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Assessment of Livelihood Resilience in Relation to Cyclones and Climate Change along the South-Western Coastal Belt of Bangladesh

Master's Thesis in Natural Resource Management, Specializing in Geography

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Abstract

The world has started to witness the increased frequency and severity of extreme natural disasters, due to the impact of climate change. This added risk for already vulnerable coastal poor as their lives and livelihoods largely depend on natural resources. Regarding this, the southwestern coastal part of Bangladesh is most vulnerable as it is hit by cyclone almost every year due to its geographical position. Most recently, two consecutive cyclones, Sidr in 2007 and Aila in 2009, struck Bangladesh and left the southwestern coastal people to bear enormous sufferings. Following the disaster, several helping agencies started to work to improve their livelihood condition in the affected areas. This study was conducted in Dacope upazila of Khulna district which was one of the worst impacted by cyclone Aila. The specific objectives are to investigate livelihood patterns, to identify their most impacted sectors as well as to explore their survival strategies against adversity. Overall 160 households were interviewed using semi-structured questionnaire to collect data from four villages of Dacope upazila. Additionally, two Focus Group Discussions were conducted. The collected data were analyzed using descriptive statistics, frequency distribution, chi-square, and logistic regression. The findings indicate that the households are relatively poor as they have low income, poor housing and facing food and water challenges. The major losses due to cyclone were observed in house damages and income loss. Challenges related to transport, and food and water storing due to adversity were also detected. Results revealed that households primarily relied on own resources both before and during cyclone for surviving and managing themselves. Whereas, during the post cyclone period they relied on helping agencies for their coping and recovery. The study discovered lack of community-based intervention and less medical facilities in the areas. Temporary migration of households was found both before and during cyclone to avoid the unfortunate consequences. The households require more assistances both from Government and non-government organizations to recover satisfactorily. Since information on vulnerable aspects, livelihood pattern, coping, and recovery of households at local level are hardly found in Bangladesh, these findings could be useful in designing different intervention programs for capacity building to manage cyclones.

Dedication

I Farhana Haque do hereby declare that this thesis entitled “Assessment of Livelihood Resilience in relation to Cyclone and Climate Change along the South-Western Coastal Belt of Bangladesh” is my own research work. This research was conducted from 2017 to 2018 academic year under the supervision of Professor Haakon Lein from the department of Geography, Norwegian University of Science and Technology (NTNU), Trondheim.

Any part of this research has not been used or submitted elsewhere for the award of any degree and full acknowledgement has been provided where other people’s effort has used.

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Farhana Haque (Student)

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Prof. Haakon Lein (Supervisor)

May 2018

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1 Introduction

1.1 Background of the Study

The Earth is becoming warmer over the last century. The global warming for the 19th century was estimated to be 0.8°C, but as greenhouse gases became the most dominant agent to influence the climate in recent decades, the rise in temperature in past three decades alone was 0.6°C at the rate of 0.2° C per decade (Hansen et al., 2006; Solomon, 2007; Rosenzweig et al., 2008; Wood, 2008). The anticipated rise of the global temperature for 2050 to 2100 is at least 2 °C (Leal Filho et al., 2018). This warming process may not only invite substantial impairment to both nature and human societies by abolishing ecosystem services but also may pose threat for the existence of the planet earth. Various societies around the world already experiencing climate change impacts from different standpoints: socially, culturally and specifically, through a country's natural capitals (Leal Filho et al., 2018).

The impact of climate change falls excessively on the livelihood systems of the poorest residents, eroding their capability to manage livelihoods sustainably and enhancing their vulnerability. Whereas, a livelihood can be defined as "the capabilities, assets (stores, resources, claims and access) and activities required for a means of living" (Chambers & Conway, 1992). During the past two decades, the livelihood concept has drawn from various backgrounds to evolve into a more comprehensible set of ideas within the arena of development. Moreover, the expansion of livelihood research has been observed into the worlds of policy and practice due to the development of a 'sustainable livelihoods framework'. Various international agencies use this framework to direct programs for poverty alleviation by locating household livelihood assets within wider contexts (cultural, policies, ecosystem) that encourage or hinder access to diverse resources. Specially, a livelihood perception places people at the core of the analysis, situated within, rather than governed by, technologies, political contexts, ecosystems, markets and resource systems (Tanner et al., 2015).

In the context of climate change, livelihood resilience is drawing attention worldwide (Tanner et al., 2015). This is because livelihood resilience emphasizes the role of human intervention, which includes both their individual and collective capacity to response against stressors. People lives are too often compact to regulated susceptible communities or countries, becoming simply 'resilient pixels'. Even in discussions of intervention, human responses to environmental variation are too often stated as generalized involvements within preparations for resilience (Tanner et al., 2015). Nevertheless, a livelihood resilience approach highlights people's ability

for, and changes in, observing risk and taking defensive activities, either independently or mutually. Information and resource movements through social nets (social capital) are vital ideas to resilience, providing informal protection, and transporting available physical, economic and logistical backing during environmental crises. Simultaneously, livelihood resilience provides attention on reformulations of livelihood systems that allow the most vulnerable people to manage potentially disrupting global fluctuations on their own ways to keep basic human dignity (Tanner et al., 2015).

The Fifth Assessment Report of Intergovernmental Panel on Climate Change (IPCC) define resilience as the capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation (Change I. C., 2014). Hence, resilience focuses more on coping and adaption strategies that include task of human both at individual and collective level. According to the Fourth Assessment Report of IPCC, climate change has begun to affect the frequency, intensity and length of many extreme events such as storms, floods, droughts and extreme temperatures, there is an urgent need for timely and effective adaptation to be undertaken (Uy, Takeuchi, and Shaw, 2011). Simply stating, a resilient livelihood is flexible enough to react to the changing environment and able to mitigate the risk against adverse weather in broad sense.

Coastal communities and settlements are most vulnerable to climate change (Jahan, 2012; Parvin, Takahashi, and Shaw, 2008). Some obvious effects of climate change in coastal areas are sea level rise, salt water intrusion in groundwater reservoirs, inundation of wetlands and estuaries, and threatening of historic and cultural resources together with infrastructure (Pendleton, Thieler, and Williams, 2008). Regular and intense cyclonic activities with associated storm surges due to increased sea surface temperature are the most notable and significant effects in many coastal zones. The dominant impacts of that climate related hazards on coastal populations comprise (i) damages to agriculture, coastal forests and tourism, infrastructure, property, (ii) insecurity in food access and health facilities as they are in position of front line for maximum climate adversities, (iii) forced migration of the poor people, most importantly in developing nations, owing to food price rise and income reduction (Leal Filho et al., 2018).

Several empirical findings strongly support that the coastal ecosystems will significantly be impacted by an altering climate (Saha & Ali, 2016; Leal Filho et al., 2018). In response to the

stresses posed by climate change that affect the coastal livelihood, innovative approaches are now imperative, for managing these coastal areas. Along the way, making coastal ecosystems adaptive and resilient against climate adversity is challenging (Leal Filho et al., 2018). Simultaneously, the necessity of integration of climate change adaptation and forthcoming planning progressively resonates in all sectors of society, predominantly in regions that require socioeconomic development and are seriously exposed to the climate change consequences. This circumstance depicts the case of underprivileged poor who live near vulnerable areas like coastal and delta regions where deliberate adaptation is desirable to foster resilience (Leal Filho et al., 2018).

Despite the poverty and proneness to multiple natural calamities (cyclone, storm surge and flooding, etc.), coastal communities make relentless efforts to cope with extreme impacts through their age-old local (native/indigenous/traditional) knowledge and practices. An assessment of existing literature discovers that, although various studies have been conducted in Bangladesh focusing on diverse issues of coastal flooding, cyclone and storm surge, the documentation of local knowledge and practices and the identification of how different basic factors underpin coping and adaptation strategies are still lacking (Paul & Routray, 2011). So far, it is anticipated that climate change and its accompanying hazards will distress the adaptive capacities of the population, which is already oppressed by absolute poverty, repeated natural disasters, and governance-related issues. (Parvin et al., 2008).

Bangladesh is one of the top sufferer of last decade (1999–2009) in the world (according to Climate Risk Index 2011) owing to climatic disasters (Islam & Hasan, 2016). Table 1.1 provides the top 10 most important storm disasters from 1900 to 2012 arranged by numbers of people died in different countries which shows more frequency in Bangladesh. Consequently, it is a consensus today that the Bangladeshi poor people are experiencing hell-like miseries for climate change induced risks (Islam & Hasan, 2016). One report of Ministry of Environment and Forest (2009) stated that, it is the most vulnerable country with respect to climate change and the situation will deteriorate in the coming years. Climate change and the recurrence of natural disaster (flood, tropical cyclone, storm surge, drought etc.) have already had an impact on the lives and livelihoods of coastal people of Bangladesh (Dasgupta et al., 2010; Ali, 1999) as these lowlands are densely settled and growing rapidly (McGranahan, Balk, and Anderson, 2007). Moreover, the Bangladesh coast is gradually prone to the salinity, arsenic contamination and water pollution problems etc. (MoWR, 2005). The livelihood of the coastal inhabitants is largely dependent on natural resources, forestry, agriculture, fishery, salt farming and near shore

transportation etc. Under the present situation of fragile resource base and disapproving man-land proportion, lives and livelihoods of the coastal people of Bangladesh become defenseless after any hazardous occurrence (Paul & Routray, 2011).

Table 1:1 Ten most important storm disasters from 1900 to 2012 arranged according to numbers of people killed at the country level)

Date	Country	Number of peoples killed
12/11/1970	Bangladesh, Tropical cyclone	300000
29/04/1991	Bangladesh, Tropical cyclone	138866
02/05/2008	Myanmar, Tropical cyclone	138366
27/07/1922	China P Rep, Tropical cyclone	100000
Oct-1942	Bangladesh, Tropical cyclone	61000
1935	India, Tropical cyclone	60000
Aug-1912	China P Rep, Tropical cyclone	50000
14/10/1942	India, Tropical cyclone	40000
11/05/1965	Bangladesh, Tropical cyclone	36000
28/05/1963	Bangladesh, Tropical cyclone	22000

Source: Kabir, 2014

Since the independence of Bangladesh (1971), isolated attempts have been made by several ministries of government and by various organizations to report diversified complications and hazards in coastal areas. But, the effort of Integrated Coastal Zone Management (ICZM) was only familiarized in 2002. Remarkable efforts of ICZM are: (a) the demarcation of coastal zones, (b) the inventory of projects and enterprises in coastal zones, reorganized in 2004, (c) Coastal Zone Policy formulation in 2005, (d) "Priority Investment Programs" formation in coastal areas in 2005, and (f) the invention of the Coastal Development Strategy in 2006 (Parvin et al., 2008). Furthermore, different priority investment programs by several ministries of government have been listed out for coastal communities. Yet, all these priority projects, strategies and policies holds inappropriate attention towards local people's perceptions,

vulnerabilities, their local knowledge and various coping processes in response to different hazards they experience (Parvin et al., 2008).

The devastating natural disasters like cyclones and floods caused displacement of around 39 million people in Bangladesh from 1970 to 2009 (Mahmood, 2012). Among the major natural disasters of Bangladesh, cyclone alone bears the huge griefs for the coastal dwellers. Based on the reasoning of Ali (1999), both the frequency and intensity of cyclone would increase along the Bay of Bengal with the rise in sea surface temperature. Moreover, he predicted that the likelihood of cyclone creation would augmented from the depression along the coastal areas of Bangladesh, with a surge of 2°C in sea surface temperature. Due to the geographical position, the southwestern coastal portion is more vulnerable in this respect. Besides the unique geophysical features, the socio-economic characteristics of coastal inhabitants have contributions on their vulnerability to cyclones (Paul, 2009). It is now apparent that the frequent exposure to cyclone like disaster, augmented risk for already vulnerable coastal people. However, resilient livelihood can reduce the vulnerability of the coastal community by coping or adapting with the changed environment. Consequently, the status of their existing surviving mechanisms with respect to cyclone and climate change in livelihood sector is of considerable importance.

1.2 Coastal Belt of Bangladesh

Physically, Bangladesh is a very vulnerable country to sea-level rise. According to the World Disaster Risk Report 2012, Bangladesh can be regarded as the 5th most disaster-prone country (Islam & Hasan, 2016). It is one of the largest deltas of the world, commonly known as Ganges-Brahmaputra-Meghna (GBM) Delta. The highest sediment transport of these mighty rivers is 334.2 million tons/month and the lowest is 4 million tons/month (Barua, 1990). Bangladesh consists of 47,201 km^2 coastal area from the total 147,570 km^2 of territory, which alone accounts 28% of the country's population and represents one-third of the country (Parvin et al., 2008). The coastal areas of Bangladesh own a comparatively low and flat terrain where the usual height is no more than three meters.

Bangladesh is sloping gently from North to South with Bay of Bengal at the southern end. According to the coastal zone policy (2005), the coastline is 710 km long along the Bay of Bengal. 19 districts and 147 sub-districts are affected by coastal problems like storm surges, cyclones, saline water intrusion, tidal influences etc. either directly or indirectly but among

them only 48 sub-districts of 12 districts are directly exposed to the sea or lower estuary and considered as ‘exposed’ coastal areas (CZPo, 2005). The exposed coastal areas are most vulnerable to natural disasters (Fig.1). The total coastal population is 36.8 million where significant portions (52%) comprised of poor and approximately 41% falls under the age of 15 (Saha & Ali, 2016). The population density in Bangladesh coast has augmented about fourfold in the last century. This has made an obligation for thousands of coastal populations to exist in low lying areas that are extremely vulnerable to several natural calamities (Paul & Routray, 2011). Also, according to Bangladesh Government, the poverty rate of coastal districts was above the national average of 40% in 2005 (Paul, 2009).

Traditionally the coast of Bangladesh is divided into three parts; the Ganges Deltaic Coast, Estuarine coast and the cliff Coast (Islam, Majlis, and Rashid, 2011). Pramanik [1983; cited in (Islam M, 2001)] named these regions as Western, Central and Eastern coastal regions respectively. The Ganges Deltaic Coast or the Western coast covers the mangrove forest-Sundarbans, the greater Khulna district and a part of Patuakhali district. The Estuarine coast or Central coast consists of Meghna estuary and few parts of lower Meghna delta. It extends from eastern part of Sundarbans to Feni estuary. It includes many islands such as Bhola, Hatia, Sandip etc. (Sarwar, 2005). The cliff coast or the Eastern coast starts from southern tip of the main land of Feni river estuary and ends at Teknaf. It is a narrow zone. A series of mountains run parallel to this coast line. The mountains are part of Indo-Burman mountain range.

Moreover, the coastal areas of Bangladesh containing the Sundarban mangrove ecosystem, which declared as ‘World Heritage Site’ and an ‘ecologically critical areas’ consequently grasped the concentration of environmentalists (Parvin et al., 2008). However, these areas are highly susceptible to both natural and anthropogenic (man-made) hazards and disasters (MoWR, 2005). Along with different types of hazards, poor housing and sanitation conditions, low income levels of costal dwellers have accelerated their vulnerability. Paul (2009) mentioned in his study, that only 5% of the existing housing of the coastal areas are strong enough against cyclone induced storm surges (Paul, 2009). To improve the resilience of coastal people and settlements, about 2000 cyclone shelters, 6000-km-long coastal embankments and polders, and 9000 km of coastal green infrastructure have been executed in Bangladesh (Leal Filho et al., 2018).

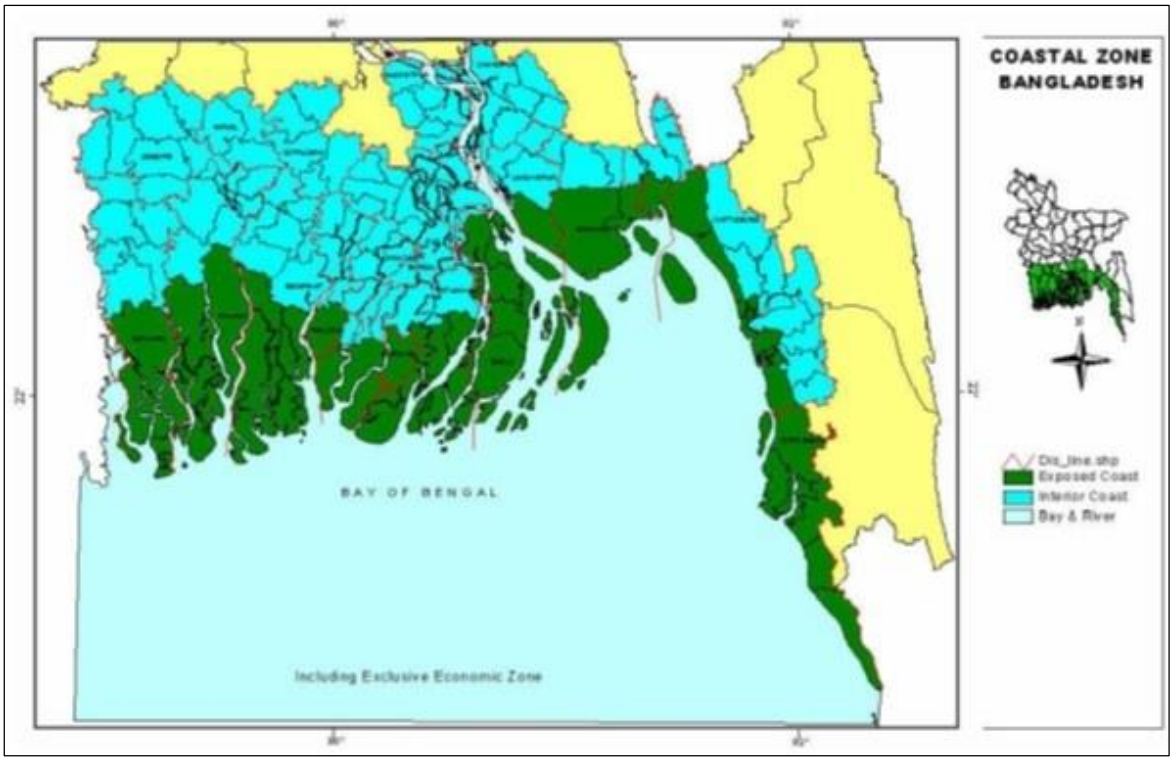

Figure 1:1 Coastal Zone of Bangladesh

Source: Islam, 2004

1.3 Problem Statement

Cyclones and induced surges (abnormal rise of sea water) have recognized as the world's leading natural hazard that even exceeds the earthquake. Unfortunately, severe cyclones and its associated surges are very common in the coast of Bangladesh. Each year at least one hazardous tropical cyclone with storm surges attacks the Bangladesh coast which influence hundreds of thousands of lives and render as more insecure than many other areas of the world. Moreover, the major prerequisite physical and meteorological environments necessary for the creation of tropical cyclones prevails in the Bay of Bengal. Hence, the Bay of Bengal provides the perfect ground for cyclonogenesis which accounts 6–10% of world's tropical cyclones (Paul & Routray, 2011).

Historical statistics claimed that over the past four decades, Bangladesh has experienced over 450,000 deaths and massive economic losses due to cyclones (United Nations, 2010). Among them, the most devastating cyclones that struck the vulnerable southwestern coast of Bangladesh, were Sidr (cyclone-5) in 2007 and Aila (category-1) in 2009. Both cyclones and associated surges caused numerous loss of lives and properties and responsible for making

millions of people homeless. Before the attainment of recovery work from cyclone Sidr, this region has again attacked within 2 years by cyclone Aila. Some empirical studies narrated that this is one of the significant reasons for causing huge sufferings and increased vulnerability at the time of Aila attack (Jahan, 2012). About 12, out of 19 coastal districts of Bangladesh were severely affected by the recent deadliest cyclone, Aila, on May 25, 2009. The affected districts were Satkhira, Khulna, Bagerhat, Pirojpur, Barisal, Patuakhali, Bhola, Laksmipur, Noakhali, Feni, Chittagong and Cox's Bazar (Kibria, Khan, and Kabir, 2016). Despite having comparatively low death toll (193) of Aila cyclone, the loss of houses, institutions, infrastructures, cultivable lands and crops, as well as livelihoods were simply ruined in the affected zones (Mallick, Rubayet Rahaman, and Vogt, 2011; Islam & Hasan, 2016).

Though the recent Aila Cyclone, belongs to a weak cyclone (category-1) by classification, the huge financial cost and long-term sufferings it caused, outweigh the financial damage of any previous cyclone. Nearly, 2.3 million coastal inhabitants suffered during Aila. Several thousands were stranded in that areas as they had no safe places to take shelter or safe substitutes to survive (Kumar, Baten, Masud, Osman, and Rahman, 2010). The height of the surge water rose to about 3 to 4 meters which overflowed the embankments. Consequently, the cyclone caused breaching at numerous points of the embankments and inundation of all kinds of coastal settlements (Kumar et al., 2010). According to scientific literatures, embankment failure caused by Aila rather than the wind speed was more accountable for the prolonged level of destructions. Virtually, all the fisheries and croplands were damaged along the coastal region owing to saline water intrusion. Additionally, the breached embankments caused destruction of road networks in that affected areas and made the sufferings even worse. Unfortunately, the coastal system did not arrive to their former position even after three years of Aila. Moreover, the long-standing of saline water enhanced soil salinity, which destroyed agricultural yield in the following years (Kibria et al., 2016).

1.4 Study Area

The study area of the proposed research is the southwest coastal region of Bangladesh. The southwest coastal region comprises the districts of Bagerhat, Khulna, Satkhira, Jessore, Narail and Gopalganj. It has an area of 15, 118 square km. It is characterized by a highly productive mangrove ecosystem (Sundarbans); intricate web of life and wetlands. The local civilization, culture and livelihood evolved through the interaction of the people with the various natural

resources of the land and water. As the southwestern coastal belt of Bangladesh is a vast area, Dacope upazila (upazila is the second lowest tier of regional administration in Bangladesh) under Khulna district was selected for conducting this study. Dacope upazila has a total area of 991.57 square km. Among which 286.01 square km is land area, 494.68 square km is reserve forest and 210.87 square km is river area. It has a total population of 152,000 living in 36,597 households and the average size of households is 4.13 (Statistics, B. B. O. 2013). Since it is a coastal region, as well as impact zone of the Sundarbans, natural disasters like tropical cyclone, flood, river bank erosion, and salinity intrusion etc. are taking place frequently.

1.5 Objectives of the Study

The general objective of the study is to assess the status of livelihood resilience of the households in relation to cyclone and climate change of the selected southwestern coastal portions of Bangladesh.

The specific objectives are as follows:

1. To investigate the livelihood pattern (demographic, socioeconomic, other characteristics) of the surveyed households of the study areas.
2. To identify major vulnerabilities of the households.
3. To explore the coping strategies and recovery status of the households.

1.6 Research Questions

1. What are the livelihood conditions of the households?
2. What are the major effects of the households by cyclones?
3. What challenges are households facing in the post-cyclone period?
4. How well are the households coping and managing themselves before, during and after cyclone?
5. What are their existing conditions of livelihood recovery and perceptions about helping organizations?
6. What are their perceptions of climate change and cyclones?

1.7 Motivation for the Study

Being a citizen of southwestern coastal zone, I had a wish to work on cyclone that the coastal dwellers always encounter here. With their age-old knowledge and perceptions, these inhabitants are trying to cope relentlessly against such exposure. Apart from their self-initiatives, Government and many non-government organizations took part in relief and rehabilitation programs in the post-cyclone period, highlighting their steps in several books, papers and manuals (Alam & Collins, 2010). However, there remains a conspicuous absence of research regarding households' major vulnerable sectors and local coping with cyclone hazards. So, empirical study addressing local-level coping mechanism of coastal community is hardly found in Bangladesh. Moreover, it is projected that climate change and its associated hazards will affect the adjusting capacities of the coastal population. Therefore, I tried to provide a brief overview in this study, about cyclone vulnerability and their current efforts to diminish the adverse effects posed by cyclones and induced surges upon their livelihood. For this purpose, I intend to discover different pre-disaster, during disaster and post-disaster coping measures coastal households employed in the past cyclones. Hence, studying the existing livelihood resilience against cyclone assumes valuable for designing the proper capacity-building interventions. In addition to this overview, I aim to examine the coastal community's perception regarding the climate change and portion of their recovery. Besides, I expect that all the findings would be a realistic backing to the intervention of development organization for managing cyclone and enhancing the community's preparation and response abilities. Furthermore, I wish that this thesis can serve as a baseline study for opening the window of advance research.

1.8 Organization of the Thesis

The present study has been organized in a sequential way and is divided into seven chapters:

Chapter One: Introduction

The introduction chapter includes the background of the study, scenario of the southwestern coastal belt of Bangladesh, introduction of the study area, problem statement, objectives of the study, key research questions, motivation of the research, and organization of the thesis.

Chapter Two: Cyclone History, Concepts and Theories

The basic concepts and theories that I have used for facilitating the thesis, described in this chapter. It contains the status of cyclone in Bangladesh, concept of vulnerability, coping and adaptation as well as resilience concept.

Chapter Three: Study Area and Methodology

The pertinent topics of this section are methodological approach of the study, selection of the study area, questionnaire designing, pilot survey, sampling procedure, data collection method, field work process, ethical consideration, data validity and reliability; data management and analysis; challenges and limitations of the study.

Chapter Four: Livelihood Pattern of the Households

This chapter presents the findings about livelihood condition of the respondents of the study area. Socio-economic characteristics, demographic characteristics, profile of the households, housing and toilet condition of the respondents have been deliberated here.

Chapter Five: Vulnerability and Respondents' Perception of Climate Change

This chapter draws on the vulnerability aspects of the respondents of the study area. The challenges faced by the respondents after cyclone, types of losses of households, perception regarding climate change and cyclone, responses about cyclone shelter and warning system, have been discussed to highlight their existing susceptible condition.

Chapter Six: Coping and Recovery Status

This chapter deals with the coping strategies of the households against cyclone and their present extent of recovery. The findings depict how the local inhabitants are coping by their self-initiatives and by the help from aiding agencies, what kinds of preparation they are taking before cyclone, their perceptions regarding recovery and helping organizations.

Chapter Seven: Conclusion

This chapter gives an overview about the procedure of the study. It includes answers of the research questions given in the introduction chapter. Few recommendations as well as information gaps have also been mentioned in this section that can be completed by further studies.

2 Cyclone History, Concepts and Theories

2.1 Introduction

In this chapter, I will introduce some basic concepts and theories that will help be used in this study. Based on the research objectives, I will focus on the concepts of vulnerability, adaptation and resilience. This is because vulnerability can be reduced by taking appropriate coping or adaptation measures and thereby can create resilience.

Since this study focused on livelihood resilience with respect to cyclone along the southwestern coastal belt of Bangladesh, it will describe major devastating cyclones happened in Bangladesh. This will give an overview about the severity of past cyclones. Subsequently, the concepts of vulnerability, adaptation and resilience will be elaborated from different perspectives. In the current study, coastal people's responses involve the actions (survival strategies) of household members and the involvements of different social networks like aiding agencies and relatives for mitigating loss during crisis period.

2.2 Major Cyclones

Natural disasters in Bangladesh are a common phenomenon and it could be said that they have become part of peoples' normal life. Various natural disasters, with the results of life-threatening climatic events in terms of intensity and frequency of floods, droughts and cyclones have amplified worldwide recently. A further rise of global temperature might increase the trend of tropical cyclones with substantial damages in the twenty-first century (Paul & Routray, 2011). Approximately 100 cyclones, 60 flash floods and other natural calamities like drought and heatwaves attack Bangladesh in the past 30 years (Kabir, 2014). Among all, cyclone is the most frequent and devastating disaster in Bangladesh (table 2.1). Significantly, extreme climatic events hit the southwest coastal region of Bangladesh frequently and were responsible for unbearable and unforgettable destruction of coastal lives and livelihoods (Kulsum & Azam, 2009).

Table 2:1 Major tropical cyclones in Bangladesh since 1965

Date	Year	Name	Maximum wind speed (km/hr)	Storm surge height (meter)	Death toll	Main affected districts
11 May	1965	Cyclone	161	3.7-7.6	19,279	Barisal
15 December	1965	Cyclone	217	2.4-3.6	873	Cox's Bazar
01 October	1966	Cyclone	139	6.0-6.7	850	Noakhali
12 November	1970	Cyclone Bhola	224	6.0-10.00	300,0000-500,0000	Bhola
25 May	1985	Cyclone	154	3.0-4.6	11,069	Noakhali
29 April	1991	Cyclone Gorky	225	6.0-7.6	140,000	Cox's Bazar, Chittagong
19 May	1997	Cyclone	232	3.1-4.6	155	Cox's Bazar, Chittagong
15 November	2007	Cyclone Sidr	223	6.1-9.1	3363	Bagerhat, Pirojpur, Barguna, Patuakhali
25 May	2009	Cyclone Aila	170	5.2-10.00	190	Khulna, Shatkhira

Source: Kabir, 2014

Generally, cyclones have inner spiraling winds that rotate around a strong zone of low barometric pressure. In most of the southern hemisphere and the Indian Ocean, tropical cyclones are simply termed as cyclones. Depending on the strength and location, tropical cyclones are denoted as hurricane (western Atlantic/eastern Pacific), typhoon (western Pacific), cyclone (southern Pacific/Indian Ocean), and tropical depression. However, a hurricane/typhoon/cyclone mostly carry winds stronger than 74 MPH and the water temperature needs to have above 27 °C. So, a tropical cyclone is referred to as a non-frontal storm system

that has a low-pressure center, spiral rain bands and strong winds (Kabir, 2014). Usually it initiates over tropical or subtropical waters and follows clockwise pattern in the southern hemisphere and anti-clockwise pattern in the northern hemisphere. The process is powered by heat released when humid air increases and the water vapor it holds condenses ("warm core" storm system). Usually, cyclonic storms rise from the Bay of Bengal in the two transitional periods, pre-monsoon (March to May) and post-monsoon (October to November) (Riquet, 2012). Cyclones from the months of October to November (post-monsoon periods) are generally more destructive. The seasonality of climate related hazard is shown in figure 2.1.

Figure 2:1 Climate hazard calendar

Source: Kabir, 2014

The Bay of Bengal experiences about 5 to 6 times higher cyclonic disturbances than the Arabian Sea; the proportion of tropical cyclones is 4:1 between the Bay of Bengal and the Arabian Sea (Kabir, 2014). Cyclone is often accompanied by storm surges (abnormal rise in seawater level during a storm caused primarily by storm's wind) and that is the main reason of causing extensive damages in the coastal regions (Alam & Collins, 2010). Usually Bangladesh encounter cyclones that originate in the Southern Bay of Bengal between 5° and 15° N latitude and progress in the northerly and northwesterly direction and to attack the Bangladesh coast changing their track towards northeastwards (Kabir, 2014).

Observing the data of Sea Surface Temperature (SST) about the Bay of Bengal from 1951 to 1987, Joseph (1995) revealed a rise in SST since 1951 (Kabir, 2014). Ali (1999) explained that both the frequency and intensity of cyclones would increase along the Bay of Bengal because of expansion in SST. He predicted that the likelihood of cyclone creation from the depression along the coastal areas of Bangladesh would rise due to an increase of 2°C in SST. About ten

severe cyclones had taken place in Bangladesh with an average of one cyclone yearly from 1960 to 1970 (Choudhury, 2009). The last Cyclone Sidr (2007) and Cyclone Aila (2009) are the examples of shocking storm-surges in Bangladesh. Figure 2.2 showed the areas that usually affected by cyclones in Bangladesh. Some of the devastating cyclones of Bangladesh have also discussed below. Some most disastrous cyclones have described below.

2.2.1 Cyclone Bhola in 1970

One of the great cyclone happened in Bangladesh on 12 November 1970, called Cyclone Bhola. It is regarded as the most catastrophic among all the happened cyclones with respect to casualties. The official death toll triggered by this cyclone was 500,000 the highest so far and caused a tremendous human desolation in deed (Choudhry, 2009). It wiped out many villages and about 45% of the coastal population (167,000) of the area of Tazumuddin Upazila, were severely suffered as well as almost 46,000 fishermen lost their lives in the cyclone-affected region (Emanuel, 2005; Choudhury, 2009).

2.2.2 Cyclone Gorky in 1991

The cyclone Gorky was another super cyclone that attack the coastal areas of Bangladesh on 29 April 1991. Around 138,000 deaths had taken place by this cyclone on the offshore islands of Kutubdia and Sandwip, and in the coastal low areas from Chittagong to Cox's Bazar (Bern, et al., 1993). Due to the intense velocity of this cyclone, it was named as super cyclone and the speed near the sea during that cyclone was 240 km/hour. The larger dimensions of this cyclone caused an indescribable suffering of the Bangladesh coast as it is only a few feet above sea level (Choudhury, 2009).

2.2.3 Cyclone Sidr in 2007

Cyclone Sidr struck Bangladesh with wind speed up to 240 kilometers per hour on 15 November 2007, resulting serious devastation to life and livelihoods (WFP, 2007). It was accompanied by heavy rain and storm surges and occurring with maximum heights of nearly 20 feet in some portions of the country. Cyclone Sidr caused massive flooding in low-lying areas together with impairment to infrastructure, crops and causalities (Government of Bangladesh, 2008b). Among the divisions of Bangladesh, Barisal, Khulna and Dhaka were severely impacted by Sidr. Around 12 districts were affected by cyclone Sidr i.e. Bagerhat, Barguna, Barisal, Bhola, Gopalganj, Jhalokhati, Madaripur, Patuakhali, Pirojpur, Satkhira, Khulna and Shariatpur (Kabir, 2014). Around 18.7 million people from the mentioned districts

were suffered and the cyclone took away 3,406 lives and 1,001 were missing (Government of Bangladesh, 2008a).

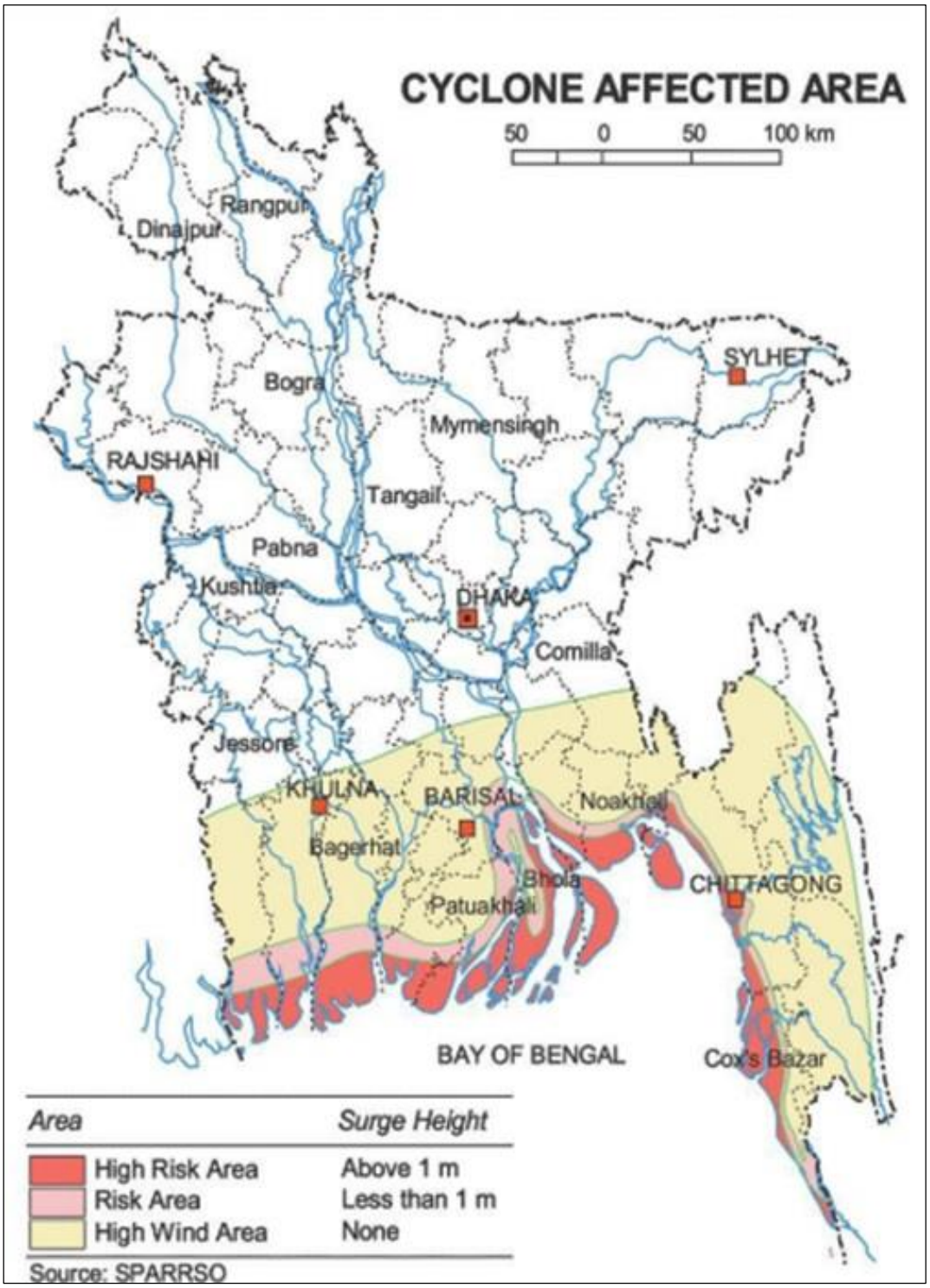

Figure 2:2 Main affected areas of cyclone in Bangladesh

Source: Kabir, 2014

The cyclone killed thousands of animals providing milk and meat, destroyed millions of fruit trees, demolished food storages and coastal people's small stockpiles, and consequently people had to fight for their daily sustenance (Government of Bangladesh, 2008b). Even after the cyclone, many people were homeless and lived under the open sky for several days. There was a shortage of drinking water as the local ponds and other sources of drinking water were contaminated by the corpses of human and animal (Choudhury, 2009). Approximately 11, 612 hand tube wells and about 7,155 ponds were entirely and partly destroyed in 12 highly impacted districts (Government of Bangladesh, 2008b). The prime economic sources in the cyclone affected areas were severely affected by hampering fishing industries and shrimp hatcheries (Kabir, 2014).

2.2.4 Cyclone Aila in 2009

The condition of this cyclone formation initiated on 21 May 2009 and became a severe cyclonic storm on 25 May (United Nations, 2010). Though it was a cyclone of category 1 (the wind speed was around 65-75 mph), the impact of it was tremendous (Kumar et al., 2010). The severely affected areas of Bangladesh include Koira and Dacope upazila of Khulna district, southern districts of Barisal and Khulna divisions, Ashasuni and Shamnagar subdistricts of Satkhira district, Soronkhola and Morrelganj subdistricts of Bagerhat district.

Owing to the high tidal surge of Cyclone Aila, almost 3.9 million people were suffered, and many residents were stranding in the flooded villages. The height of the water level was 7-10 feet and washed away several hundred houses, agricultural fields and water resources (Kabir, 2014). Approximately, 190 deaths and 7100 injuries took place due to this cyclone. Only a small proportion of people could manage to go to a cyclone shelter during cyclone and other people took shelter on the roads and roofs of the local government buildings, madrasas, schools, colleges, and mosques (Kumar et al., 2010).

The total communication systems in the affected areas were hampered due to the destruction of the road networks and impairment of embankments of the river. Over 60,000 people migrated in search of income from the affected areas. The cyclone affected areas were without electricity for about 24 hours (Kabir, 2014). The situation of Khulna and Satkhira districts were aggravated due to the ongoing monsoon season and embankment failure, while the conditions of 9 other affected districts were improving (Riquet, 2012). Study of Kabir (2014) stated that all the ponds in the affected areas were unsuitable for drinking due to the saline water contamination and the salinity was severely increased due to the breaching of embankments (Kabir, 2014). He further

informed that severely impacted households were still displaced and living on the embankments. Even though the migrated families returned to their homes, didn't get adequate income facilities to continue their livelihood. Owing to limited income opportunities, affected families could manage one meal per day along with degraded quality. The principal sources of livelihood were fishing in the cyclone affected areas which included 60% people directly or indirectly in fishing sectors. Incidence of Aila damaged almost all the fishponds and were still flooded with broken embankments even after 2 years. Several people lost their boats, some were damaged and needed repairing and many people had to sell their boats for covering daily expenses (Aid, 2009).

The food and nutrition sectors were still insecure for the worst affected, even though they received a minimum year of support from the government and non-government agencies. Few portions of the affected households were still incapable to recover and remained highly vulnerable even at the end of 2011 (Riquet, 2012). Again, Kabir (2014) discussed from Roy et al. (2009) findings that Aila caused 95 percent of the waterlogged areas to remain in unsafe sanitation. Folks were forced to defecate on surrounding water and used the unclean saline water for household activities. He mentioned that the salinity of coastal agricultural lands had increased five times more than the previous state and made it hard also to get safe drinking water and hygienic sanitation for all. Increased salinity of the lands posed a great threat in the earning source by making the lands unworthy to plough paddy as the affected area have been suffering from negative impacts of climate change (Kabir, 2014).

2.3 The Concept Vulnerability

The concept 'Vulnerability' is important for this study as it refers to states of susceptibility to harm, power discrimination and marginality in both physical and social systems. Most importantly, the pattern of vulnerability may change over time and thus, challenges created by vulnerability can also change. There are several dimensions like environmental, physical, social etc. explaining people's vulnerability. Obviously, measurement of vulnerability that explicitly contains its risk-response-outcome mechanisms remains a challenge and difficult to undertake.

Vulnerability has appeared as a fundamental concept for perceiving the state of people and societies that allows a hazard to develop into a disaster (Tapsell, McCarthy, Faulkner, and Alexander, 2010). Moreover, the fundamental reasons of vulnerability to adversities more locally are frequently economic and social, for instance, through landlessness, disintegration of

community organization, and inadequate entree to political representation (Alam & Collins, 2010). The general principles of vulnerability concept embrace the following: a) it is progressive and refers to the likelihood of facing a loss in the future with respect to some benchmark of wellbeing, b) a household can be declared to be vulnerable to future damage of welfare and this vulnerability is triggered by uncertain occurrences, c) the extent of vulnerability depends on risk features and the household's capacity to retort to the risk, d) vulnerability is closely related to time horizon, like that a household may be vulnerable to risks even for the subsequent month, year, etc. and their responses are time dependent as well , and e) that the near-poor and poor, likely to be vulnerable due to their inadequate access to assets and restricted abilities to respond to risk (Alwang, Siegel, and Jorgensen, 2001).

Chambers (1989) stated, "Vulnerability, though, is not the same as poverty. It means not lack or want, but defenselessness, insecurity, and exposure to risk, shocks and stress"(Chambers, 1989, p. 1). Again Cannon (1994) mentioned "Vulnerability is a characteristic of individuals and groups of people who inhibit a given natural, social and economic space, within which they are differentiated according to their varying position in society into more or less vulnerable individuals and groups. It is a complex characteristic produced by a combination of factors derived especially (but not entirely) from class, gender and ethnicity" (Cannon, 1994, p. 19).

Further, Singh, Eghdami, and Singh (2014) narrated the view of Wisner et al. (2004) where vulnerability is defined as "the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist, and recover from the impact of a natural hazard (an extreme natural event or process). It involves a combination of factors that determine the degree to which someone's life, livelihood, property and other assets are put at risk by a discrete and identifiable event (or series or 'cascade' of such events) in nature or in society" (Singh, Eghdami, and Singh, 2014, p. 5).

Vulnerability can be seen as a political ecological concept which emphases the affiliation that people have with their environment as well as close consideration about the society's political economic characteristic which shape that affiliation. With respect to hazards and disasters, vulnerability is at the theoretical nexus that links the association that people have with their environment to social forces and organizations and the cultural ideals that sustain or challenge them. Consequently, uniting components of environment, society and culture in many proportions, the notion of vulnerability provides a theoretical framework that includes the multidimensionality of disasters (Comfort et al., 1999; Cutter, 1996).

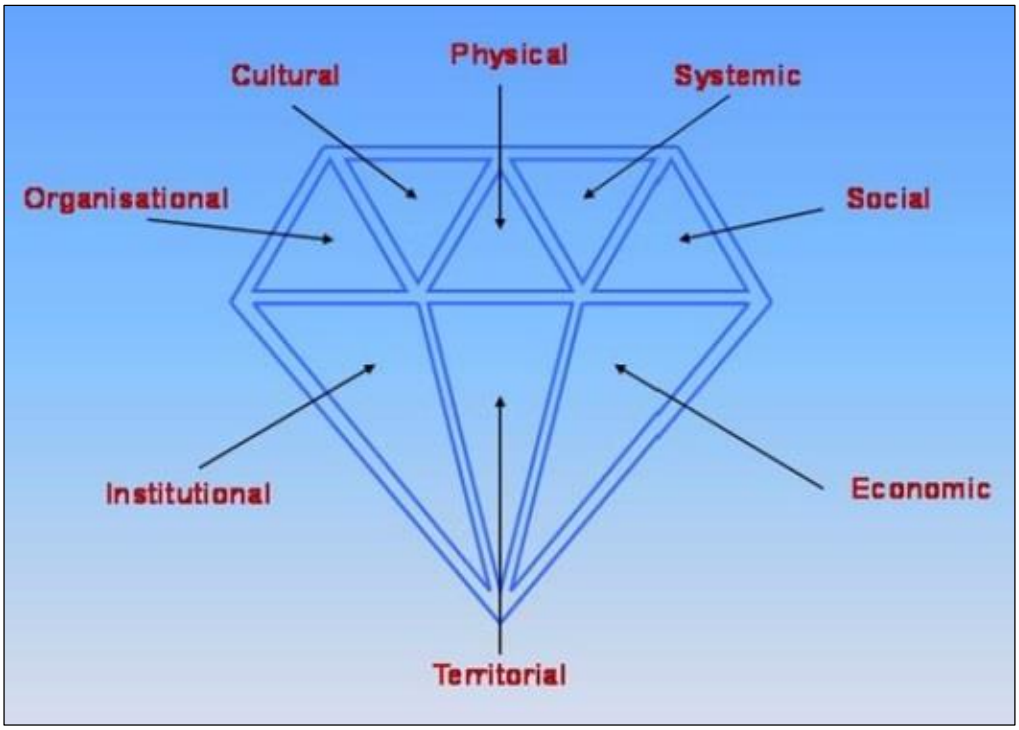

Figure 2:3 One illustration for conceptualizing the multifaceted nature of vulnerability

Source: Tapsell et al., 2010

Conceptualization about vulnerability needs more than merely understanding societies' past and existing relations with respect to disaster and development. According to the International Strategy for Disaster Reduction (UN/ISDR, 2004), vulnerability is determined by physical, economic, social, and environmental issues or processes, which gives rise to the susceptibility of a community to the effect of hazards. Also, the United National Development Programme (UNDP) outlines vulnerability as a human state or procedure resulting from physical, social, economic and environmental factors, which govern the likelihood and measure of damage from the impact posed by a hazard (International Strategy for Disaster Reduction, 2004). In other words, vulnerability characterizes the physical, political, social or economic defenselessness or predisposition of a community to damage in the case of a disrupting phenomenon of natural or anthropogenic cause. Figure 2.3 also provides the multifaceted picture of vulnerability. The dimensions of the facets and their place within the diagram are not demonstrative of additional relationship appearances (Tapsell et al., 2010).

Yamin, Rahman, and Huq (2005) sees vulnerability - as an impediment to development process in any country. Climate variabilities often making the poor communities more vulnerable in developing countries by increasing floods, droughts, irregular rainfall and other extreme events.

Hence, these communities facing disproportionately higher levels of mortality, social discrimination and economic interruptions (Yamin, Rahman, and Huq, 2005). According to Neil Adger, vulnerability is the experience of individual or collective groups to livelihood stress because of environmental variability (Adger, 1999). He stated that vulnerability even can arise from social norms, political institutions, resource endowment, technologies and discriminations during and after a climatic shock or in other words environmental shock. Thus, the extent of vulnerability is also ruled by the efficiency of institutional arrangement in the concerned disaster affected areas. Hence, vulnerability can be a combination of social institutional factors and environmental risks. It is also argued that vulnerability is closely related to the concept of development, which is a proxy for adjusting with livelihood condition. Institutional inertia might affect the socio-political harmony and may jeopardize the welfare maximization; which in turn escalates the vulnerability (Adger, 1999).

Singh et al. (2014) described that vulnerability is rooted in complex social relations and procedures. They further considered it as a social problem which require social solutions. Accordingly, they emphasize to address how multifaceted the problem truly is, because it is not like that a cyclone approaches or an earthquake shakes the ground. Rather, the problem arises from an "interface of society and environment" that is a pre-existing condition (Singh et al., 2014, p. 73). Their review stated that risk is socially formed and is not intrinsic to the hazard, disasters, which consequence from a misfit between human arrangements, the built environment, as well as the physical world, tend to expose undoubtedly the social complications that create response and recovery hard both at individual and household levels (Singh et al., 2014).

Barnett and Adger (2007) introduced another dimension of vulnerability with respect to the human security problem. They elucidate that climate change trends undermines human safety by reducing peoples' access to, and quality of natural resources indispensable for sustaining livelihood. Simultaneously, climate catastrophes diminish states' capacity to provide opportunities and facilities to people for securing their livelihood. This may pose a threat of increasing violence within the communities that eventually destroy the peace of society (Barnett & Adger, 2007).

One more dimension of vulnerability is presented by Adger and Kelly depends on capacity. They define vulnerability in terms of individual and social groups' capacity to respond to i.e. coping with, recovering from and adapting to any external shocks that may influence their livelihood or well-being. In this context, resource accessibility for the groups is considered as

a significant element for vulnerability. They emphasized on land ownership pattern as a capacity pointer, which finally shows the degree of resource accessibility (Adger & Kelly, 1999).

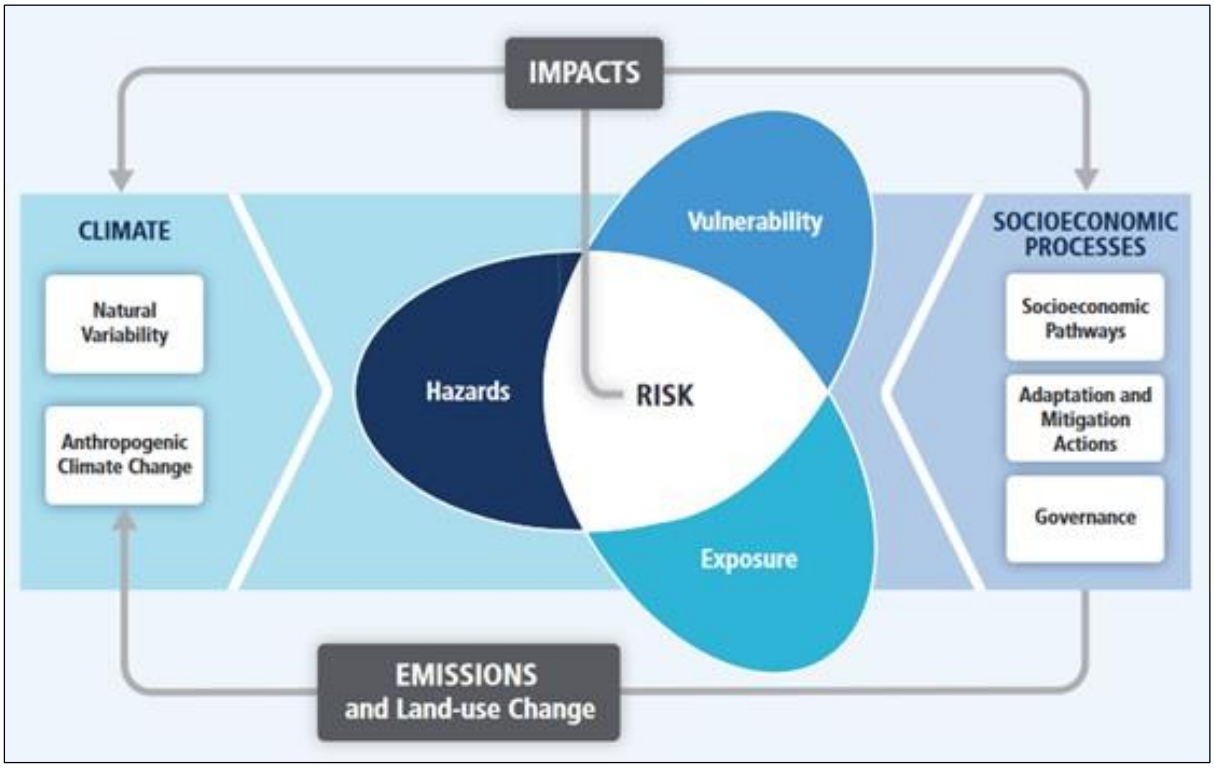

Figure 2:4 Diagram of the core concepts from the fifth assessment report of IPCC

Source: IPCC, 2014a

The Intergovernmental Panel on Climate Change (IPCC) also provide definitions of vulnerability. One previous definition of vulnerability from IPCC was 'the extent to which climate change may damage or harm a system; it depends not only on a system's sensitivity but also on its ability to adapt to new climatic conditions.' Sensitivity is in this case seen as, 'the degree to which a system will response to a change in climatic conditions' (Houghton, Meira Filho, Griggs, and Maskell, 1997). The Fourth Assessment Report of IPCC defined vulnerability as 'the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity' (IPCC, 2007). The Fifth Assessment Report of IPCC in 2014, defined vulnerability as 'the propensity or predisposition to be adversely affected.

Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt' (IPCC, 2014b). The difference is that exposure has been taken out from the definition of vulnerability. Figure 2.4 shows the diagram from the fifth assessment report of IPCC.

Vulnerability is closely allied with the notion of risk. Risk is considered as the function of probability and magnitude of different impacts. These events are themselves categorized by their frequency, their magnitude (including size and spread), and length, and their history – all of which influence vulnerability from the risk. Social activities can diminish risk or exposure to risk. Commodity price maintenance programs, for instance, decrease price risk. Similarly, households can manage or reply to the risks in numerous ways. Households can use both formal and informal risk management tools depending on their access to these tools. Risk management includes ex ante and ex post arrangements. Ex ante arrangements are applicable prior to a risky event takes place, and ex post management are taken after its recognition. Ex ante risk reduction can lessen risk (such as annihilation of malaria -bearing mosquitos) or lower experience to risks (such as malaria pills, mosquito nets). Ex post risk handling actions are responses that occur after a risky event is grasped and contain actions concerning realized losses such as eliminating children from school, selling assets, movement of selected family members, seeking temporary income source. In some cases, governments offer safety nets, for example food support or income generating work programs, that support households to cope with risk (Alwang et al., 2001).

Households often experience limitations to adopt effective risk management performs. These limitations include asymmetric information, inadequate or mislaid financial and insurance markets, failures of risk assessment, segregation from social networks (Holzmann & Jorgensen, 1999; 2000). Policy can decrease or eradicate some constraints, while others may need another means of risk management as the cost of the policy surpasses its benefits. For a definite household, the set of existing risk management opportunities is influenced by its assets, broadly defined (see Siegel & Alwang, 1999).

Risk, together with the household responses, lead to an outcome. Thus, the household is said to be vulnerable from the risk or vulnerable to an outcome. The magnitude, timing and history of risks and risk responses help determine the outcome. A household might be able to mitigate or cope with a risk or set of risks in a given period, but the process can result in limited ability to manage risk in subsequent periods – especially when assets are degraded (see Holzmann & Jorgensen, 1999; 2000; Siegel & Alwang, 1999).

Alwang, Siegel, and Jorgensen (2001) stated in their report, that different literature of vulnerability holds some common themes and mention their ideas distinctly in light of the risk-response-outcome framework. Their report also said that many of them helps to understand the definition and measures of vulnerability, but some common themes are really "myths" that can hamper the progress in evolving definitions and measures of vulnerability. The common themes mentioned in their reports are as follows:

a) Households are vulnerable to different negative outcomes and that can be measured in dissimilar ways. Moreover, sources of risk for vulnerability can be multiple. b) The poor are more exposed to risk. c) Ideal measures differ depending on the determination of measurement: targeting, monitoring and evaluation. d) The meaningful measure of vulnerability needs a benchmark e) Vulnerability is different from poverty, while the latter is a static concept and the former is a dynamic concept (Alwang et al., 2001).

One study conducted by Brouwer, Akter, Brander, and Haque (2007) in Bangladesh revealed that households with lesser income and poor access to productive resources are more vulnerable to climate related hazards. They also presented that under the climate disaster, together with income and asset disparity, individual households become least capable to face a common shock like cyclone or flood (Brouwer, Akter, Brander, and Haque, 2007).

Mallick et al. (2011) conducted a study in Bangladesh, on the challenge shapes of vulnerability with respect to cyclone SIDR 2007. They used a systematic random sampling in the Baniasanta union of Dacope upazila of Khulna district in Bangladesh, for conducting household survey of 124 households (sample size). Among the 124 respondents, female respondents were few due to their restriction to talk to strangers. Victims of Sidr and some senior citizen shared their experiences with that disasters during in-depth interview. They found that different characteristics (daily laborers, fishermen and small businessman, hunting and trading) of the respondents, created the disaster experiences differed from individual to individual, group to group and community to community. Also, they mentioned, the waiting for relief and reconstruction materials makes the affected communities dependent on relief incentives which creates them more susceptible to other calamities. Thus, this rises the poverty ratio and forces them to stay in a "vulnerability trap" for any type of calamity in future. They stated that it will be very beneficial to exploit the social capital i.e. social incorporation, social unity, solidarity, and networking between and among all segments of the community to survive against diverse adversities (Mallick et al., 2011).

Laila (2013) had carried out a study in the southwestern coastal Bangladesh assessing the social vulnerability of coastal communities. Following the components proposed by the Intergovernmental Panel on Climate Change, she studied the vulnerability indicators i.e. exposure, sensitivity and adaptive capacity. The exposure component displays that housing constructions and geographical settings of the studied communities are vulnerable with the older and disable people among the most defenseless group. Whereas sanitation, water condition, livelihood activities, monthly income and food security are studied to indicate sensitivity. The findings of her study show that peoples in the area have few livelihood options and they are heavily dependent on natural resources like land, water etc. Also, communities' limited preparations were found against the adverse effects of climate change. Moreover, absence of telecommunications like radio, television etc. make tougher for the Governments or local administrations in disseminating the information effectively in the community during emergency. However, she recommends further study on the adaptation options and coping mechanisms connected to the living in the south-western coastal region of Bangladesh for achieving sustainable growths in the coastal civilization (Laila, 2013).

2.4 The Concept Adaptation and Coping

One report, entitled 'Cyclone disaster vulnerability and response experiences in coastal Bangladesh' of Alam and Collins (2010) argue that hazard response '…encompasses all the ways in which a society may act to reduce the effects or increase the benefits of a hazard'. These embrace arrangements immediately before hazards (like warning signals, emergency evacuation or other precautionary measures), or long-standing actions (i.e. planting crops that are salt tolerant or less susceptible to drought), or adaptation to extreme situations (such as building villages on levees). Henceforth, human response against natural hazards comprise both short-term and long-term steps that can be termed as 'adjustment' and 'adaptation' respectively. For instance, '…house designing to struggle against a storm surge would be an adjustment; establishing a community for longer time in a location so that the houses are beyond the storm surge, would be an adaptation' (Alam & Collins, 2010, p. 933)

Adaptation also entails the sense of adaptive capacity (Smit & Wandel, 2006), referring the ability of a system to accommodate, to deal with, adapt to and to recover (Smit, Burton, Klein, and Wandel, 2000). However, one of the most important factors shaping the adaptive capacity of individuals, households and communities is their access to and control over natural, human,

social, physical and financial resources. Examples of resources affecting adaptive capacity include: human Knowledge of climate risks, conservation agriculture skills, good health to enable labor, women's savings and loans groups, farmer-based organizations, traditional welfare and social support institutions, physical irrigation infrastructure, seed and grain storage facilities, natural reliable water sources, productive land, vegetation and trees, financial micro-insurance, diversified income sources. In general, the world's poorest people often have limited access to those livelihood resources that would facilitate adaptation. Access to and control over these resources also varies within countries, communities and even households. It is influenced by external factors such as policies, institutions and power structures. Nevertheless, it is important to mention that adaptive capacity can vary over time based on altering conditions and may differ within hazards as well (Kelly & Adger, 2000; Smit et al., 2000; Smit & Wandel, 2006).

Adaptive capacity has been evaluated in numerous ways, including through thresholds and ''coping ranges'', demarcated by the situations that a system can deal with, accommodate, adapt to, and recover from. Most societies and sectors can cope with (or adapt to) usual climatic conditions and modest deviations from the norm, but exposures concerning extreme happenings may occur outside the coping range or may surpass the adaptive capacity of the people. Some authors employ ''coping ability'' to shorter period capacity or the capability to just survive and apply ''adaptive capacity'' to longer period or more sustainable adjustments. While some use ''adaptability'' for the shorter period coping and ''potentiality'' for the longer period capacity (Smit & Wandel, 2006).

Simultaneously, the fourth assessment report of Intergovernmental Panel on Climate Change's (IPCC) states that adaptive capacity is the ability of a system to adjust to climate change [including climate variability and extremes], to moderate potential damages, to take advantage of opportunities or to cope with the consequences (IPCC, 2007). Whereas the fifth assessment report of IPCC defines adaptive capacity as the ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences (IPCC, 2014b).

Adaptation with respect to human extents of global change usually denotes to a process, action or outcome in a system (household, community, group, sector, region, country) for the system to well adjust or manage or cope with some changing state, risk, stress, hazard or opportunity. Several meanings of adaptation are found in climate change literature, with distinctions on a common theme. Brooks (2003, p. 8), defines adaptation as ''adjustments in a system's behavior

and characteristics that enhance its ability to cope with external stress''. Smit, Burton, Klein, and Wandel (2000, p. 225), in the climate change context, refer to adaptations as ''adjustments in ecological-socio-economic systems in response to actual or expected climatic stimuli, their effects or impacts.'' Pielke (1998, p. 159), also in the climate background, explains adaptations as the ''adjustments in individual groups and institutional behavior to reduce society's vulnerability to climate.'' Adaptations can be preventive or reactive and can be autonomous or planned, depending on their timing and their degree of spontaneity respectively (Smit et al., 2000).

Adaptation concept has been used in the social sciences, both explicitly and implicitly. Some researchers of adaptation have applied the concepts and terminology of biophysical ecological variation (e.g. Odum, 1970) and related concepts of resilience, equilibrium and adaptive management (e.g. Holling, 1986). Others, mainly in the natural hazards standpoint, given emphasis on perception, adjustment and management of environmental hazards (e.g. Burton, et al., 1978). Analyses of adaptation to changing climatic conditions have been undertaken from long ago, for a variety of purposes (Kelly & Adger, 2000; Smit et al., 2000). Smit and Wandel (2006), cited the work of Butzer (1980) as an example of the previous research, who focused ''cultural adaptation'' (human ingenuity including technological innovation and long-range planning) in light of projected climate change and its expected impacts on world food stock (Smit & Wandel, 2006).

Adaptation can thus include building adaptive capacity, thereby enhancing the capability of individuals, groups, or organizations to adjust to variations and employing adaptation decisions, i.e., altering that capacity into action. In this framework, adaptive capacity denotes the qualifications that are essential to enable adaptation and embraces social characteristics, and physical and economic elements. Both dimensions of adaptation can be executed in preparation for, or in response to, effects created by environmental or other changes. Hence, adaptation is an unceasing stream of activities, actions, verdicts, and attitudes that enlighten decisions regarding all aspects of life and that reflect existing social norms and processes (Nelson, Adger, and Brown, 2007).

With respect to environmental change, adaptation refers to an adjustment in ecological, social, or economic systems in response to experimental or expected changes in environmental inducements and their effects to lessen adverse impacts of change. Emerging crucial research areas on adaptation to environmental change are (a) detecting system limits, barriers and thresholds to execute adaptation; (b) explaining successful or sustainable adaptation in

encouraging proper technological options for adaptation; (c) cognitive processes of risk evaluation and preparation; and (d) public and private actors' virtual role in adaptation (Nelson et al., 2007).

As regards the concept of coping '…coping is the manner in which people act within the limits of existing resources and range of expectations to achieve various ends. In general, this involves no more than "managing resources", but usually it means how it is done in unusual, abnormal and adverse situations' (Wisner et al., 2004, p. 113). The report of Alam and Collins (2010) denoted coping as 'the actions of ordinary people or disrupted remains of institutions, in contrast to official and planned response' (Alam & Collins, 2010, p. 933). Coping capacity is defined by UNISDR as "… the ability of people, organizations and systems, using available skills and resources, to face and manage adverse conditions, emergencies or disasters …" which can "… contribute to the reduction of disaster risks" (Wamsler & Brink, 2014, p. 89).

The traditions in which capacities are mobilized in times of disaster reflect coping strategies. According to United Nations International Strategy for Disaster Reduction (2002), coping strategies refer to the means in which people and organizations use current resources to attain several helpful ends during unfamiliar, irregular and adverse circumstances of a disaster phenomenon or procedure (Galliard, 2010). Nevertheless, coping strategies may be effective if a household is able to distribute resources to manage a crisis without negotiating the long-term purpose of livelihood security. On the contrary, coping may ineffective when all ways to manage the crisis are failed, such as selling of productive assets and labor, consumption flattening and gathering of wild foods; and in worst case causes destitution (Paul & Routray, 2011).

Further, a system's adaptive capacity and coping range (one feature of capacity) are not stationary. Coping ranges are flexible and reply to deviations in economic, social, political and institutional situations over time. For illustration, population burden or resource reduction may gradually decrease a system's coping capability and limit its coping range, while economic progress or improvements in technology or organizations may increase adaptive capacity (Smit & Wandel, 2006). However, in most cases, coping and adaptive practices are implemented at local level, while risk is formed by features working at larger scales. Also, they are grounded on happenings that have occurred and hence not on unpredictable events (Wamsler & Brink, 2014).

Throughout human history, people have continuously coped with and adapted to their environment. This action is documented as being critical to define resilience and

transformation. Nevertheless, little is known about different communities' coping and adaptive practices, and they are rarely taken into consideration by authorities and organizations. Coping and adaptation overlap significantly; they are intimately connected, there are synergies and trade-offs, and their allied capacities play a vital role. Though some academics distinguish between coping (i.e. local adjustments with respect to extreme weather events) and adaptive practices (i.e. longer-term or essential changes made to steadily lessen potential damage or take advantage of openings rising from weather deviations), their distinction is not clear-cut and is very context definite. In other words, it includes more than institutionally founded measures and people's local coping approaches that already existing. Moreover, it embraces capacity that may be used in the long run to lessen and adapt to disaster risk (Wamsler & Brink, 2014). Further, the efficiency of individual coping and adaptation measures though is important, it cannot be taken either as a pointer of the individuals' or households' adaptive capacity or of its role in enhancing resilience and transformation. This is because, a short-term strategy of one person or household can render as a long-term solution for another, based on the context and the combination of strategies. A single coping measure mostly not active alone, can be a vibrant complement to other measures, which together generate a sustainable coping or adaptation system.

Earlier studies concerning with household coping are narrowly devoted on famine and food security. Little consideration has been accounted on coping with other types of natural catastrophes. In Bangladesh, however, human response to natural calamity has typically provide attention on riverine hazards; such as how different groups of communities respond to flooding, local adjustment policies to flooding, adjustment policies to agricultural cropping forms, coping with riverbank erosion. Some studies have also pursued on sectors like cyclone warning, cyclone disaster reduction, propagation of forecast data and adaptation responses, disaster awareness and management issues and the gender extents of climatic hazards (Paul & Routray, 2011).

2.5 The Concept Resilience

Like 'vulnerability', the view of resilience has received much variation over the past 25 years. In the context of resilience 'adaptation' and 'adaptive capacity' playing a dominant role (Hufschmidt, 2011). Although, all the recent resilience definitions differ somewhat in their phrasing, most of them mention similar elements. Resilience often depicted in the past as a

product that can be measured and observed, a growing number of academics and experts now identify that a more suitable way to theorize resilience is to recognize it as an ability (Béné, Newsham, Davies, Ulrichs, and Godfrey- Wood, 2014). To be more explicit, it is the 'ability to resist, recover from, or adapt to the effects of a shock or a change' (Mitchell & Harris, 2012, p. 2).

Literally, an understanding of resilience is then projected to allow actors to better assess the possibility and desirability of changes among diverse system formations. With respect to rural livelihoods, resilience and its focus on system and holistic thinking does also discover some resonance in natural resources and the environment sector. Basically, poor people are known to depend more deeply on natural resources (Béné et al., 2014). Thereby, the resilience of rural community is intimately related to the environment and its existing resources.

The concept of resilience is constantly being changing and redefined. The emerging literature on ecology has evolved into a more elaborative concept than the previous relatively narrow definition, derived from Holling 1973 where resilience was defined as the ability of a system to bounce back or return to equilibrium following disturbance (Folke, 2006). The capability to adapt and transform are therefore the cornerstones in this resilience conceptualization. Adaptability refers here to the capacity of a system (or parts of this system) to integrate experience and knowledge, to learn as well as adjust its replies to altering external drivers and internal processes and remain evolving within the existing stability realm or basin of attraction (Berkes, Colding, and Folke, 2003). On the contrary, transformability is defined as the capability to generate a fundamentally new system when the prevailing system becomes unsustainable due to ecological, economic, or social structures (Walker, Holling, Carpenter, and Kinzig, 2004).

In the 'Special report on managing the risks of extreme events and disasters' the Intergovernmental Panel on Climate Change describes resilience as the 'ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions' (Field et al., 2012, p. 5). According to Béné, Wood, Newsham, and Davies (2012), resilience is the consequence of absorptive, adaptive and transformative capacities. These three dimensions (absorptive capacity, adaptive capacity and transformative capacity) have seen as the three critical features of resilience (Folke, 2006; Folke et al., 2010). The stimulating aspect of this 3D conceptualization is that it aids to realize that resilience appears due to all these three capacities

rather than one. Specifically, each of those leading to dissimilar conclusions: persistence, incremental adjustment or transformational responses (Béné, Wood, Newsham, and Davies, 2012) and figure 2.5 shows the concept of resilience in a diagram according to them.

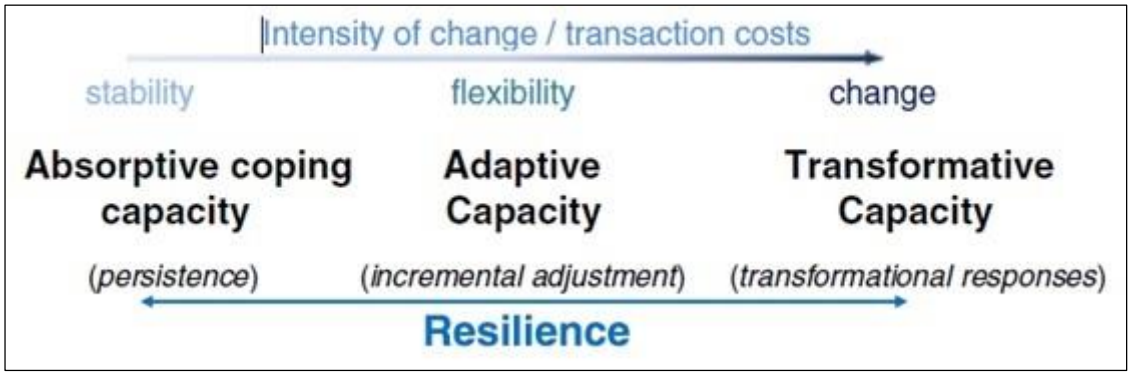

Figure 2:5 Resilience as the product of absorptive, adaptive and transformative capacities

Source: Béné et al., 2014

When the absorptive capacity, that is, the numerous coping strategies by which individuals and/or households moderate the effects of shocks on their livelihoods and elementary needs, is exceeded, the individual will then apply their adaptive resilience (Cutter et al., 2008). Adaptive resilience denotes the various adjustments (incremental changes) that people undertake to continue functioning without chief qualitative changes in function or structural identity. These incremental adjustments can be of several forms (e.g. implementation of new farming practices, livelihood diversification and involving in new social networks). These can occur at numerous stages (intra-household, groups of individuals/households, community, etc.) and can be individual or collective. These observations are vital as they raise a series of consequences. First, it expresses that adaptation at one level can diminish adaptation at another, since adaptation is not a zero-sum game. Besides, adaptation is difficult to track or to measure because of its continuous and incremental process (Levine, Ludi, and Jones, 2011). In that respect, people or societies may not even be conscious of a coping policy for another. Consequently, if the deviations required are so vast that they engulf the adaptive capacity of the household, community or (eco)system, modification will have to occur. So, deviations are not incremental but transformative, resulting in alterations at individual or community's prime structures and meanings.

Indeed, the resilience concept recommend that handling of resilience entails directing a system that encourages resistance for minor disturbance, adaptation for bigger disturbance and transformability at the time of unviable conditions. This explanation is theoretically useful but rationally too naive to capture accurately the multi-stressor nature of vulnerability and because of many diverse shocks and stresses combine and happen together, each affecting the system with various virtual intensities, at different scales, and each demanding discrete or united levels of resilience (o'Brien et al., 2004). Additionally, it is also imperative to understand that a certain shock may even can create different impacts in the same community. A simple instance may demonstrate this fact: a phase of drought in Ethiopian low-lands may influence a farming household severely and inspire them to occupy in adaptive resilience strategy (or probably transformative resilience), while the same drought may merely stimulate some absorptive resilience for other households, say a municipal servant in the same community. Moreover, this reflects that creating resilience would need interventions that reinforce the combination of three components (absorptive, adaptive and transformative resilience), and at many levels (individual, households, communities, region, etc.). So far, we have still very nominal understanding concerning how diverse systems differ in their capability to cope, adapt or transform with dissimilar types of complex variation. A developing belief embraces that this mission seems to entail both stability and change as well as linking multilevel affairs across and within different scales (temporal, spatial etc.) (Béné et al., 2014). However, definition of resilience according to Folke et al. (2002) (using the view of Kasperson et al of 1995), infer that 'adaptation' affects resilience. Also, mentioned that resilience due to adaptive actions anticipate and lessen further impairment (Folke et al., 2002).

Many scientific articles emphasized on the aids of implementing resilience concept as a basis for analysis (Carpenter, Walker, Anderies, and Abel, 2001; Berkes et al., 2003; Walker et al., 2004). One of the most beneficial features of resilience to many scholars, is its capacity to help framing difficulties in a systemic approach and to deliberate 'holistically', a characteristic that is predominantly relevant in the specific background of development, for numerous reasons.

First, a systemic method is appropriate because several sorts of shocks that distress households and societies are now becoming progressively covariant, upsetting both households and entire communities (Béné et al., 2014). Second, implementing a systemic approach also helps to account a huge number of the procedures and dynamics that impact people and their surroundings, occurring from local to global and are often described by feedbacks (Folke, 2006). The resilience approach is thus advantageous, as it permits a systemic understanding on

social-ecological connections, which seems necessary to realize the relations between human systems, ecosystems as well as shocks and trends.

The multi-dimensional sight that exemplifies resilience can also help in detecting the relation (and preferably complementarities) of several forms of connections, as well as the thresholds of various types of systems. It therefore assists in recognizing some general features, which create a system resilient with respect to exposure to multiple kinds of hazards and uncertainty. So, it obtains the potential for disseminating light on the multiple causes of vulnerability that can affect the society at various scales (Wisner et al., 2004). Rather than replacing the vulnerability concept, resilience should relate to and balance vulnerability analysis. A decent example of this dual approach is the effort on 'resilience in the context of poverty' directed by Béné and his colleagues in Niger river Basin where these writers apply a vulnerability mapping tool (Mills et al., 2011), which they integrated with the resilience approach to allow the identification of socially distinct system thresholds across scale (Béné et al., 2014). Their joint resilience-vulnerability approach places significant variances within communities with respect to access to resources and entitlements, which eventually influences individual or communal abilities to absorb or adapt to deviations.

However, not any of these arguments are entirely new. Over the past 10 years, they have been debated to several degrees in the academic works. Yet, the concept of resilience is evolving now as the initiatives for integrating discourse, a 'mobilizing metaphor' that takes practitioners, policy makers, several organizations with distinct agendas and communities from different backgrounds, jointly, in the same board, with an equal aim: 'strengthening resilience' (regardless of what this term denotes accurately) (Béné et al., 2014). Furthermore, different scholars' view reveal that change is a central feature of any system, and the level of system adaptedness changes as the background changes. Due to the transient characteristics of adaptedness, a resilience context stresses the standing of preparation for surprises and system regeneration. Hence, Resilience is constructed on complex systems studies with an attention on adaptive capacity and maintaining the capability to deal with future indefinite change. To conclude, the intrinsic pressure between high adaptedness and system resilience results in trade-offs between existing efficacy and future vulnerabilities (Nelson et al., 2007).

2.6 Summary

The above discussion indicates that vulnerability, adaptation and coping as well as resilience studies have evolved from diverse disciplines and research backgrounds. The different views made it clear that defining vulnerability and resilience are still a matter of debate. Nevertheless, vulnerability can be said as the state of a system before an occurrence causes a disaster (Tapsell et al., 2010). The present study provides information about their housing pattern, economic condition, income sources, food and water sources and so on. All these characteristics give an insight regarding risks of facing severity against cyclone like event by identifying their livelihood pattern. Also, the study emphases the challenges and losses caused by cyclone to depict the major vulnerabilities of the households. It reveals the sensitive sectors of the households which faces challenges and losses due to disaster. This is because vulnerability can be regarded as the likelihood of the consequences of the losses of a system measured in the form of economic or human life losses.

Review of literatures also explore that both vulnerability and resilience have focused on adaptation and adaptive capacity. This further indicates that vulnerability can be reduced by increasing adaptation and thereby can create resilience by bringing recovery. The view regarding this, vulnerability is a mixture of a specific state of that system with other features such as capability to manage and recover; the latter presenting the concepts of resilience and resistance. (Tapsell et al., 2010). However, the present study paid attention only on the short-term (coping) strategies of households to manage themselves for well in advance, immediately before cyclone and after cyclone instead of long-term (adaptation) strategies. No attempt has been made to elucidate how different variables such as occupation, age, education, income, gender, and other exogenous aspects influence the adoption of coping strategies. However, for assessing the livelihood resilience of households, I have focused on absorptive coping capacity, adaptive capacity and transformative capacity. In this regard, I considered households' ability to adjust and bouncing back following cyclone disaster. Above all, attention was given to the sectors that commonly experience losses and challenges, their way of coping (both from self-initiatives and helping organizations) against the cyclone adversity and their perception of recovery, vulnerability as well as helping interventions.

3 Study Area and Methodology

3.1 Introduction

According to Bryman and Bell (2011), research methodology is a planned way of seeking a solution to a problem. Moreover, research methodology gives an organized and proper way for conducting research as well as the science and philosophy behind all research (Adams, Khan, Raeside, and White, 2007). This chapter describe in detail the methods employed in the present study. The salient features of this chapter are: selection and background of the study area, determination of sample size and sampling technique, data collection process, field work plan, and data analyzing techniques. The present chapter also provided attention on ethical issues and limitations of the study.

Table 3:1 Objectives of the research and methods applied

Objectives	Methodology followed
To investigate the livelihood pattern (socioeconomic, demographic, other characteristics) of the surveyed households of the study areas	Questionnaire survey
To identify major vulnerabilities of the households	Questionnaire survey and focus group discussion
To explore the coping strategies and recovery status of the households	Questionnaire survey and focus group discussion

3.2 Methodological Approach of the Study

Basically, the study is based on quantitative primary data, but some qualitative primary data has also been collected. The purpose of using sampling in quantitative research is to make a valid conclusion about a larger group. Qualitative research helps the researcher to achieve as much information as possible about the different features of households and in-depth knowledge about an event.

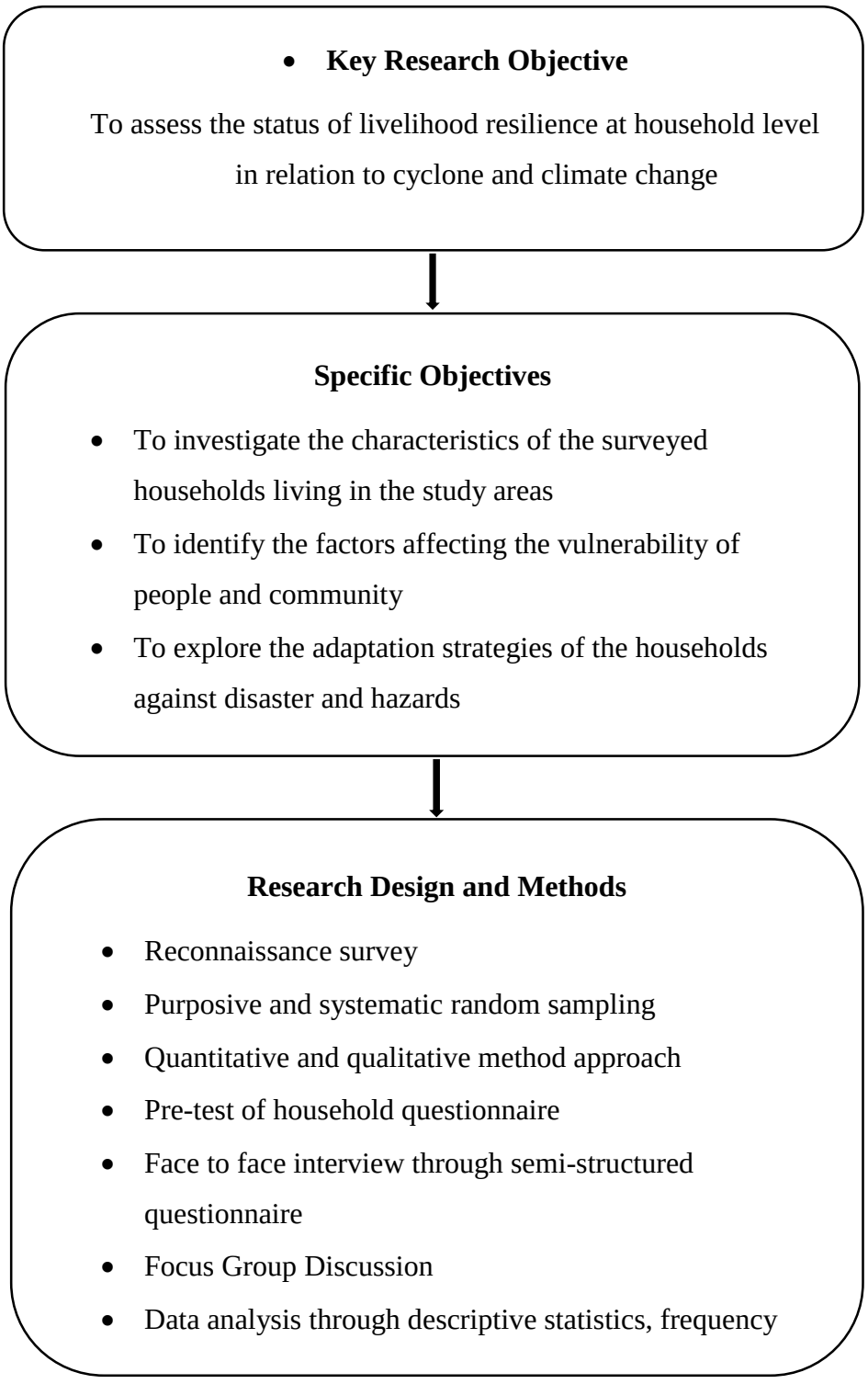

Figure 3:1 Flow chart of research procedure to pursue the thesis

To begin with the study area selection, a reconnaissance survey was carried out to get a view of the social, economic, environmental and physical condition of the study area. In this process, some discussions were made with the people working at the upazila (local government) office

as well as with the people living in the villages. In addition, existing maps and relevant literatures regarding the study area were taken into consideration. Priority was also given to accessibility to the villages selection, as it was not possible to visit and survey the most distant villages of the Southwestern coastal belt. Since the research topic highly focused on cyclone prone areas of Southwestern coastal Bangladesh, Dacope upazila of Khulna district was selected for this study. Notably, the administration of Bangladesh is divided into several hierarchical units and these units are Division, District, Upazila and Union. Dacope upazila is a large upazila and almost all the villages (lowest rural geographic unit) are vulnerable to cyclone. As it was not feasible to visit many villages within restricted time and cost. Subsequentlfour villages namely Kamarkhola, West Srinagar, Sutarkhali and Nolian were chosen.

Figure 3:2 Discussions before selecting the villages

Source: Author, field survey 2017

Among the selected villages, Kamarkhola and West Srinagar is under Kamarkhola Union and Sutarkhali and Nolian is under Sutarkhali Union. Whereas, Union (smallest administrative rural

geographic unit) consisting of mauzas and villages and containing Union Parishad institution (Statistics, B. B. O. 2013). Nevertheless, the reasons behind the selection of the villages were:

1. all the four villages frequently experience cyclones.
2. the livelihood of most of the households in these areas is one way or another significantly affected by cyclones.

3.3 The Study Area

Dacope upazila of Khulna district which is, one of the cyclone prone areas, situated along the Southwestern region of Bangladesh. Figure 3.2 shows the location of the study area. This upazila is positioned at 22.5722°N latitude and 89.5111°E longitude in Khulna district and consists of three polders. A polder is a low-lying tract of land that has been reclaimed from a body of water by building embankments (dikes) and by drainage canals. The polders are number 31, 32 and 33 (Kibria et al., 2016). The coastal areas of Bangladesh have 139 polders and Cyclone Aila in 2009, had tremendous effects on the polder 32. Dacope upazila is surrounded by the Bhadra river, the Shibsa river, the Dhaki river and the Sutarkhali river on the east, the west, the north and on the south side (Kibria, Khan, and Saha, 2016) respectively (figure 3.6). Also, several canals including Jaliakhali, Gulbonia, Mistripara pass through the polder.

Most of the lands in this area are medium high land (inundation depth 0.30-0.90 m). The most practiced agricultural crops in this upazila include aman (monsoon rice) and homestead vegetables (winter crops) with small scale boro (winter) rice, watermelon, sunflower and sesame. The landless and marginal groups constitute the majority, among the farmers of the study area (Kibria et al., 2016). The Sundarbans, the large mangrove forest starts on the southern part of the study area. Local sources of income are crop cultivation, wage labor and fish farming. Dry season cropping is inhibited by high soil salinity, ranging from high to very high (13-30 dS/m) throughout dry season (MoL, 2011). The study area has a population of 43,749 with an area of 78.17 km2. The average literacy rate in Dacope upazila is 46.66%, male is 53.89% and female is 38.98%. About 66.07% occupationally derive their livelihood from agriculture (Statistics, B.B.O. 2011). Temperature of the study area during pre-monsoon period is the highest of the year and may rise above 39°C in April. The monthly average minimum and maximum temperatures are 22°C and 34°C respectively. Temperature during winter period is the lowest of the year and may fall up to 6°C in January. It has found that humidity of the study

area varies with season. The highest monthly average humidity is around 87% in June whereas the lowest is about 68% in February as well as in March.

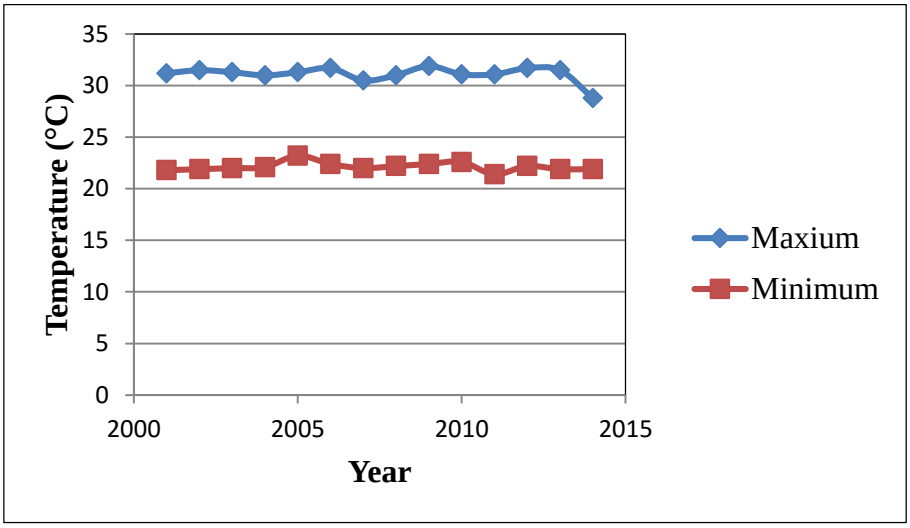

Figure 3:3 Annual maximum and minimum temperature in Dacope from 2001 to 2014

Source: BMD, 2014

Heavy rainfall is common in the study area and occurs more than two times in a year. Average rainfall in this area is 1750 mm. Figure 3.4 shows the pattern of annual rainfall in mm from 2001 to September 2013 for the study area.

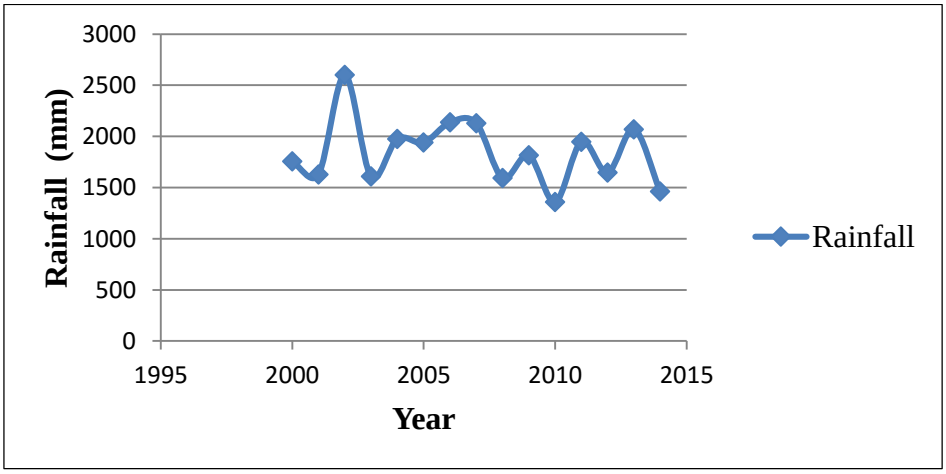

Figure 3:4: Annual rainfall (in mm) in Dacope from 2001 to 2014

Source: BMD, 2014

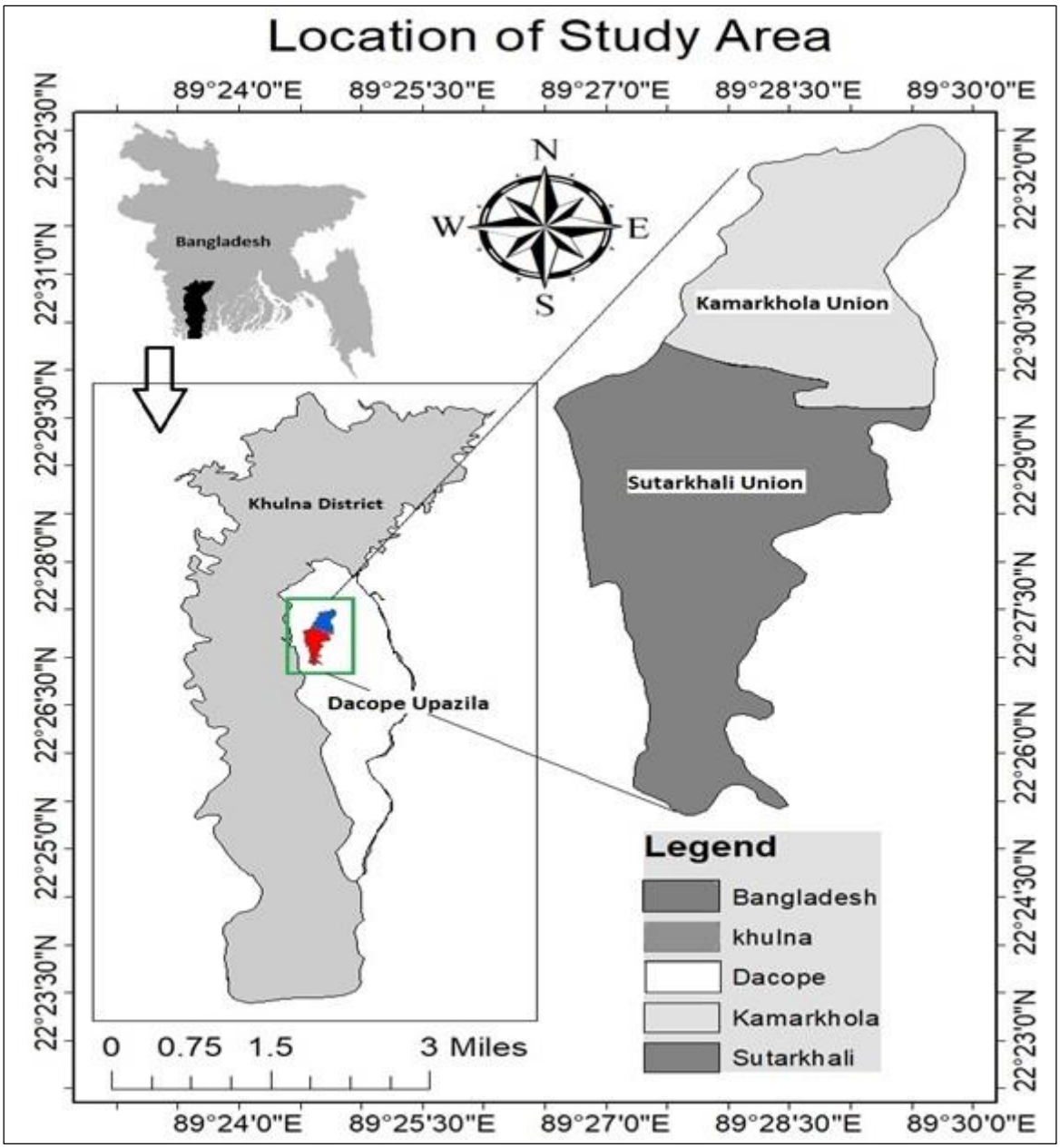

Figure 3:5 Location of the study area

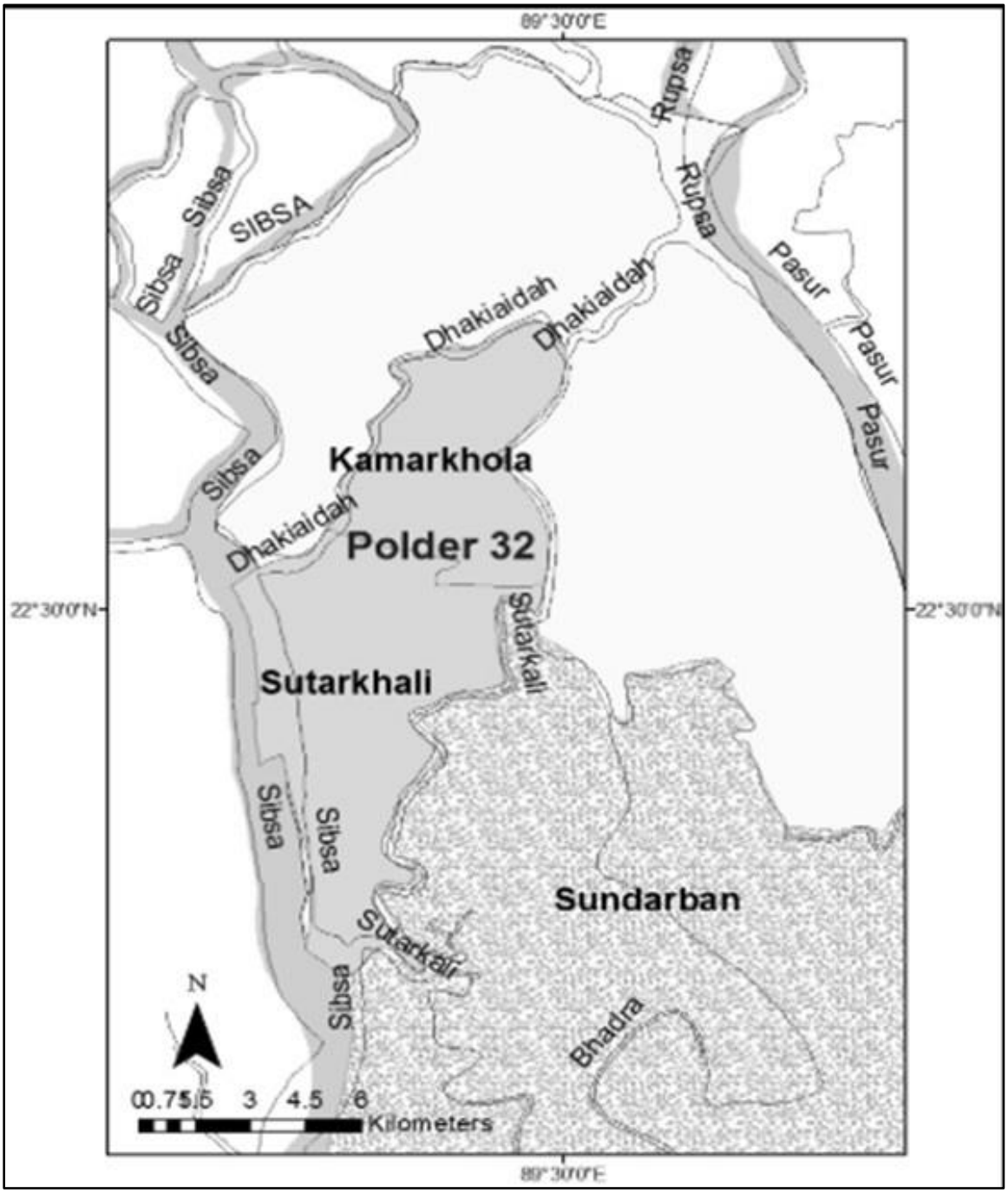

Figure 3:6 Map of the study area

Source: Kibria et al., 2016

3.3.1 Information about Kamarkhola and Sutarkhali Union

Sutarkhali union contains 30,430 people, of which the male is 49.16% and female is 50.23%. About 70.35% are Muslims and about 29.13% are Hindus. Literacy rate in this union is 43.24%. The total number of people living in Kamarkhola union is 13,319. Among them, male is 52.14%

and female is 47.86%. In this union, about 31.16% are Muslims, 61.1% are Hindus, 1.66% are Christian and others include 1%. Literacy rate of Kamarkhola is 50.53%.

Table 3:2 Brief information on Kamarkhola and Sutarkhali unions

Name of union	Area in Hector	Unit no.	No. of villages	Population			Literacy Rate %
				Male	Female	Total	
Sutarkhali	12092	6	5	15663	14767	30430	43.24
Kamarkhola	7214	3	14	6944	6375	13319	50.53

Source: Statistics, B.B.O. (2011); Kamarkhola and Sutarkhali Union Parishad Offices, (2017)

The educational status of the two unions was quite poor due to several socio-economic barriers. Poor families are forced to engage their children in household activities instead of sending school, especially girls. Moreover, it poses a tradition that provide little room for formal education and its associated benefits. About 60 percent children dropped out from school, before completing their primary education. (Kamarkhola Union Parishad Office, 2017).

3.3.1.1 Infrastructures

The infrastructures of Sutarkhali Union include 5 high schools, namely Gunari Shital Chanda High School, Kalabogi Sunderbans High School, Sutarkhali High School, Nalian High Achool, North Gunari High School along with 8 government primary schools, 9 registered primary schools and 2 madrasas (religious school) in this union (Sutarkhali Union Parishad Office, 2017).

Besides, there is one union parishad near Nalian bazaar, 3 forest offices, one police station, 4 post offices and one union land survey office. Moreover, 4 small concrete bridges, 18 culverts and 36 sluice gates and 4 wooden metal bridges are present in this union (Sutarkhali Union Parishad Office, 2017).

The infrastructures in Kamarkhola Union include 2 high schools namely Kalinogor High School and Joynogor High School as well as 9 Primary schools. Also, there are 11 mosques, 23

temples and one Church. There are 2 bazars, 11 trawler ghats, one launch ghat, and 8 boat ghats in this union (Kamarkhola Union Parishad Office, 2017).

3.3.1.2 Cyclone shelters

Kamarkhola union and Sutarkhali union have 2 and 9 cyclone shelters respectively.

Table 3:3 Cyclone shelters in Kamarkhola Union

Cyclone shelter name	Latitude and longitude	No. of floor	Capacity (people)	Floor space (ft)
J.P High School	Latitude 22.32'2" Longitude 89.27'37"	2	1,155	2,310
Sreenagar Uttarpara Non-novernment Primary School	Latitude 22.31'10" Longitude 89.29'30"	2	1,150	2,300

Source: Kamarkhola Union Parishad Office, 2017

Apart from the above, some schools also used as cyclone shelter during cyclone, in Kamarkhola union such as, Uttar Kamarkhola Govt. Primary School, Cannir Chawk Primary School, Joynogor High School, Kamarkhola Primary School, Poschim Joynogor Primary School, Joynogor Madrasha, etc. (Kamarkhola Union Parishad Office, 2017).

3.3.1.3 Land and land use pattern

The total cultivable land of Sutarkhali union is 12092 acres. Most lands in this area are used as agricultural land, fishing ground (mainly shrimp culture), human settlements, roads, institutions, and other infrastructures. The main crops composed of paddy, potato, onion and garlic. Currently, minor crops include jute, sesame, aus, and boro paddy. (Sutarkhali Union Parishad Office, 2017).

The total cultivable land of Kamarkhola is 5926 acres. Of which, 92.92% is using for single crop and 7.08% as double crop. Among the farmers, landless, small, intermediate, rich are 20%, 30%, 35% and 15% respectively. Paddy, potato, onion, and garlic are the major crops here. The extinct or nearly extinct crops are jute, sesame, aus and boro paddy. The available fruits include coconut, guava, sofeda and palm (Kamarkhola Union Parishad Office, 2017).

Table 3:4 Cyclone shelters in Sutarkhali Union

Cyclone shelter name	Latitude and longitude	No. of floor	Capacity (people)	Floor space (ft)
19 no. Kalibogi Saliha GPS	Latitude 22.27'32" Longitude 89.28'39"	2	825	1650
38 no. Purba Kalibogi GPS	Latitude 22.26'11" Longitude 89.26'09"	2	825	1650
Gunari Shital Chandra High School	Latitude 22.30'17" Longitude 89.26'09"	2	1,250	2,400
Kalibogi Sunderban High School	Latitude 22.26'10" Longitude 89.26'49"	2	1,150	2,300
Nalian Forest Govt. Primary School	Latitude 22.27'45" Longitude 89.26'18"	2	1,800	3,600
Nalian Forest GPS	Latitude 22.27'45" Longitude 89.26'21"	2	825	1,650
Nalian High School cum cyclone shelter	Latitude 22.27'44" Longitude 89.26'16"	2	850	1,700
South Kalabogi Govt. Primary School	Latitude 22.27'46" Longitude 89.26'10"	2	825	1,650
Sutarkhali high school cum cyclone shelter	Latitude 22.29'19" Longitude 89.28'13"	2	850	1,700

Source: Sutarkhali Union Parishad Office, 2017

3.4 Data Collection Methods

Data collection is a central part of the research design as well as needs the skill to meet the research objectives. Apart from this, the effectiveness of data collection largely determines the specific answer of the research questions (Adams et al., 2007).

The present thesis used both quantitative and qualitative primary data for analysis. The quantitative primary data was collected from the household of the study areas by face-to-face interviews through structured questionnaire. Study of Kabir (2014) narrated interview concept based on Monette et al in 1986. He stated that, an interview comprises an interviewer reading questions to respondents and recording their replies (Kabir, 2014). Though, the interview can be done by several ways, the researcher has considered face-to-face interview method as most relevant. This is because; the researcher can review more suitable answers by iterating or clarifying to the respondents when it comes to confusion. Simultaneously, it permits the researcher to collect the spontaneous answers and to observe non-verbal actions for assessing the rationality of the respondent's response directly. During field survey, the interview lasted approximately 40 to 50 minutes, for every household.

In addition to above, two Focus Group Discussions (FGDs) were conducted at both Unions (Kamarkhola and Sutarkhali) to achieve qualitative primary data using semi-structured guidelines. Focus group discussions cover interactions and discussions around a subject that has been chosen by the researcher himself (Kabir, 2014). Principally, focus group discussions have been used in this study to examines respondent's answers. The survey participants of the FGD were household members of the community, farmers-landless, fishing communities, day labour, women, NGOs, local and central government representatives. The study managed to include 8-10 persons from the selected unions for having each focus group discussion. Moreover, during conversation, questions regarding different initiatives (fund, information, programming, and technology), challenges, policies, the vulnerability perspective and recommendations for livelihood strategies were focused. The focus group discussions were happened at the Union Parishad offices of Kamarkhola and Sutarkhali. Each group discussions were lasted for approximately between two to two and half hours. In this respect, with the help of the local people of Dacope upazila, the researcher received an opportunity to meet the chairman and asked permission for collecting the primary data. Further, the researcher got help from the chairman for selecting the members of the group discussions conducted in this study.

3.5 Questionnaire Designing

Basically, research questionnaire varies with the population, research questions and resources existing (Kabir, 2014). The present research has used a semi-structured questionnaire for collecting the quantitative data as it delivers uniform data and flexible for data analysis (easy

to count answers) as well. Questionnaire survey is comparatively less expensive and enable the researcher to grasp an extensive audience. However, questionnaire can sometimes be obscure to the respondents by carrying diverse meanings. Both closed-ended and open-ended questions were asked to the household respondents during field investigation. The questionnaire had approximately 60 questions (given in the appendix A) covering issues such as households' livelihood scenario, adaptation or coping strategies against cyclone, factors affecting vulnerability, perception regarding disaster and climate change. As discussed above, the questionnaire was pre-tested (pilot survey) among the local inhabitants of the study area and then rearranged for final execution.

3.6 The Pilot Survey

Usually, pilot studies are conducted by the researcher, to detect the probable pitfalls, as well as to evaluate, test and authenticate the research tools (Adams et al., 2007). Besides, pilot survey allows the researcher to develop more explicit understanding concerning the research topic and offers experimental knowledge for getting familiar with the methodological approach of the research. A 5-day pilot survey was carried out at the end of the June 2017. A total of 30 households was interviewed from the selected villages i.e. Kamarkhola, West Srinagar, Sutarkhali and Nolian. The purposes of the pilot study have given below:

1. To confirm that questionnaire is comprehensible and bear the same meaning for all the respondents.
2. To recognize the drawbacks of the questionnaire by highlighting possible ambiguous or uncomfortable questions. Afterwards, some questions were modified, removed or newly added.
3. To have an overview regarding the time required for accomplishing the household interview through questionnaire.
4. To conduct an initial assessment about the villages for determining the number of households that can be surveyed for this study.

After pre-testing the questionnaire, the final survey was implemented.

3.7 Sampling Method

According to Adams et al. (2007), sampling is the process or method of picking an appropriate sample for defining parameters or features of the whole population (Adams et al., 2007).

In a complete survey (census) data is collected from each element of the population. Although this reduce uncertainty, it is costly and time consuming. Sample surveys have some rudimentary advantages over complete censuses concerning cost, and time as data is collected from selected elements only.

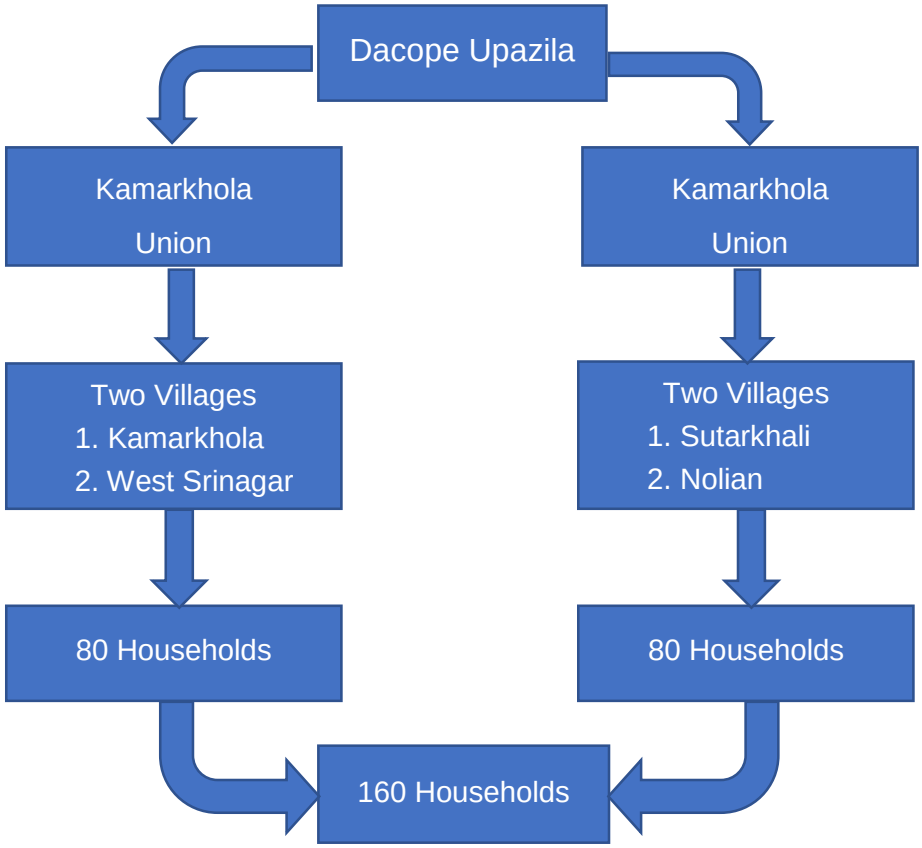

Figure 3:7: Sampling plan for questionnaire survey

Bearing in mind time and financial restrictions, the researcher selected a sample size feasible to conduct for this research. The present research considered purposive sampling for selecting the study areas. Since the research topic broadly involves assessment of livelihood resilience against cyclone, four cyclone prone villages i.e. Kamarkhola, West Srinagar, Sutarkhali and Nolian were selected purposively.

The sampling unit for analysis was households. According to National Statistics of the United Kingdom, household can be defined as a single person or assemblage of people living at the same house who either share at least one meal a day or shared the living accommodation, e.g. a kitchen or living room or sitting room. Regarding sample size, 160 households were selected from the study areas. Systematic random sampling method was followed to choose the households from the four villages. In this regard, complete list of households for the study villages, available in Union Parishad, was used. Consequently, almost 40 households from each village were interviewed for accomplishing the data collection process. Any adult person (beyond 18 years of age), not necessarily the household head, with whom the researcher meet first, were the respondents. Table 3.5 provides information regarding sample taken and percentage covered from the total households.

Table 3:5 Information about sample size

Villages	**Total household**	**Sample drawn**	**Percentage**
Kamarkhola	392	41	10.5%
West Srinagar	149	39	26%
Sutarkhali	441	40	9%
Nolian	635	40	6.3%

Source: Author, field survey 2017

3.8 Field Work Process

The researcher started to collect primary data from the first of July 2017 to the end of August 2017. For data collection, two graduate students from a public university (Khulna University) in Bangladesh assisted the researcher. Proper steps were implemented for collecting correct information and all interviewers were very much conscious about this. Concerning the interview, training like how to talk with folk people or how to carry an interview, was given by the researcher to the assistants before gathering data from households. Besides this, the survey assistants had previous experiences regarding questionnaire survey, as they worked in several academic research projects. Prior to the study, the researcher also explained the purposes of the data collection to the research assistants. The household questionnaire and semi-structured

guidelines for FGDs (Focus Group Discussions) interview of the study were clearly described. Both the questionnaire and semi-structured guidelines were translated into Bengali (local language) for conducting the survey. During interview, the researcher and the survey assistants also took notes on several issues based on the households' perception besides the questionnaire.

The journey from Khulna Zila to Dacope upazila was made by Easy Bike (one kind of three-wheeled local public transport). To reach the villages from upazila, the researcher and the survey assistants had to cross two small canals by Trawler (one type of mechanized boat) and one big river by ferry. No transport facilities were available in the villages and the interviewers walked down the villages and completed the household survey. All the four villages (Kamarkhola, West Srinagar, Sutarkhali and Nolian) were surveyed by both the researcher and the assistants for getting in-depth information about the households. At the inception of data gathering, tasks were assigned to the survey assistants and a crosschecking was carried out at every evening to avoid any overlapping. Each interview took much time, effort and cost (as the research was fully self-funded).

Figure 3:8 On the way to the study area

Source: Author, field survey 2017

Since the field survey was happened during monsoon season, it was hard for the interviewers to interview the households. Due to continuous rainfall, the researchers need to wait long for moving from one household to another. Most importantly, it was not possible to do the household survey every day for bad weather. Thereby the researcher and the survey assistants tried to complete the questionnaire survey each day as many as they could.

Figure 3:9 During field work

Source: Author, field survey 2017

On an average, the researcher and the survey assistants finished 3 household surveys per day. Besides this, the interviewers had encountered few problems sometimes for finding the correct information about losses from cyclones. Throughout the data collection (household questionnaire survey) process, the interviewers repeated complex questions to the respondents if they asked to elaborate further for understanding, so that the provided answer of the respondents can elucidate the asked question. The first surveyed village was Kamarkhola and then West Srinagar followed by Nolian and Sutarkhali. For conducting FGDs, the researcher acted as a moderator during discussions and the two assistants helped by taking notes. Some refreshments (snacks and lunch) were also arranged by the researcher for the participants during the discussions in both the Union Parishad offices of Kamarkhola and Sutarkhali. In the

beginning, an explanation of the research purpose was provided to the group members and it was guaranteed that every information would be treated anonymously.

3.9 Ethical Consideration

Awareness about ethical matters is an essential part of the research. Research of Kabir (2014) narrated that social researchers should continue their research work in an ethical manner. The researcher discussed with the local people, Union Parishad officers and the local leaders, prior to the survey, if the interview is ok to them or not. Since the research was related to their current livelihood scenario and adaptation against disaster along household level, most of them had no objection in giving interview. Basically, the coastal poor always try to inform the outsiders concerning vulnerable intensity and asking for help. Almost all the households had previous experience in some ways related to interview as different organizations worked in those areas before.

The questionnaire survey had been conducted by taking the consent of the household respondent. It contained the questions only relevant for the present study and no personal questions were asked to the respondents. At the beginning of the questionnaire survey, the researcher had given a brief about the research and made a promise to the respondents about its confidentiality. Moreover, the respondents were free to leave, if they feel embarrassed or not willing to answer the questions. Remarkably, cover letter of the questionnaires describes the objectives of the survey and the right to admit or deny for participating in the interview was given to the respondents of the study area. Most importantly, the researcher was fully aware about taking permission from the respondents for using their name and mobile number (if they have) in the questionnaire. This was just for having an opportunity to contact again if any further clarification for data accuracy required after the survey.

3.10 Quality Control of the Study

The thesis has evaluated in terms of validity and reliability, as it ensures the quality of the research.

3.10.1 Validity:

In general, validity is an indication of how sound one research is and for a test to be reliable, it also requires to be valid. Validity of a research refers to the integrity of the deductions that are

created from it. It is based on determining whether an indicator that is planned to evaluate a concept really evaluates that concept (Bryman & Bell, 2011). Two types of validity are usually found in research-one is external validity and the another is internal validity. Internal validity refers to the extent in which the research condition is regulated so that the independent variable creates a change or effect in the dependent variable (Kabir, 2014). In this study, the researcher carefully chosen coastal areas that were directly and indirectly affected by cyclone for assessing coastal peoples' livelihood resilience against cyclone. With respect to validity, a pilot study was also carried out in this study. Data were collected from cyclone affected persons through face-to-face interviews using structured questionnaire. Here cyclone is the independent variable and the central aim of the study is to assess the households' livelihood resilience in relation to cyclone and climate change along southwestern coastal areas. Having accomplished the study, the researcher then analyzed the gathered data through different statistical analysis. Again, external validity also denoted to the generalizability of the research study (Kabir, 2014). The conclusions of the present research are applicable to other groups of the interest or inhabitants. Thereby, the researcher strongly trusts that the study result will be transferable for the population of similar background and environment i.e. who are suffered by cyclone in another place.

3.10.2 Reliability

Reliability denotes that particular method will yield consistent outcomes in different studies (Kabir, 2014). It also indicates the uniformity of a measure of a concept (Bryman & Bell, 2011). Any research tool can be termed reliable when the participant reaction to a specific question renders the equal way in repetitive times. Virtually, data reliability in any study, can be measured by two ways. Checking the constancy of measurements using a test-retest method (repeatability) is one way and exploring internal evenness is another way (Adams, et al., 2004). The test-retest method of evaluating the reliability of data was found to be appropriate for this study because it will carry the identical result when the questionnaire will be administered with the same inhabitants on repetitive time. Reliability can be guaranteed by picking the most appropriate method for examining the data and by cautiously documenting all the stages of analysis to assure future replicability. In this study, the researcher examined the surveyed questionnaire with her assistants every afternoon and 5% of the selected questionnaire was re-interviewed randomly to check the consistency of the responses after completing the data collection process.

3.10.3 Data Management and Analysis

After having the field survey from Bangladesh, coding and data entry were completed. The collected data has been analyzed by using IBM SPSS (a statistical software version 24). Different tables and figures has been used for summarizing the results and for showing relationship among various parameters. The data contains both dependent and independent variables. In this research, livelihood resilience is dependent variable because different factors affect this. Income, housing pattern, experience with climate change, education level, attitude towards risk etc. are some of the examples of independent variable. The socio-economic (income level, occupation, education etc.), demographic (gender, age, marital status etc.) and other household characteristics (housing condition, drinking water source etc.) have analyzed through univariate analysis to describe the pattern of the data. Descriptive statistics has been used for univariate analysis. Distribution (frequency distribution), central tendency (mean) and dispersion (standard deviation, range) has been used for evaluating the existing data of the four villages.

Figure 3:10 Cyclone shelter of Sutarkhali Union

Since univariate analysis is a simplest way of describing data, it is not possible to identify the cause effect relationship. So, the researcher used bivariate analysis to explore the relationship between two variables whether there is an association or not. Also, whether there are differences and the significance of the difference has been observed. Crosstab with Chi-Square test has been used for this purpose. Multivariate analysis has also been taken into consideration for examining the relationship among different variables through regression analysis. Binary logistic regression has been used by the researcher for identifying the influence of different independent variables on dependent variable.

3.11 Challenges and Limitations

Like other researcher, I also had encountered some challenges in the field survey for collecting the data. Before starting questionnaire survey in the villages, I had to discuss with different types of people who has the information regarding households. It was a cumbersome process and I had to spent about a week for looking the eligible people in the Union Parishad offices. Officers in Union Parishad often refused to give the information produced by government organization. In such situation, I managed to collect the required secondary data by explaining the research importance to them. Additionally, information regarding households at village level often not updated and is difficult to investigate. Nevertheless, it did not affect the quality of the data, obtained from survey.

Since some portion of the collected data, based on respondents' perception, it was difficult to verify within the short time schedule. One more drawback of the study was that information about other members of the households was gathered by questioning the household heads. This has its intrinsic limitations as it depends on the knowledge of the participants. The limited sample size of the research is another drawback which made it difficult to unfold the hidden reason affecting livelihood resilience of the coastal people.

4 Livelihood Pattern of the Households

4.1 Introduction

The present section describes the livelihood situation of the households residing in the selected cyclone-prone villages, namely Kamarkhola, West Srinagar, Sutarkhali and Nolian. The presentation displays the households' profile, including family size, socioeconomic characteristics, housing pattern, information on drinking water sources, toilet facilities as well as source of staple food and cooking fuel of the interviewed households. Mainly, frequencies and percentages has used to present the aforementioned analyses.

4.2 Profile of the Households

Table 4.1 reveals the demographic characteristics of households such as gender, age, marital status, educational status and level of education (illiterate, primary, secondary, higher secondary and above) and the number of years living in the study areas. Since the questionnaire survey conducted at the place of the respondents' residence, it was not always possible to collect information from the household heads. In that case, available senior citizens or respondents above 18 years was interviewed. Most respondents were male (nearly 68%). This is mainly due to the social rituals and cultures, which compels us to prioritize male respondents always than female respondents (Islam & Hasan, 2016). About half of the respondents have been found for 36 to 50 years of age. However, some are above 50 years i.e. old and below 20 years as well. The most prevalent group of education level was primary level (41.3 %) whereas about 25% of the respondents were illiterate. The second highest level of education was found for secondary level (30%) and very few percent of the respondents belongs to higher secondary level (table 4.1). Most (58.8%) respondents in the study villages had been residing there for many years, ranging from 26 to 50 years. Almost all the respondents were married and male-headed household (table 4.1) that ultimately depicts the typical culture of the Bengali society.

Table 4:1 Demographic characteristics of the households

Variables	Sub-categories	Frequency	Percentage
Gender of respondents	Male	108	67.5
	Female	52	32.5
Age of the respondents	20-35	53	33.1
	36-50	80	50.0
	≥51	27	16.9
Marital status	Unmarried	7	4.4
	Married	153	95.6
Level of education	Illiterate	40	25.0
	Primary	66	41.3
	Secondary	48	30.0
	Above secondary	6	3.8
Duration of living	8-25 years	41	25.6
	26-50 years	94	58.8
	≥51 years	25	15.6
Household Head	Male	157	98.1
	Female	2	1.3
	Others	1	0.6

Source: Author, field survey 2017

4.3 Household Composition

Table 4.2 displays the information regarding household member i.e. number of male, female and children in every surveyed family, in the study areas. The statistics showed that most of the households (48.1%) have total 5-7 members in their family whereas only 5% of the households have more than 7 family members. Approximately 92% households have 1 to 3 female members and 67.5% of households have 1 to 2 male members in the surveyed family.

Also, most interviewed households (75%) have 1 to 2 children in their family. On an average, there are 1.075 children in their households.

Table 4:2: Household compositions

Variables	Sub-categories	Frequency	Percentage
Total family members	2-4	75	46.9
	5-7	77	48.1
	≥8	8	5.0
Female members	1-3	147	91.9
	4 and above	13	8.1
Male members	1-2	109	68.1
	≥3	51	31.9
Children in the family	No children	37	23.1
	1-2	120	75.0
	≥3	3	1.9

Source: Author, field survey 2017

4.4 Socioeconomic Characteristics

This section describes data regarding occupational status of the household heads, household income and household expenditure. The survey data shows that three major sources of income was i.e. agriculture and livestock rearing; day labor and fish farming. Nearly half (48.1%) of the respondents in the villages are engaged in agriculture and livestock rearing (table 4.3). In this respect, some respondents use their own agricultural field, and some leased from others for pursuing cultivation. The next leading occupation is day labor (34.4%) that includes employment in road construction, working in other peoples' agricultural field and house construction. Local people informed that after Cyclone Aila on 2009, dependency on income from day labor has increased due to loss of permanent income sources (mainly due to loss of agricultural land). Only 6.9% of the respondents were involved in fish farming. However, most

of the respondents was engaged in white fish (basically local fish, namely Vetki, Telapia, Parshey and many others) cultivation in ponds, situated in their homestead areas.

Table 4:3 Socioeconomic characteristics of the households

Variables	Sub-categories	Frequency	Percentage
Occupation of household heads	Agriculture and livestock rearing	77	48.1
	Fish farming	11	6.9
	Day labor	55	34.4
	Others	17	10.6
Monthly income of the households	2,000-4,999	57	35.6
	5000-9,999	93	58.1
	10000 to above	10	6.3
Monthly expenditure of the households	2,000-4,999	40	25.0
	5000-9,999	105	65.6
	10000 to above	15	9.4

Source: Author, field survey 2017

People in the villages had previously been involved in shrimp farming but according to the local senior respondents, people started to quit shrimp farming after 2007, due to deterioration of water and soil quality, thereby reducing the livelihood options. The practice of abandoning shrimp culture has augmented after cyclone Aila in 2009. One study of Kibria et al. (2016) from Dacope upazila mentioned that almost 80% of the local people switched from shrimp farming and 30% of them instead involved in dry season crop production and the practice is enhancing (Kibria et al., 2016). In addition, the local people held shrimp farmers responsible for breaching of embankment as residents used to insert pipes through the embankments for allowing the saline water intrusion into the polders to favor the shrimp culture. Gradually, this weakened the main function of polder and during Aila brought untold sufferings for the dwellers due to malfunction. In addition to crop cultivation, day labour and fishing, a few people have found income as van (one kind of three-wheeled cart pulled by one to carry both passenger and goods) puller, boatman and small grocery shop holder. Table 4.3 indicated that the monthly income of

the most respondents' family is from BDT (Bangladeshi currency) 5,000 to almost 9,999 (about 60 to 120 US$) and the monthly expenditure of the respondents in the four villages is almost the same as income level. On an average, monthly household income and expenditure are 6534.38 BDT (almost 78 US$) and 6374.38 BDT (almost 77 US$) respectively, for the studied villagers. Whereas, the Gross Domestic Product (GDP) Per Capita in Bangladesh is corresponding to 8% of the world's average (Trading Economics, 2018). Also, from 1960 to 2016, the Gross Domestic Product (GDP) per capita in Bangladesh averaged 487.18 USD and the GDP Per Capita of Bangladesh was 1,544.00 USD in Jun 2017 (Accurate Macro & Micro Economic Data, 2018). Hence compared to the country's average, the income of the surveyed households is very low.

4.5 Other Aspects of Households

Table 4.4 provides information about access to water, food and cooking fuel. The major drinking water sources in the four villages were wells, shallow tube-wells, ponds and PSF (Pond sand filter) before the incidence of recent cyclone Aila. Most importantly, the ponds were the principal (Jahan, 2012) sources among the mentioned sources before Aila. Haque, Haque, and Ansari (2010) discussed in their study, that about 98% of all water foundations had either broke or partially damaged and rendering unfeasible due to submergence by storm surge during Aila. Consequently, ponds and other water bodies were polluted by the intrusion of saline water and thereby creating drinking water crisis which still prevails (Haque, Haque, and Ansari, 2010). The field survey revealed that household respondents emphasized rain water harvesting and this is the vital source of drinking water. According to the household respondents, more than two third (68.8%) of the residents used rain water for drinking and cooking purposes. Those who do not have good facility to store rain water for long time, using PSF (Pond-Sand-Filter) technologies and tube well as a secondary source of drinking water. It is noteworthy to mention that females take the prime responsibility in water collection in every surveyed family (almost 95%) for all the studied villages. However, the key drawback of rain water harvesting is the highly dependence of available rainfall. Furthermore, data shows that about half of the surveyed respondents face water crisis (51.3%) during summer due to shortage of rainfall. The field visit also found that about half of the respondents produce their staple food (table 4.4) in the study areas.

Table 4:4 Other aspects of households

Variables	Sub-categories	Frequency	Percentage
Drinking water source	Tube well	26	16.3
	Rainwater collection	110	68.8
	Pond sand filter	24	15.0
Collector of drinking water	Male	9	5.6
	Female	151	94.4
Facing water problem around the year	No problem	78	48.8
	Summer	82	51.3
Produce staple food	No	76	47.5
	Yes	80	50.0
Adequacy of food	No	137	85.6
	Yes	23	14.4
Sources of cooking fuel	Straw/ agricultural residue	45	28.1
	Wood	61	38.1
	Cow dung	52	32.5
Access to mass media	TV	14	8.8
	Radio	11	6.9
	Newspaper	2	1.3

Source: Author, field survey 2017

However, very few respondents (14.4%) could manage with that small portion of food whatever they produce round the year and ultimately had to rely on purchasing food from market for the remaining demand. The common practice of using fuel for cooking in the four villages are wood, cowdung and straw/agricultural residues. Among them, wood secured the prime position as fuel for cooking and this is mainly due to the access to the nearest Sundarbans. The analysis also showed that cowdung is used by 32.5% whereas 28.1% of the households also rely on agricultural residues/straw as fuel for cooking.

Table 4.4 also reveals that most of the respondents do not have access to media, only 8.8% and 6.9% of the households have TV and Radio respectively. Moreover, in all the selected villages, people relied completely on solar power, that primarily was used for lightening the houses and mobile charging. During rainy season when there is inadequate sunlight, they sometimes purchase batteries for meeting emergency need.

Figure 4:1 Rain water harvesting tank (sample 1)

Source: Author, field survey 2017

Figure 4:2 Rain water harvesting tank (sample 2)

Source: Author, field survey 2017

Figure 4:3 Pond Sand Filter (PSF) (sample 1)

Source: Author, field survey 2017

Figure 4:4 Pond Sand Filter (PSF) (sample 2)

Source: Author, field survey 2017

4.6 Toilet Facility and Housing Pattern

Figure 4.5 shows the toilet facility of the surveyed households found in the study area. The field survey explored four types of toilet facility (figure 4.3) namely, pit latrine with slab and water seal; latrines with an open pit; sanitary latrine and hanging latrine in the selected areas. No respondents have found to support open space for defecation. The predominant form of toilet facility is pit latrine with slab and water seal (68.13%). Indeed, every house contains small or big ponds along with their homestead areas, and the pit latrine with slab and water seal type situated near the water source of the households. Whereas, another option is latrines with an open pit and about 22% of the household use this type of toilet. However, there are some sanitary latrines that people have, mostly due to the various aiding agencies (JJS, DSK, RUPANTOR) worked there, after Cyclone Aila. A few hanging latrines are still in use in some portions of the study areas, though those are not very common. The following images (4.6, 4.7 and 4.8) showing types of latrines, which I have found during field survey in the study areas.

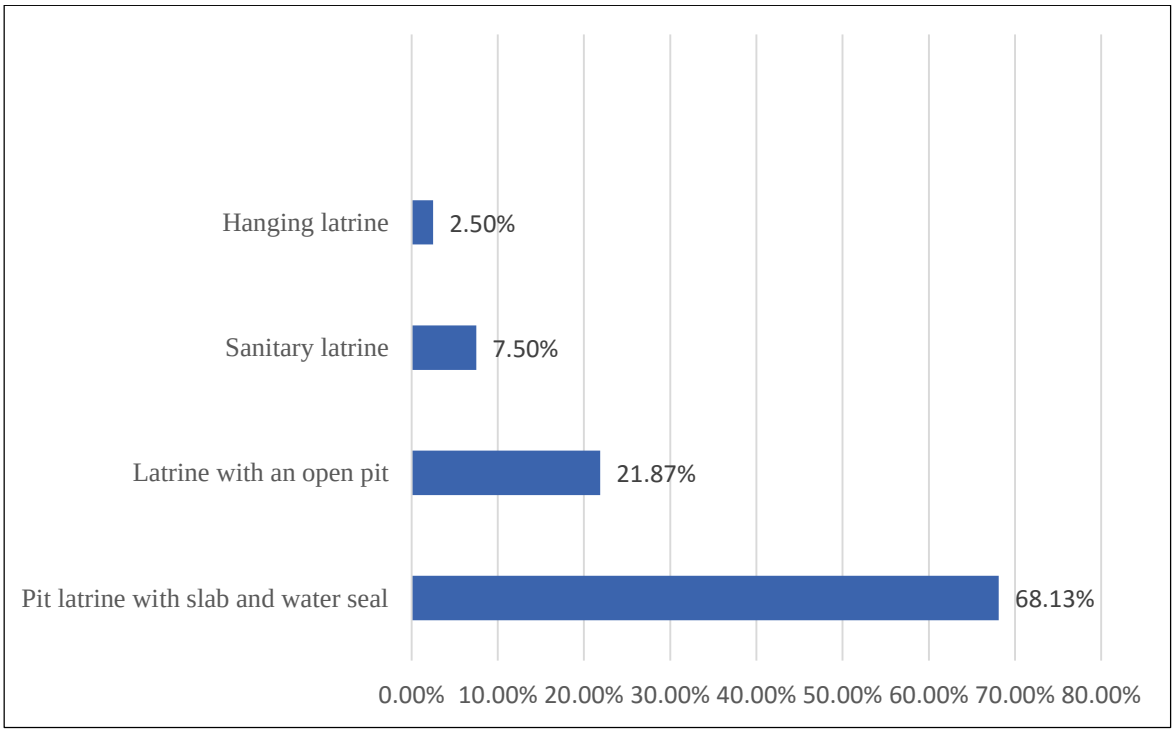

Figure 4:5 Existing toilet facilities

Source: Author, field survey 2017

Figure 4:6 Image of sanitary latrine

Source: Author, field survey 2017

Figure 4:7 Image of latrine with open pit

Source: Author, field survey 2017

Figure 4:8 Image of pit latrine with slab and water seal

Source: Author, field survey 2017

Various combination of materials for housing has observed in the selected areas. To avoid the complexities, the study primarily differentiates the available houses into three categories, namely Pacca, Semi-pacca and Kacha. Pacca means the presence of brick and cement on floor and wall and the presence of corrugated iron as roof. However, the number of pacca house is very limited. Whereas the semi-pacca means the presence of corrugated iron on wall as well as on roof and concrete on floor. The most common form of housing is kacha in the study areas. Different combinations are also present for the kacha category. In most cases, the presence of mud on the floor and straws/wood for walls as well as corrugated iron as roofs has observed. Alternately, golpatta (one kind of leaves local people use as house constructing material) has also noticed as roof and wall instead of corrugated iron in some houses of the villages. Above all, the presence of mud on the floor of the houses is the unique material for all types of kacha house. The following figures (4.9, 4.10, 4.11 and 4.12) showing types of houses (kacha) that I have found in the study areas.

Figure 4:9 Kacha house (sample 1)

Source: Author, field survey 2017

Figure 4:10 Kacha house (sample 2)

Source: Author, field survey 2017

Figure 4:11 Kacha house (sample 3)

Source: Author, field survey 2017

Figure 4:12 Kacha house (sample 4)

Source: Author, field survey 2017

4.7 Summary

The findings of this chapter show that the main occupation of the household heads for the studied villages is agriculture and livestock rearing. Almost all the households are male-headed

and most of the respondents have primary level of education. Most respondents are relying on rainwater harvesting for their drinking and the women of the households are mainly responsible for collecting that. Regarding food security, most respondents mentioned that it is not adequate. Also, the household respondents have less access to mass media. Most of the respondents use pit latrine with slab and water seal and almost all the existing houses of the villages are kacha type.

5 Vulnerability and Respondents' Perception of Climate Change

5.1 Introduction

This chapter narrates the findings related to the vulnerability of the coastal residents. Some issues like challenges the respondents face after cyclone, types of losses occurred due to cyclone, respondents' perception regarding reasons that makes people vulnerable as well as knowledge about climate change is described. These issues are explored based on data from literature survey and discussions with the households of the southwestern coastal communities.

5.2 Challenges due to Cyclone

Different scientific literatures disclosed that cyclone creates several challenges in the affected areas (Kabir, 2014; Parvin et al., 2008; Jahan, 2012). During household survey, local people also mentioned different types of challenges that arise immediately after a cyclone (or cyclone Aila). In figure 5.1 information regarding cyclone induced challenges is presented.

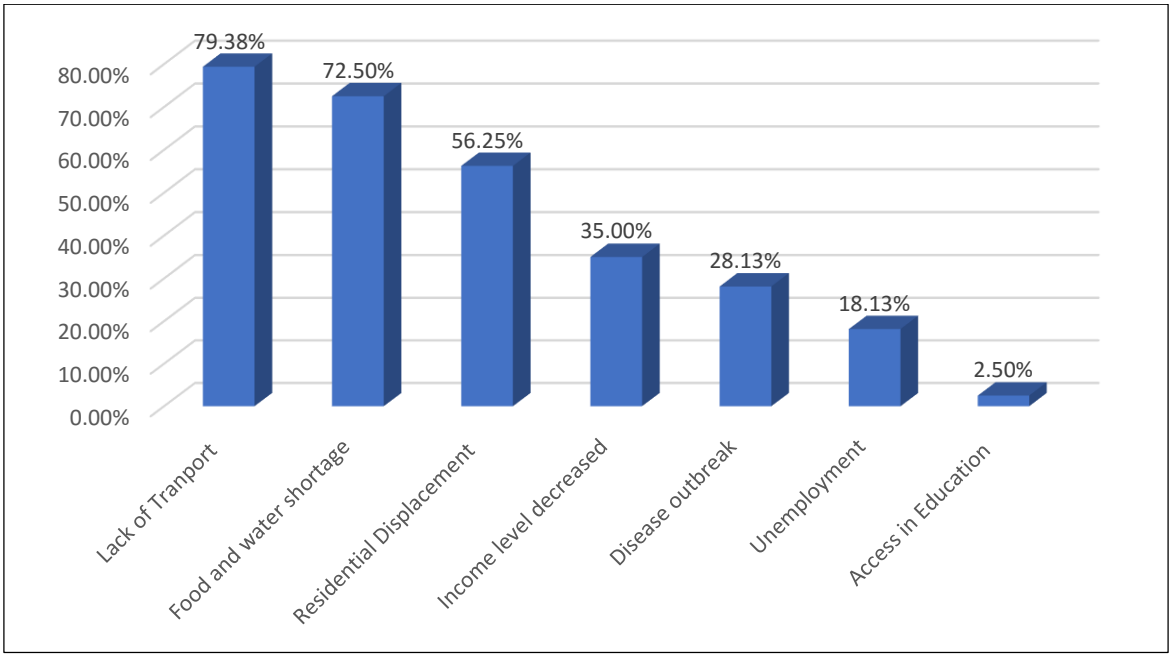

Figure 5:1 Challenges due to cyclone (percent of household reporting a problem among the 3 most important)

Source: Author, field survey 2017

According to the figure, 79.38% of the respondents claimed that they lacked transport facilities after cyclone. Food and water shortage is the next common situation (almost 73%) in the study areas. Besides these, residential displacement also comprises a major challenge.

Participants of both interview and FGDs, narrated that most of the rural roads are usually earth roads (unpaved), undulated and obsolete (due to rivers and canals) which make the communication system difficult. Water logging condition caused by cyclone induced surge, makes this communication system even worse and slow. Besides the surge water, trees uprooted by winds often block and damage the earth roads. Discussions revealed that damaged roads always create difficulties in moving and continuing household activities after cyclone. With respect to transport problem, local people mentioned that they need more attention from Government to restore the embankment which was breached by earlier cyclones. Few senior residents stated that the breached embankment has a contribution on the augmentation of water level inside the villages during and after cyclone. Deteriorated communication system further has contribution on the availability of food and water as well as on employment. Moreover, local people stated that strong wind and associated storm surge of cyclone displaced huge people by damaging their houses. Some respondents also mentioned reduction of income and prevalence of disease as barriers for coping. Respondents reported that most of the diseases occurs due to the polluted water carried by storm surge during cyclone. Skin diseases, diarrhea, dysentery, fever etc. are some of the examples of such diseases occurs here after cyclone. Few respondents listed education problem among the 3 most important challenges.

Figure 5:2 The earth roads of the study areas

Source: Author, field survey 2017

5.3 Types of Losses for Households due to Cyclone

Present study discovered cyclone induced losses of households, mainly in three segments. These include effects on earning sector, health sector as well as effects on house and household assets. Table 5.1 displays types of losses caused by cyclonic events in the villages.

Among the damages of house and household assets, damages of houses are the most noticeable one. Almost all (97.5%) the respondents experienced house damages from cyclone. This is because the dominant form of housing is “Kacha” type in the study areas, which are very susceptible to the strong wind and storm surge of cyclone. Most of the kacha houses in the villages are constructed by bamboo, straw, corrugated iron sheets, earth etc. Since various combinations of kacha house are found there, different households experienced house damages differently. Some lost the roofs or the walls of the houses or both together with the damage of the floor of the houses which are basically made of mud in most houses. Similarly, 89.4% of the households reported furniture damages which were mostly happened due to house damage. The type of furniture damaged by cyclone include cupboard, bed, table, chair, almirah etc. Similarly, among other valuable assets, a significant number of the participants (about 61%) lost agricultural tools due to cyclone. Whereas, loss on earning segments include losses of livestock/poultry, land and income sources (table 5.1). Data showed that most of the respondents (almost 94%) lost livestock/poultry. Some households had income from those and ultimately this loss aggravated their financial condition. Moreover, about 58% of the respondents stated that they lost their income sources. Apart from these, 20% of the households encountered disease immediately after cyclone. Regarding loss on health, only one household reported about death caused by cyclones (table 5.1) and about 7% were injured by breaking hand and leg.

Table 5:1 Types of losses caused by cyclone

Variables	Frequency	Percentage
Health Sector		
Disease	32	20.0
Physical injuries	11	6.9
Death of household member	1	0.6
House and household assets sector		
House damages	156	97.5
Loss of furniture	143	89.4
Loss of agricultural tools	98	61.3
Loss of fishing tools	50	31.3
Loss of valuable assets	40	25.0
Loss of rickshaw/van/boat	2	1.3
Earning sector		
Loss of livestock/poultry	150	93.8
Loss of income sources	92	57.5
Loss of land	60	37.5

Source: Author, field survey 2017

5.4 Variations among Villages for Cyclone Induced Challenges and Losses

Table 5.2 shows the analyses for challenges and types of losses among the villages using Pearson Chi-square test. The results indicate that disease outbreak varies among the four villages and the Pearson Chi-square test is significant at a 5% level (as $p = 0.001$). Among the other challenges of cyclone, unemployment and lack of transport also scored significantly using the Chi-square test ($p = 0.002$ and $p = 0.035$ respectively).

Table 5:2 Variations among villages for challenges and losses caused by cyclone

Variables	Kamarkhola [a]	West Srinagar [a]	Sutarkhali [a]	Nolian [a]	Chi-square test (p =)
Challenges of cyclone					
Lack of transport	87.8	76.9	87.5	65.0	8.585 (0.035)
Unemployment	9.8	17.9	7.5	37.5	15.097 (0.002)
Disease outbreak	12.2	20.5	50.0	32.5	15.870 (0.001)
Types of losses due to cyclone					
Loss of income sources	73.2	33.3	55.0	67.5	15.180 (0.002)
Loss of land	39.0	59.0	22.5	30.0	12.514 (0.006)
Loss of fishing tools	12.2	43.6	42.5	27.5	12.311 (0.006)
Loss of valuable assets	7.3	33.3	30.0	30.0	9.349 (0.025)

[a] Value in column denotes percentage of the respondents who answered "yes"

Findings also indicate that loss of income sources, loss of land, loss of fishing tools and loss of valuable assets (jewellery, sewing machine, mobile phone etc.) in the four villages vary significantly. Though cyclone creates almost similar types of challenges (figure 5.1) and losses for households (table 5.1), the Pearson Chi-square values infers variation among the villages for some options and it is statistically significant (as shown in the table).

During questionnaire survey, the respondents were not asked questions that can unveil the reasons for such inter-village variations. However, reconnaissance survey and focus group discussion revealed that the reasons can be the different geographical locations or the pattern

of settlements and the proximity or distance from the rivers to villages. Besides this, we discovered that helping organizations (both Government and non-government) implementing different types of programs in different villages. Hence, variation in provisions and facilities available there, might lead to a variation in household's experience of challenges and losses. Apart from these, different households adopt different coping strategies which includes help ranging from helping agencies to their own knowledge or by both. So, such complex interaction incurs a challenge to expose the reasons of differences among the villages.

5.5 Respondents' Knowledge and Perception of Climate Change and Cyclone

For revealing vulnerability aspects and coping measures of coastal communities, it is imperative to realize people's perception and response to various hazards happening around them. Similarly, the frequency and severity of hazards greatly enhance coastal peoples' vulnerability to disaster (Parvin et al., 2008). This section presents respondents' knowledge and perception about climate change as well as cyclone by collecting information on some aspects. These include their sources of hearing about climate change, the types of weather change they have been noticing in last 5 years, their perception regarding connection between climate change and cyclone severity as well as frequency. The analysis for variations among villages concerning climate alterations has also given below. I have also collected their opinion for minimizing climate change induced cyclone severity.

5.5.1 Sources, experiences and perception of climate change

The study revealed that even though significant percentage of the respondents have low educational (primary level) background (table 4.1), majority have heard about climate change. Besides this, most of the respondents have been living here since long and their local experiences of climate alterations have considerable importance. Analysis indicates that 84.4% of the household respondents have heard about climate change from different sources.

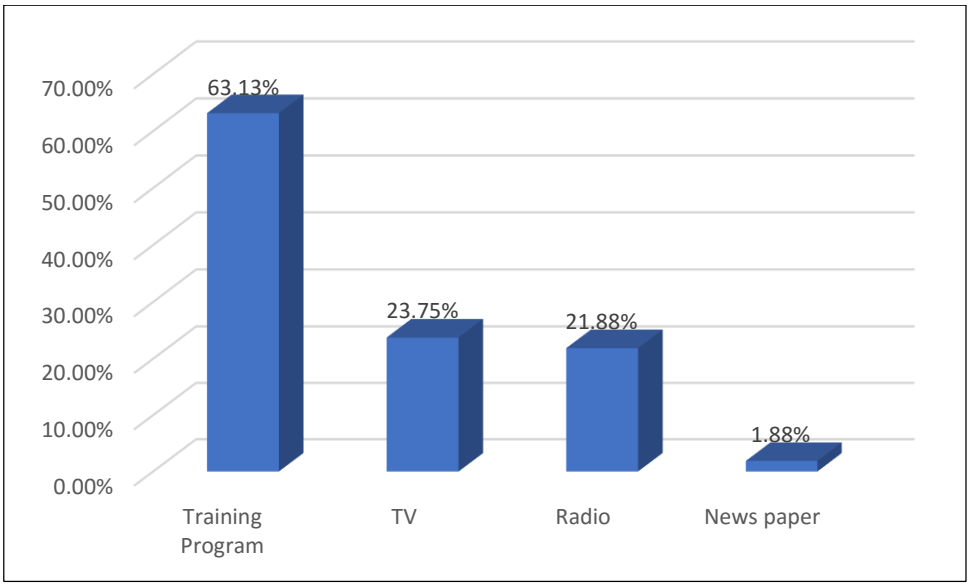

Figure 5:3 Sources of hearing about climate change

Source: Author, field survey 2017

Figure 5.3 shows the sources of hearing about climate change. About 63% of the respondents heard about climate change from training program mostly run by NGOs focusing disaster preparedness activities. Some respondents also came to know about climate change from media like TV, Radio. Data indicates that 91.3% of the respondents (table 5.3) had observed changes in weather in the last 5 years.

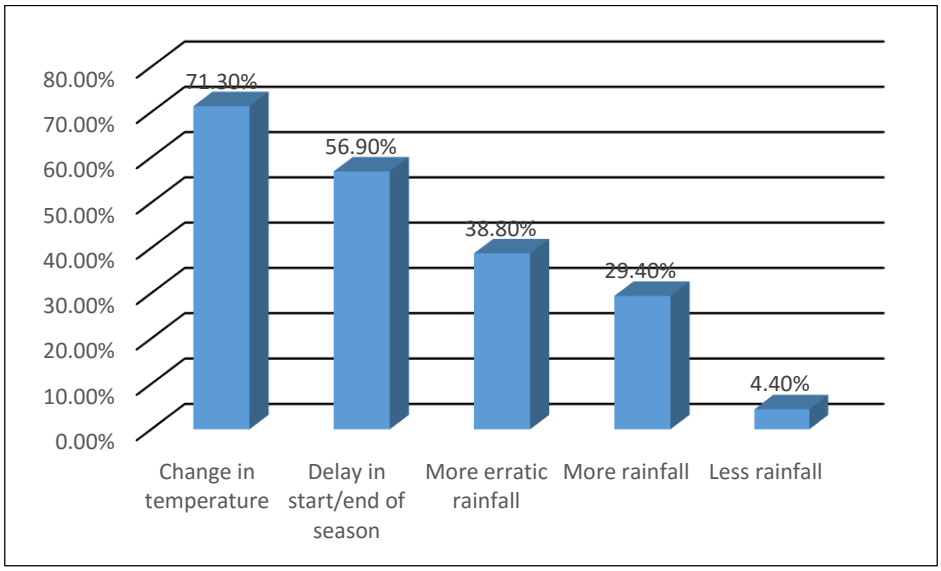

Figure 5:4 Respondents' experience on kinds of climate change

Source: Author, field survey 2017

Figure 5.4 shows the findings regarding types of climate alteration. According to the respondents, changes in temperature, delay in the start and end of the season, more erratic rainfall, more rainfall and less rainfall are the types of climate changes dominating there. About 71% of the participants said that they are witnessing temperature increase. Around 57% of the respondents observing delay in the start or end of the season. Approximately 39% of the interviewee mentioned about the rise in erratic rainfall as changes in weather.

Table 5:3 Perception of climate change

Variables	Frequency	Percentage
Last 5 years seen changes in weather		
Yes	146	91.3
No	14	8.8
Perception on relation between climate change and cyclone frequency		
Yes	72	45.0
No	2	1.3
No idea	86	53.8
Perception regarding cyclone frequency and severity		
More severe	36	22.5
More frequent	7	4.4
Both	105	65.6
No idea	12	7.5

Source: Author, field survey 2017

Table 5.3 provides respondents' perception of climate change. About 45% of the respondents believe that climate change has a bearing on cyclone frequency. Whereas, significant portion (53.8%) of the respondents have no idea about climate change impact on cyclone frequency. Table 5.3 also provides respondents' perception regarding frequency and severity of cyclone. Around 67% of the respondents claimed that both the frequency and severity of cyclone have increased. Approximately 23% of the participants emphasized cyclone severity than frequency.

Participants in focus group discussions mentioned that most of the people informed about climate change due to helping organizations working there. Specifically, people of the aiding agencies often arrange different training programs concerning disaster preparedness activities where climate change issue has also been discussed. Most of the respondents, though observing the increase in cyclone frequency and severity, more than half of the people have no idea whether climate change has a bearing on cyclone frequency. According to the coastal residents, increased rainfall of rainy season further hampers people's daily activity by rising high saline water that comes into the breached embankments.

5.5.2 Variations among villages regarding experience on types of climate change

Though figure 5.3 displays the types of climate alteration, the household respondents observing, the following table provides information about the variation in experience for individual villages.

Table 5:4 Analysis for villages and kinds of climate alteration

Variables	Kamarkhola [a]	West Srinagar [a]	Sutarkhali [a]	Nolian [a]	Chi-square test (p =)
Change in temperature	87.8	59.0	62.5	75.0	10.124 (0.018)
Delay in start/end of season	65.9	38.5	62.5	60.0	7.414 (0.060)
More erratic rainfall	58.5	23.1	35.0	37.5	11.063 (0.011)
More rainfall	19.5	46.2	12.5	40.0	14.882 (0.002)
Less rainfall	7.3	7.7	2.5	0.0	4.040 (0.257)

[a] Value in column denotes percentage of the respondents who answered "yes"

With respect to "temperature change" experience, Kamarkhola shows high percentage (87.8%) than other villages. Result also indicates that the variation in experience among the villages for temperature change is statistically significant as the *p* value is less than 0.05 (5% significance level). Likewise, West Srinagar holds comparatively high percentage of respondents (46.2%) in "more rainfall" experience and the Chi-square test provides significant variation among the villages ($p = 0.002$). Among the types of climate change in the table 5.8, "delay in start or end of season" and "less rainfall" provide no statistically significant variation as the *p* values are above 0.05 ($p = 0.060$ and $p = 0.257$ respectively). However, significant variation among the villages has also been observed for "more erratic rainfall" ($p \leq 0.05$).

In the present study, the questionnaire didn't cover the issues like reasons of variation in climate alterations among villages. The table indicates that all the studied villages are experiencing the same types of climate alterations even though the percentages vary. Yet, field survey and focus group discussion helped to assume that the reasons of such variations can be geographical (locational) mainly. Similarly, socio-demographic i.e. education, age, gender etc. factors might have contributions on individual perception and knowledge regarding climate alterations.

5.5.3 Respondents' opinion for reducing climate change induced cyclone severity

Since most of the respondents don't have any clear idea about the relation for climate change and cyclone severity, based on their local knowledge and experience they provide some opinions for reducing the cyclone severity. Figure 5.5 portrays the opinion of respondents that can be helpful against climate change induced cyclone severity.

Among the opinions provided by the respondents, afforestation secured the top position i.e. 37.5%. Household respondents mentioned that tree plantation can have a positive bearing to reduce impact of cyclone severity. Besides above, 31.3% of the respondents reported that restoration of embankment can minimize their sufferings posed by cyclone. Whereas, 19.4% of the respondents also stated that they have no idea what can be done to avoid the severity of cyclone. Moreover, some respondents focused on Government initiative (14.4%) and awareness raising (about 18%) as options, to lessen the negative impacts. Only 5% of the participants proposed for proper training against the consequence.

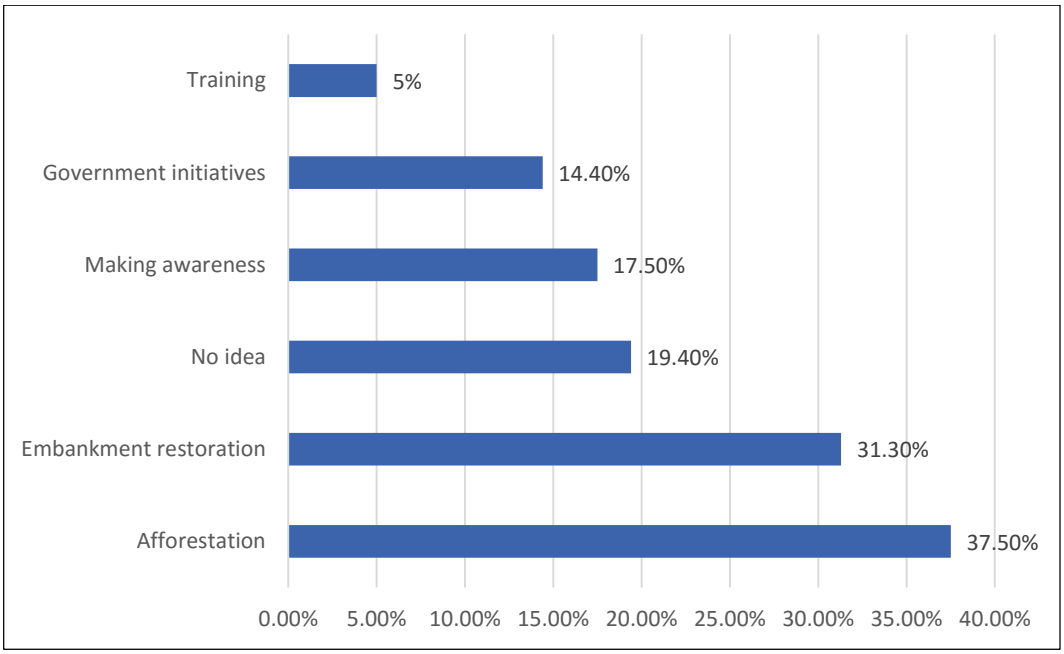

Figure 5:5 What can be done to reduce climate change induced cyclone severity

Source: Author, field survey 2017

During focus group discussions, the participants stated that most of the local inhabitants informed about tree plantation from different training program of helping organizations and media (TV, radio). Participants also claimed that embankment failure after cyclone Aila brought a massive impact to them. So, they mentioned about embankment restoration which can reduce the impact of cyclone induced surge. They also confessed that everybody has responsibility towards climate change as they are experiencing several natural calamities and they should be aware about that.

5.6 Respondents' Response about Early Warning Process and Cyclone Shelter

Earlier studies disclosed that, although an early warning system was effective in principle, disbelief of cyclone warnings and a dearth of cyclone shelters were among the reasons recognized by affected people for causing massive loss (Alam & Collins, 2010). Hence, responses of the affected communities with respect to their belief in early warning and cyclone shelter place significant emphasis for comprehending the underlying reasons of vulnerability. Field survey found that the existing early warning systems and cyclone shelters of the studied villages are basically managed (table 6.4) by local peoples during disaster.

Table 5.5 shows the response of the participants about cyclone warning process. However, the analysis unveils that almost all the surveyed households believe in warning system before any imminent cyclone.

Table 5:5 Believe in early warning system

Categories	Frequency	Percentage
Yes	158	98.8
No	2	1.2

Source: Author, field survey 2017

Different Government and non-government schools are used as cyclone shelter in the study areas (table 3.3 and table 3.4). Besides those, some local Government offices also provide shelter during crisis period. Figure 5.6 displays both the percentage of respondents goes to cyclone shelter and the reasons for not going. The causes found for not going to cyclone shelter are, no wish to go, emotional attachment, too far, inadequate space and too late.

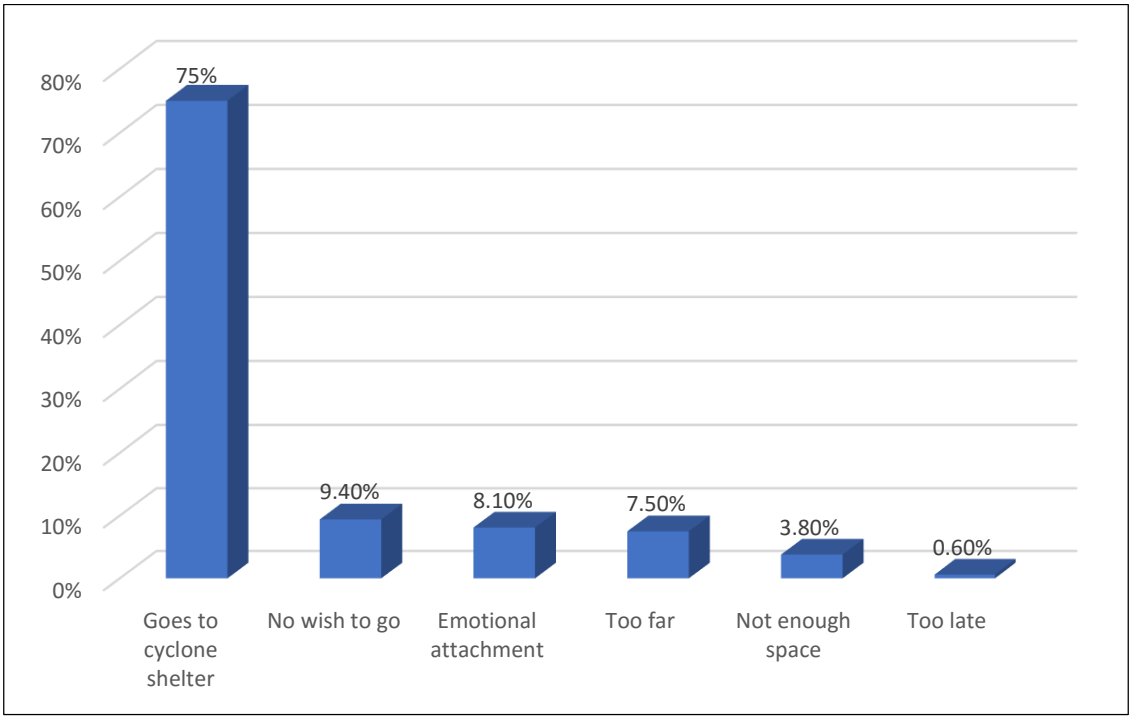

Figure 5:6 Response regarding cyclone shelter

Source: Author, field survey 2017

Results show that the response of households reagrding cyclone shelter is good so far. Also, 9.40% of the respondents didn't feel (no wish to go) to go to the cyclone shelter as they keep their trust completely on God. They also disclosed that a cyclone is God's will and it is beyond their control. So, God will protect them from the severity. About 8% of the participants were also reluctant to go to cyclone shelter for their emotional attachment to household belongings as it was impossible to move with valuable assets. Few respondents (7.50%) didn't manage to go to cyclone shelter for having long distance from their houses (figure 5.6). They thought, on that long way they can be injured with flying debris if the winds of cyclone gather pace.

During focus group discussions and interview, household respondents claimed that, though people believe in cyclone warning system, some didn't wish to go to cyclone shelter. Most importantly, the households in these communities are very much concerned about their livestocks/poultry. They treat them as household members and to many households the animals are the principal means of livlihood. So, despite having cyclone adversity, the households couldn't go to cyclone shelter leaving their domestic animals behind. Participants of discussion group repeated that some religious people love to rely on God instead of going to cyclone shelter and increase their religious activities (prayer, reading religious books etc.) during disaster. Discussions also revealed that both Government and non-government organizations have contribution on the dissemination of early warning. Most importantly, local people reported that Government has played a vital role for increasing cyclone shelters.

5.7 Gender and Some Issues of Cyclone

The study of Alam and Collins (2010) described that disasters can influence different persons in different ways reliant on their gender, age, social status, class and caste. Also, their literature stated that women and children constitute the major vulnerable groups to cyclones for numerous reasons. The facts commonly cited as causes in their study, include women's inclination not to leave their households, a mother's defensive nature (being ready to accept whatever happens to them for saving her children), and the types of cloths women wear (saree, salwar-kamiz) as well as long hair of Bangladeshi women (hampering movement in tidal waves while trying to swim) (Alam & Collins, 2010). Similarly, the present study tried to know whether there are any differences between gender and some cyclone related issues (believe in early warning, going to cyclone shelter etc.).

This section presents findings regarding gender and believe in early warning, going to cyclone shelter, opinion about connection between climate change and cyclone frequency. Table 5.6 holds information for all the above-mentioned factors.

Table 5:6 Gender and some issues of cyclone

Variables	Gender		Chi-Square test (*p* =)
	Male (%)	Female (%)	
Believe in warning system			
Yes	99.1	98.1	0.000 (1.000)
No	0.9	1.9	
Going to cyclone shelter			
Yes	75.0	75.0	0.283 (0.595)
No	25.0	25.0	
Opinion for connection between climate change and cyclone frequency			
Yes	52.8	28.9	8.181 (0.017)
No	0.9	1.9	
No idea	46.3	69.2	

Source: Author, field survey 2017

Although various studies discovered variation between gender and their response during disaster (Paul & Routray, 2011; Jahan, 2012; Kabir, 2014; Alam & Collins, 2010), the present study did not find significant variations between gender and cyclone issues. Analysis indicates that there is no significant variation between gender and believe in cyclone warning system. Both male and female respondents of the surveyed villages, believe in cyclone warning system. According to the participants of focus group discussions, rapid campaign (early warning) of Government and non-government organizations before any impending cyclone helps to realize the cyclone severity.

Likewise, the findings infer that 75% respondents are interested in going to cyclone shelter irrespective of gender. Concerning perception for connection between climate change and

cyclone frequency, comparatively more male respondents (52.8%) supported the fact. However, a significant percentage (69.2%) of the female respondents are also ignorant about that relation.

5.8 Gender and Perception about Causes of Increased Vulnerability after Cyclones

Since male and female members of the households have different types of responsibilities for maintaining the livelihood, it can influence their perceptions of vulnerability differently. Table 5.6 shows perception of male and female respondents concerning reasons of vulnerability increase after cyclone.

Table 5:7 Gender and perception about causes of increased vulnerability after cyclones

Variables	Sub categories	Agree	Neither agree or disagree	Disagree	Chi-Square test (p=)
Lack of Government initiatives	Male	77.8%	17.6%	5.6%	1.792 (p=0.617)
	Female	84.6%	9.6%	5.8%	
Lack of awareness	Male	81.5%	8.3%	10.2%	11.724 (p=0.008)
	Female	69.2%	17.3%	13.5%	
Lack of proper training	Male	78.7%	17.6%	3.7%	16.764 (p=0.001)
	Female	50.0%	32.7%	17.3%	

Source: Author, field survey 2017

Correspondingly, the reasons upon which the perceptions have been collected are lack of proper training, lack of government initiatives and lack of awareness. Most of the male (77.8%) and female (84.6%) respondents agree that improper initiative of Government has contribution on the augmentation of vulnerability in the post-cyclone period. The Chi-square test presents no significant variation as the p value is above 0.05. This is because all the respondents realized that Government needs to provide more attention towards coastal communities. However,

regarding lack of awareness statistical variation has found as the *p* value is 0.008. Analyses also indicate that variation has found between male and female for lack of proper training and it is statistically significant (as the *p* value is below 0.05). Since most of the females are engaged in household chores, they have limited chances to know about issues increasing vulnerability. Hence, they may have inadequate knowledge to mention lack of proper training as a reason of vulnerability increase after cyclone.

During focus group discussions, participants also mentioned that Government initiatives, awareness and proper training are equally important in reducing vulnerability after cyclone. Additionally, they claimed that both Government and local people hold responsibilities to minimize vulnerability by restoring livelihood.

5.9 Summary

This chapter outlines that most of the surveyed households face problem in transportation sector during and immediately after cyclone. Significant amount of losses of the surveyed households due to cyclone, have found for house damage and livestock/poultry lost. Majority of the respondents observing climate change in the last 5 years. Among the changes of climate, most of the respondents mentioned about temperature increase. Almost all the respondents believe in cyclone warning and no significant variation has observed among gender regarding this. Significant portion of the surveyed participants have no idea about the relation of climate change and cyclone frequency. Moreover, their perception discovered that afforestation could help to reduce the climate change induced cyclone severity. Regarding perception of vulnerability increase after cyclone, significant percentage of both male and female claimed on inadequate support from Government. Few analyses regarding variations among villages on challenges and losses as well as climate change issues have also presented though the exact reasons behind the variations were not explicitly discussed during field survey.

6 Coping and Recovery Status

6.1 Introduction

One of the objective of this study is to explore the coastal peoples' coping strategies against cyclone along the southwestern coastal belt. During field investigations, the households were asked about their ways of managing themselves during and after cyclone. According to the coastal inhabitants, dealing with cyclone is a common occurrence for them and they are coping both by the help of Government and Non-Government Organizations (NGOs). Moreover, the respondents of the study areas trying to adjust with cyclone by their own initiatives as well.

6.2 Coping through Households' Self-initiatives

Coping response exposes an individual's insights and efforts to manage belongings for diminishing the adverse impacts of hazards (Wisner et al., 2004). It usually initiates when the household is required to move its properties in response to a disaster. Asset disbursement, borrowing from relatives, consumption of savings, etc. are some examples of coping measures commonly found in rural areas. Most importantly, coastal people usually adopt a sequence (before, during and after disaster) of coping measures instead of following the strategies randomly (Paul & Routray, 2011). The households of the study areas also take some steps both before an impending cyclone as well as during cyclone for adjusting with the changed environment caused by cyclone.

6.2.1 Preparation before cyclone

In this stage, coastal households commonly adopt some impact reducing strategies and preparedness actions based on their earlier experiences of cyclone and surge events. The impact reducing strategies refer to actions that reduce loss and enable recovery (Paul & Routray, 2011).

Table 6.1 holds the information regarding initiatives that the household respondents of the study areas often take before any anticipated cyclone. Unfortunately, very few opportunities are available to the coastal inhabitants as precautions and none of those rendering safe completely. Nevertheless, to reduce the severity of any impact of a cyclone, the coastal residents habitually apply some traditional techniques.

Table 6:1 Preparation before cyclone (self-initiatives)

Categories	Percentage	
	Yes	**No**
Storing of food and water	74.4	25.6
Protecting valuable assets	52.5	47.5
Temporary migration	46.9	53.1
Saving money	24.4	75.6
Raising the plinth of the house	10.0	90.0
Selling livestock/productive assets	6.3	93.8

Source: Author, field survey 2017

Food and water storing, temporary migration, securing assets by using box (made with wood /timber) or polythene bags, saving money, house modification, selling livestock/poultry are some of the measures taken, detected in those areas. Among the participants, the most prominent practice is storage of food and water (about 75%) in advance. Apparently, food and water are the first and foremost necessity for all in everywhere. The respondents having experienced food and water shortage following disaster and so try to stock food (especially dry foods) as much as they can. Some of their preferred food items include rice, fried rice, onion, muri (puffet rice), chira (flattened rice), gur (sugar bar), biscuits, cakes, coconut, flour, oil, chili, potato, pulses, etc. During interview, some respondents mentioned that they use different kinds of pots like earthen pots/tin pots/plastic box/wooden box/aluminum pots etc. for storing foods. Usually, people hang these types of pots through ropes (locally called “Shika” and made from jute or hugla plants) from the roofs. In some cases, “Machan” (one kind of local structure made of bamboo or wood) is used for keeping those pots. Basically, it is a platform set for sleeping as well as for keeping the household belongings during crisis period (flood, cyclone etc.). Also, some people use “trellis” (another indigenous structure made of wood crossed over each other as well as hang from the roof using rope) for placing those food containing pots. Simultaneously, water is stored both in “Motka” (an indigenous earthen pot to store water, seeds etc.) and plastic pots.

Nearly 53% of the respondents store valuable assets like ornaments, cloths, watches, mobiles, batteries, some utensils, medicines etc. For this purpose, many respondents use wooden box to

keep the small necessary goods. They found it useful for saving valuable goods from surge water and keep the boxes comparatively on elevated place (like “Machan”) before the impending cyclone. Alternatively, some respondents use polythene bags (water resistant) to save valuable assets and dig a safety-hole in the floor of the house to protect those from being washed away during cyclone. A safety-hole usually needs to be dug around 2–3 feet into the floor of the house or in an exposed place to preserve valuable assets. Coastal dwellers cover the items by using polythene-bags or cloths and keep those inside the hole and then place a soil layer over it. However, households retrieve the valuable belongings from there after the calamity.

Another important policy to avoid the consequences of a cyclone is temporary migration, almost half (47%) of the respondents reported this. Also, rural- urban migration is a regular occurrence in coastal Bangladesh to earn money or for finding an income source. According to the coastal dwellers, the usual time of cyclone is between March-May and October-November in Bangladesh. Hence, some of the respondents leave their home in that probable time to evade the livelihood crisis and take shelter in the nearest village or peri-urban/urban areas. In most cases, they return to their village few months later. This temporary migration is prevalent in comparatively poor households.

Approximately, 24% of the respondents save money as a preparation before cyclone and the practice takes place in relatively well-off households. A small proportion of the household respondents (10%) raise the plinth of the houses. In this respect, an initial effort starts by using mud or bricks before the imminent cyclone that tend to increase the water height. They try to avoid the use of housing materials prone to surge water for this purpose. This traditional practice is found in the households near riverside. Further, very few respondents (6.3%) sell their livestock or poultry before cyclone.

6.2.2 Preparation during cyclone

Based on a particular context, the adoption of specific measures depends on people’s socio-economic, cultural condition as well as physical position. In addition to above, the features of the cyclone and induced surge and household’s state of vulnerability and capacity to absorb shock influence the adoption of household’s coping strategies (Paul & Routray, 2011). Hence, coping methods vary significantly, in terms of place, hazard and population (Parvin et al., 2008). Using local knowledge, available resources and abilities, population of the study area similarly implemented various coping methods during past cyclone for managing unfortunate

consequences. Table 6.2 presents some accustomed initiatives that the household respondents follow to protect themselves and their belongings during the event.

Table 6:2 Preparation during cyclone (self-initiatives)

Categories	Percentage	
	Yes	No
Going to cyclone shelter	73.1	26.9
Raising the furniture heights	41.9	58.1
Strengthening the house using indigenous techniques	38.8	61.2
Temporary migration	33.1	66.9
Taking shelter to neighbor house	24.4	75.6
Reducing no. of meals	1.9	98.1

Source: Author, field survey 2017

According to table 6.2, reducing number of meals during cyclone is the least common option for coping. The probable reason for that is, they learned from the former cyclones and do store food and water before the tentative crisis. Many household (about 73%) prefer to go to the nearest Cyclone Shelter and assume it as a feasible option. A sizeable portion of the household respondents (nearly 42%), use bricks or log, to raise the furniture heights for protecting it, from the cyclonic inundation. Simultaneously, almost 39% of the household respondents implement some measures to defend their shelter during cyclone. Since most of the houses in the study areas are made of straw, bamboo and corrugated iron sheets, they are not supportive enough against strong wind and surge water of cyclone. In most cases, the respondents tie the four sides of the houses by strong rope or wire to the nearest large trees if available. Additionally, they set some poles around the house, sinking them into new holes. Locally, this is called “Thekas” (setting new poles diagonally around the house) which is a familiar technique to save houses in the cyclone prone areas. Again, temporary migration (around 33%) has found equally important to the surveyed household next to house strengthening for adjusting. Some households (about 25%) also took shelter to the neighbor house in the last cyclonic events when they couldn’t manage to go to the cyclone shelter for having long distance. Figure 6.1 shows one indigenous technique of strengthening houses observed in the study areas.

Figure 6:1 One of the indigenous techniques of households to strengthen house

Source: Author, field survey 2017

6.3 Coping by Taking Help from Helping Organizations

The field survey explored that different aiding agencies have already worked for helping the local people in the selected villages. Usually, the household respondents received assistance from both Non-Government Organizations (NGOs) and Government Organizations (GOs) for coping after cyclone. Apart from these, few contributions of international organizations have also been observed in the study areas. Figure 6.1 provides the information regarding the sources of locating the helping organizations.

6.3.1 Sources of getting information about aid

People in the study area usually collected news about helping assistances from different sources. Figure 6.2 shows that 55% of the respondents have not heard about helping agencies from anywhere. They just discovered the helping initiatives by themselves and received help after going to the helping organizations.

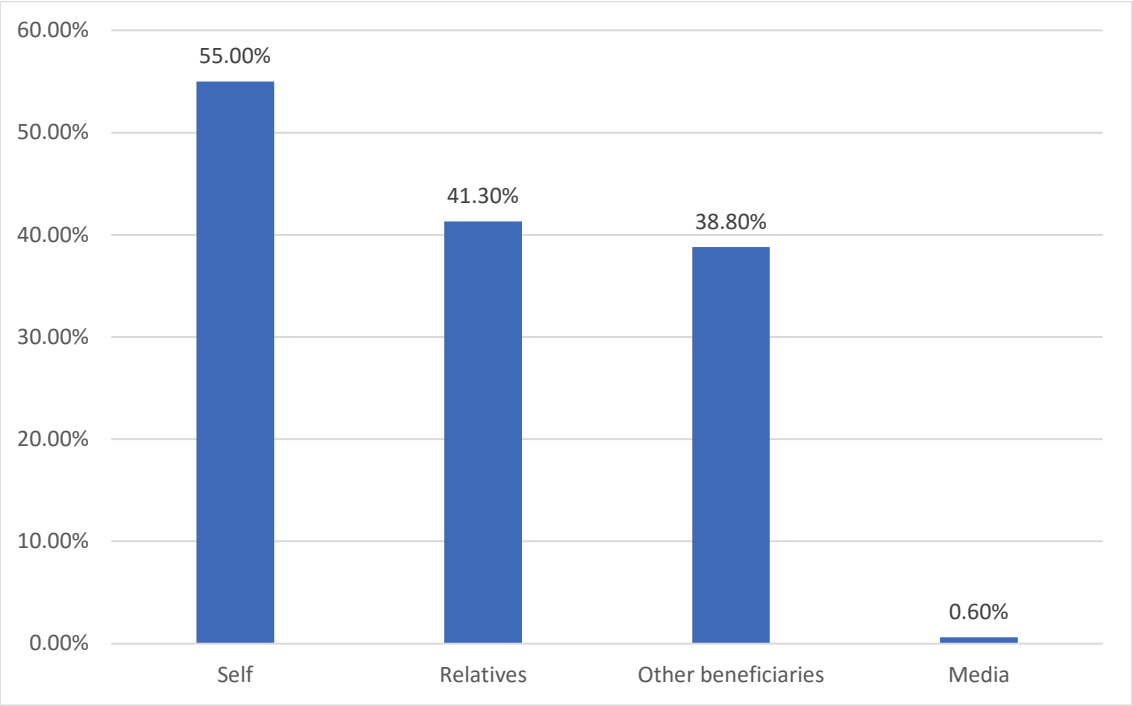

Figure 6:2 Sources of locating helping interventions

Source: Author, field survey 2017

Around 39% of the respondents came to know about the help from other beneficiaries of the humanitarian agencies. Among the sources, media means TV or Radio or newspaper. Only one respondent was informed by TV. Certain amount (nearly 41%) of the respondents also informed by their relatives.

According to the participants, Non-Government organizations (NGOs) played a major role together with Government Safety Net programs in their locality for reducing the extensive damages caused by the cyclone Aila. JJS, DSK, RUPANTAR, SUSHILAN are some of the notable examples of such NGOs. Many of them also works with the international agencies like CONCERN worldwide for implementing the rehabilitation activities (road construction, water tank supply etc.) there. Several projects are still running in the studied villages, through which households are getting benefit. Table 6.3 shows the leading form of assistances provided for coping and recovery after cyclone. The aiding resources include supply of food and water, training on agricultural practices, financial support, provision of water tank, provision of house construction material and temporary income source. It is logical to mention that not all the respondents received same type of assistances at the same time.

Table 6:3 Resources from helping initiatives for coping and recovery after cyclone

Provisions	Percentage	
	Yes	No
Food and water	86.9	13.1
Financial assistance	73.8	36.2
Sanitation facilities (water tank)	45.6	54.4
Housing materials	41.9	58.1
Training	40.6	59.4
Medical Facilities	9.4	90.6

Source: Author, field survey 2017

About 87% of the surveyed residents narrated that they received help from the helping agencies in the form of food and water. Financial assistance (cash/money) from the agencies, is next (around 74%) to the food and water provision for coping and recovery after cyclone. Data reveals that 45.6% of the respondents also got help in sanitation sector by receiving tanks to store water. With respect to house construction, almost 42% of the respondents received help from different helping agencies which include house constructing materials like bamboo, corrugated iron (tin) sheets or sometimes as cash. Further, about 41% of the respondents received assistance by attending different training programs like agricultural practices, sanitation practices, post-disaster preparation etc. Whereas the most neglected sector for coping and recovery during cyclone is medical facilities they reported i.e. 9.4%.

6.3.2 Sources of help and respondents' initiatives for managing problems to receive help

People in the study areas received assistance after cyclone mainly from Government and Non-Government Organizations (NGOs). Figure 6.3 shows the types of institutions providing help for the terrible situation of cyclone.

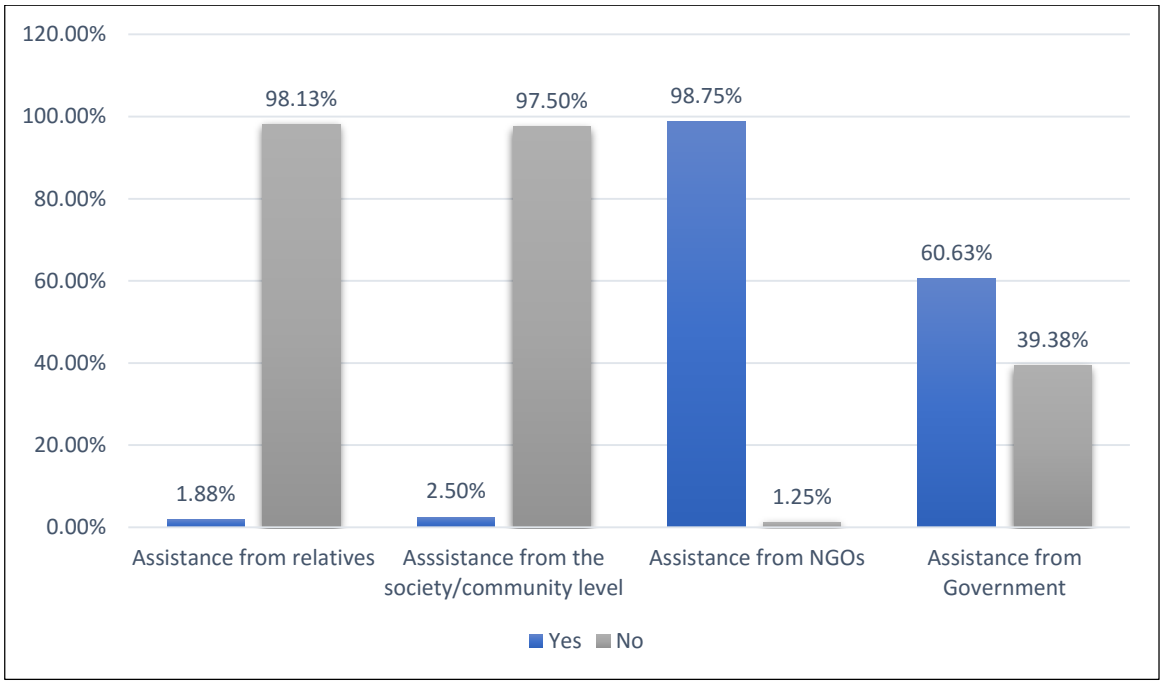

Figure 6:3 Sources of assistances for livelihood recovery

Source: Author, field survey 2017

Almost 99% of the households got help from NGOs and admit their contributions in attenuating the negative impact caused by cyclone. About 61% of the respondents received assistance from Government organizations. However, respondents rarely got help from the community or from their relatives.

During focus group discussion, the participants mentioned that Government organizations sent help in the form of food, water, cloths, cash, medicine etc. immediately after cyclone. Along the way, monitoring arrangements for such initiatives of Government organizations remains in obscure as it costs huge, the households highlighted. However, participants from local Government offices informed that Bangladesh Government tried to minimize the severity arise in the last severe cyclone Aila. Jahan (2012) conducted a study in the Aila affected areas and reported that Government created Vulnerable Group Feeding (VGF) card after the disaster. Each VGF card bearer received 10 kg rice per month. Moreover, they sent help for repairing the damages of the embankments, as well as shelter grants (Tk 20,000 per family) for rebuilding their houses. Additionally, NGOs and other International organizations had also implemented several programs for improving the running situation caused by Aila (Jahan, 2012). Figure 6.4 depicts how many respondents face problem in receiving help from the helping organizations and how they have managed the situation.

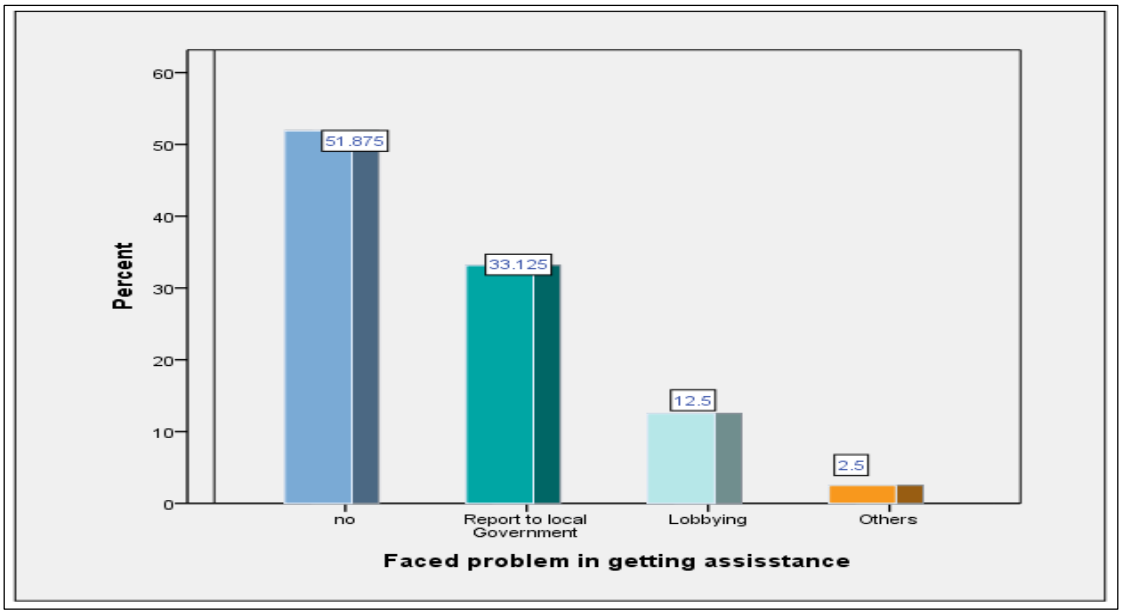

Figure 6:4 Respondents' initiatives of managing problems to receive help

Source: Author, field survey 2017

Nevertheless, the study discovered the absence of community or society assisted help in those places. The underlying reason for that, may focus on the existence of various helping organizations. Almost half of the surveyed household faced no problem (about 52%) in getting assistance from helping or aiding institutions, existing there. Concerning the access complexities, significant respondents (around 33%) used to manage by reporting the assigned authorities or local government. While some respondents try to influence the local leaders for getting help from any organization. Very few of the respondents are sitting idle or migrate in search of other helping sources.

6.4 Local Facilities for Managing Cyclone

Unfortunately, during the last large cyclone Aila (2009), there was a shortage of several management options and many have established afterwards for giving support against such likelihood. Though, Government and non-government organizations deliver multifarious facilities often, adequacy with respect to household members, matters the most here. Table 6.4 showing the arrangement available in those villages. The study found three categories of facilities like early warning, safe places to take shelter and safe resources for managing the consequences of cyclone.

Table 6:4 Local facilities for managing cyclone

Facilities	Percentage	
	Yes	**No**
Early warning system		
Announcement	91.3	8.7
Flag raising	75.0	25.0
Mobile warning	16.9	83.1
Safe places to go		
Cyclone shelter	73.8	26.2
Embankment	26.3	73.7
Raised platform	1.3	98.7
Safe resources		
Safe drinking water source	2.5	97.5
Emergency relief	2.5	97.5

Source: Author, field survey 2017

One of the fundamental arrangements, found in those area is early warning system for making people informed about a possible cyclone. Announcement, flag raising, and mobile warning are some of the examples of early warning process here. Nearly, 91% of the household respondents take precaution by hearing the announcement and they consider this step effective. Also, flag raising before the cyclone is common in the study areas. During focus group discussions and household interview, participants mentioned that after knowing the weather forecast, the assigned people from local government convey the message to the local leaders (chairman, member etc.). Along the way, local leaders hire some people for announcing the cyclone information to the coastal residents. Sometimes people do it either by using microphone inside the mosque or by using hand microphone sitting on a van, going through the entire village. Also, they informed that concerned people raise the flag according to the strength of cyclone to warn the coastal people. Further, the participants of the FGDs said that the introduction of mobile warning system is getting popular in those area. One aiding agency, JJS is the pioneer

in providing such kind of support to these coastal inhabitants. Regarding this, the organization construct a committee, composed of some key persons with mobile sim card allowing early monitoring system through special apps. Once receive the cyclone signal, the assigned persons disseminate it to the coastal residents. However, it costs huge for making common to all according to the participants of focus group discussions.

Another local facility is the provision of safe places for the local people during cyclone like unpleasant events. This include cyclone shelter, embankment and raised platform like for instance, a mosque. During interviews, some participants mentioned that the present embankment is not supportive enough to manage many people. A significant portion (almost 74%) of the household respondents admit that the provision of cyclone shelter is good so far. Data also indicates that around 26% of the household managed to take shelter on embankment during cyclone. Besides these, the provision of safe resources like safe drinking water source and emergency relief system in the surveyed villages are limited (table 6.4).

6.5 Steps of Helping Agencies for Bringing Livelihood Recovery

In most of the coastal areas of Bangladesh, both Government and NGOs programs are working in coastal areas. One report of 'Inventory of Projects and Initiatives in Coastal Zone' was narrated by Parvin et al. (2008), which stated that about 400 NGOs are active in coastal areas. Hundreds of development projects addressing physical and socioeconomic environment of coastal communities, have commenced by these NGOs (Parvin et al., 2008). Simultaneously, various organizations have started to work after the devastating Aila on 2009 in the study areas for executing development. Hence, all the surveyed households achieved some improvement in living. However, the enhancement in livelihood sector is different for different households.

6.5.1 Kinds of support for livelihood recovery

Table 6.5 presents participants' response on helping initiatives that causes enhancement in their living. About 71% of the households are beneficiaries of house rehabilitation and it resembles a positive influence on them. Approximately 48% of the respondents said that sanitation related help brought notable enhancement on their livelihood quality. Water tank supply, tube-well establishment, and to a lesser extent, materials of latrine construction are the resources provided by helping institutions.

Table 6:5 Initiatives of helping agencies for bringing improvement on living

Categories	Percentage	
	Yes	**No**
House rehabilitation	71.3	28.8
Sanitation improvement	47.5	52.5
Financial support	38.1	61.9
Income opportunities	27.5	72.5
Training	23.8	76.3
Communication improvement (embankment/road reconstruction)	15.0	85.0

Source: Author, field survey 2017

Most importantly, the delivery of water tank helped them to harvest and store rain water easily. According to some household, financial help (cash) from helping initiatives also contributes improvement (table 6.5). Also, 15% of the respondents agreed that the intervention programs provide help to improve communication facilities through road and embankment reconstructions. Thereby, they consider it as a positive impact on living.

Interview and FGDs revealed that the households got house constructing materials like corrugated iron, bamboo as well as the related labor cost. Also, respondents informed that Aila caused massive damage to their houses and the contribution of the helping agencies in the house reconstruction was remarkable. Although, the houses are not supportive enough against cyclone, they are managing household activities comparatively better than it was in their previous damaged house.

Regarding income opportunities, some agencies provide micro-credit or loan to the very poor, for starting small business (vegetable cultivation and small scale white fish farming in their homestead pond areas). The helping organizations also distributed domestic animals (cattle/sheep) and seeds of crop varieties to few respondents. Apart from that, the Non-government organizations often arrange training on crop cultivation (changes in cropping pattern and crop type) and sanitation practices (rain water harvesting, health and hygiene etc.). Such training programs basically composed of agricultural officers, public health officers, local people and other resource persons. The thoughts and knowledge shared in the training programs

includes the introduction of short period cash crops like sunflower, sesame, watermelon, etc. and salt tolerant crops, in combination with small scale boro rice production. The local inhabitants mentioned that, there were no or very nominal crop production for three consecutive years after Aila, due to the long-standing saline water. They said that such training programs brought some impact on their living for adopting new strategies in agricultural sector. Additionally, households now storing rain water in the existing canals to mitigate the irrigation water problem in dry seasons.

6.5.2 Monitoring activities of helping organizations

In the present study, I also collected information on the monitoring status of the helping organizations working in these areas. Figure 6.5 shows the frequency of the aiding agencies to visit the respondents after providing benefits.

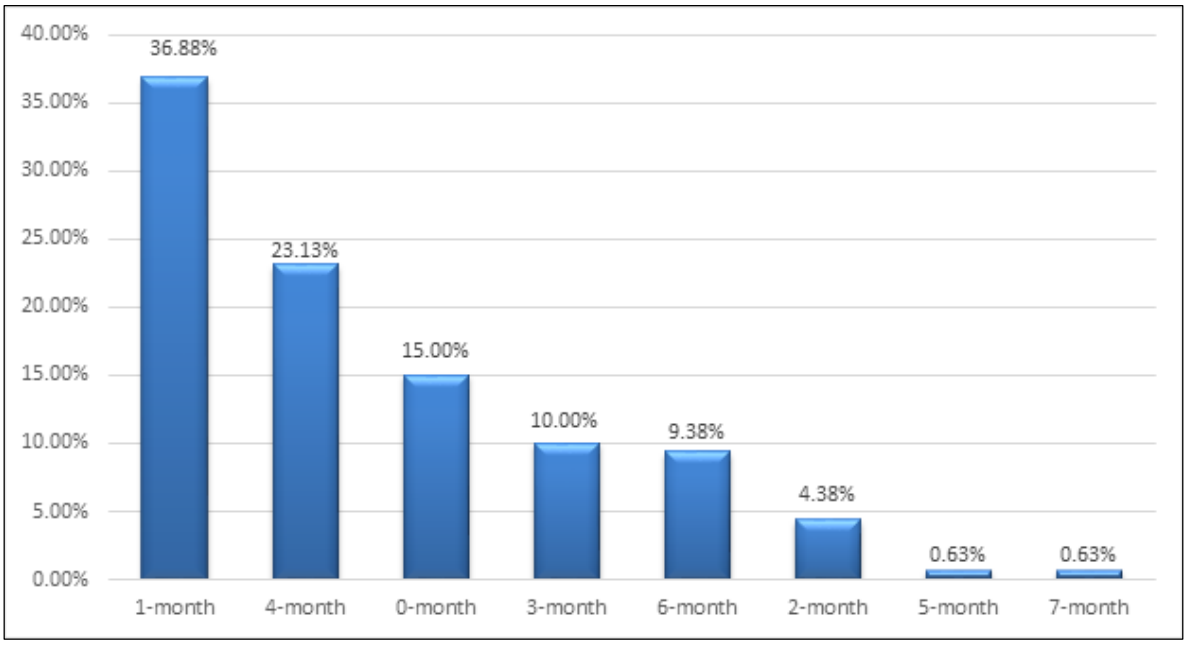

Figure 6:5 Frequency of monitoring by helping organizations

Source: Author, field survey 2017

For monitoring, the ranges found from 1 month to 7 months. About 37% of the households reported that every month people from the helping organizations visited them to know the updates of their improving. Data indicates that 15% of the participants received no monitoring after getting help from them. Approximately 23% of the households received attention from

them in every 4th month. Focus group discussions also discovered that local people valued the kinds of support they received for livelihood recovery from helping organizations.

Likewise, they appreciated monitoring activities of them. Usually, most of the organizations revisit the coastal inhabitants to receive the feedback about their livelihood condition after providing help. Although, frequency of visiting coastal people largely deals with the type of initiatives given by the institutions, they stated.

6.6 Respondents' Perception Regarding Extent of Recovery and Helping Initiatives

The respondents of the study area are getting benefits from several organizations (both non-government and Government) since cyclone Aila, 2009, so questions were asked during field survey about their perception of livelihood recovery. Also, respondents provide observations regarding time that may need to improve satisfactorily. Figure 6.6, 6.7 as well as table 6.6 presents respondents perception on recovery portion, recovery time and helping initiatives respectively. Additionally, table 6.7 provides result of analysis between portion of recovery and different variables.

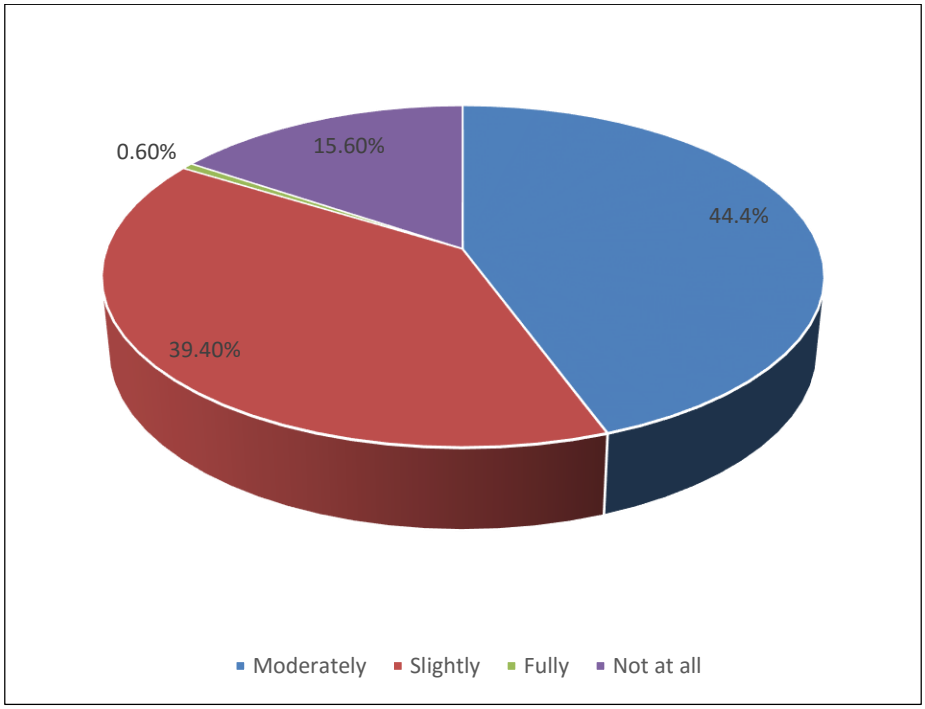

Figure 6:6 Respondents' perception for livelihood recovery

Source: Author, field survey 2017

Figure 6.6 presents households' perception on how far they have achieved recovery. The observations have found on four segments such as fully, moderately, slightly and not at all. About 44% of the households believed that they have recovered moderately and only 16% of the respondents did not feel any change in their living. Findings of Jahan (2012) in the Aila affected areas also unveiled that even though several organizations worked, the people were still in vulnerable situation after three years.

Participants in focus group discussions stated that people have recovered to some extent by receiving help from various organizations. At the same time, they mentioned about limited initiatives of the organizations that is inadequate to recover fully in livelihood sector. During discussions, coastal residents and attendants from aiding institutions confirmed the monitoring activities. However, their perceptions revealed that it will take time to recover satisfactorily. Figure 6.7 also provides respondents' response regarding the time required to recover fully.

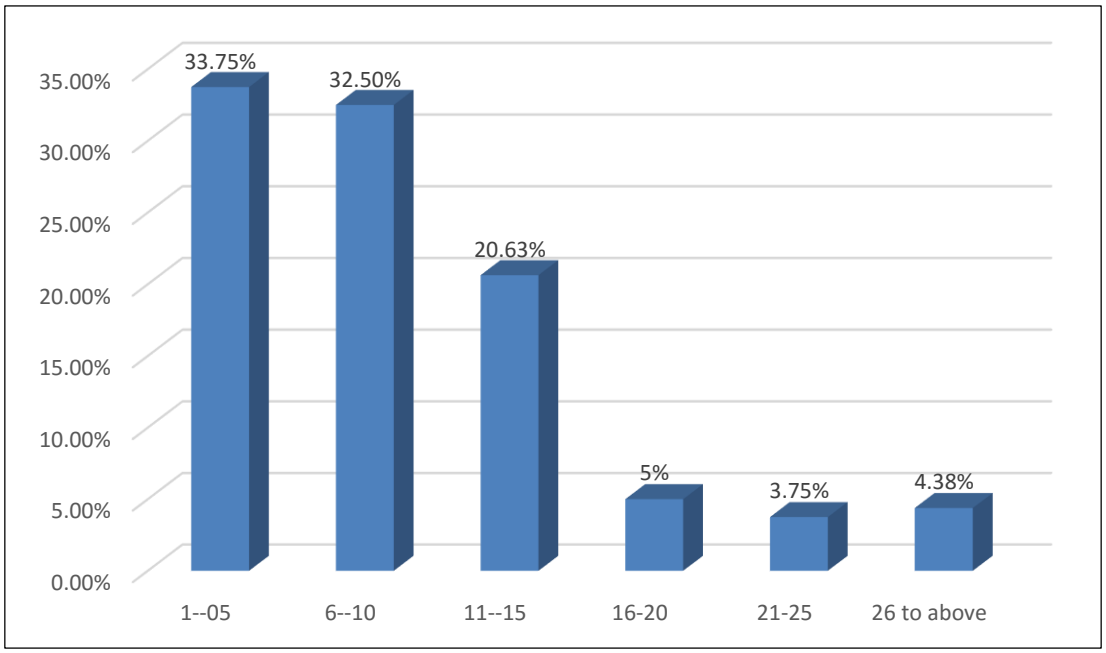

Figure 6:7 Respondents' response regarding recovery time

Source: Author, field survey 2017

According to figure 6.7, participants of the studied villages mentioned different time schedule for their complete recovery. About 34% of the respondents believe that they require at least 5 years and almost 33% of them require 6-10 years for well recovery. However, only 4.38% of

the respondents think that they need more than 25 years to improve. Table 6.6 provides respondents' perception about helping initiatives.

Almost all the surveyed households disclosed that the initiatives taken by the aiding agencies is relevant for their locality. Also, they acknowledged that these interventions brought positive impact on their livelihood.

Table 6:6 Perception regarding helping initiatives

Variables	Frequency	Percentage
Relevancy of initiatives taken in the locality		
Yes	159	99.4
No	1	0.6
Impact of intervention on livelihood		
Yes	160	100
No	0	0
Existence of monitoring activities		
Yes	138	86.3
No	22	13.7
Number of Beneficiary		
Yes	159	99.4
No	1	0.6

Source: Author, field survey 2017

6.7 Analyses among Portion of Recovery and Several Socioeconomic and Demographic Variables

Table 6.7 provides the analyses among portion of recovery and different variables. Nearly, all the variables mentioned below do not showing statistical significance except production of staple food. Since all the *p* values are greater than 0.05, there are no association between portion of recovery and the following (age, gender, monthly income, monthly expenditure, total family

member, years of schooling, and have enough food) variables. The analysis indicates association only between portion of recovery and staple food production as the *p* value is equal to 0.05.

Table 6:7 Analyses among portion of recovery and socioeconomic, demographic variables

Variables	Pearson Chi-square Test Value	Degree of Freedom	Aymp.Sig.(2-sided) (*p* value)
Gender	5.867	3	0.118
Age	4.526	6	0.606
Monthly income	2.981	6	0.811
Monthly expenditure	4.695	6	0.584
Total family member	3.952	6	0.683
Years of schooling	6.489	9	0.690
Have enough food	3.248	3	0.355
Produce staple food	7.857	3	0.049

6.8 Variations among Villages on Self-initiatives Before and During and Local Facilities for Managing Cyclone

Though studies have been conducted focusing on different issues of coping and adaptation, the underlying factors influencing coping or adaptation behavior are not fully understood. However, literatures revealed that local peoples' knowledge, perception, available resources, experience and other unexplored factors can affect the coping and adaptation pattern (Paul & Routray, 2011; Alam & Collins, 2010; Parvin et al., 2008). No single variables can be responsible for creating variation in coping trends and discovering these reasons remains a challenge yet at local level. Also, local facilities for managing cyclones vary from location to location due to the intervention programs of both Government and non-government associations. Though table 6.1, 6.2 and 6.4 show household initiatives before cyclone, during cyclone and local facilities for managing cyclone respectively, variations have found only for

some options among the villages by doing statistical analyses. Table 6.8 summarizes the results of Chi-square test for the studied villages.

Table 6:8 Variations among villages regarding self-initiatives and local facilities for managing cyclone

Variables	Kamarkhola [a]	West Srinagar[a]	Sutarkhali [a]	Nolian [a]	Chi-square test (*p* =)
Preparation before cyclone (self-initiatives)					
Storage of dry foods and water	85.4	51.3	72.5	87.5	17.201 (0.001)
Preservation of assets	73.2	10.3	62.5	62.5	38.141 (0.000)
Saving money	36.6	2.6	32.5	25.0	14.822 (0.002)
Preparation during cyclone (self-initiatives)					
Taking shelter in neighbor house	26.8	2.6	37.5	30.0	14.623 (0.002)
Going to cyclone shelter	61.0	92.3	45.0	95.0	36.222 (0.000)
Local resources for managing cyclone					
Mobile warning	46.3	7.7	7.5	5.0	34.250 (0.000)
Cyclone shelter	68.3	94.9	52.5	80.0	19.755 (0.000)
Embankment	34.1	5.1	40.0	25.0	14.247 (0.003)
Flag raising	75.6	76.9	50.0	97.5	24.218 (0.000)

[a] Value in column denotes percentage of the respondents who answered "**yes**"

With respect to preparation before cyclone, West Srinagar shows comparatively lower percentage for storage of dry foods and water, storing goods using box as well as saving money, among the four villages. The variations are statistically significant as all the *p* values for the options are less than 0.05 (table 6.8). Besides, respondents of Sutarkhali village, take shelter to

their neighbor house more as compared to respondents in other villages and the variations are significant (p = 0.002). Based on the availability of the local facilities for managing cyclone, Chi-square test shows statistically significant variations for mobile warning (p = 0.000), cyclone shelter (p = 0.000), embankment (p = 0.003) and flag raising (p = 0.000) only. Results indicate that mobile warning is more prominent in Kamarkhola village and embankment is less used in West Srinagar village for managing cyclone. Apart from these, flag raising, and cyclone shelter are well managed during cyclone in Nolian and West Srinagar villages respectively.

Though the analyses manifest variations, the reasons of variations concerning coping by self-initiatives and local facilities had not been adequately dealt during household survey. Several reasons (socioeconomic, demographic, locational etc.) can have a bearing on this which I mentioned earlier. Moreover, it is hard to explore the reasons of such variation within limited time and resources. It could be said that further analyses are required as the variations have found for some options of coping and local facilities only.

6.9 Variations among Villages Regarding Helping Initiatives to Cope and Recovery after Cyclone

Table 6.9 provides results regarding variation in resources provision and types of helping agencies working for recovery in the villages. Analyses indicate that there are significant differences among villages for sanitation facilities, housing materials and financial assistance provided by the helping organizations for coping and recovery after cyclone. For sanitation facilities and housing materials, West Srinagar village received comparatively less attention and the Pearson Chi-square tests are significant at 5% level for both options (p = 0.011 and p = 0.002 respectively). Whereas, the household respondents of Kamarkhola received less financial assistance than other villages and the difference is significant as p value is less than 0.05. Concerning actors who are implementing helping programs, table 6.9 shows that respondents of Sutarkhali village received poor attention from Government organizations and respondents of West Srinagar village got no assistance from international non-government organizations.

Table 6:9 Analyses for villages regarding helping initiatives

Variables	Kamarkhola [a]	West Srinagar[a]	Sutarkhali [a]	Nolian [a]	Chi-square test (*p* =)
Provision of resources by helping agencies after cyclone					
Sanitation facilities	48.8	23.1	52.5	57.5	11.193 (0.011)
Housing materials	51.2	15.4	47.5	52.5	15.090 (0.002)
Financial assistance	46.3	100.0	75.0	75.0	29.856 (0.001)
Actors implementing helping programs					
Government	39.0	59.0	25.0	67.5	17.776 (0.000)
International non-government organization	24.4	0.0	25.0	12.5	12.575 (0.006)

[a] Value in column denotes percentage of the respondents who answered "yes"

Though the questionnaire did not cover the issues directly regarding variation of provisions and types of helping associations, focus group discussions gave an insight for this. Some participants of focus group discussion were from different helping organizations who mentioned that they have different projects on different issues in those areas. Based on fund, intentions, capacities and resource persons for handling the programs, they have implemented diverse programs. Consequently, the variation in responses among the villages could arise.

6.10 Logistic Regression Analysis

Table 6.10 portrays the results of binary logistic regression for respondents' portion of recovery and their initiatives before and after cyclone. Likewise, it holds the results for the influence of demographic as well as economic variables on respondents' recovery status. In the case of Union, the Odds Ratio (OR) shows no significant difference between Union Kamarkhola and Union Sutarkhali for recovery after cyclone. The OR value in the following table indicates that

household respondents who stored valuable assets before cyclone are 3.258 times (*p*-value=0.004) more likely to recover than the respondents who did not store valuable assets before cyclone (reference variable) as a precaution.

Table 6:10 A logistic regression table showing the influence of socioeconomic and demographic variables on portion of recovery of household respondents

Variables	B (Co-efficient for constant/intercept)	OR (Odds Ratio)	P-value	S.E.	95% C.I.for EXP(B)	
					Lower	Upper
Union Kamarkhola (ref)						
Union Sutarkhali	.005	1.005	.988	.360	.497	2.036
Not store valuable assets before cyclones (ref)						
Stored valuable assets before cyclone	1.181	3.258	.004	.414	1.447	7.334
Not saving money before cyclones (ref)						
Saving money before cyclone	.457	1.580	.0368	.508	.584	4.272
Getting no housing materials after cyclone (ref)						
Getting housing materials after cyclone	.416	1.515	.253	.363	.744	3.087
Getting no medical facilities after cyclone (ref)						
Getting medical facilities after cyclone	1.825	6.202	.010	.711	1.540	24.974
Not use cyclone shelter (ref)						
Use cyclone shelter	.955	2.598	.054	.495	.984	6.862
Family member ≤ 4 (ref)						
Family member > 4	.264	1.302	.455	.354	.651	2.604
Household income ≤ 5000 (ref)						
Household income > 5000	.136	1.146	.711	.367	.558	2.353
Constant	-3.489	.031	.000	.971		

Also, table 6.10 shows that household respondents who saved money before cyclone are 1.580 times (*p*-value= 0.0368) more likely to recover than the respondents who did not save money (reference variable) before cyclone. With respect to post-cyclone period, respondents who received housing materials after cyclone are 1.515 times more likely to recover than those who did not get housing materials in the post-cyclone period. Similarly, portion of recovery is 6.202 times (*p*-value=0.010) more for the respondents who received medical assistances after cyclone than those who didn't. The logistic regression displays that respondents who used cyclone shelter to survive are 2.598 times (*p*-value=0.054) more likely to recover from cyclone than those who did not use cyclone shelter. The portion of recovery is 1.302 times more for the respondents whose family have more than 4 members than those who didn't. And portion of recovery is 1.146 times more for the respondents whose family have income above 5,000 Taka (Bangladeshi currency) than those who didn't.

6.11 Summary:

The major findings of this chapter indicate that most of the household respondents store food and water as precaution before any impending cyclone. Besides that, a significant portion of the respondents goes to cyclone shelter for surviving during cyclone. Most respondents narrated that they received food and water from different helping organizations for coping and recovery after cyclone. Likewise, the respondents appreciated the initiatives of aiding agencies in house rehabilitation sector for bringing improvement in their living. In all the surveyed villages, non-government organizations played a major role for helping the local inhabitants. Announcement is familiar way to warn the local inhabitants before the imminent cyclone. Regarding helping organization, all the respondents received assistance from them whether it was adequate or not. The study also found variations regarding some options of self- initiatives, local facilities and helping agencies provisions for managing cyclones. However, the household respondents' perception and Focus Group Discussions revealed that they require more attention equally from Government and non-government organizations to recover satisfactorily.

7 Conclusion

7.1 Introduction

This chapter provides a summary of the findings as well as conclusions obtained from the analyses of the study. It also gives an overview of the ideas undertaken in this study and research gaps that can be accomplished by further studies. I have added few recommendations at the end of this chapter based on the findings of the study as well.

Bangladeshi coastal communities have been facing natural calamities i.e. cyclone, coastal floods, salt water intrusion, river erosion etc. for centuries (Jahan, 2012; Parvin et al., 2008). Almost all the lives and livelihoods in the coastal areas largely depend on natural resources (land, water etc). Moreover, most of the households rely on the climate-sensitive part of agriculture as the key sources of livelihood (Jahan, 2012). Furthermore, the repetition of such natural disaster diminishes the asset base of the households and thereby makes future recovery difficult. Though coastal dwellers are trying to adapt with the adverse environmental conditions poses by natural calamities, information relating to their local coping mechanism is rarely found in Bangladesh. Hence, limited documentation on local coping strategies and recovery pattern reveals the research gap in cyclone prone areas till now. However, the core of this study was to discover in detail their ways of managing themselves from cyclonic consequences as well as maintaining their livelihood at local level.

This study set out to assess households' livelihood resilience of the selected southwestern coastal people of Bangladesh in relation to cyclone and climate change. In order to accomplish this objective, firstly the livelihood pattern (demographic, socioeconomic, other characteristics) of the surveyed households have investigated. Secondly, the major vulnerable aspects of the households have described. Finally, the coping strategies and recovery status of the households against cyclone with respect to local people's past experiences have explored.

In the present study, data were collected through face to face interview based on semi-structured questionnaire at household level. Besides this, some data were also collected through Focus Group Discussions (FGDs). The purpose of using FGD is mainly to justify the information provided by the household respondents during interview. Apart from these, FGD gave more room to the researcher to reveal the participants' ideas, thoughts and experiences about some of the relevant issues that were not covered by questionnaire survey.

This study has focused on vulnerability, adaptation and coping as well as on resilience concepts for illustrating the research. In addition to the concepts aforementioned, some previous

devastating cyclones of Bangladesh have also been discussed to get an overview about the frequency and severity of cyclone. In this region, cyclones are always accompanied by storm surges which often is the main cause of losses and sufferings of coastal communities. Simultaneously, I have presented vulnerability definitions from different perspectives by different scholars. Then, adaptation and coping concepts have discussed here. Lastly, the resilience concept has described from various academic literatures about how it incorporates components of adaptation and vulnerability. The literature surveys explored that, the concept of resilience embraces absorptive coping capacity, adaptive capacity as well as transformative capacity which have components for reducing anticipated risk or vulnerability.

Based on the purpose of the study, Dacope Upazila from Khulna District was chosen from the large southwestern coastal area. Further, depending on easy communication and data accessibility, four cyclone prone villages namely Kamarkhola, West Srinagar, Sutarkhali and Nolian were chosen from Dacope Upazila. Overall 160 household respondents were interviewed from the study areas irrespective of community and systematic random sampling was followed to choose them. The questionnaire was pre-tested before conducting the final survey. The interviews were happened at their place of residence and were conducted in Bengali language. Moreover, all the household respondents were above 18 years old. The field survey was conducted in monsoon season.

7.2 Summary

The findings of this study have been summarized below:

What are the livelihood conditions of the households?

The livelihood conditions of the surveyed households in this study composed of socioeconomic, demographic as well as other household characteristics.

Demographic characteristics: The findings reveal that most of the household respondents are male and are from mid-age (36-50) group. Maximum respondents possess educational background for primary level and almost all the households are male-headed (table 4.1). Female members are more in the family than male members for the surveyed households. Moreover, most of the families have less than 3 children (table 4.2).

Socioeconomic characteristics: The prime occupation of the household heads is agriculture and livestock rearing followed by day labor. Most of the households' monthly income and

expenditure found from 5,000 to almost 10,000 BDT (table 4.3). Also, the average for monthly household income and expenditure are 6534.38 BDT (almost 78 US$) and 6374.38 BDT (almost 77 US$) respectively.

Other household characteristics: The results indicate that most of the respondents are relatively poor as they have low income and inadequate food (more than 80%). Almost 95% lives in vulnerable housing (Kacha type) which is also an indication of their poor economic condition. Simultaneously, their dependency on rain water clearly manifest the water crisis of the study areas and it even aggravates during summer when there is inadequate rainfall. Females are mainly responsible for the collection of water.

What are the major effects of the households by cyclones?

This study discovered major affected sectors of households by identifying respondents' loss on several sectors. The losses have observed on three main categories. These include impacts on health, on house and household assets as well as on income. According to the findings, the first major loss caused by cyclone were linked to house and household assets. Another major loss, the households experienced were reduction of income.

Among the types of losses, almost all the household respondents experienced house damages (97.5%). This is because most of the existing houses are not supportive (kacha) enough against cyclone. Likewise, most of the respondents (93.8%) have lost livestock/poultry due to cyclones.

What challenges are households facing in the post-cyclone period?

Results of the analysis disclose that significant portion of the surveyed respondents experienced lack of transport immediately after cyclone (figure 5.1) and reported this as the most severe challenge. Since most of the village roads are earth roads, associated surge of cyclone eventually worsens that localities. Further, the water-logged condition caused residential displacement that constitute another big challenge for the coastal dwellers. Apart from these, reduction in income, disease outbreak and unemployment also mentioned by the respondents as dominant challenges in their areas.

How well are the households coping and managing themselves before, during and after cyclone?

The household respondents are coping and managing themselves from cyclone both by their own initiatives and by taking help from helping agencies. Besides those, in the surveyed

villages, some local arrangements have found useful to them for adjusting against cyclonic adversity.

Coping through households' initiatives: The findings reveal that respondents use their own initiatives as well as indigenous technique both before cyclone and during cyclone (table 6.1 and table 6.2). Food and water storage, using box for storing valuable goods, temporary migration, saving money, raise the plinth of the house and selling livestock/poultry are some of the common techniques followed by the respondents before cyclone in the study areas (6.1). Among their self-initiatives as preparation, storing of dry foods and water (nearly 75%) is most familiar as the villages face food and water crisis immediately after cyclone.

Apart from above, the respondents also undertake some initiatives for coping during cyclone. Going to cyclone shelter, using bricks/logs to raise the furniture heights, strengthening the house using indigenous techniques (e.g. using rope), temporary migration and taking shelter to neighbor house are most commonly found in those localities during cyclone (table 6.2). A sizeable portion of the respondents (73.1%) goes to cyclone shelter during cyclone. Results also show that temporary migration is undertaken by the respondents both before and during the cyclone for managing themselves.

Coping through the assistances of helping organizations: Since all the selected villages are cyclone prone, several helping organizations are working there to improve their livelihood condition. Food and water, housing materials, financial assistance, water tank for storing water, training facilities are some of the notable provisions of aiding agencies for coping and recovery after cyclone (table 6.3). Though both Government and non-government organizations (NGOs) worked for the livelihood recovery of coastal inhabitants, NGOs played a remarkable role in the post-cyclone period (figure 6.2). The respondents noticed about helping interventions through several sources. Some discovered by themselves, some from relatives or other beneficiaries and some from all sources (figure 6.1).

Local facilities for managing cyclone: The local services for handling the cyclonic consequences of the areas, have found for three categories like early warning, safe places to take shelter and safe resources (table 6.4). Announcement about the imminent cyclone and flag raising according to the severity of cyclone are mostly practiced here for warning people. The findings also unfold that almost all the respondents believe in cyclone warning (table 5.3). Moreover, presence of cyclone shelter is the most effective safe place to them during cyclone.

Further, local arrangements regarding safe resources (emergency relief, safe drinking water source etc.) for supporting the residents during cyclone are merely found here (table 6.4).

What are their existing conditions of livelihood recovery and perceptions about helping organizations?

Based on the analyses, it can be said that most of the participants (44.4%) have recovered to some extent (slightly) by taking help from aiding organizations (figure 6.5) as compared to previous situation caused by Aila in 2009. Only one household believe that they have recovered fully. The respondents' perceptions indicate that the supports given by the helping organizations are relevant to their area and all these interventions have positive impact on their livelihood (table 6.6). Though all the respondents received benefit from the aiding agencies in some ways, the supporting resources are not enough to recover satisfactorily.

The respondents reported that often some of them faced problem to receive help from helping organizations. However, their initiatives to manage the situation include reporting to the local leaders, lobbying or migration to other localities (figure 6.3). Also, the respondents narrated the steps taken by the helping organizations that brought improvement in their livelihood. In most cases, helping organizations monitor their beneficiaries after providing help but the frequency largely depends on the type of assistances the coastal inhabitants received (figure 6.4). With respect to recovery time, perceptions varied among the respondents (figure 6.6). However, most of them required 5 to 10 years to recover satisfactorily in livelihood sector from their terrible past caused by cyclone Aila.

What are their perceptions of climate change and cyclones?

The respondents heard about climate change mostly from the training programs arranged by NGOs working there. Other prominent sources include TV and Radio (figure 5.2). Nevertheless, their responses depicted limited knowledge concerning climate change. Most of the respondents observing climate change in the last 5 years. Changes in temperature, delay in start/end of the season, more erratic rainfall and more rainfall are some examples, the respondents reported about climate change (figure 5.3).

According to their perceptions, both cyclone frequency and severity have increased. But significant portion of the respondents have no idea about the relation between climate change and cyclone frequency (table 5.2). Additionally, some respondents cited few opinions to reduce

the climate change induced cyclone severity. Afforestation, Government initiatives as well as awareness raising are valued by the respondents (figure 5.4).

7.3 Conclusion

In my theoretical framework, I presented various ways of measuring and defining vulnerability provided by scholars. The literatures on previous cyclone reviewed here, drawn attention to coastal inhabitant's inability to cope or resist against such disaster. Hence, my empirical findings disclosed households' vulnerability by identifying their cyclone induced losses and challenges. However, I tried to explore the survival strategies local households applying both by using their traditional knowledge and by taking help from helping organizations (both Government and NGOs). For this purpose, I narrated the detail picture of respondents' preparations before, during and after cyclone to manage the consequences. So, the empirical results supported the adaptation and coping theories by uncovering their ways of adjusting in response to cyclonic adversity. Moreover, the kinds of support and resources the respondents receiving from different sources, helped to understand their present livelihood recovery as well. Above all, the households are trying to adapt with the cyclone adversity and have achieved recovery in some ways than their previous condition caused by Aila. Observing the findings, it can also be said that the households are bouncing back moderately. Hence households' ability to adapt and recovery pattern further supports resilience concept. Consequently, the results and discussions have been guided by the concepts that were used for the study and recognizing the link between empirical data and conceptual framework.

7.4 Limitations and Further Studies

The study did not focus on the questions relevant for evaluating the major vulnerable groups to cyclone. It just incorporated the findings on challenges and losses of households that accompanying vulnerability. The influences of demographic (age, gender etc.) and socioeconomic (occupation, income, expenditure etc.) characteristics have not been adequately dealt with to identify their vulnerability. Thereby, further studies are required to reveal what contributes to vulnerability of the households of these areas.

The study also did not mention how and what influences the household's perception regarding recovery. All the respondents answered the questionnaire with respect to their experience on

previous cyclones and it was hard to verify their responses within the limited time and resources. More advance studies can concentrate on these features as well. This study managed to provide short-term survival mechanisms (coping), that the households are using to overcome the disaster. Information on households' long-term strategies at local level have not been properly discussed here and the gap can be filled by further research.

7.5 Recommendations

This study found that Government organizations provide assistances mainly immediately after the disaster. They did not work for long periods like other non-governmental organizations. Moreover, they hardly monitor the affected people after providing help. In spite of having prominent experience and continuing advancement for managing with disaster, Bangladesh still lacks ideal synchronization among physical, technological and societal systems along its hazardous regions. Hence, to recover satisfactorily from cyclone like disaster, the Government of Bangladesh should enhance their helping programs in these areas and should work in collaboration with the non-governmental organizations. Besides, Bangladesh should adopt and execute proper strategies for preventing people from the insecurity of cyclone. Consequently, adequate information relating to the consequences of cyclone on coastal population and land masses are foremost in framing policies to recover and to bring secured livelihood in the coastal regions of Bangladesh.

Simultaneously, Bangladesh Government requires the support from international society and developed countries mainly, with far more operative care on post disaster relief and renovation work, along with increasing the on-going provision for disaster management. The study also revealed the lack of community people involvement in post cyclone period. So, both Government and non-government organizations should promote local people to co-operate and engage spontaneously for reducing the potential threat of cyclone that might arise on their livelihood.

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Appendix A: Household Questionnaire

Assessment of livelihood resilience in relation to cyclone and climate change along the southwestern coastal belt of Bangladesh

Serial No.	Questions	Options
Household Questionnaire		Questionnaire No…… Holding No:……. Informed Consent ……... Union: ……. Village: …….. Name:…….. Role in household: ……. Mobile No:……..
Section-A: Livelihood scenario of household		
1.	Sex of the respondent:	i) Male ii) Female
2.	What was your age on your last birthday?	…… years
3.	How many family members are there currently living in this household:	Total: ……. Male: …… Female: ……. Children (under 18): ….
4.	What is your marital status?	i) Unmarried ii) Married iii) Divorced/widow iv) Separated
5.	How long have you been living in this area?	……..……
6.	a) Have you ever been to school?	i) Yes ii) No
	b) If yes, what is the highest class you have completed? …… Class.	
7.	What is the main source of income of your household head?	i) Agriculture and livestock rearing ii) Service holder

<table>
<tr><td></td><td></td><td>iii)Fish farming
iv) Day labor
v) Others</td></tr>
<tr><td>8.</td><td colspan="2">Additional sources of income if any ……</td></tr>
<tr><td>9.</td><td>Who is the head of your household?</td><td>i) Husband ii) Wife iii) Others</td></tr>
<tr><td>10.</td><td colspan="2">Total amount of cash income (taka) of your household (per month) ……</td></tr>
<tr><td>11.</td><td>What is the main source of drinking water of your household?</td><td>i) Tube well ii) Rainwater collection iii) Unprotected well iv) Pond sand filter</td></tr>
<tr><td>12.</td><td>Who collect the drinking water for your family?</td><td>i) Male ii) Female iii) Children</td></tr>
<tr><td rowspan="2">13.</td><td>a) Is the water adequate that you get all the year around?</td><td>i) Yes ii) No</td></tr>
<tr><td>b) If no, in which season you face acute problem for getting drinking water?</td><td>i) Summer ii) Winter iii) Rainy season</td></tr>
<tr><td rowspan="2">14.</td><td>a) Do you produce your staple food?</td><td>i) Yes ii) No</td></tr>
<tr><td>b) If yes, is it adequate for your family?</td><td>i) Yes ii) No</td></tr>
<tr><td>15.</td><td>What kind of toilet facility your households have?</td><td>i) Hanging latrine
ii) Pit latrine with slab and water seal
iii) Latrines with an open pit
iv) Sanitary latrine
v) Others</td></tr>
<tr><td>16.</td><td colspan="2">Tick in the appropriate box after observing the construction materials of the respondent’s house.
<table>
<tr><th>Construction material</th><th>Tin
1</th><th>Finished (Cement /Concrete)
2</th><th>Tally
3</th><th>Earth
4</th><th>Bamboo
5</th><th>Natural (Straw/ Thatch)
6</th><th>Jute stick
7</th><th>Wood
8</th><th>Others</th></tr>
<tr><td>Floor</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Wall</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Roof</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td>17.</td><td>What kind of fuel do usually you use for cooking?</td><td>i) Straw/agricultural residue
ii) Electricity iii) Kerosene
iv) Wood vi) Cowdung</td></tr>
</table>

18.	Do you have electricity in your household?	i) Yes ii) No
19.	Do you have TV?	i) Yes ii) No
20.	Do you usually listen to the radio?	i) Yes ii) No
21.	Do you usually read newspaper/magazine?	i) Yes ii) No
22.		i) Yes ii) No
23.	What is your monthly expenditure (including all) in taka…….....	

Section B: Perception about disaster/hazard

1.	Has this area experienced tropical cyclone in last 5 years?	i) Yes ii) No
2.	If yes, how many times? …… time	
3.	What are the main challenges here during cyclone? (rank the 3 most important)	i) Food and water shortage ii) Lack of transport iii) Residential displacement iv) Income level decreased v) Unemployment vi) Disease outbreak vii) Access in education viii) Getting assistance from local governments office
4.	a) Did your household experience any loss due to cyclone?	i) Yes ii) No
	b) If yes, then which type of? (List 3 most important)	i) Death of household member ii) Loss of non-productive (household) assets iii) Physical injuries iv) House damages v) Loss of income/earning source vi) Loss of land vii) Loss of cattle/domestic animals viii) Faced health disease ix) Could not maintain education x) Others

<table>
<tr><td>5.</td><td>Information on the loss of household assets due to the recent cyclone:
<table>
<tr><th>Type of asset</th><th>Affected or Lost
1=Yes;
2=No</th><th colspan="4">Status of recovery
1=No recovery yet;
2=Recovered by 1 year;
3=Recovered by 3years;
4=Recovered by 5years</th></tr>
<tr><td>Livestock/poultry</td><td></td><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td>Agricultural tools</td><td></td><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td>Fishing tools</td><td></td><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td>Rickshaw/van/boat</td><td></td><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td>Valuable assets (Mobile phone, jewelry, TV, radio, sewing machine)</td><td></td><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td>Furniture</td><td></td><td>1</td><td>2</td><td>3</td><td>4</td></tr>
</table></td></tr>
<tr><td rowspan="2">6.</td><td>a) Did you receive any assistance for livelihood recovery from cyclone loss?</td><td>i) Yes ii) No</td></tr>
<tr><td>b) If yes, source….</td><td>i) Assistance from the society/ community level
ii) Government safety net program
iii) Assistance from NGOs
iv) Assistance from relatives</td></tr>
<tr><td rowspan="2">7.</td><td>a) Did you face any problem in getting assistance from Government / NGOs?</td><td>i) Yes ii) No</td></tr>
<tr><td>b) If yes, what steps you followed to overcome the situation?</td><td>i) Report to local government/NGO officers
ii) Lobbying
iii) Migrated
iv) Nothing</td></tr>
<tr><td>8.</td><td>How do you prepare before a cyclone?</td><td>i) Selling livestock/productive assets
ii) Temporary migration
iii) Storage of dry foods and water
iv) Use box for storing valuable assets
v) Raise the plinth of the house
vi) Saving money
vii) Others specify</td></tr>
</table>

9.	How do you cope during cyclone?	i) Reducing no. of meals ii) Strengthening the house using materials iii) Temporary migration iv) Use bricks to raise the height of the big furniture v) Taking shelter in neighbor house vi) Going to cyclone shelter
10.	In your opinion, what increases your vulnerability after cyclone	
	a) Lack of proper training	i) Strongly Agree ii) Agree iii) Neither Agree nor Disagree iv) Disagree v) Strongly Disagree
	b) Lack of government initiatives	i) Strongly Agree ii) Agree iii) Neither Agree nor Disagree iv) Disagree v) Strongly Disagree
	c) Lack of awareness	i) Strongly Agree ii) Agree iii) Neither Agree nor Disagree iv) Disagree v) Strongly Disagree
11.	At what extent you have recovered after cyclone?	i) Fully ii) Moderately iii) Slightly iv) Not at all
12.	In your opinion how much time it may need to recover fully?	
	Section C: Information on different initiatives for adaptation	
1.	Is there any intervention program in your area for reducing impact of cyclone?	i) Yes ii) No
2.	Please name some actors who are implementing the programs in your area for helping?	i) Community People ii) Government iii) NGO (Mention) iv) INGO v) No idea
3.	a) Are you a beneficiary (direct or indirect) of any intervention program implemented in your area?	i) Yes ii) No

	b) If yes, from where you are getting the benefits?	i) Government ii) NGO iii) INGO iv) Community people v) Others
4.	What are the resources provided to you by the interventions for coping and recovery after cyclone?	i) Water & food ii) Sanitation facilities (Specify) iii) Housing/housing materials iv) Financial assistance iv) Training v) Medical facilities vi) Others
5.	What are the resources available to your locality for managing cyclone?	i) Cyclone shelter ii) Mobile warning iii) Announcement iv) Safe places v) Embankment vi) Safe drinking water source vii) Emergency relief viii) Flag raising
6.	a) Do you believe in warning system?	i) Yes ii) No
	b) If no….why	i) Too far ii) Did not have enough space iii) Too late iv) No wish to go-explain why? ...
7.	Can you please recall, what was your source of obtaining the program (Helping initiatives)?	i) Self ii) Relatives iii) Other beneficiaries iv) Media (TV/Radio/Newspaper) v) Others
8.	Do you think that this intervention has any impact on your livelihood?	i) Yes ii) No
9.	Please tell some positive impacts on your livelihood due to program initiated.	1. ……. 2. ……. 3. …….

10.	a) Do they ever monitor your area after providing help?	i) Yes ii) No
	If yes, ….. What is the interval …….	
11.	Do you think that, the initiatives had been taken under the program is relevant to your area?	i) Yes ii) No
12.	If no why?	1. …… 2. …… 3. ……
Section D: Perception of climate change		
1.	a) Have you ever heard the term climate change?	i) Yes ii) No
	b) If yes, then from where you have heard this term?	i) TV ii) Newspaper iii) Seminar/training program iv) Radio v) Others
2.	a) Do you feel or see any change in climate over the last 5 years?	i) Yes ii) No
	b) If yes, what kinds of change?	i) More rainfall ii) Less rainfall iii) Change in temperature iv) Delay in the Start/end of the season v) More erratic rainfall vi) Other signs
3.	a) Do you think that cyclone has become more frequent or more severe than before?	i) Yes ii) No
	b) If yes….	i) More frequent ii) More severe iii) Both
4.	In your opinion, is there any connection between climate change and frequency/severity of cyclone	i) Yes ii) No iii) No idea
5.	Could you please tell what can be done in this respect? ……	

Appendix B: FGD Interview Guide

For knowledgeable and community people:

Livelihood pattern and vulnerability aspects of the local households

Hints: What are the major sources of income of the local people now and how the condition was before Aila, what are their drinking water sources now and how it was before, what are the major challenges here after cyclone and why, what kinds of losses are dominating here due to cyclone and why, which factors increasing their risk after cyclone etc.

Coping and adaptation strategies of the local households

Hints: How the local peoples are managing themselves before, during and after cyclone, what are the local facilities available here for managing cyclone, do they face any problem in receiving help from the available sources, if so then how do they manage etc.

Cyclone shelter, warning systems and climate change

Hints: Do they believe in cyclone warning or not, do they go to cyclone shelter or not, what is their perception regarding cyclone frequency and severity, what type of changes they are observing in weather in the last 5 years, what can be done against climate change induced cyclone severity etc.

Perception about helping initiatives working

Hints: What kind of helping agencies are working for the coastal peoples, what kind of steps they are taking to reduce the impact caused by cyclone, whether the initiatives provided by helping organizations are relevant for them, whether the supports given by the helping organizations brought positive impact on their livelihoods, how they are recovering as compared to before etc.