyclone shelters. The CDRI scores in physical dimensions vary from average 1.8 to 2.4 (Table 7.2) which means very low to low condition of physical condition of the households under study. It was found that the resilience capacity of female headed household is 1.8 (very low) and male headed household is 2.4 (low) in Kunder Char union. On the other hand male and female headed households have similar resilience capacity of 2.4 and 2.1 (low) respectively in Char Chandia union. It is evident from the Figure 7.2 that the women headed households have very low to low physical resilience score and also scored lower

value in related indicators than male headed households in both the study sites. This may be explained by the fact of their different constrains, unemployment and uncertain income sources. The overall CDRI assessment from physical dimensions shows that the Char Chandia union is less resilient than riverine Kunder Char union in this regard (Figure 7.1and Table 7.2). The main reasons for low resilience in physical dimensions are due to weak housing, land use pattern, size of homestead area and existing water and sanitation system and most importantly no access to safe drinking water. Both the *char* sites did not have well-functioning hygienic water and sanitation services and communication system.

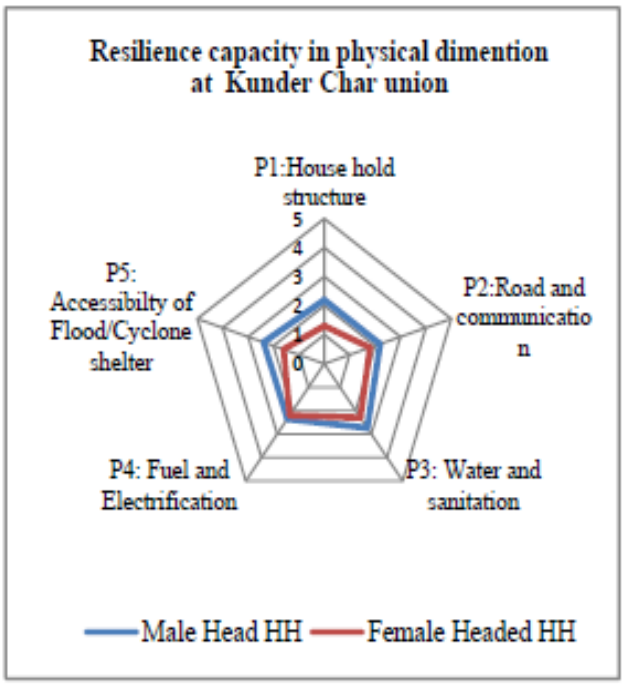


Figure 7.1 Physical dimension of Kunder Char

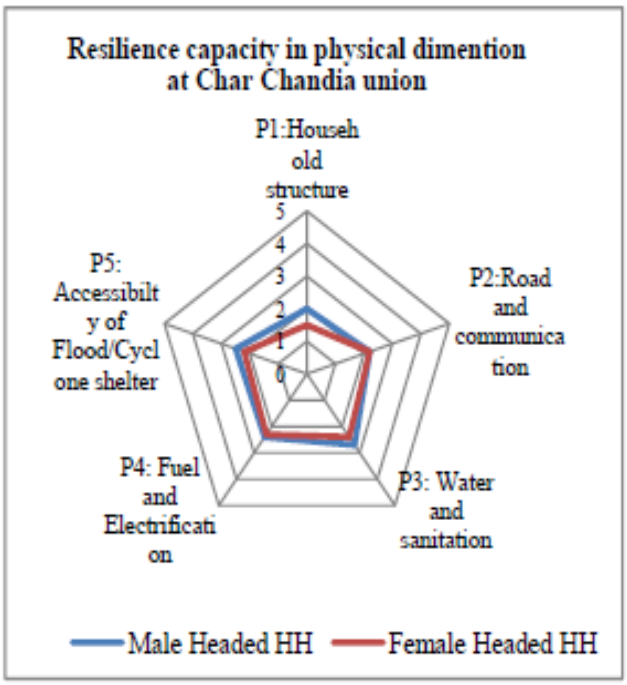


Figure 7.2 Physical dimension of Char Chandia

7.2 Resilience capacity: social dimensions

From the social perspective household demography, family and community kinship, health, education, awareness and preparedness for disaster are the most important factors to understand the resilience capacity of *char* dwellers in terms of climatic hazards. Among the households in the *char* community women's participation in household decision making were found moderate in male and female headed households of both the study sites. The expand WATSAN facilities,

availability and functionality of health and education services during disaster is very low to moderate (1.8 to 2.6) in riverine and coastal *char* lands. Lower scores in social dimension in female headed households (1.6 to 2.1) were also noted in both Kunder Char and Char Chandia. Education is an important indicator of household resilience capacity to climatic hazards as illiteracy constrains the ability to understand the coping strategies in adverse situation, early warning and access to information. Better education levels also correlate with community preparedness which make it a more knowledgeable community to be better prepared for climate-related hazards and may respond (resilience) more positively to such an incident compared to a less-educated community. Figure 7.3 and 7.4 provides the social scenario of the study sites.

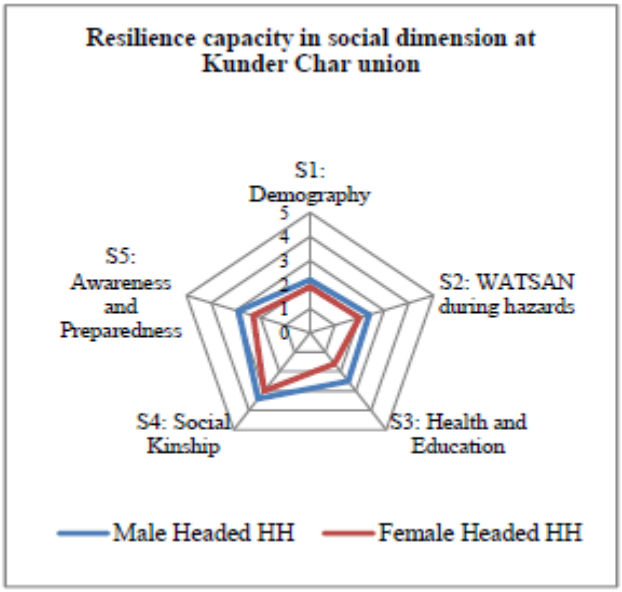


Figure 7.3 Social dimension of Kunder Char union

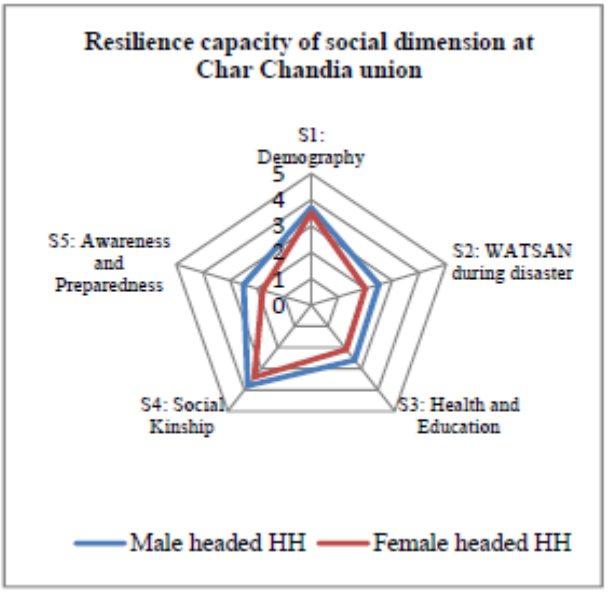


Figure 7.4 Social dimension of Char Chandia union

Social CDRI scores (figs 7.3 and 7.4) ranging between 2.2 to 3 shows that the households have low to moderate level of social resilience in both the *char* lands. It also varies in terms of households head and different *char* types aspect. It shows the overall low social resilience capacity value (2.7) in Kunder Char union and the moderate value (3) in Char Chandia union. In comparison to other dimensions social dimension is stronger in Char Chandia union than Kunder Char union. This is because of the fact that the coastal community has older settlement whereas most dwellers of Kunder Char union have been displaced during last few years and their social kinship are not in stable and strong position.

7.3 Resilience capacity: economic dimensions

Five important parameters for measuring economic dimension such as household income, expenditure, household assets, employment, credit and savings were considered to construct the economic dimension for CDRI (figures 7.5 and 7.6). The economic resilience scores depict that Kunder Char have low economic scores for both male headed households (2.4) and female headed households (2.3). The coastal Char Chandia union have lower scores in both male headed (2) and female headed households (1.6) indicating that this is less economically resilient than riverine *char* land. Employment would be complementary factors to enhance the *char* community's economic dimension of CDRI. The results show that the population has a positive correlation with income and expenditures mainly because of the increase in contribution of service sectors. Besides the education status of a person affects his occupation, income, skill and adaptation to modern technology (Hossain et al., 2009). Males are more literate than female members in both the study sites and therefore more economically resilient.

Women headed households are comparatively low resilient than male headed households in this dimension in both the sites. The female headed households of coastal *char* lands have lower income sources because of their illiteracy, unemployment or uncertain income sources. On

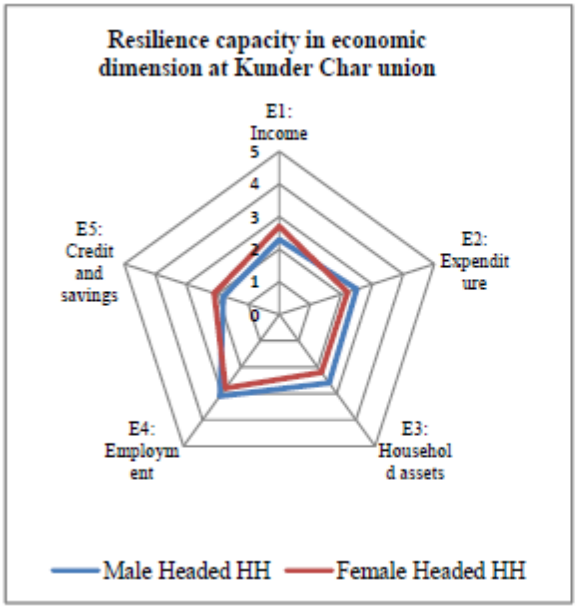


Figure 7.5 Economic dimension of Kunder Char

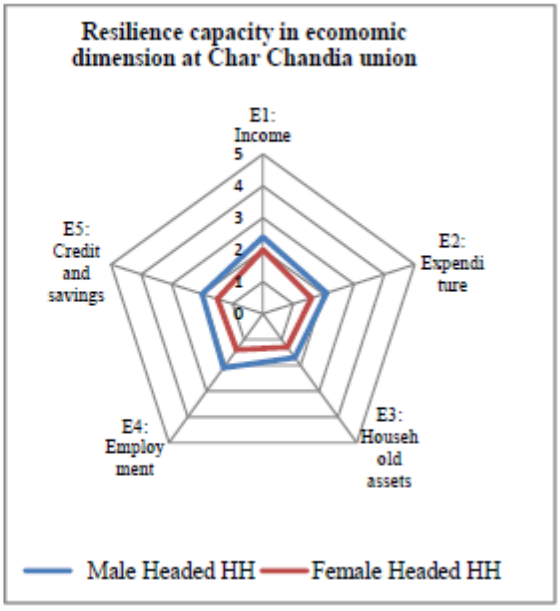


Figure 7.6 Economic dimension of Char Chandia

the contrary, female headed households of Kunder Char union have higher income then male headed households due to the earnings of their family members living abroad and sending remittance. Besides, they have more land ownership and better agricultural production and more income from farming. Their savings was also found higher than male headed households.

7.4 Resilience capacity: institutional dimension

Institution can be broadly defined as the rules, social norms and organizations that facilitate coordination of human action (Diaz and Rojas, 2006). A wide range of government institution and presence of NGO's can play a key role in supporting local community for coping practices in reducing vulnerability to climate change and building resilience capacity of vulnerable *char* land communities. This study fiound a positive correlation among institutional collaboration with organizational stakeholders and social and economical factors. For this study, some closely relevant parameters were considered to assess climate resilience capacity of the study sites with respect to institutional dimension that includes community responses in disaster risk reduction, household based coping practices, effectiveness of local government (UP) to respond to a disaster, access to educational institution and health facilities, access to cyclone and flood shelters, access to the nearest growth centers, institutional supports from MFIs and NGOs, institutional support from sub-national and local government. The social capitals mainly community kinship can play an important role in institutional collaboration with community-based organization and can be very effective in alternative decision making during disaster which can reflect the effectiveness of the crisis management framework. Households of this *char* sites have moderate access to emergency shelter and services as these are located within close proximity to *char* land sites. Among the services, the availability of primary education facility and hearth care centre within the vicinity of community is considered as indicators of climatic resilience capacity to disaster. It was found that being developed as a growth centre settlement, in the central part of the *char* sites has comparatively better infrastructural facility than other parts. In the two study unions, of the governments and other line agencies are found operating in the field.

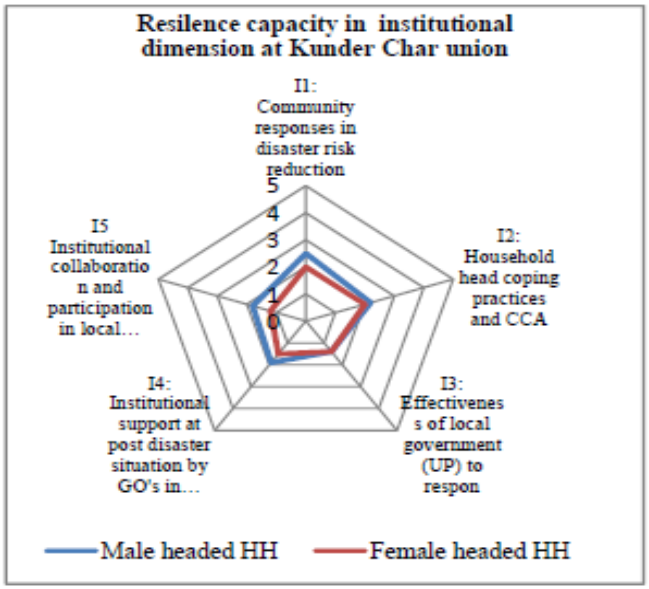


Figure 7.7 Institutional dimension of Kunder Char union

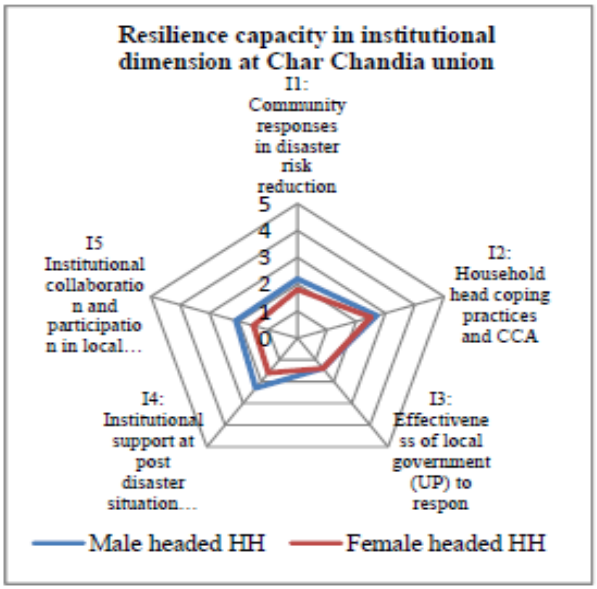


Figure 7.8 Institutional dimension of Char Chandia Union

Among these agencies Department of Agriculture Extension (DAE) and Department of livestock, average scored has been very low to low in terms of institutional dimension. However, coastal char community is better than riverine char community in this regard. Department of fisheries, Department of health, Department of Water and Sanitation, Local Government and Engineering Department (LGED), BMDA have block-level presence in both unions and other NGOs like BRAC, ASA, Grameen Bank, SDS are working at both study areas.

The result from the survey shows that intuitional dimension scores are very poor in both male (1.9) and female headed households (1.6) in Kunder Char union. In coastal *char* land of Char Chandia union where scores for male and female headed households were 2.1 and 1.5 respectively. It was noted that no training has been given to the local people regarding disaster impact reduction and disaster implications. As such general people and women in particular remain backward in community disaster response and institutional support in post-disaster situation.

7.5 Resilience capacity: natural dimension

Women play a unique role in the stewardship of natural resources and support households and communities. They are active agents of change in shaping adaptive mechanisms in vulnerable

areas. The vulnerability to climate change are adversely affecting the ecosystems and livelihoods of the char dwellers, especially in the coastal Char Chandia. As such lives and livelihoods of Char Chandia dwellers are highly stressed. The poorest people rely on local ecosystems to support their livelihoods. Many of the poor communities are struggling to cope with the ecosystem service and predictions of the impact of climate change suggest that this variability is likely to increase. Some of the farmers are managing to increase their resilience by planting crop varieties that are salinity tolerant and early maturing. A resilient ecosystem can withstand shocks and rebuild itself when necessary. For this study, some closely relevant parameters are selected to assess the natural resilience capacity which are- severity of natural hazards, frequency of hazards, severity of natural hazards, severity of damage and food security, availability of resource. The result of natural dimensions shows that the coastal Char Chandia union is less resilient (male headed households scored 2.6 and female headed households scored 2.2) because it is highly vulnerable to tidal surge due to its location near the coast. In comparison male headed households have moderate (3) and female headed households have low (2.7) level of resilience capacity in riverine Kunder Char. This is because knowledge of disaster and awareness which helped their communities in maintaining the ecosystem where they live (figs 7.9 and 7.10).

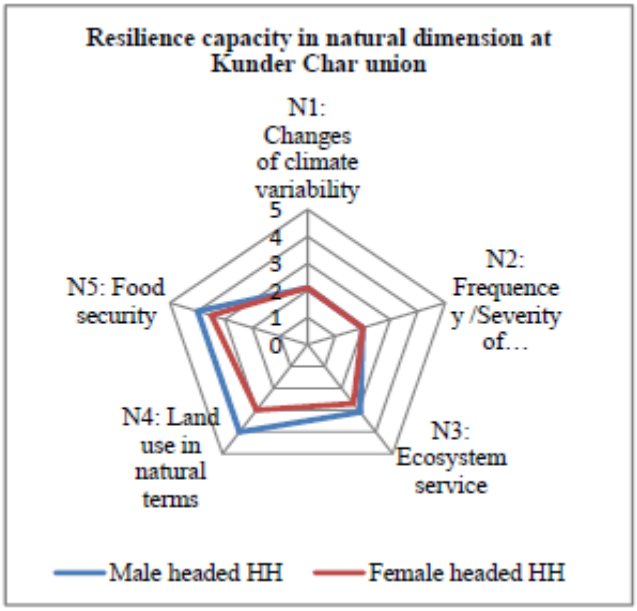


Figure 7.9 Natural dimension of Kunder Char union

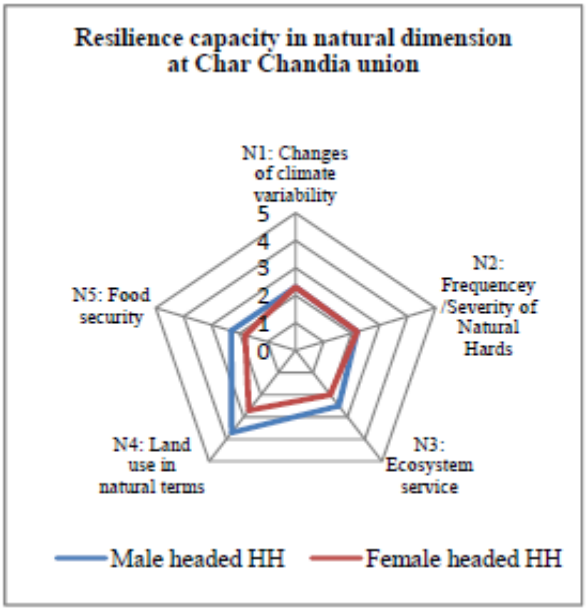


Figure 7.10 Natural dimension of Char Chandia union

Overall resilience capacity in study sites

Table 7.2 highlights the findings of overall resilience capacity of physical, social, economic, institutional perspectives of the study sites. The overall climate disaster resilience ranges from 1.5 to 5. The highest average score in all dimensions for male headed is 2.5 and 2.4 in Kunder Char and Char Chandia union respectively. On the other hand female headed households' average score in all perspective is little less 2.1 in Kunder Char and 2 in Char Chandia union. The relatively low score of women headed households show weaker resilience than male headed households in all dimensions may be explained by the fact of their high load of household chores, burden with heavy manual jobs, unemployment and uncertain income sources. Women are marginal in all respects both within the households and within the society.

Table 7.2 shows the average resilience value of different dimensions using CDRI results which compare the male and female headed household's resilience capacity. The overall climate disaster resilience perspective reveals that male headed households of riverine Kunder Char has

Table 7.2 Details of overall climate disaster resilience capacity from the CDRI perspective

Dimensions	Kunder Char union		Char Chandia union	
	Male headed HH	Female headed HH	Male headed HH	Female headed HH
Physical	2.4	1.8	2.4	2.1
Social	2.7	2.2	3	2.6
Economic	2.4	2.3	2	1.6
Institutional	1.9	1.6	2.1	1.5
Natural	3	2.7	2.6	2.2
	2.5	**2.1**	**2.4**	**2**
Overall resilience	**Kunder Char 2.3**		**Char Chandia 2.2**	

higher (2.5) overall climate disaster resilience because of its moderate physical (2.4), social(2.7), economic (2.4), institutional (1.9) and natural (3) values. The result reflects that the riverine site has better preparedness against climatic hazards due to good agronomic management, good households coping strategies and moderate cooperation and kinships in neighborhoods. On the

other hand, male headed households of Char Chandia have lower overall resilience value (2.2) because of its moderate social (3), low physical (2.4), low economic(2), low institutional (2.1) and low natural (2.6) resilience value. Such scores demonstrates medium to poor preparedness of both the sites against climate disaster vulnerabilities.

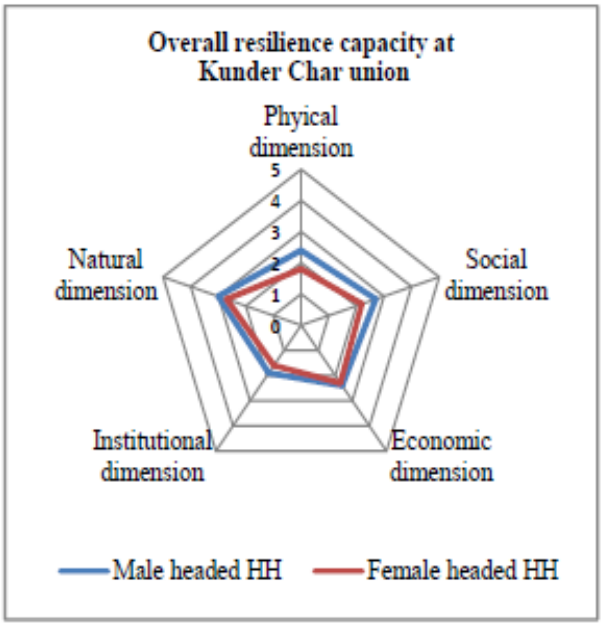


Figure 7.11Overall resilience capacity of Kunder Char union

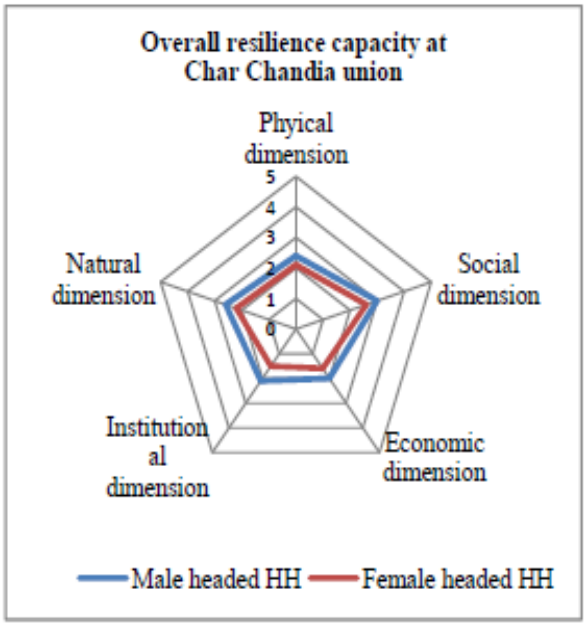


Figure 7.12 Overall resilience capacity of Char Chandia union

In terms of overall resilience, Char Chadia showed little lower CDRI scores (2.2) against 2.3 score of Kunder Char. In fact, Kunder Char scored more in all CDRI dimensions i.e. physical, social, economic, institutional, and natural (figure 7.11 and 7.12). It was observed that the poor scores in economic and natural dimensions have contributed to low level of overall CDRI scores in Char Chandia union.

The overall analysis of CDRI scores and the correlation between different sectors and issues imply a few common facts for the two *char* land sites indicating that both are poor and vulnerable to climatic hazards.

CHAPTER EIGHT

SUMMERY AND CONCLUSION

Bangladesh is frequently cited as one of the highly vulnerable countries to climate change induced natural hazards for its geophysical location, flat and low-lying topography between the mountain Himalayans in the north and that Bay of Bengal in the South with high poverty incidence and poor socio-economic condition. The frequent climatic extreme events are adversely affecting the poor, marginal communities and their livelihoods in different climate vulnerable zones of the country. As a result, millions of people are displaced from their homes and livelihoods. A large majority of the people of Bangladesh depends heavily on natural resources for their livelihoods which are depleting fast due to the climate change impacts, socio-economic factors as well as lack of institutional support. The central flood plain and coastal zone regions are highly affected by climate change impacts. People living within the fragile *char* lands of these zones suffer from multiple and unique forms of vulnerability caused by climatic hazardous events. The *char*-women in particular are suffering more for multiple and frequent natural hazards. This study focused upon the vulnerabilities issues of the *char* land women which are closely related to their lives, livelihoods and daily activities in different climatic hazards considering their social and economic status, extent, magnitude and duration of hazards, etc.

The findings of the study indicate that homesteads of the study sites usually stand on elevated mounds in *Char* lands. The elevation of the study sites area varies between 1.5 to 2.0 meters from agricultural field, while average plinth level of housing structures varies between 2.5to3.0 meters from agricultural land in riverine Kunder Char union. Every homestead looks like a small hillock in the dry season and like a small island in the monsoon season. The elevation of the homestead area varies between 0.5 to 1.0 meters from agricultural field and average plinth level of housing structures varies between 1.0 to 1.5 meters in coastal Char Chandia union. It was revealed that the women headed households of both study sites have small amount of homestead land (7.8 decimal in Kunder Char and 7.7 decimal Char Chandia) which is lower than male headed households (8.1decimal in Kunder Char and 16.7 decimal in Char Chandia). It was noted that the operated agricultural lands of female headed farming households in riverine *char* land was significantly smaller land size (70 decimal) than male headed farming household (166 decimal). On the other hand, female headed farming households of Char Chandia union have larger operated

land (31 decimal) than male headed households (16 decimal). As the agricultural production is not profitable because of tidal surge and salinity intrusion in coastal char areas, the male headed members are more involved in other non-farm livelihood activities or working abroad. It was also observed that the wealthier households have stronger and safer housing structures in both study sites.

The educational establishments of the both study areas are in poor condition due to insufficient fund, frequent shifting of structures due to erosion, improper management, difficult transport and communication facilities, lack and absence of teachers, involvement of children in income generation activities and high educational expenses. Despite these limitations, the proportion of female students (13%) is higher than male students (12%). 23 percent of total population of Kunder Char comprises students, while in Char Chandia union is 27 percent where 12 % are male students and 14 % are female students respectively.

The access to healthcare services in the study areas is extremely poor. These vulnerable *char* dwellers especially the children and old people suffer more from health complications like fever, cough and cold, diarrhoea, dysentery, skin disease, etc. There is no good health care center and certified skilled doctor in both the *Char* sites. So, the dwellers have to depend on non-certified doctors or local pharmaceutical shops or quacks within the locality for tiny sickness. The survey result shows that the difficult communication system in the monsoon season and remote location of the areas, the field staffs of health department are reluctant to visit these vulnerable villages. As many of the dwellers of both the *char* fall below poverty line, so they depend fully on upazilla health complex for major health complications located far away from their localities. Many *char* women remain out of health care services particularly for gynecologic complications. Pregnant women are more vulnerable and suffer the most during disasters. In general, the *Char* people badly need basic health care services.

The members of both male and female headed households in both the study areas are involved in farming and non-farming based primary and secondary livelihoods like farm-based wage labour, non-farm wage labour, cattle and poultry rearing, fishing, homestead gardening, tailoring, rickshaw driving, handicrafts making, sewing etc. The *char*-land women are usually in charge of the entire household responsibilities- childcare, homestead gardening, poultry and livestock rearing. These women in farming households (42 percent in Kunder Char and 43 percent in Char Chandia union) are also engaged more or less in farm based livelihoods like crop

harvesting, husking, crop processing, seed preservation, etc. Some extreme poor *char* women of both sites are involved in farm based wage labor and small business within the village. In addition, riverine flood plain *char* women remain engaged in making handicrafts (bamboo made product, quilt/*kantha* making) during monsoon. Some poor women work as day laborer in government sponsored food for work programmes such as 'Goat rearing', 'Thirty days programme for village development' etc. Failing to find employment within their own village, some women from landless households temporarily move to work in mills and factories of the nearer urban centers for cash earning. The study revealed that during disasters adult and some older women and men who have no or irregular income try to earn money by selling their assets like trees, furniture, ornaments, and stored crops to meet their basic needs for survival. Poor women have to struggle more for disruption of livelihoods due to changes in the climate. The overall climate change hazards affect on women's livelihoods more than those of men because of their dependence on natural resources and environment for the most of their activities to meet the basic needs of their families.

Annual income is an important indicator of household status. Kunder Char union has comparatively higher annual average income (81,300 BDT) than Char Chandia union (74,000 BDT). It shows that Char Chandia union has 9% less average household income than Kunder Char union. The study found that the annual income of female headed households is 69,600 BDT in Kunder Char union and 52,200 BDT in Char Chandia union. It means that in both study sites annual income of female headed households is lower than the male headed households. It may therefore be stated that the continuing vulnerability of *char* land women for seasonal hazards reduces livelihood opportunities, household income and employment of *char* people.

The percentage of expenditure on food is an indicator of poverty. It has been found that the expenditure on food is higher in climate vulnerable *char* areas - 89 percent of the total annual budget in Char Chandia compared to 75 percent in Kunder Char union. So, they are almost unable to meet their other needs. Some males of the study sites become unemployed during and post-hazard period. They are forced to migrate to urban areas for earning to cope with such situations. Then women are left at home and have to bear all household activities including caring for the children as well as looking after the family solely. Thus they are put under extra pressure. The effect of natural disaster is much more severe on women than men because of the biological and psychological factors and family responsibilities. So, all these make them more vulnerable to hazards. Weak housing structures are an important aspect of vulnerability in *char* land settlements.

The *char* women are active participants in taking care of their household properties and support their male members in homestead repair and maintenance like thatching, polishing the mud floor of their houses, plastering, etc. But these activities remain invisible and unrecognized. Women have to encounter various climatic hazards carrying out their regular activities that cause great sufferings to their life and bring a lot of miseries. Many households in the study area are forced to shift away from their homesteads due to riverbank erosion and flood, when women have to adjust and continue her activates in difficult situations. The respondents of the study areas mentioned that climatic hazards cause heavy loss of their production, their physical structures and others livelihood assets. It is also noted that among the livelihood activities farm-based wage labour and farming livelihoods are severely affected by all kinds of coastal hazards and ranked in first and second respectively in the context of level of vulnerability. Women in both the study sites usually devote more time for household activities like cooking, food processing, fuel and water collection, washing clothes and utensils, cleaning/sweeping/mud polishing rooms, looking after children and other family members. But disasters make all these activities tough to carry out especially collection of jute sticks, drying cow dung, straws, etc.. As a result, many *char* women store fuel woods in kitchen ceilings for using them during hazard/disaster time.

Char women of both the study sites have adapted to live with hazards with their own coping mechanism that enabled them to survive with hazards. The coping strategies of both types of *char* land women are influenced by their activities, knowledge, skills, resources as well as their experiences. The *char* dwellers usually have multiple perceptions and diverse coping strategies that lead to multiple responses at household-level and community level.

Soil erosion is a continuous process in the char land areas. To prevent soil erosion from wave and river erosion, the *char*-dwellers plant different kinds of vegetation like cane plant and catkin grass in and around their homestead area. Some people also make temporary fences with bamboo, jute-stick, and water hyacinth to protect soil being eroded away from their homesteads. This is a very common practice of homestead protection in the study areas. For house repairing and maintenance, men are responsible for digging mud and women are responsible for plinth raising and polishing work. Maintaining kitchen is usually women's responsibility. They prepare and repair earthen ovens and are damaged by each inundation.

Meal preparation and food processing become very challenging for women during hazards as the kitchen becomes inundated or damaged by flood or tidal surge. Purchasing of food items on

credit is common practice in both the study sites during disasters. Women's nature is very important in terms of borrowing dry food from their well to do neighbors. Modification of food habits and management of daily necessities at minimum expenses become one of the important coping strategies of the households that include reduction in meal frequency. The variety of food items is also reduced and many survive from only eating rice with water and salt. Women usually cook food once a day to minimize the problem of cooking and fuel use in critical situation. Washing utensils during safe water scarce situation is also a great problem. The common practice of *char* land women is to reduce own food consumption and save it for other members of the family hindering sometimes their health. The households also suffer from income loss and do not get enough credit to purchase food items during such disaster time and food security becomes critical. The most of the fruits, vegetables and spices grown by women are sold to meet household expenditure during hazard periods besides home consumption. As their home gardens are submerged and lack of a flood-free land during flood, women of Kunder Char union usually cultivate vegetable on raised ground up to one meter height usually done by earth filling from flooded lands. Creeper vegetables are also planted on pots that grow on roof tops or trees in both the study sites. Storage of food, particularly the dry food like puffed and pounded rice (*chira, muri)*, potato, eatable seeds, oil and spices are also a common practice by the women as a disaster mitigation strategy.

Domestic water supply in the *char* land areas of Bangladesh is not satisfactory. Only river water is used for household purposes in dry season (winter) as some of the village ponds and ditches dry up. Shallow and some deep tube wells are used as only source of drinking water in the both *char* lands. Women, during dry period, collect water for drinking from tube-wells located on high ground or from distant places which is troublesome and risky. Children of the family join in fetching drinking water. The survey revealed that nearly half of households (41 percent in Kunder Char and 58 percent in Char Chandia) have no tube-well facilities at all. These households collect safe drinking water from their neighbors. The most of the respondents mentioned that they preserve drinking water before cyclone or tidal surge and collect containers to carry and save enough water for emergency use. The households that do not have the capacity to collect drinking water from neighbors store it in plastic containers.

The *char* dwellers take protective measures to keep the latrines fully or partially usable by various means. Temporary bamboo bridges are sometimes made to reach the flooded latrines.

When toilets become totally unusable, temporary hanging latrines are constructed by raising the base of toilets supported by bamboo or a tree. Poor households use neighbors' latrines or defecate in the open from boats or floats. The mothers having infants devote considerable time and attention for child care during the disaster situation in fear of any accident. But in many cases they are unable to allocate enough time during hazards as they are burdened with different kinds of household tasks for preparing and coping with the situation. Caring activities are, therefore, shared by elderly women and men or young girls and boys of the household.

The inquiry into the resilience capacity of *char* women shows that the Char Chandia women are less resilient than Kunder Char women. It was observed that the main reasons for low resilience in terms of physical dimension are the weak housing structure, existing land use practices, small size of homestead area and poor water and sanitation system and inadequate access to safe drinking water. The social part of Climate Disaster Resilience Index (CDRI) scores ranging between 2.2 to 3 (in a scale of 1-5) shows that the households have low to moderate level of social resilience in both the *char* lands. The low level of education and awareness, poor health status in general are responsible for such state of the social dimension of resilience in both study sites. In comparison to other dimensions, social dimension is stronger in Char Chandia than Kunder Char. The CDRI scores of economic resilience depict that Kunder Char also have scored low in this respect for both male headed households (2.4) and female headed households (2.3). The coastal Char Chandia union in this respect have also scores low in both male headed (2) and female headed households (1.6) indicating that this is less resilient than riverine *char* land in economic dimension.

Employment is a complementary factor to enhance the *char* community's economic dimension of CDRI. Women headed households are comparatively less resilient than male headed households in economic dimension in both the sites. The female headed households of coastal *char* lands have low income because of their illiteracy, unemployment or uncertain income sources. But the female headed households of Kunder Char union have higher income than male headed households due to the earnings of their family members living abroad and sending remittance. The result from the survey shows that institutional dimension scores are very poor in both male (1.9) and female headed households (1.6) in Kunder Char. The scores for male headed households is 2.1 compared to 1.5 of the women headed households in Char Chandia. The study noted that the training facilities to the local people regarding disaster implications and disaster impact reduction

were almost non-existent as no such training was received by the respondents in this regard. Therefore, the people of the areas and women in particular remain backward in community disaster response and institutional support in post-disaster situation.

The result of natural dimensions shows that the Char Chandia is less resilient (male headed households scored 2.6 and female headed households scored 2.2) because it is highly vulnerable to tidal surge. Male headed households have moderate (3) and female headed households have little low (2.7) level of resilience capacity in Kunder Char as they possess better knowledge of disaster education through institutional support and indigenous knowledge which helped their communities in maintaining the ecosystem where they live.

The overall climate disaster resilience score shows that female headed households' average score in all perspective is almost the same - 2.1 in Kunder Char and 2 in Char Chandia union. The low score of women headed households show weaker resilience than male headed households in all dimensions may be explained by the fact of women's high load of household chores, burden of heavy manual jobs, unemployment and uncertain income sources were responsible for this. It has been noted that with few exceptions women are marginal in all respects both within households and within the society in the studied areas. The overall climate disaster resilience perspective reveals that male headed households of riverine Kunder Char has higher (2.5) resilience because of its moderate physical (2.4), social (2.7), economic (2.4), institutional (1.9) and natural (3) values. The result reflects that the riverine site has better preparedness against climatic hazards due to fair agronomic management and good households coping strategies and moderate cooperation and kinships in neighborhoods. On the other hand, male headed households of Char Chandia have comparatively lower overall resilience value (2.2) because of its moderate social (3), low physical (2.4), low economic(2), low institutional (2.1) and low natural (2.6) resilience value. This also demonstrates medium to poor preparedness against climate disaster vulnerabilities.

It could, therefore, be concluded that despite their low CDRI scores (2.1 in Kunder Char and 2 in Char Chandia) and many other limitations, the *char* land women's main resources are their confidence, indigenous knowledge and hardworking capacity in harsh situation induced by climatic hazards. They demonstrate their resilience to cope with any adverse climatic hazard situations and are able to apply their skill to mitigate the problems when impacted by climate induced hazards.

Problem encountered during the research

Since the study areas are vulnerable and are hard to reach areas, it was highly difficult to visit such areas frequently and stay there in hazardous situation. As most of the respondents were illiterate and were busy with their daily activities, it was not easy to get their response in one session. As such several attempts were made to collect accurate information; some respondents were reluctant to cooperate when they knew that there was no financial benefit out of this research. Every research has some limitations and this study is not beyond those limitations. The observation of the research lacked the real scenario of various types of hazards like storm surge, cyclone etc. In few cases the respondents were missing because of their displacement due to hazards or livelihood searching.

Directions for future research

Bangladesh is already experiencing the effects of climate change in the form of erratic rainfall behavior, frequent climatic hazards and severe disaster. The *char* areas are highly vulnerable in this regard. Women, living in these areas, are most vulnerable among the affected groups. Virtually no research has been undertaken to identify the climate change hazards vulnerability of the *char* lands. *Char* women, who are the most vulnerable groups, were mostly overloaded in these studies. This research has examined the vulnerability of women in the context of climate change hazard and their resilience capacity and added the important information to the body of knowledge. However many aspects remains to be researched. Some of these are as follows:

- **i.** research is needed to other environmentally fragile areas to fill up the knowledge gap regarding the vulnerability of women at risk;
- **ii.** studies should be undertaken to find out linkages between gender and climate change issues in a wider perspective;
- **iii.** further research is needed on women's resilience capacities in relation to climate change may reveal the indigenous practices that could be replicated in other parts of the country.
- **iv.** urgent study should be undertaken for up scaling the adaptation practices to minimize the loos and damage in climatic hazards vulnerable areas in Bangladesh.

v. research is also needed to reveal the suitable climate context livelihood options for women in vulnerable areas

Recommendations and policy implications

There is an urgent need to pay particular attention to the multiple climatic hazard induced vulnerable communities to enhance their gender sensitive responses, climate resilient preparedness activities and decision making capacity of *char* land women living with the climate hazards. The following recommendations are made to strengthen gender-sensitive response.

- Available natural resource based income generation activities and need-based skill development trainings should be introduced for the *char* land women;
- Entrepreneurs should be encouraged for poultry rearing, improved horticulture practices, tailoring and sewing, dry food preparation and packaging, etc. SME training may be arranged by GOs and NGOs aiming at the climate vulnerable *char* land women especially the poor female headed households to enhance their income;
- GOs and NGOs should pay special attention to provide basic services like education, health care, and rehabilitations of these vulnerable *char* land community and women in particular;
- Sustainable transportation and communication system should be developed to improve the mobility and accessibly of the vulnerable *char* people to reach the nearby growth centers to avail different services and facilities;
- Capacity of union disaster management committee should be enhanced with necessary equipments;
- It is highly recommended to disseminate appropriate technologies and knowledge in climate vulnerable *char* communities for addressing the negative impacts of climate change hazards to strengthen their livelihood;
- It is recommended to introduce *char* community-based disaster preparedness training in order to reduce loss and damage;
- Active flood plain and exposed coastal communities management plans should be undertaken to provide the basic services in local context;
- Knowledge shearing sessions could be arranged by the GOs and NGOs to the climate vulnerable *char*-dwellers especially women form poorer groups in connection with sustainable livelihood responding to climate stressed situation;

- An early warning system can save life, property and their traditional livelihood of the *char* dwellers. The *char* communities do not know how to react to the flood or erosion forecasts/ warning information. Therefore, flood and cyclone warning on time in local dialect is needed to ensure the safeguard of the affected people.
- Young volunteers should be trained to evacuate the elderly, sick, children and pregnant women and move them to safer places during disasters and monitor their needs properly. Regular community based Focus Group Discussions to disseminate knowledge in this regard may come handy.

Finally I would like to conclude by quoting *Cecilia Schubert saying* "A woman's resilience to the various impacts of climate change depends on her social status, her access to resources, and involvement in social networks. In some cases, one woman can be more resilient than her neighbor, and even be more resilient than some men in her village. Women are also not necessarily victims of climate change but can contribute to finding solutions on how to cope with climate change (*Cecilia Schubert*, 2012).

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Annexure -1

University of Dhaka

Department of Geography and Environment

Climate Change Hazards Vulnerability and Resilience Capacity Assessment of *Char* Land Women of Bangladesh

Interview Schedule for Household Survey

Date: **Time:**

Household Identification				Types of HH Head (√)		Types of HH (√)	
Union	Mouza	Village ID	Household ID	Male Headed	Female Headed	Farm HH>5dcml	Non-farm HH<5dcml

Union: 1= Char Chandia (CC), 2= Kunder Char (KC); **HH Head:** 1=Male, 2=Female; **Types of HH:** 1=Farm, 2=Non-farm;
Mouza: 1=Char Chandia, 2= Purba Bara Dhali, 3= Babur Char, 4= Eakub Matabbarer Kandi, 5= Kalmir Char
Village: 1= Chhoto Gram Samaj (CGS), 2= Haji Jinnat Ali Samaj (HJS), 3= Purba Bara Dhali (PBD),
4= Saral Khar Kandi (SKK), 5= Eakub Matabbarer Kandi (EMK), and 6=Kalu Bepari Kandi (KBK);

A. Socio-demographic Information

1. Household member's information (including household head✱ and Women respondent®: ……

Sl. No.	Name	Age	Sex	Relation with HH head	Marital Status	Year of schooling	Major Occupation	Secondary Occupation	Remarks
1✱									
2®									
3									
4									
5									
6									
7									
8									
9									
10									

Relation: 1=Respondent him/herself, 2=Household head, 3=Son, 4=Daughter, 5=Wife, 6= Husband, 7=Father, 8=Mother, 9=Brother, 10=Sister, 11=Grand Father/Grand Mother, 12=Others (specify _____)
Sex: 1=Male, 2=Female , **Marital status**: 1=Married, 2=Single, 3=Widow/Widower, 4=Divorced, 5=others
Occupation code: 1=Agriculture, 2=Business, 3=Salaried employee, 4=Fishermen, 5=Wage labor, 6=Construction labor, 7=Transport labor, 7=Fisherman, 8=Homemaker, 9=Student, 10=Unemployed, 11=Unable to work, 12=Pre-school child 13=Not applicable, 14=Others (specify _____).

2. Land ownership pattern

Land type	Ownership pattern with respect to land type and amount of land			
	Homestead	Agricultural	Fallow land	Total
Land size (decimal)				
Present market value of land (BDT)				

N.B. Unit: 100 Decimal = 1 acre; 33 Decimal = 1 Bigha

3. Status of drinking water:

1= Fresh	2=Saline affected	3= Arsenic affected	4=Iron affected	5=Polluted by environment

4. Sources of **drinking water** (Make circle-Answer may be more than one):

1= Deep tube well	2= Shallow tube well	3=Pond/Ditch /wetland	4= River	5= Dug well	8=Rainwater Harvesting System (RWHS)	9=Others (Specify....)

5. Sources of **domestic water usage** (Make circle-Answer may be more than one):

1= Deep tube well	2= Shallow tube well	3=Pond/Ditch /wetland	4= River	5=Dug well	8=Rainwater Harvesting System (RWHS)	9=Others (Specify..)

6. Types **of latrine** used (Make circle):

1= Semi-pacca	2= Ring-slab	3= Open latrine	4= No latrine

7. Does your house have **electricity** (Make circle)?

1= Yes	2= No	3= Others (Specify here)……

If yes, what type of **ele**ctricity do you use?

1= Power Grid	2= Solar energy	3= Local Electricity Production (Generator)	4=Others (Specify here)…….

8. Ownership **of household assets** according to Sex (Male/Female):

Sl no.	Asset	Quantity	Value of the asset (BDT)	Sex code		
				Male	Female	Both
Immovable asset						
i.	Tree			1	2	3
ii.	Homestead area			1	2	3
ii.	Livestock-shed			1	2	3
v.	Toilet			1	2	3
v.	Kitchen			1	2	3
	a. Sub-total					

Movable asset						
vi.	Living house			1	2	3
ii.	Livestock (Cow/ Goat/lamb/other			1	2	3
ii.	Poultry/bird			1	2	3
x.	Fishing Instruments			1	2	3
x.	Agricultural instruments			1	2	3
xi.	Furniture			1	2	3
ii.	Mobile phone/Radio			1	2	3
ii.	Others (specify)			1	2	3
b. Sub-total						
Total (a+b)						

9. Household income distribution

Sector of income	Income in BDT	Gender contribution in %	
Agricultural sector		Male	Female
Farming			
Farm-based wage labour			
Livestock & poultry rearing			
Fishing			
Others (Farm)			
a. Sub-total			
Non-agriculture			
Business			
Service			
Non-farm wage labour			
Remittance			
Others (Non-farm)			
b. Sub-total			
Grand total (a+b)			

10. Household **expenditure** (Annual)

Purposes	Expenditure in BDT
Food	
Health	
Education	
House repair and maintenances	
Savings	
Others	

11. Do your households have received any amount of credit/loan in the last 12 months?

1 = Yes	2 = No

12. If yes, what type of sources and amount of credit/loan have you received?

Sources	Amount in BDT	Purposes
Schedule Bank		
MFI/NGOs		
Relatives		
Money lenders		

B: Risk and Vulnerability Assessment of *Char* land Women

13. Sector wise risks and vulnerabilities of *Char* land women due to **Flood/ Tidal surge hazards:**

	Climate Hazard Risks				Prepared activities	Coping practices
Sector	N =1	L=2	M=3	H =4		
Meal preparation						
Cooking						
Fuel collection						
Drinking water collection						
Child caring						
Taking care of family member						
Child education						
Agricultural activities						
Homestead gardening						
Family health care						
House maintenance						
Washing cloths						
Community networking						
Mobility						

14. Sector wise risks and vulnerabilities of *Char* land women due to **Cyclone/ Storm hazard:**

	Climate Hazard Risks				Prepared activities	Coping practices
Sector	N =1	L=2	M=3	H =4		
Meal preparation						
Cooking						
Fuel collection						
Drinking water collection						
Child caring						
Taking care of family member						
Child education						
Agricultural activities						
Homestead gardening						
Family health care						
House maintenance						
Washing cloths						
Community networking						
Mobility						

15. Sector wise risks and vulnerabilities of *Char* land women: **Riverbank erosion**

	Climate Hazard Risks				Prepared activities	Coping practices
Sector	N =1	L=2	M=3	H =4		
Meal preparation						

Cooking						
Fuel collection						
Drinking water collection						
Child caring						
Taking care of family member						
Child education						
Agricultural activities						
Homestead gardening						
Family health care						
House maintenance						
Washing cloths						
Community networking						
Mobility						

C: Climate change knowledge and impact

C1. Have you heard about weather/climate/seasonal change?

1 =Yes	2 = No

C2. Do you observe any changes in the weather/climate in last 20 -30 years?

Sl. No.	Name of event (Make circle)	Increase/decrease (Make circle)		
		1= Increase	2=Decrease,	3= No change,
1	Flood	1	2	3
2	Temperature	1	2	3
3	Drought/ lack of rainfall	1	2	3
4	Excessive/Heavy rainfall	1	2	3
5	Sea level rise/	1	2	3
6	High tide	1	2	3
7	Cyclone	1	2	3
8	Tornado	1	2	3
9	Tidal surge	1	2	3
10	Salinity intrusion	1	2	3
11	River erosion	1	2	3
12	Other (specify……)	1	2	3

C3. Do your livelihood/ Household assets affected by any climatic/natural disasters? (Make circle)

1. Yes 2. No

C4. How the sources of household income do is being affected by natural disaster /climatic hazards:

Income sources	Natural disasters/hazards										
	Flood	**Increase Temperature**	**Drought /Lack of Rainfall**	**Excessive Rainfall**	**Sea level/ tide level rise**	**Cyclone**	**Tidal Surge**	**Salinity**	**Water-logging**	**River bank erosion**	**Other (specify)**
Crop production											
Horticulture											
Fishing (Capture)											
Fish cultivation (Open wetland)											
Livestock rearing											
Poultry rearing											
Agricultural wage labor											
Non farming wage labor											
Business											
Service											
Remittance (from abroad)											
Others (specify)											
Code: Very high=5, High=4, Moderate=3, Low=2, Very low =1.											

D. Role of women and decision making at household level

D1. **Role and performance at household level (Gender-wise):**

SL	Activity	Normal Period			Disaster Period		
1	Meal preparation	1	2	3	1	2	3
2	Collection of drinking water	1	2	3	1	2	3
3	Collection of domestic water	1	2	3	1	2	3
4	Livestock rearing	1	2	3	1	2	3
5	Poultry rearing	1	2	3	1	2	3
6	Taking care of children	1	2	3	1	2	3
7	Taking care of elder members	1	2	3	1	2	3
8	Crop farming	1	2	3	1	2	3
9	Crop harvesting	1	2	3	1	2	3
10	Post harvest activities	1	2	3	1	2	3
11	Homestead gardening	1	2	3	1	2	3
12	Non-farm labour	1	2	3	1	2	3
13	Small business	1	2	3	1	2	3
14	Fuel collection	1	2	3	1	2	3

15	Fish/Shrimp culture	1	2	3	1	2	3
16	Shrimp fry collection	1	2	3	1	2	3
17	Service	1	2	3	1	2	3
18	Going to market	1	2	3	1	2	3
19	Going to Health Care centre	1	2	3	1	2	3
20	Going to the Bank	1	2	3	1	2	3
21	Receive credit from NGO	1	2	3	1	2	3
22	Participation in NGO activities	1	2	3	1	2	3
23	Homestead maintenance	1	2	3	1	2	3
24	Housing structure maintenance	1	2	3	1	2	3
25	Other (specify)……	1	2	3	1	2	3
Gender Code: 1 =Male, 2=Female, 3= Both							

D2. Describe the decision making process of your family by Sex (Male/Female):

SL	Decision making	Normal period			During disaster		
1	Food related (Meal preparation, distribution etc.)	1	2	3	1	2	3
2	Meet up food deficit	1	2	3	1	2	3
3	Selling assets (land, house, livestock, seeds)	1	2	3	1	2	3
4	Selling agricultural production (crops, seeds)	1	2	3	1	2	3
5	Buying household assets (livestock, ornament, trees, buy house etc.)	1	2	3	1	2	3
6	Buying agricultural production (crops, seeds etc.)	1	2	3	1	2	3
7	Receive credit from (Mohajon/relatives/bank/NGO/GO)	1	2	3	1	2	3
8	Agricultural work (Crop cultivation, land mortgage etc.)	1	2	3	1	2	3
9	Household work (Collection of Water, Collection of natural resource e.g. fuel wood etc.)	1	2	3	1	2	3
10	Household decision making (Engage in new income generating activity, Conceiving a baby, Use saving, ownership of VGD/ VGF)	1	2	3	1	2	3
11	Female and children healthcare decision making	1	2	3	1	2	3
12	Decision making about communication (Female going outside the homestead, going for work, education for children)	1	2	3	1	2	3
13	Decision making on disaster preparedness/coping/adaptation (Going to a shelter, Engage in alternative livelihood activities, collection of relief materials)	1	2	3	1	2	3
14	Other (Specify here)						
		1	2	3	1	2	3
Sex code: Male =1, Female=2, Both=3							

E. Health Care System

E1: Information on frequency of diseases suffered by the HH members in the last 12 months:

Name of Disease	HH members above 5						HH members below 5					
	Male			Female			Male			Female		
	How many persons	How many times	How many days	How many persons	How many times	How many days	How many persons	How many times	How many days	How many persons	How many times	How many days
Diarrhea												
Cholera												
Dysentery												
Jaundice												
Skin disease												
Typhoid												
Pneumonia												
Fever/Cold -cough												
Malaria												
Kidney Diseases												
Others (specify here)												

E.2 Information on diseases (Specially Women) suffered by the HH members in the last 12 months:

Only Female health issues		How many person	How many times	How many Days
a.	Pregnancy related			
b.	Menstrual problems			
c.	Problems related to ovum			
d.	Others (specify)			

E3. Have you/ your family received any medical care during normal period?

1 = yes	2 = No

E5. If yes, from which source do you receive medical support? (Make circle-Answer may be more than one)

1= Government health centre/community clinic	2= NGO health facility	3= Private health facility	4= Pharmacy/dispensary
5= Quacks	6= Herbal/homeo treatment	7= Staying home	8= Others (Specify)

E6. What is the condition of MNCH (Maternal and Neo- natal Child health) facilities in your locality?

1=Bad, 2=Fair, 3=Good

E7. What are the specific **problems** that **women** have to face due to climatic **disaster?** (Make ✓ Tick Mark)

SL	Problems	Normal period	During disaster	Post disaster
1	Insecurity /Social Insecurity			
2	Domestic Violence			
3	Increased work load			
4	Increased drop off from school			
5	Restriction of mobility (to shelter, relief collection)			
6	Water & Sanitation Problem			
7	Health Care Problem			
8	Other (specify here)……..			

F. Livelihood of women / Capacity Building Activity:

F1. In what types of income generation activities involved by women in your HH?

1=Homestead gardening	2=Horticulture	3=Poultry	4= Fish & shrink cultivation	5=Livestock
6=Tailoring	7=Embroidery/Batiks & printing	8=Handicraft	9=Small business	10=others-indicate

F2. Is there any disaster management committee exists in this area?

1=Yes	2=No

F3. If yes, what initiatives were taken by the disaster management committee of this area?

1= Aware every one	2= Bring to the shelter	3= Financial help	4= Distribute Relief	5=Help in preparedness	6= others

F4. Did you or any of your family members receive any training on disaster management?

1= Yes	2= No

F5. Does any female member of your household have received training on income generation or livelihood activity? (Make circle)

1= Yes	2= No

F6. Generally, what do you/your female family member do by the money from selling commodities/products?

1= Handed over the earned money to the male member of the family	2= Invest in same livelihood activities	3= Invest in other livelihood activities
4=Deposit in Bank	5= Invest in NGOs	6= Others (Specify here)……

F7. Is that earned money is sufficient to cope with climate change induced disaster? (Make circle)

1=Yes	2=No

F8. If yes, how you/your family spent such money for adaptation?

1= Create alternative way of earning	2= Better livelihood for women	3= Ensuring safe food and water	4= Others (Specify here) ……

F9. How the capacity of women should be developed to reduce climate induced risks?

1= Make women aware about the climate change impact	2= Participation of women in climate risk management	3= Forming new small entrepreneur	4= Participation of women in local government activities
5= Managing new livelihood options for women (e.g. homestead gardening)	6= Running new income generating project for women= (Handicraft or others)	7= Forming local people based organization (C.B.O) in participation of women.	8= Other (specify here) …….

G. Social safety of women

G1. Do the women face any social security risk due to climate change impact?

1= Yes	2= No

G2. As your perception, for ensuring women's social safety net what sustainable initiatives should be taken?

1= Economic empowerment of women	2= Increase of women's literacy rate	3= Enhance participation of women in social activities	4= Enhance participation of women in local government
5= Develop women's decision making	6 = Develop women's health system	7= CBO formation with the contribution of women	8= Others (Specify here)……..

H. Food Security

H1. Do you have sufficient own production for the year round household food consumption?

a) Yes b) No

H2. If no, which time of the last year you faced problem in food production?

Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Causes												
Damage type												

Causes: 1=financial crisis, 2=lack of seed money, 3=crisis of seed & fertilizer, 4=early flood, 5=seasonal flood, 6=catastrophic flood, 7=drought, 8=cyclone, 9=tornado, 10=Salinity, 11=others

Damage type: 1=Very high, 2=high, 3=moderate, 4=low, 5=very low

H3. Do you have sufficient own production for the year round household food consumption? a) Yes b) No

H4. What time of the last year you had most food scarcity and why?

Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Demand type												
Causes												

Demand type: 1=Very high, 2=high, 3=moderate, 4=low, 5=very low

H5. What time of the last year you faced problem in food production?

Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Causes												
Damage type												

Causes: 1=financial crisis, 2=lack of seed money, 3=crisis of seed & fertilizer, 4=early flood, 5=seasonal flood, 6=catastrophic flood, 7=drought, 8=cyclone, 9=tornado, 10=Salinity, 11=others

Damage type: 1=Very high, 2=high, 3=moderate, 4=low, 5=very low

H6. During last 1 month how many times you have bought rice for your household?	1. Never 2. Seldom-(1/ 2 times a month) 3. Sometimes (1/ 2 times a week) 4. Often (3/ 4 times a week) 5. Most of the time 6. (5/ more than 5 times a week)
H7. During last 1 month how many times a day you or any other member of your household had to starve for scarcity of food?	1. Never 2. Seldom-(1/ 2 times a month 3. Sometimes (1/ 2 times a week) 4. Often (3/ 4 times a week) 5. Most of the time 6. (5/ more than 5 times a week)

Annexure -2

University of Dhaka

Department of Geography and Environment

Climate Change Hazards Vulnerability and Resilience Capacity Assessment of *Char* Land Women of Bangladesh

Date: **Time:**

Focus Group Discussion (FGD)

Check-list

FGD ID:	Date and time
Address with specific location:	
No. of participants:	Duration
Facilitator:	Recorder

Issue-1	Basic information regarding household activities (normal & hazardous situation)
Discussion Topics	-Water collection - Sanitation facilities - Health & hygiene practices - Food and meal preparation - Fuel collection - Child caring - House cleaning
Issue-2	Basic information regarding daily livelihood information
Discussion Topics	- Homestead gardening - Cattle rearing - Poultry rearing - Goat rearing - Handicrafts - Sewing and tailoring - Farm based wage labor - Non-farm wage labor
Issue-3	Household income and expenditure
Discussion Topics	- Household income sources - Household expenditures sources - Savings - Credit facility
Issue -4	Information regarding food security

	- Sources of food - Seasonal food scarcity - Knowledge about food storing - Existing food storing capacity - Types of Agricultural production(Kharif-1&Kharif-2) - Serial and non-serial production
Issue-5	Information regarding education system
Discussion Topics	- No. of primary school - No. of high school - No. of other educational - Problem of the school/institutions - Distance of the school/institutions - Communication system
Issue-6	Information regarding health care system
Discussion Topics	- No. of health care centre - Mode of communication system - Types of services - Major problems - Performance during disaster - Distance from your village
Issue-7	Vulnerabilities of the char land women
Discussion Topics	- Livelihood activities - Women's household activities - Agricultural production - Households sources of income &expenditure - Education system - Diseases and health-care services - Transportation and communication
Issue-8	Coping strategies of Char land people
Discussion Topics	- Disaster preparedness - Damage recovery system - To protect physical structures - To protect livestock and poultry - Agricultural production
Issue-9	Role of women in hazard preparedness and response
Discussion Topics	- Disaster preparedness at household level - Disaster preparedness at community level - Hazard warning dissemination and acknowledgement - Role of women in disaster response - Damage recovery at post disaster situation

Annexure -3

University of Dhaka
Department of Geography and Environment

Climate Change Hazards Vulnerability and Resilience Capacity Assessment of *Char* Land Women of Bangladesh

Participatory Vulnerability Assessment (PVA)

Participatory Vulnerability Assessment (PVA):

PVA is a systematic process of assessment that involves community people, vulnerable groups and key stakeholders for comprehensive understanding and examination of the local contexts, perspectives of different socio-economic groups, their risks, vulnerability, current coping as well as the needs of people in general and vulnerable groups.

Methods and tools for PVA:

- Community Hazard Mapping
- Seasonal Hazard Calendar
- Seasonal Livelihood calendar for Male/Female
- Index of hazard impacts on char livelihood
- Index of hazards impacts on Female household activities

Participants for PVA:

- Women Participants: 12-15 persons
- Women household head: 2 persons
- Housewife: 3 persons
- Female UP member : 1 persons
- Female wage labor: 2 persons
- Female school teacher: 1persons
- Female farmer:2 persons
- High school /college going female student: 2persons

Community Hazard Mapping

ইউনিয়নের দুর্যোগ মানচিত্র অংকন (পুরুষ ও মহিলাদের আলাদা আলাদা)

১. অংশ গ্রহনকারী এলাকার লোকজনের কাছে ইউনিয়নের মানচিত্র সরবরাহ করা হবে।

২. একজন সাহায্যকারী এলাকার লোকজনের কাছে মানচিত্রটি উপস্থাপন করবেন।

৩. মানচিত্রটি উপস্থাপনের পর, পুরুষ ও মহিলাদের দুটি আলাদা আলাদা দল তৈরী করতে হবে এবং আলাদা দুটি মানচিত্র তৈরী করতে হবে।

৪.অংশ গ্রহনকারীরা তাদের এলাকার দুর্যোগগুলো চিহ্নিত করে, উক্ত মানচিত্রে দুর্যোগগুলো লিখবেন এবং দুর্যোগ সমূহের ফলে ক্ষতিগ্রস্থ/ ঝুকিপূর্ন এলাকাগুলো চিহ্নিত করবেন।

৫. জলবায়ু পরিবর্তন জনিত দুর্যোগের ফলে ক্ষতিগ্রস্থ এলাকা সমূহ সঠিক ভাবে চিহ্নিত করতে হবে।

৬. জলবায়ু পরিবর্তন জনিত দুর্যোগের ঝুকি মোকাবেলায় মহিলাদের করণিয় সমূহ ও তাদের কাজের উপযোগি অঞ্চল সমূহ চিহ্নিত করতে হবে।

Seasonal Hazard Calendar

মৌসুমীভিত্তিক দুর্যোগ দিনপঞ্জিকা / মানচিত্র (পুরুষ মহিলা আলাদা)

দুর্যোগের নাম	মাসের নাম											
	বৈশাখ	জৈষ্ঠ্য	আষাঢ়	শ্রাবন	ভাদ্র	আশ্বিন	কার্তিক	অগ্রহায়ন	পৌষ	মাঘ	ফাল্গুন	চৈত্র
অনাবৃষ্টি												
অতিবৃষ্টি												
শিলাবৃষ্টি												
ঘূর্নিঝড়												
খরা												
বন্যা												
নদী ভাঙ্গন												
ঘনকুয়াশা												
শৈত্য প্রবাহ												
অনান্য												

 = খুব অল্প,  = অল্প,  = বেশী,  =খুব বেশী,

১. অংশগ্রহনকারীরা এলাকার দুর্যোগসমূহ চিহ্নিত করে উক্ত দিনপঞ্জিকার বাম দিকের কলামে ক্রমানুসারে (বেশী থেকে কম সংঘটিত দুর্যোগ) লিখবেন।

২. লেখার পর কোন কোন মাসে দুর্যোগসমূহ সংঘটিত হয় তা লম্বা রেখার মাধ্যমে প্রকাশ করবেন।

৩. ওপরের নির্দেশনা অনুযায়ী, বেশী ক্ষতি হওয়া দুর্যোগ সমূহ মোটা রেখা ও কম ক্ষতির দুর্যোগ সমূহ চিকন রেখা দ্বারা চিহ্নিত করতে হবে।

Seasonal livelihood calendar for Male/Female

মৌসুমীভিত্তিক জীবিকায়ন দিনপঞ্জিকা / মানচিত্র (পুরুষ ও মহিলাদের আলাদা আলাদা)

জীবিকা সমূহের নাম (সম্পুরক কাজের নাম সহ)	মাসের নাম											
	বৈশাখ	জৈষ্ঠ	আষাঢ়	শ্রাবন	ভাদ্র	আশ্বিন	কার্তিক	অগ্রহায়ন	পৌষ	মাঘ	ফাল্গুন	চৈত্র
কৃষি (খরিপ-১) ফেব্রু-মে)												
কৃষি (খরিপ-২) জুন-অক্টো)												
কৃষি (রবি)												
মাছ ধরা												
কৃষি দিন মজুর												

১.অংশগ্রহনকারীরা পুরুষ ও মহিলা আলাদা দল হয়ে, এলাকার প্রচলিত পুরুষ ও মহিলাদের জীবিকা সমূহ চিহ্নিত করে উক্ত দিনপঞ্জিকার বাম দিকের কলামে ক্রমানুসারে (প্রধান, দ্বিতীয় থেকে অনান্য জীবিকা নাম) লিখবেন।

২. প্রধান জীবিকায়ন এর সাথে যদি কোন সম্পুরক (কৃষি কাজের ভিতরে বীজ সংগ্রহ-বীজ বপন-জমি তৈরী-ফসল মাড়াই ইত্যাদি) কাজ আলাদা ভাবে করা হয়ে থাকে, তবে সেটাও অর্ন্তভূক্ত করতে হবে।

৩. লেখার পর কোন কোন মাসে কোন জীবিকা নির্বাহের উপর তারা নির্ভর করে থাকেন তা রেখা দ্বারা চিহ্নিত করবেন।

৪. চিহ্নিত করনের সময় রেখার আকার কাজের গুরুত্বের উপর নির্ভর করে মোটা বা চিকন হতে পারে ।

Index of hazard impacts on char livelihood

জীবিকায়নের উপর দুর্যোগ ঝুকি নিরুপন সুচী (পুরুষ ও মহিলা আলাদা করতে হবে)

জীবন-জীবিকার নাম (সম্পুরক কাজের নাম সহ) জলবায়ু পরিবর্তন জনিত দুর্যোগ ঝুঁকি		এলাকার প্রধান প্রাকৃতিক দুর্যোগের নাম				
		নদী ভাঙ্গন	বন্যা	ঝড়	লবনাক্ততা	খরা
জীবিকার উৎস সমূহ	কৃষি (খরিপ-১) ফেব্রু-মে)	++++	+	+	++++	++++
	কৃষি (খরিপ-২) জুন-অক্টো)	+	+++++	++	+	+
	কৃষি (রবি)	++	+	+	+++	++

নোট: + = খুবই স্বল্প ক্ষতিকর প্রভাব, ++ = স্বল্প ক্ষতিকর প্রভাব, +++ = মধ্যম ক্ষতিকর প্রভাব, ++++ = ক্ষতিকর প্রভাব, +++++ = মারাত্মক ক্ষতিকর প্রভাব

১. অংশগ্রহনকারীরা উপরোক্ত ছকের বাম দিকের কলামে চিহ্নিত জীবিকা সমূহের নাম লিখবেন ও উপরের সারিতে জলবায়ু পরিবর্তন জনিত দুর্যোগ ঝুঁকি গুলোকে লিখবেন।

২. পরবর্তিতে জীবিকার ওপরে জলবায়ু পরিবর্তন জনিত দুর্যোগ ঝুঁকি কোন মাত্রায় প্রভাব ফেলে তা নোটে উল্লেখিত উপায়ে মাত্রা নির্ধারণ করবেন।

Index of hazards impacts on female household activities

কাজের নাম জলবায়ু পরিবর্তন জনিত দুর্যোগ ঝুঁকি		এলাকার প্রধান প্রাকৃতিক দুর্যোগের নাম				
		নদী ভাঙ্গন	বন্যা	ঝড়	লবনাক্ততা	খরা
	Cooking	++++	+	+	++++	++++
	Fuel collection	+	+++++	++	+	+
	Drinking water collection	++	+	+	+++	++
	Child caring					
	House cleaning					
	Poultry rearing					
	Cattle rearing					

নোট: + = খুবই স্বল্প ক্ষতিকর প্রভাব, ++ = স্বল্প ক্ষতিকর প্রভাব, +++ = মধ্যম ক্ষতিকর প্রভাব, ++++ = ক্ষতিকর প্রভাব, +++++ = মারাত্মক ক্ষতিকর প্রভাব

১. অংশগ্রহনকারীরা উপরোক্ত ছকের বাম দিকের কলামে চিহ্নিত জীবিকা সমূহের নাম লিখবেন ও উপরের সারিতে জলবায়ু পরিবর্তন জনিত দুর্যোগ ঝুঁকি গুলোকে লিখবেন।
২. পরবর্তিতে জীবিকার ওপরে জলবায়ু পরিবর্তন জনিত দুর্যোগ ঝুঁকি কোন মাত্রায় প্রভাব ফেলে তা নোটে উল্লেখিত উপায়ে মাত্রা নির্ধারণ করবেন।

Annexure -4

Checklist

Climate Change Hazards Vulnerability and Resilience Capacity Assessment of *Char* Land Women of Bangladesh

Climate and Disaster Resilience Initiative (CDRI)

Date: **Time:**

Union: 1= Char Chandia (CC), 2= Kunder Char (KC); **HH Head:** 1=Male, 2=Female; **Types of HH:** 1=Farm, 2=Non-farm;
Mouza: 1=Char Chandia, 2= Purba Bara Dhali, 3= Babur Char, 4= Eakub Matabbarer Kandi, 5= Kalmir Char

Household Identification				Types of HH Head (√)		Types of HH (√)	
Union	Mouza	Village ID	Household ID	Male Headed	Female Headed	Farm HH>5dcml	Non-farm HH<5dcml

Village: 1= Chhoto Gram Samaj (CGS), 2= Haji Jinnat Ali Samaj (HJS), 3= Purba Bara Dhali (PBD),
4= Saral Khar Kandi (SKK), 5= Eakub Matabbarer Kandi (EMK), and 6=Kalu Bepari Kandi (KBK);

Resilience scale: 1=Very Low, 2= Low, 3=Moderate, 4=High, and 5=Very High

Dimensions	Parameters	Sl. No.	Variables	1	2	3	4	5	Remarks
Physical	P1: Household structures	Q.1	Main living house						
		Q.2	Homestead area						
		Q.3	Plinth height						
		Q.4	Kitchen functions						
		Q.5	Livestock sheds						
	P2: Road and communications	Q.6	Road inside the village						
		Q.7	Village road to the growth centers						
		Q.8	Usages of Country boat/Rickshaw/Van/Cycle						
		Q.9	Usages of TV/Radio						
		Q.10	Usages of cell phone						
	P3: Water and sanitation system	Q.11	Quality of drinking water (salinity/arsenic)						
		Q.12	Availability of water in dry season						
		Q.13	Climate context technologies for water						
		Q.14	Existing sanitation facilities (types)						
		Q.15	Easy access to toilet for women and children						
	P4: Fuel and Electrifications	Q.16	Available sources of fuel in normal period						
		Q.17	Available sources of fuel during disaster						
		Q.18	Fuel storing capacity						
		Q.19	Lightening facilities/electrification facilities						
		Q.20	Alternative options of lightening (SHS/Generator)						

	P5: Accessibility of Flood/ Cyclone shelters	Q.21	Distance from house to shelter						
		Q.22	Road communication system						
		Q.23	Water and sanitation facilities in shelter						
		Q.24	Population capacity of shelter						
		Q.25	Safety net of women, children and elderly people						

Dimensions	Parameters	Sl. No.	Variables	1	2	3	4	5	Remarks
Social	S1: Demography	Q.1	Household size						
		Q.2	Earning member						
		Q.3	Population under 14 years						
		Q.4	Population above 64years						
		Q.5	Population density						
	S2: Water and Sanitation	Q.6	Sources of drinking water during disaster						
		Q.7	Quality of drinking water (salinity/arsenic)						
		Q.8	Sources of domestic water during disaster						
		Q.9	Types of toilet						
		Q.10	Functionality of toilet during disaster						
	S3: Health and Education	Q.11	Availability & distance of the nearest health centre						
		Q.12	Access to health care centre's during disaster						
		Q.13	Emergency MNCH services during disaster						
		Q.14	HH head year of schooling						
		Q.15	Functionality of school during disaster						
	S4: Social Kinship	Q.16	Relationship among the family members						
		Q.17	Relationship between HH and neigh						
		Q.18	Acceptance in the community						
		Q.19	Women participation in HH decision making						
		Q.20	Women participation in community decision making						
	S5: Awareness and Preparedness	Q.21	Aware of forecasting of hazards						
		Q.22	Adequate preparedness at HH level						
		Q.23	Response after getting forecast						
		Q.24	Move in safe place with movable assets						
		Q.25	Family members evacuating voluntarily						

Dimensions	Parameters	Sl. No.	Variables	1	2	3	4	5	Remarks
Economic	E1: Income	Q.1	Major sources of income						
		Q.2	Adequate income for the HH						
		Q.3	Alternate sources of HH Income						
		Q.4	Income with seasonality						

		Q.5	Degree of impact on major livelihood of HH						
	E2: Expenditure	Q.6	HH food expenditure (%)						
		Q.7	% of HH health expenditure						
		Q.8	Expenditure (%) of disaster preparedness						
		Q.9	Expenditure (%)for education						
		Q.10	Expenditure (%) for other consumption						
	E3: Household assets	Q.11	House hold have livestock						
		Q.12	HH have television , Mobile phone						
		Q.13	HH have transportation vehicles (boat, cycle)						
		Q.14	HH have agricultural and fishing tools						
		Q.15	Household having flood free homestead						
	E4: Employment	Q.16	No. of earning Members in HH						
		Q.17	No. of Women involved in IGA						
		Q.18	No. of youth unemployed						
		Q.19	Seasonal employment opportunities						
		Q.20	Seasonal migration for alternate livelihoods						
	E5: Credit and Savings	Q.21	Availability of Credit sources (MFI/Bank/Money lender)						
		Q.22	Accessibility of credit facilities						
		Q.23	Availability of credit facility to prevent disaster						
		Q.24	Saving practices of HH						
		Q.25	Adequate savings for disaster preparedness						

Dimensions	Parameters	Sl. No.	Variables	1	2	3	4	5	Remarks
Institutional	I1: Community responses in disaster risk reduction	Q.1	Understanding level of forecasting information						
		Q.2	Receiving mode of forecasting information (TV/radio/mobile)						
		Q.3	No. of labour force						
		Q.4	No. of children/elderly/disable people						
		Q.5	Location of the nearest shelter						
	I2: Household based coping practices and CCA	Q.6	Coping in physical structures						
		Q.7	Coping in livelihood options						
		Q.8	Coping in water & sanitation						
		Q.9	Coping in food preparation & consumption						
		Q.10	Coping in transportation						
	I3: Effectiveness of Local government (UP) to respond to a disaster	Q.11	Disseminate hazard warning						
		Q.12	Response to evacuation						
		Q.13	Response to emergency relief						
		Q.14	Response to medical support						
		Q.15	Response to rehabilitation						
	I4: Institutional support at post disaster situation by GOs in sub-national level	Q.16	Support in MNCH sector						
		Q.17	Support in agricultural sector						
		Q.18	Support in livestock treatment						
		Q.19	Support in WATSAN sector						
		Q.20	Support in education sector						
	I5: Institutional collaboration and participation in local	Q.21	Participation in village contingency plan development						
		Q.22	Accessibility in UDMC						
		Q.23	Participation in village DRR						

	DRR		decision making						
		Q.24	Involvement of UP member & VDP in DRR						
		Q.25	Institutional supports from GOs-NGOs and MFIs in DRR						

Dimensions	Parameters	Sl. No.	Variables	1	2	3	4	5	Remarks
Natural	N1: Changes of climate variability's	Q.1	Changes in temperature						
		Q.2	Changes in rainfall pattern						
		Q.3	Intensity and duration of rainfall pattern						
		Q.4	Severity of cold wave (winter)						
		Q.5	Duration of monsoon						
	N2: Frequency / Severity of Natural Hazards	Q.6	Frequency of Flood in the last one decade						
		Q.7	Frequency of Cyclone in the last one decade						
		Q.8	Frequency of Riverbank/coastal erosion in the last one decade						
		Q.9	Severity of drought in the last one decade						
		Q.10	Severity of salinity intrusion in the last one decade						
	N3: Ecosystem service	Q.11	Access to surface water						
		Q.12	Access to ground water						
		Q.13	Vegetation opportunities						
		Q.14	Quality of air						
		Q.15	Quality of soil						
	N4: Land use in natural terms	Q.16	Homestead area vulnerable to flood hazards						
		Q.17	Agricultural production are vulnerable to flood/storm surge						
		Q.18	Vulnerable location of settlement						
		Q.19	Vulnerable location of fishing pond/shrimp						
		Q.20	Morphological vulnerability of char-land soil						
	N5: Food security	Q.21	Operated farmland						
		Q.22	Serial production with rice						
		Q.23	Rice purchase from market/year						
		Q.24	Food and seed storing capacity						
		Q.25	Fuel stock and cooking capacity						