The Role of Women in Disaster Risk Reduction in Bangladesh: An Empirical Study on Waterlogging in DND Project Area

Pratima Dev

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For the fulfillment of the requirement for the degree of

DOCTOR OF PHILOSOPHY

Declaration by the Researcher

I do hereby declare that the research works embodied in thesis entitled **"The Role of Women in Disaster Risk Reduction in Bangladesh: An Empirical Study on Waterlogging in DND Project Area"** is the result of my own works. I further declare that the thesis has been completed and written by me and no part of it has been submitted to any other University or institution of higher education for the degree or diploma.

Signature

. . . . ……

(Pratima Dev)

Registration No 222/2012-13
Re-Registration 46/2017-2018
Institute of Disaster Management and Vulnerability Studies
University of Dhaka, Bangladesh

Certificate from supervisor

In my capacity as supervisor of the thesis, **'The Role of Women in Disaster Risk Reduction in Bangladesh: An Empirical study on waterlogging in Dhaka Narayanganj Demra (DND) Area' submitted by Mrs. Pratima Dev** for pursuing Doctor of Philosophy degree in Disaster Management and Vulnerability Studies, I do hereby certify that the dissertation has been conducted by the researcher's own efforts. I further declare that the dissertation meets the requirement and the standard for the degree of Doctor of Philosophy in Disaster Management and vulnerability Studies.

Signature

…….

Supervisor
(Dr. Khondoker Mokaddem Hossain)

Professor and Director of
Institute of Disaster Management and Vulnerability Studies (IDMVS)
University of Dhaka

…….

Co-Supervisor
(Dr. Ishrat Shamim)
Professor (Retired)
Department of Sociology &
Adjunct Faculty of Institute of Disaster Management and Vulnerability Studies (IDMVS),
University of Dhaka

Abstract

Bangladesh is a vulnerable country because of its distinctive socio-economic and physical characteristics. Every year near about 10 million people are affected directly or indirectly because of living in climatic vulnerable countries. Historically Bangladesh lies to the threat ended categories of land and natural hazards. However, natural disaster causes uneven vulnerabilities for both men and women. Waterlogging is one of the disasters that causes serious crisis upon human livelihood patterns. It also creates challenges upon human daily living condition. We faced various kinds of vulnerability because of lacking sufficient purred drinking water and balanced food. Waterlogging sometimes continues from a day to several months. Human life become tough because of employment opportunities, proper communication system and so on. Waterlogging also interrupts regular activities of the educational institutions and damages agricultural crops. Likewise, all other natural disasters waterlogging leads to equal damage in the nature but the burden of copping with disaster, vulnerabilities and mitigation process lies mostly on women's shoulder is known as engendering disaster. This study indicates that during disaster women are responsible to take care of their family members (e.g., arranging food for their family members, nursing injured people, special care for aged people and children, cooking for family members, collecting drinking water from distant places, etc.). The broad purpose of this study is to address women's strategic roles and indigenous coping mechanisms in reducing vulnerabilities induced by waterlogging in the study area. Again, the specific objectives of the study include exploring consequences of waterlogging on women, addressing, women's role in reducing risk in the context of economic and social vulnerability, identifying the gender aware steps to reduce the negative impacts of waterlogging on women, identifying the women's role in disasters preparedness including reconstruction, rehabilitation and resilience and addressing strategies of sustainable disaster risk reduction.

The conceptual framework of the study indicates that, the higher the vulnerability of women, the lower the adaptation and thus existence of waterlogging situation persists. On the other hand, the lower the access to decision making both inside and outside family, health care service, education, income the higher the adaptation and the outcome is the prolonged vulnerability of waterlogging. The current study followed the triangulation of qualitative and quantitative method. The 'universe of units' for this study for quantitative data were only females who have experienced and affected by waterlogging. A semi structured questionnaire was used in this study as tool for collecting quantitative data from 400 females from four villages under the DND embankment area in Narayanganj district. Furthermore, six FGDs, 25 case studies and six KII have been conducted to gather information about the nature of vulnerabilities, coping mechanisms followed by women role played by women to mitigate vulnerabilities and problems encountered by women effective as effective managers.

The Monthly income ranged between: BDT 1000- 10,000 plus and the expenditure incurred by the respondents ranged between: BDT 1000 and 10,000 plus. The housing pattern of the respondents of the study area shows that most of the respondents lived in semi-*pakka* houses. Over 70% of the respondents found illiterate. However, the majority of the respondents (75%) were housewives. Findings of the study also show that peak season of waterlogging is between the months of May-October and according to the respondents it continues from 7-120 days based on extreme climatic variability and weather condition (e.g., heavy rain). Findings of this study has revealed that women's vulnerability enhances due to unequal access to basic services, like access to income and related opportunities, improve health care service, access to proper sanitation, dual work burden and non-recognition of their contribution and also socio-cultural barriers to participate in disaster and reconstruction processes. Women become sufferer of domestic brutality and sexual aggravation and sometimes, under compulsion get themselves engaged in prostitution to maintain their family livelihoods in absence of earning male members. However, the traditional social structure and patriarchal societal norms made maximal women of the survey area worst victims of waterlogging as the findings confirms.

As the findings suggest, the women rarely used any indigenous coping mechanisms on their own. They occasionally assist their male family members in undertaking actions to ensure their survival. Because of the severity of the situation, the majority of respondents (59.2%) indicated their coping techniques were ineffective. Furthermore, the findings reveal that, in normal circumstances, 15.8% of women can make decisions both within and beyond their families. The remaining women reported that they were unable to perform their leadership roles both within and outside the house. In contrast, the majority of respondents (90.5%) were able to play a decision-making role during a disaster. The study's findings indicated several immoral behaviors, such as politicization, land encroachment, and unlawful buildings in wetland areas. Industries were established on agricultural land, and industrial waste was poured down the drain, causing the natural flow of water to be interrupted.

In this study the qualitative in-depth findings complemented and supplemented the quantitative findings. The recommendations and strategies include for future research placed in the dissertation have been extracted from the suggestions and observations during field research.

Dedication

I dedicate this work to my father Late Sudhangshu Kumar Dev and Mother Uma Dev.

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It is indeed an honor and privilege for me to express my deepest sense of gratitude and heartfelt thanks to Professor Dr. Khondoker Mokaddem Hossain, the Professor and founding director of the Institute of Disaster Management and Vulnerability Studies (IDMVS), University of Dhaka, my thesis supervisor and my mentor and also Founder Director of the Institute of Disaster Management and Vulnerability Studies who always flare up my memory for my commitment and dedication in ensuring that my thesis was successfully and timely completed. His excellent supervision, patience and advice have astounded me from the process of writing the research proposal and preparation for fieldwork until the end of the writing process. I personally do not have enough vocabulary to express my earnest and sincere appreciation for his high level of commitment. My acknowledgement goes to my co-supervisor Professor Dr. Ishrat Shamim, University of Dhaka who has helped me to finalize my proposal through providing potential feedbacks. My affiliation with IDMVS and the continuous support of the Director not only enrich my knowledge in the area of disaster management but also helped me to complete my dissertation within the timeframe.

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List of Abbreviation

ADB	Asian Development Bank
BBS	Bangladesh Bureau of Statistics
BDT	Bangladeshi Taka
DMB	Disaster Management Bureau
DM&RD	Disaster Management and Relief Division
DRR	Disaster Risk Reduction
FGD	Focused Group Discussion
GoB	Government of Bangladesh
HFA	Hyogo Frame Work for Action
HH	Household
IPCC	Intergovernmental Panel on Climate Change
KII	Key Informant Interview
MDG	Millenniums Development Goal
MDMC	Municipal Disaster Management Committee
MoEF	Ministry of Environment and Forests
MoFDM	Ministry of Food and Disaster Management
MoLG	Ministry of Local Government
MoWR	Ministry of Water Resource
MoWCA	Ministry of women and cultural affairs
MoFL	Ministry of Fisheries and Livestock
NDMAC	National Disaster Management Advisory Committee
NDMC	National Disaster Management Council
NAP WD	National Action Plan for women development
NGO	Non-Government Organization
RMG	Readymade Garments
SOD	Standing Orders on Disaster
UCCDMC	Union City Corporation Disaster Management Committee
UDMC	Union Disaster Management Committee
UZDMC	Upazila Disaster Management Committee
UDMP	Upazila Disaster Management Plan
UNDP	United Nations Development Program
WB	World Bank
WHO	World Health Organization

Glossary

Boat: a wooden made vehicle to run in the water.
Disaster: Disaster refers to the disarranging of the activities of a group of people, resulting in a great deal of individual, material, economic or environmental losses. A disaster is related to the risk process, by which risk is actually realized. There are three things- hazards, vulnerability and insufficient capacity-leading to disaster.
Vulnerability: Vulnerability is related to the extent of being adversely affected. That means, how much an individual, household, community or area are affected by a disaster. There are four types of mechanisms and processes- physical, social, economic and environmental- increasing the vulnerability of communities to hazards.
Disaster Risk Reduction: Disaster Risk Reduction (DRR) refer to the system and process by which policies, strategies and practices are developed and applied so that it is possible to reduce susceptibility and disaster risks across a community. Disaster Risk Reduction (DRR) controls some elements like disaster risk: vulnerability, hazards.
Waterlogging: Waterlogging takes place by a heavy rainfall, as water remains lifeless methodically because of shortage of proper extraction system and created many inauspicious impacts on daily human life.
Adaptation: Adaptation is termed as the moderation process which helps to make an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which lessen harm.
Female headed household: The households which are headed by woman who may be either divorced, deserted, widow and elderly with no one to support her family.
Female maintained household: Some households are apparently female headed (widow or abandoned) but may father, brother or adult son is taking the responsibility to run the household but there are some households which is completely depending on female member of the family.
Lac: 100 thousand

Van/ rickshaw: light vehicle for transporting goods, carrying passengers and run by human.
UP: Union Parishad, elected local government institution comprising several villages.
Upazila: Is a sub-district comprising of several unions.
Municipality: A municipality is usually a single urban or administrative division having corporate status and power of self-government or jurisdiction as granted by national and state laws to which it is subordinate.
City Corporation: A city corporation is the legal term for a local governing body, including (but not necessarily limited to) cities, counties, towns, townships, charter townships, villages, and boroughs.

Chapter One
Introduction and Background of the study

1.1 Introduction

We face many problems because of climate change and are turned slowly into disaster-prone countries due to global warming. A total of 376 natural disasters were recorded worldwide in 2015 and the death toll caused by natural disasters during this period was some over 22,000 (Guha-Sapir, 2015; Holguín-Veras, 2012). Among the victim countries, Bangladesh is situated in South Asia, which lies under the most threatened land categories for natural disasters. Bangladesh is the most disaster-prone and vulnerable nation and also prone to climate change. The previous research on climate change revealed that about 10 million citizens in Bangladesh are affected directly and indirectly by one or more natural hazards annually (GoB, 2011; Sabur, 2012). A natural disaster is also known as a recurring event in Bangladesh (Nasreen, 2004). Disasters in Bangladesh have a short past but a long history. Geographical location has made Bangladesh one of the world's most climate-vulnerable countries. The mighty river system and its nearly unpredictable courses, soil conditions, the agriculture industry, and millions of people's livelihoods depend extensively on locational context. Women are almost 50% of the total population in Bangladesh (Chisamya, 2012; Delisle, 2012); nevertheless, historically, they have become the most vulnerable group in the country during different natural calamities, such as Cyclone of 1970, 1988 flood, 1991, 2007, 2009 etc. Disaster is gender-neutral, not vulnerability; it affects people and their livelihoods regardless of caste, social class, ethnicity, or gender, but researchers (Saha, 2015; Khan & Azad, 2015; Nasreen, 1995, 2008, 2010, 2012; Khatoon, 1995; Khondker, 1996; Matin, 2001; Akhter 1992; Kabeer, 1991). Men and women are affected differently because of their different impacts on them and their lived experiences.

Waterlogging is considered one of the major natural disasters worldwide, but countries like Bangladesh are the worst victim of it (Rahman & Debnath, 2015). However, in order to understand the problem of waterlogging in the DND area, we need to look at the history of past development activities carried out in the DND area. The DND areas was developed as flood control, drainage and irrigation (FCDI) project by which was then known as East Pakistan Water and Power Development Authority (EPWAPDA) [currently known as Bangladesh Water Development Board (BWDB)] in 1962 and the operations began in 1965. At that time, it was envisaged that agricultural products from the DND areas would be supplied to the market

of Dhaka City. However, over time, the DND area experienced an unplanned urbanization. With land price increasing exponentially in Dhaka City and its outskirts, a pressure to develop land in the areas adjacent to DND project was felt. The DND area is surrounded by embankments to protect it from the river flooding. The area is shaped like a basin or bucket, with the lowest points located in the middle of the area. The drainage of the DND project was designed considering the adjacent areas as agricultural lands. However, as the DND area has undergone a rapid transformation, from agricultural land to become urban settlements, the drainage system started to underperform and hence resulting in waterlogging problem in that area. The waterlogging situation is so bad at that place that, even normal rainfall causes inundation in many areas for a long period of time. Therefore, it is evident that waterlogging problem in the DND area should be coined as an anthropogenic or human-induced one as opposed to the term natural hazard. In the past, people of rural areas, especially farmers, were vulnerable to waterlogging but now dwellers of the big urban areas are the worst victims hereby. Waterlogging causes serious humanitarian crises creating challenges in living conditions, livelihood, health, food, security, employment, education, and communication for several months. Farmers took measures to increase agricultural production (block or fill up the drainage canals), development structures such as embankments, polders, bridges, culverts, and roads that cause the demise of water drainage (Rahman & Debnath, 2015). In addition, unplanned buildings in wetlands, illegal encroachment of low-lying areas, and a lack of regular cleaning of the drains (*The Daily Star*, August 30, 2014), unplanned urbanization cause water congestion and makes urban landscape a death trap for the dwellers. Most of the drainage canal and channels are actually clogged due to indiscriminate solid waste disposal (Rahman & Debnath, 2015). The impact of waterlogging is immense for the inhabitants of the particular area. Stagnant water causes traffic jam and loss of working hour(Rahman & Debnath, 2015). Waterlogging leads to sanitation problems and also gives birth of many other diseases. People of approximately 16 districts of south-western districts of Bangladesh are getting displaced due to waterlogging (Rahman & Debnath, 2015).

In contrast to the coastal people of Bangladesh, large cities including Dhaka, Khulna, Sylhet, Chittagong, Narayanganj are facing enormous problem due to waterlogging. The city corporation authorities take measures to mitigate the people's vulnerabilities, but those projects do not run for a long time. Currently, Dhaka-Narayanganj-Demra (DND) embankment area is the worst suffered zone that happens every year causing dangerous losses and damages in the living conditions and the whole ecosystem (Rahman & Debnath, 2015). DND embankment

area becomes waterlogged dangerously due to torrential rainfall from June to August. Sometimes it continues round the year. During this period, most roads, markets, business centers, houses, and schools went under ankle-to-knee deep water.

It is noteworthy that almost all the cities in Bangladesh have been designed in an unplanned way. So, whenever floods occur due to heavy rainfall, it is common for the dwellers of megacity Dhaka to have a bitter experience- waterlogging. In this very critical situation, women tend to become most vulnerable. Women also demonstrate their capacity and ability to overcome the adverse effects of disasters and vulnerability by applying their own coping mechanisms and developing their resilient power during flooding and severe waterlogging.

Women and men play different roles in society. There are some socially constructed roles, responsibilities and opportunities for men and women, governing the relationships between them worldwide. Besides, gender-specific differences are noted in consumption patterns, lifestyles, and access to resources. It is quite natural that climate change would have different effects on them because of their differentiated access to social, economic and physical resources (Nasreen, 2010). According to the intergovernmental panel on climate change report (Smith, 2009), climate change has gender-specific implications in terms of both vulnerability and adaptive capacity. Women, especially poor women, bear a disproportionate burden of climate change consequences. Some 70 percent of the 1.3 billion people in the developing world living below the poverty line are women (Denton, 2002). There are some limitations with poor women in having access to resources, rights, and voice in community and household decision-making, thus making them much more vulnerable than men to the effects of climate change.

Women play a significant role in keeping natural resources safe by collecting water and fuel. Dankelman (2002) notes that women are the main energy managers in many households in the south, for example, collecting firewood for fuel. Women have a great influence in many households in collecting water so that it is possible, with agricultural production, to ensure the family's food security. Many argue that women hold the key to adaptation in certain places (Babugura 2010). Women contribute a lot to disaster reduction, often through participating in disaster management activities (Pachauri, 2007). Gender roles and responsibilities are based on regions and localities and vary in time.

In addition to different gender roles, women experienced differential vulnerabilities. Cannon (2002) argues that there are specific gender attributes that increase women's vulnerabilities in

some respects. For example, increased salinity of drinking water has been found to increase maternal health risks during pregnancy in Bangladesh.

1.2 Rationale of the study

Waterlogging in the urban area is not a new problem but the intensity of the problem is increasing day by day due to unplanned urbanization and rapid rural-urban migration (Anisha and Hossain (2014). Increasing urbanization is not providing adequate drainage, which leads to waterlogging. Waterlogging is the key reason behind ecological damage in urban area. Furthermore, the local people have become financially, socially, culturally, psychologically crippled due to regular frequent waterlogging.

The Dhaka Narayanganj Demra (DND) embankment area has been covered by the river Buriganga and Shitalakhya as well as by the Meghna. When the DND project was (1962-68) launched, the area was mainly agro-based. But, over the last couple of years, the entire scenario has changed as the lands are being converted into residential and industrial area. Moreover, excessive and unpredictable heavy rains have become a perpetual problem for over two million people who are living inside the DND (Dhaka-Narayanganj-Demra) project area on the southern edge of the capital. The DND project primarily had a drainage system for agriculture production but it has now turned into a township that is apparently 10 to 15 feet below the flood level during the rainy season and there is no mechanism to pump out the stagnant rainwater immediately. Moreover, the construction of unplanned and haphazard establishment and infrastructure adversely impacted the existing drainage system of 10,000 hectares of land inside the DND area (Azad, 2015). Therefore, stagnant flood water is a big challenge of the life of dwelling inhabitants. For the last 25 years, in addition to the study area, many parts of Dhaka city became part of the unplanned and haphazard urbanization process. Moreover, a substantial increase in built-up areas has taken place due to illegal developments of the areas through private land developers and real estate investors (Tawhid, 2004). These activities have resulted in a substantial increase in impervious area and obstructed the natural drainage pattern. As a result, flooding due to rainfall has become a severe problem for DND embankment area, which remains inundated after each severe shower mainly due to the drainage congestion (Huq and Alam, 2003). The city has been experiencing waterlogging for the last couple of years, leading to large infrastructural problems for the city and a huge economic loss in production with severe damages of existing property and goods (Mark and Chusit, 2002). In addition, the ecological balance of the city is also disrupted and diseases spread, which is a gross inconvenience to its

inhabitants (Mowla, 2005). Due to not having long-term effective urban planning, the urbanization process is taking place. On the other hand, the difficult waterlogging situation has turned into a perpetual threat for the dwellers for the last three decades.

In slums and low-income areas, most of the people live in temporary (*kacha*) and vulnerable habitations. These building houses become badly damaged during the period of waterlogging.

The most adverse impact of waterlogging is the incidence and prevalence of various diseases in the study areas. In poorly drained areas, urban runoff mixes with sewage from overflowing latrines and sewers, causing pollution and a wide range of problems associated with waterborne diseases. Sometimes, the poor people have to rely on the surface or shallow groundwater sources that are polluted, as they do not have access to portable water during the monsoon period. Malaria, respiratory problems, eye and skin disease, jaundice, vector-borne diseases, etc. are also common in waterlogged areas.

Women are prone to disasters, like cyclones, floods, tornadoes, riverbank erosion, droughts, cold waves, earthquakes, waterlogging, arsenic contamination, and saline water intrusion are the most common (Nasreen 2008, 2012; Azad, 2013). Women are particularly vulnerable to natural disasters compared to men because of their involvement in household tasks, such as collecting water and fuel wood, cooking, managing food, and providing childcare (Nasreen 1995, 2008; Azad, 2013). In all of these activities, women are closest to the environment (Nasreen, 1995; 2009). They may also become victims of violence and face additional problems because of long-existing gender disparities (Nasreen, 2008; 2010). Women, further, may become victims of violence and face additional problems due to their gender (Nasreen 2008; 2012). Poverty is a relatively common phenomenon in Bangladesh among women, particularly in female-headed households, making women more vulnerable to natural disasters (Khondoker, 1996). Therefore, the present study identifies the persistence of female vulnerabilities and their livelihood patterns, especially the disadvantaged, marginalized, poor, and destitute women's during and after floods in the DND area.

1.3 Objectives of the study

Broad objective:

To evaluate the role of women in disaster risk reduction in the DND study region.

Specific objectives:

1. To explore the consequences of waterlogging on women.
2. To identify women's role in reducing risk in the subject of socio-economic vulnerability.
3. To explore the women's awareness-building mechanism in reducing adverse impacts of waterlogging.
4. To identify the women's role in disasters preparedness, including reconstruction, rehabilitation and resilience.
5. To identify strategies for sustainable disaster risk reduction.

1.4 Research Question

Research question refers to narrow down and focusing more precisely (Bryman, 2012) on what the researcher wants to know about whether women's knowledge about disaster risk reduction is better in the project area?

1. To what extent are women vulnerable due to waterlogging in the study region?
2. What kind of role do women play in reducing risk on the subject of socio-economic vulnerability due to waterlogging?
3. What kind of role women play in economic development at the household and community level?
4. What are the gender-aware procedures to minimize the negative consequences of waterlogging on women in the DND area?
5. What is the gender-based mechanisms adopted by the women to reduce the negative implications of waterlogging in DND embankment area?
6. What are the functions played by women in the backdrop of calamity preparedness including reconstruction, rehabilitation and resilience?
7. Do women perceive and experience the impacts of waterlogging in different ways due to their different roles in society?
8. What are the disaster risk reduction efforts being practiced by women in the study area?
9. What are the challenges for women in disaster risk reduction in the study area?
10. How will women be impacted by waterlogging in the different socio-economic background?
11. Whether the coping mechanisms of men and women are different?

12. What recommendations can be offered for future disaster risk reduction efforts?
13. What kind of women play role reducing risk in disaster risk reduction?
14. What kind of role women play in reducing the adverse impacts of waterlogging?
15. What kind of role women play in disaster reconstruction and rehabilitation and resilience (see object 4)?
16. What are the policy recommendations of women's out of sustainable disaster risk reduction strategy?

Chapter Two
Review of Literature

In this chapter, the researcher selected relevant literature and published items which will help to place the current study in the proper perspective. While conducting a literature review, as a researcher, the researcher came across a large number of both published and unpublished documents and therefore the researcher classified the literature into four categories. *First*- is the academic literature mostly conducted by academics both from academia and outside of academia? *Second*- are the reports published by the government and also in few cases commissioned by the government? The *third* is the NGO reports (both national and international NGOs) which are indeed useful, and these are based on the experience of working in the waterlogging affected areas. And *finally*, there are numerous reports in both print and electronic media which are illuminating to get a feeling about the extent and intensity of the impact of waterlogging on the population. The researcher has attempted to provide glimpses from all this huge body of literature. In doing so, the researcher has pointed out the existing literature's limitations and shows how my research and methodology will contribute to better understanding the role of women in mitigating waterlogging in the study area and the situation created in the aftermath of waterlogging.

The present chapter explores the researchers' previous work that is relevant to the study. Most of the literature relates to the disaster, climate change, and waterlogging issue with a wide range of situations aiming to describe gendered vulnerabilities due to disaster and indigenous coping strategies taken by people in the national and international arena. This chapter will help us understand the nature of vulnerability due to waterlogging, conditions related to waterlogging and explore the strategies to cope with the situation.

2.1 Disaster, vulnerability and disaster risk reduction

Natural disaster is as old as the history of the planet, but the increased intensity is an alarming phenomenon for the earth's policymakers, statesmen, and inhabitants. So, this is time to halt that rise through comprehensive disaster risk reduction rather than sole emphasis. In general, all sorts of disasters disrupt the normal functioning of life and society, but some disasters like waterlogging have long-term consequences. There are many factors behind disasters, especially from natural hazards and people’s vulnerabilities. Due to the limited capacity to face

vulnerabilities, it becomes very difficult to control disasters. Poverty, social class, and gender relations are some of the factors for which risks arise. The existing gender relations are very important in disaster risk reduction to do with the roles and responsibilities of both women and men. These roles lead to different identities and social responsibilities. Though women's vulnerability has been highlighted, their responsibilities and active participation in disaster risk reductions have not been focused. Before the disaster, the women's socio-economic position determines their vulnerability in a post-disaster scenario. Suppose women are not self-sufficient in economic terms before the disaster. In that case, they are likely to take a secondary place in the labor market, work for the informal sector, have insufficient rights of inheritance, and shoulder considerable domestic responsibilities in addition to babysitting following a disaster (Dursan and Vardareri, 2010).

Waterlogging halts community functioning and the situation sometimes remains for weeks and sometimes even for months. Nonetheless, several studies have been conducted on the disaster and vulnerability of women, but very few studies have focused on women's vulnerability during waterlogging in urban areas. Moreover, traditional socio-political and economic structure, dominant nature of patriarchy, gender norms, and positionality of women in society make women more vulnerable during disaster. Nonetheless, international disaster management strategies have addressed the importance of women's participation in disaster risk governance (Hemachandra, 2018).

Therefore, this novel study attempts to explore and emphasize the role of women in disaster risk reduction risk governance efforts and to uncover the barriers that limit their role in disaster risk governance in the context of waterlogging in the DND embankment area. Accordingly, it reveals that the role of women in disaster risk governance as vital for effective disaster risk governance and resilience. Further, the study identified socio-cultural factors, individual characteristics, legal and institutional factors and socio-economic factors as the barriers that limit their role in disaster risk reduction and disaster risk governance efforts.

2.2 Gender identity and vulnerability of women in disaster

Gender is considered a demographic variable in disaster studies (Fothergill, 1999; Kahn, 2005; Van Aalst et al. 2008). Nonetheless, feminist theories and research have mostly focused on women's vulnerabilities during the disaster (MacGregor, 2010). Measures have been taken nationally and internationally to ensure women's rights and enhance their livelihood capacity and links to land, information, and training (Alston, 2015). In this chapter, the researcher have

focused on literature to understand the discourse of disaster, gender and vulnerability relating to socio-political and cultural norms, violence against women during disaster, women's health and sanitation status during disaster, women's access to household resources, women's unpaid and invisible work burden during disaster and women's participation in different phases of disaster (i.e. mitigation, preparedness, recovery and response). More precisely, the researcher has reviewed literature on disaster, gender and gender relations disaster management process, coping and adaptation mechanisms of women, women involvement with decision making process, involvement of women with income generating activities etc. and changes and improvement of ways of life and the local norms and institutions.

Alston (2015) argued that the worst victim of climate change and natural disasters. He added that the reason behind women's vulnerability is their dependence on local natural resources for their livelihoods. Those charged with the responsibility to secure water, food and fuel for cooking and heating face the greatest challenges [and] when coupled with unequal access to resources and decision-making process, limited mobility places women in rural areas in a position where they are disproportionately affected by climate change. It is evidenced that disaster affects women and men but the burden of coping falls heavily on women (Nasreen, 2012; Khondker, 1996). It increases women's domestic burden and great hardship and undermines women's well-being because of their dependence on economic activities linked to the home. Poor women suffer from lacking food, clothing, and shelter. Young girls suffer from insecurity and sometimes experience sexual harassment.

Furthermore, the vulnerability of women in the disaster-prone or affected area increases when male members and/or earning members of the household become unemployed and migrate temporarily in search of work. In the case of male members' migration, women take responsibility for protecting their houses, children, and other family members, livestock, and other belongings. A study on gendered vulnerability due to disaster shows that women of traditional societies like Bangladesh eat less during disasters due to food shortages. After eating all of their family members (Alston, 2015). Due to gendered division of labor, poor women are more likely to be exposed to natural hazards than men. Blaikie et al. (2014) argued that the low-income group often voluntarily lives in disaster-prone areas. Findings of literature show that in Bangladesh male dwellers are usually engaged in wage labor outside the home, pulling rickshaws etc. But female dwellers always stay at home and are thus more at risk. Moreover, during floods men in rural areas lose their place of work while women shoulder the

responsibilities of sustaining the households (Nasreen, 2010; 2012). The traditional gender-specific responsibility becomes so difficult for women in disastrous conditions that their lives are often at risk, especially while traveling during floods. The gender division of labor creates an additional workload for women in disastrous times, especially in the poorer categories (Nasreen, 2012; Bari, 1998). However, gender is a significant indicator of vulnerability exacerbated at the disastrous time due to loss of control over resources, production, decision making, breakdown of education, unemployment, exposure to unsafe social conditions etc. (Alston 2015; Nasreen, 2012, 2010; Dankelman, 2010; Cannon, 2002; Khondaker, 1996).

Gender roles, limited scope for migration and seclusion from public places, etc. kept women away from access to warning information in the 1991 cyclone of Bangladesh, which constrained women to decide about evacuation and take emergency preparedness measures (Ikeda, 1995; Cannon, 2002).

However, people who lose everything leave their homestead and take shelter in shelter center, on roads, damaged embankments, in markets, schools, mosques, temples and in the open place as there is no arrangement for such huge number of people over there, they face shortages of drinking water, scarcity of food, shelter and sanitation etc. Mismanagement, unplanned migration, and displacement cause physical insecurity, traumatic experience, etc., particularly for women. The influx of out-flow migration often results in sexual violence and harassment against women in the transition and destination areas (Saul, 2012).

Literature on the gendered nature indicates that women are disproportionately impacted by the disaster, which is being manifested in number mortality, morbidity, and injury, which is largely determined by gender relations, physical capacity, division of labor, socio-cultural norms, etc. disaster (Demetriades and Esplen, 2008; MacGregor, 2010). It is estimated that 90% of the victims of the 1991 cyclone in Bangladesh were women and children (Cannon, 2002; Ikeda, 1995; Khondker, 1996) and more women died in the 2004 tsunami in Indonesia, India, and Sri Lanka. The 2004 tsunami in Sri Lanka shows that many women were preparing for breakfast at home and were washed away while their husbands had already been off to sea for fishing (MacDonald, 2005). Muslim women of Sri Lanka delayed evacuating due to fear of the shame attached to leave their house and moving in public without putting on a scarf (Kett, 2005).

Disaster leads women to many forms of socio-cultural, political and economic discriminations such as early marriage, trafficking, rape, sexual abuse, physical torture etc. (Nasreen, 1995;

2010). Rape, gang rape, molestation and physical abuse of women and girls, and a sense of physical insecurity, fear, and lack of security provisions in the camp were reported in Myanmar, Philippines, Nepal, Pakistan, and Bangladesh. In post Tsunami, sexual and physical abuse incidents were reported in Sri Lanka incidents (Fisher, 2010).

Lack of security and chaotic conditions in camps and shelter centers are not women-friendly and thus, the vulnerability of women and girls increases during disastrous situations (Fisher 2010). The rate of domestic violence, including divorce cases, family violence, spousal abuse, child abuse and domestic violence, had increased in Florida after the attack of the Hurricane (Wilson, Phillips, Neal, 1998; Laist, 2006; Morrow, 1999). Sexual assault, domestic abuse, forced marriage, and human trafficking increase in society following disasters. After all losses of harvest, crops, livestock, poultry etc., from floods in Bangladesh have a disproportionate impact on women, many of whom rely on food processing, cattle, and chickens for their cash income (Baden et al. 1994). Women who used to do home-based small business and income-generating activities lose income, workplace, and production tools. On top of the financial loss for disaster, these women do not have easy access to seek outside work (Lippmann, 2011) due to their domestic duties and limited mobility. As a result, earning and financial contributions declined relative to men's involvement in income-generating activities (Bradshaw, 2002). Research shows that these women survivors could not resist violence by their husbands due to social stigma, their economic dependence on their husbands, and their fear of abandonment (Bradshaw, 2002). When men become unemployed due to disasters, they release their anger on women, including emotional, physical, sexual, and structural violence. Teenage girls are the worst victims of violence along with married, unmarried and disabled women (Nasreen, 2010).

Women vulnerability results from highly entrenched and normalized social practices and structural inequalities (Alston, 2015). There are ranges of customs such as dress code (sari), purdah system, access to resources, unequal rights on properties etc., that hamper the ability of women in Bangladesh to respond effectively and limit their capacity (Alston, 2015). It is revealed that when the women's assets are depleted and income-earning options become inferior the bargaining capacities of the women in the households become weak. As a result, women became less mobile, leaving men in crisis in a stronger "fallback position" (Enarson, 2000). Women's dependency on men's wages creates a condition of vulnerability, particularly as women lack legal entitlements to share their husbands' wages (Wiest, R. (1998; Dreze & Sen, 1989).

During a disaster, vulnerable and disadvantaged groups such as women and widows, who are the head of the household, suffer the most and are discriminated against to access resources and assistance. In patriarchal, in Sri Lanka, during post-tsunami many widows were not allowed to claim the property which used to be legally owned by their husbands (MacDonald, 2005). Similarly, in many post-famine emergency relief programs in Africa, a male-headed household is considered a model for food provision (Bolin et al., 1998).

2.3 Gender and Disaster Risk Reduction

In developing countries, the poor are severely affected by climate change, and they have a very meager capacity to adapt to climate change. So, they are susceptible to being at higher risk to hazards that climate variability and intensity have brought over. In addition, climate change does not affect equally both men and women. Women become more vulnerable than men due to climate change because of their representation of the majority of the world's poor and of being proportionally more dependent on threatened natural resources (Skinner, 2011).

It is observed from the information collected since 1980 on women's health, education, and economic empowerment that women are considered to be inferior to men. They also enjoy inferior social status to their male counterparts. There are few scopes for women to develop themselves due to their traditional societal roles. Their access to markets, education, health services, and government jobs are very limited. The traditional roles which have prevailed in society have forced them to have high fertility rates. As a result, high fertility greatly impacts malnourishment and poor health. It is also noted that poverty rates increase among women and children; not capable of taking care of themselves.

It is generally accepted that people have less access to working places when the population rate is high. There is also another discrimination of women in the social structure of Bangladesh. Female workers are not considered equal to male workers, and their wages are also less than that of male workers-ranging between 20 to 30 percent of male workers (Aizer, 2010).

Women ensure the well-being of the family, even at the cost of their lives. At the onset of natural disasters, women have to safeguard all their belongings by sending everybody to the safer refugee camp, and they stay back to ensure the safety and security of households. Thus, she faces many types of imminent hazards. Such an apparent 'passive' response to quickly on-setting hazards may lead to the death of women. The situations that have prevailed across the

country, especially in socio-economic circumstances, lead women back far behind than their male counterparts.

Women are responsible for preparing food; there is much emphasis on the need for clean-burning fuels that are affordable and convenient to obtain. In places where it was once relatively easy to get firewood, traditional fuel sources may now be scarce due to environmental degradation, and women would particularly benefit from increased availability of modern fuels such as liquefied petroleum gas (LPG), or biofuels and biomass briquettes that can be produced locally from crops and agricultural residues, available in rural areas. However, there are some techniques by which technical processes can enhance women's contribution and role in climate change adaptation (Sharmin and Islam, 2013). Therefore, women's needs must be included in international policies and projects. Social support and interventions provided by governmental policies and programs are particularly important to low-income women. Such disaster-related social policies and programs that are in place to assist women in fulfilling their post-disaster needs have largely proven to be inadequate. This includes policies that impact emergency, transitional and long-term housing, financial assistance, food security and other aspects of recovery (Pyles and Lewis, 2010).

Sharmin and Islam (2013) have focused on Bangladesh's geographic location and geomorphological conditions, which are why the country is most vulnerable to weather and climate-induced changes. They think that wetlands are very important to maintain the ecological balance of ecosystems. But there has been a reverse in the case of Bangladesh because wetland habitats of Bangladesh are under constant threats due to climate-induced changes. Sea-level is rising due to Climate change, putting wetlands at risk of excessive calamities. The wetland ecosystem has been threatened because of seasonal irregularities. Adaptation, vulnerability and resilience of people to climate change depend upon a range of conditions. These vary from their degree of exposure and dependency upon weather patterns for livelihoods and food security to varying capacities in adaptation, which are influenced by gender, social status, economic poverty, power, access, and control and ownership over resources in the household, community and society (Denton, 2010). Women are victims of different kinds of violence throughout their lives. During a disaster, violence increases along with other problems. Women have to bear some extra burdens, including food procurement, water supply, and health care. But their contributions do not come into the limelight. Women show a higher economic vulnerability than men. In general, compared to men, women have

lower average literacy and education levels, limited access to gainful employment and weak or no control over local resources, especially land ownership and legal access to water supply systems (Rodrigues, 2010).

2.4 Gender Mainstreaming in Disaster Risk Reduction

The concept 'Gender mainstreaming' has consistency among the specialists. It is also true to disaster risk reduction. Whenever gender is tried to bring into the mainstream by focusing on these two issues in disaster risk reduction, there have been a gap between governments and practitioners in policy and practical guidance. They are aware of the reasons of why it is not possible. The mainstreaming of gender has recently been transformed into Disaster Risk Reduction-Women's relationships are now analyzed within the overall gendered socio-economic and cultural context. Disaster management is focused on long-term proactive disaster risk and vulnerability reduction. Here the importance is given to sustainable development. The information available at the global level indicates the success of advocacy and awareness-raising in gender equality in DRR in inter-governmental processes.

Saito (2014) has emphasized community involvement. According to him, a community is not a homogeneous entity. It consists of a mixture of linguistic, ethnic, religious, geographical, social, and gender and other diverse characteristics. The term 'community involvement is not enough to ensure that power and benefits from participatory decision-making will be equally distributed within communities. Planning, regulation, integration, institutional system, partnerships and accountability are relevant to everyone because they are likely to affect any initiative in disaster reduction, development, and relief. Women are playing major roles in response and recovery to the recent disasters. People have realized that it is important to marshal the support of women. Women are the networkers and often the primary catalysts for communication among their neighbors (Pyles and Lewis, 2010).

2.5 Disaster and gender: coping and adaptive mechanisms in literature

A natural disaster is not a new phenomenon; human beings struggle against nature to survive from the very dawn of civilization. But women own adaptive techniques and initiatives become crucial for their family sustenance and ensuring food security to overcome the crisis (Bolin, 1998). Bari (1998) explains that fighting against poverty is tougher for women after cyclones and tidal waves hit them the hardest. Their men may have lost the fishing equipment necessary

to earn a living, their children may have died, and their homes and belongings were washed away, but at the end of each day, the wife/mother had to cook for whoever survived in her family. In all the relief lines, women stood first. They collected bits of wood and bamboo to rebuild the houses. As is customary, they deal with the children and lack of food. Women responsible for fetching water might become weaker in association with a water-borne illness, which might be more widespread among nutritionally disadvantaged women (Cannon, 2002). Still, it is revealed that women are not only victims but also active agents who cope with the disaster. Paolisso and Ritchie (2002) showed that women survivors of Hurricane Mitch well assessed the losses of their agricultural products and coped with the disaster based on their knowledge and social networks. However, drinking water sources are becoming a major problem for the people of southwest Bangladesh with the increasing climate variability and disasters. But once again it becomes the responsibility for women, irrespective to their physical condition, to provide drinking water for their families. Since water sources in the neighborhood are affected by pollution and high salinity, women travel long distances to collect drinking water (Ginige, 2009).

It is evident that despite heavy burdens, challenges, the traditional division of labor, social perception and norms, women prove their capacity to face their extremely harassed circumstances and demonstrate their strength and resilience to protect their lives and resources in Bangladesh (Nasreen, 1995, 2012; Alam, 2010; Gokhale, 2008; Fordham, 2003) argued that women manage crisis situations and demonstrate high degrees of resilience within the victimizing relationships. The role, responsibility and sensible contribution of the women in Bangladesh make society sustainable. Women have made important contributions in creating access to human, natural, financial, physical and social capital for making their livelihood sustainable (Lambrou, 2006). For example, rural women are intimately done all phases of agricultural activities, from seed sowing to harvesting and processing of crops. Women are participating in farming activities and small farmland and homestead area are being used by women (Hunt, 2007). On the other hand, at the time of crisis, the women adjust their cooking and consumption patterns sacrificing their own meals for the male members of the family. Women's work in agriculture and as day labor is very commonly seen as an extension of their domestic responsibilities rather than a separate economic activity. In rural areas, storage of food, collecting relief, water and fuel, caring for children, elderly people and livestock are more predominantly taken care of by women (Nasreen, 2012; Gokhale, 2008; Khondker, 1996; Fordham, 2003). The social role assigned to women as caregivers and nurturers naturally

extend to risk management to secure life and the continuity of livelihoods and maintain life support systems in times of disaster (Ariyabandu, 2003). The aid and assistance from different government and non-government organizations are not sufficient to meet up the needs of the family. Women make different handicrafts and mats (Azad, Hossain & Nasreen, 2013) to sell in the local markets along with livestock rearing, poultry, backyard gardening, floating garden (Anik & Khan, 2012; Irfanullah et al., 2008), and planting vegetables etc. (Ayers & Forsyth, 2009). Women work and contribute as volunteers, nurses, paid workers and as family members; also, they are taking the economic responsibility of the family in crisis. Women take on the role of preparing and storing food items which can be the source of energy and nutrition for the family for days at the time of disaster. Women ensure that their meager belongings such as clothing and bedding are stored so that they can be easily removed at the time of disaster (Ariyabandu, 2003). In the coastal area in Bangladesh, women are members of community-based organizations and participate in innovative livelihood programs initiated by the government and other organizations to build resilience. Bangladeshi women who live in flood-prone areas are trying to store seeds in high lands within the house and take livestock to safer places before the flood comes (Demetriades and Esplen, 2008).

The coping and adaptive mechanisms of women in the disastrous time in the coastal area of Bangladesh ranges from safety measures at home to decision making at the household, local, regional and national level (Arora-Jonsson, 2011; Kahn, 2005; Van Aalst et al., 2008). Women are being included in different disaster management committees at different levels of disaster and addressing safety measures at home, participating in community disaster planning, participating in awareness programs, construction skills, caring for vulnerable people, providing emotional support, assisting in relief distribution, etc. At the time of crisis, women take responsibility for looking after family, ensuring food, medicine, and household livelihoods, and demonstrating a proactive nature. While facing disaster, women gain knowledge and skill by using their own perspective and attitude as well as strategies to cope and adapt. Reasoning that women's risk reduction strategies are different from formal skills provided by different government and non-government organizations, agents, policies, and training, yet women play a vital role in minimizing their own and family losses (Pelling, 2011). Through everyday practices and activities, women exercise their coping and adaptive strategies. In Bangladesh, women's indigenous knowledge and innovative coping mechanisms play a crucial role in environmental management and the protection of their lives and livelihoods (Shah Alam Khan, 2008; Shamsuddoha, 2007). For instance, by composting

kitchen waste to produce soil-enriching fertilizer, women increased food security, planted trees around houses to protect strong winds, and selected fast-growing seedlings to make soils more stable (Mercer, 2007; Paul, 2010) in the quickest possible time. Enarson (2000) described that men go out of the locality with the onset of floods taking cattle to safe places. Women locate to high places and shift the utensils from their households. If water rises further, women bind trees with ropes and climb on with the children and elders for safety. By the time this eventuality takes place, hardly any men are left in the villages. Therefore, women have to manage with children and old people.

2.6 Women's struggle to cope with disasters

Poorer groups are more prone to natural disasters and vulnerabilities (Rashid, 2000). During disasters, women face problems to cope with climate change such as loss of possessions, increased domestic violence, unemployment, fear of extortion, and looting and isolation from networks (Alexander, 1998). During a disaster like a flood, poor people leave their houses for safe shelter, sell household assets to survive, and sell livestock. Sanitation becomes one of the major problems during disasters, especially for women and children. Due to the damage of the majority of the latrines, women and children are forced to defecate in their own homes, which sometimes puts them into shame (Rashid, 1998). The burden of collecting drinking water from distant places during disasters also shoulders on women (Wiest, 1998). However, women in Bangladesh have less access to disaster early warning.

In most cases, early warning is disseminated in the local market or in crowded places where male members have more access (Enarson and Meyreles, 2004). Research on disaster and gender studies shows it as one of the key reasons behind women's more prone to natural disasters and higher vulnerabilities. In addition, women and girls have less access to TV and radio from where they could get disaster early warning and take necessary preparations (Gwimbi, 2007). Enarson (1998) shows that women and girls are reportedly more exposed to sexual and domestic violence in disaster contexts. Women seeking shelter during cyclones are exposed to sexual harassment and assault. Nasreen (1995; 1999; 2008) argues that many women and girls don't go to shelter centers due to a lack of security. She also argues that biological problems during disasters become some great barriers for women; during their menstruation period, they suffer a lot for want of proper sanitation facilities, can't wash their menstruation rags, and stay in wet dresses because they can't make them dry. Moreover, in

case of the absence of the male counterpart, they fail to decide about shifting home to search for safe shelter. Moreover, the social vulnerability theory that discrimination also plays a major role in increasing the vulnerability of racial and ethnic minorities (Fothergill et al. 1999; Bolin 2006). However, Steward (2003) argued that women's financial dependence over men confines them inside the household and managing a household is regarded as their 'real work' which has not reflected in this study rather in a disastrous situation, women do take the responsibility of the family and go out to do income-generating activities which in other word is dual burden on the shoulder of the women.

2.7 Socio-economic and demographic context of women in Bangladesh

In Bangladesh, population size has been increasing continuously, although the annual growth rates of the population are declining. It may be noted that most of the population in the country is concentrated in the 15-49 age group and children less than 15 years and population over 60 years which constitutes the dependent population gradually decreased over the decades since 1981 (Habiba, 2012; Teitelbaum, 1975). In Bangladesh number of dependent populations has declined over the years for promoting education for all, access to health facilities, successful vaccination programs, ensuring pure drinking water, declining infant and child mortality rate for social and economic advancement, awareness about family planning issues, promoting the empowerment of women, gender mainstreaming, integrating gender issues in planning and budgetary process, strengthening women's participation in decision making, increasing employment opportunity for women, etc. The sex ratio (m/f 100), which reflects the difference in number between women and men, have improved significantly towards equality. It has been declined from 106.1 in 1991 to 100 in 2011. The decline is evident both in rural and urban areas. However, in urban areas sex ratio is much higher 126.3 in 1981 to 110.0 in 2011), because of higher rates of male migration compared to female migration. At the national level, 84.4% of the households were headed by men in 2011, whereas only 15.6% were headed by women (Habiba, 2012). There are fluctuations in the proportion of households headed by men and women, but overall male dominance prevails over time and is similar in urban and rural areas. On average, man-headed households were about five times more than women-headed households.

The literacy rate for women (7 years and over) had significantly increased over time, starting from 10.7% in 1961 to 49.4% in 2011, while at the same time literacy rate of men increased from 31.4% in 1961 to 54.1% in 2011. Concerted efforts and collaboration with different

development partners and organizations led to significant improvements in the adult literacy rate aged 15+ years. The adult literacy rate for women in an urban area in 2011 was 65.2% compared to the adult literacy rate of 44.4% in a rural area in 2011 (Habiba, 2012). The importance of nutrition to achieve optimal health is unquestionable. Balance nutrition is central to maintaining good health to fight against diseases and correct balances in the body that provide energy and enthusiasm for life. However, in Bangladesh, women are generally considered inferior sex in most rural families, but the government has considered women one of the human development indices. Despite remarkable improvement in the health sector over the last few years, malnutrition among women and children's maternal mortality rate is high in Bangladesh (Shahid, 2008). It is evident that the Crude Death rate (CDR) by sex at the national level was for men 6.2 compared to women 5.0 per 1000 population in 2010 and the same trends observed both in rural and urban areas (Habiba, 2012). Whereas WHO (2001) estimate that the morbidity rate for females is higher in Bangladesh than for males because of reproductive responsibility of the women, domestic chores responsibility, and stress for earning, which are likely to be more susceptible to health hazards than male counterparts (Begum & Sen 2009). While child mortality was higher for girls than for boys until the early 1990s, the gender gap disappeared and may even have reversed since the mid-1990s (Habiba, 2012). Under five child mortality rates halved over the last quarter of the century in Bangladesh, which was 144 per 1000 in 1990 but in 2015, it was 38 per 1000 while the target was 48 per 1000 in 2015 (Chaity, 2017). In Bangladesh maternal mortality ratio (MMR) has decreased from 6.48 in 1986 to 2.16 in 2010 nationally, with a relatively greater decline in the urban areas (Habiba, 2012).

Level of poverty of the society and individual is linked with the level of access to existing socio-economic opportunities, deprivation and inequality prevailing in the society. However, the poverty of the female in Bangladesh is manifested from the monthly average income, health status, nature paid and unpaid jobs, employment opportunities etc. Women are vulnerable to poverty since they are directly and indirectly discriminated against within the households, even in term of access and ownership of resources (Nawaz, 2009). However, the average monthly household income of the male-headed households was BDT.11763 compared to BDT.9725 for the female-headed households in 2010 which is 21% higher than female-headed households. Similarly, the average monthly expenditure of the female-headed household was BDT.8874 as against BDT.11346 for a male-headed household in the year 2010, which is 27.8 times higher than women-headed (Habiba, 2012). Empowerments of women that include involvement of women with social, political, educational etc. are increasing since 1971. For example, the

number of women elected in the general assembly of the country in 1973 was 4.8% of the total number of elected members, which have been increased to 19.7% in 2010. In the union Parishad's participation rate of the women was .47% as chairman in 2008 but as member participation rate 25.26% in 2008. The total number of chairmen in upazilla is also very poor and it is only .44% in 2009 and slightly increased to .63% in 2010 (Habiba, 2012). Participation of women in civil services in 2008 was 17.97% and 20% were in 2010 and proportionately, participation by women has increased.

Regarding role in decision-making, it is manifested that the husband undertakes 47% of decisions in respect to expenditure in the family and only in 32.6% of cases, the decision is undertaken jointly by the mother and other household members. But in the case of cooking food 50.9% of decision-making is done by mother and other members of the household 27.1%. In the case of intending health needs only in 5.6% cases, the mother can decide by herself to visit the health center for her own health compared to 39.1% by husband and 40.7% by joint decision (Habiba, 2012). In spite of the recognition of the equal right to all citizens irrespective of sex, religion, and caste by the constitution of Bangladesh, women are the most vulnerable section of the population to violence in Bangladesh. Violence against women includes rape, acid throwing, physical torture, dowry, etc. The trend of rape fluctuated over the years, sometimes increasing and sometimes decreasing. After 2003 the incidence of rape reduced in 2004, 2005 and 2006. However once again it is increased in 2007. In 2009 rape cases recorded show reduction at 2973 incidents but in 2010 and 2011, it started again to increase with the number of incidents 3367 and 3675 respectively. The rape violence situation is aggravating rather than improving. Women oppression in case of dowry 4061 incidents reported in the 2009 year, 5331 in 2010 and 7079 incidents occurred in 2011. The violence for dowry is gradually increasing over the period 2009-2011.

2.8 Gender relation in disaster in Bangladesh

In spite of rapid changes in the socio-economic and political situation in Bangladesh, women are still vulnerable during all sorts of a disastrous situations. Research findings show that Gender inequalities are exacerbated in the aftermath of disasters. Increased workload may force many girls to drop out of school. Women and girls are more likely to become victims of domestic and sexual violence after a disaster particularly when families have been displaced and are living in overcrowded emergency or transitional housing where they lack privacy (Evans, 2008; Kamal, 2018). The number of affected women in cyclone 1991 was much higher compared to men; among women aged 20-44, the death rate was 71 per 1000, compared to 15

per 1000 for men. According to IUCN/WEDO annual report, women and children are 14 times more likely to die than men during disasters (OKE, 2009). Although, Bangladesh has gained notable success in disaster management due to the proper plans and efficiency of the disaster governing bodies. Moreover, to achieve Sustainable Development Goals (SDGs) and mitigate vulnerabilities of women in disastrous situations, a gender-friendly disaster governing plan is needed to execute focusing on women's empowerment and decision-making capacity where women's role will be a partner.

2.9 Research Gap

In this chapter, the author selected relevant literature and published materials which helped the study to be examined under different contexts. While conducting literature review, the author came across a large number of both published and unpublished documents. The literatures were classified into four categories. ***First-*** is the academic literature mostly conducted by academics both from academia and outside of academia? ***Second-*** are the reports published by the government and also in a few cases commissioned by the government? Third is the NGO reports (both national and International NGOs) which are indeed useful, and these are based on the experience of working in the waterlogging affected areas. And finally, there are numerous reports in both print and electronic media that are illuminating to get a feeling about the extent and intensity of the impact of waterlogging on the population. The researcher has attempted to provide glimpses from all this huge body of literature.

From the literature review carried out under different sections, it can be concluded that while there are ample of literatures on natural hazards like flood, cyclone and waterlogging and its impact on women, the research works on exploring the impact of waterlogging through adding a gender lens in urban setting like DND areas which has a history of unplanned urbanization is rare and scarce. The socio-economic background along with adaptive capacity in response to the waterlogging disaster is quite different than what has been explained in the current literatures. Therefore, based on the research gaps identified through extensive literature review, this study was designed to explore the impact of a known disaster on a relatively unknown type of settlement and all the dynamics attached with extravagating the situation.

Chapter Three
Theoretical and Conceptual framework of Disaster and Vulnerability

3.1 Theoretical Framework

No research is neutral because they tend to reflect the values and priorities of the implementing organization in the research design or their impact on society coupled with other correlated things (Le Masson, 2016). At the same time, expected neutral approaches oversee their principal concerns and forget to address gender constraints faced in society and the reasons behind increasing existing disparities (Dankelman, 2010). Development Projects need to identify social variances, gender roles, social prospects and need assessment to adopt a gender approach. Moreover, the researcher aims to comprehend collaboration and connections of different ages, classes, religions, disabilities, ethnicity, and identity-based groups beyond the simple gender-based role and relationship. The objective of this research is to evaluate and find out reasons behind people's exposure due to the extreme impact of climate changes and long term impact of climate vulnerability along with the indigenous and local resilience is also being attempted to understand (Morchain et al., 2015).

The term disaster is highlighted differently by different disciplines- geographers explain the disaster to its connection to changes of wind of earth's plate or heavy rain due to sun's temperature, a disaster administrator will define in relation to ensuring proper relief distribution, a political official will define in relation to political significances, an economist consider on the losses to economic and sociologist on the severe danger to society to broaden knowledge. The systematic study on social aspects of the disaster emerged in the early twentieth century. Sociologists have taken an interest in disaster studies and are considered the leading pioneers and researchers in this area. From the earliest days of work, a relationship is always found between sociology and the study of disaster management (Killian, 1952).

Theoretical background is developed in this chapter to evaluate how gender relations, socio-demographic factors such as access and entitlements to resources, literacy, positionality, religion, patriarchal system, local social norms and practices etc. cause disproportionate vulnerability for women. The theoretical framework helps to get a formal mapping to conduct any research. This research has been designed to analyze women's role in disaster risk reduction

in Bangladesh. For the present study, several theories have been adopted to understand women's role in the DND embankment area to mitigate disaster risk. This chapter relates theories to examine the nature of vulnerability of women, coping and adaptation mechanisms, leadership of women. By reviewing the Marxist feminist theory, vulnerability theory and ecofeminist theory on disaster, this study has explored the discourse of disproportionate vulnerability, understanding of institutional practices such as patriarchal practices and hegemonic masculinity, women's leadership in waterlogging and related vulnerability management process and participation in the disaster management including social transformation and changes in the everyday practices of women's life livelihood.

3.2 Marxist Approach to Disaster

Disaster-induced vulnerability has a connection with political powerlessness and economic conditions of the people living in the society and this is well explained in existing Marxist literature. Common types of disasters, e.g., cyclones, earthquakes, waterlogging, tornadoes, or droughts, have adverse impacts on the poor, minorities and other marginalized people who are typically living in more disaster-prone areas with vulnerable disaster housing. Engels observed that industrialization had decayed the natural environment through the water pollution and air pollution (Engels, 1993). He further showed how modern capitalist production relation has devastated the environment and eventually made the people vulnerable (male and female) in terms of dwelling places, river, arable land, forest, or any other natural adversaries. On the other hand, the neo-Marxists stipulate that the western state is particularly accountable for and extending the consequence of disaster among the people living in the third world and under developing countries because the western world exploits their resources and produces cash crop as part of the capitalist mode of production. Even the status of peasants regarding their mode of production and destitution are forbidden to change due to the specific disaster relief management. The basic of Marxist theory on disaster is the form of exploitation of most disadvantaged of the socio-economic group including women in third world countries increases the frequency of natural disaster at the cost of socio-economic and physical environmental conditions. The three key principles of Marxist theory on disaster are:

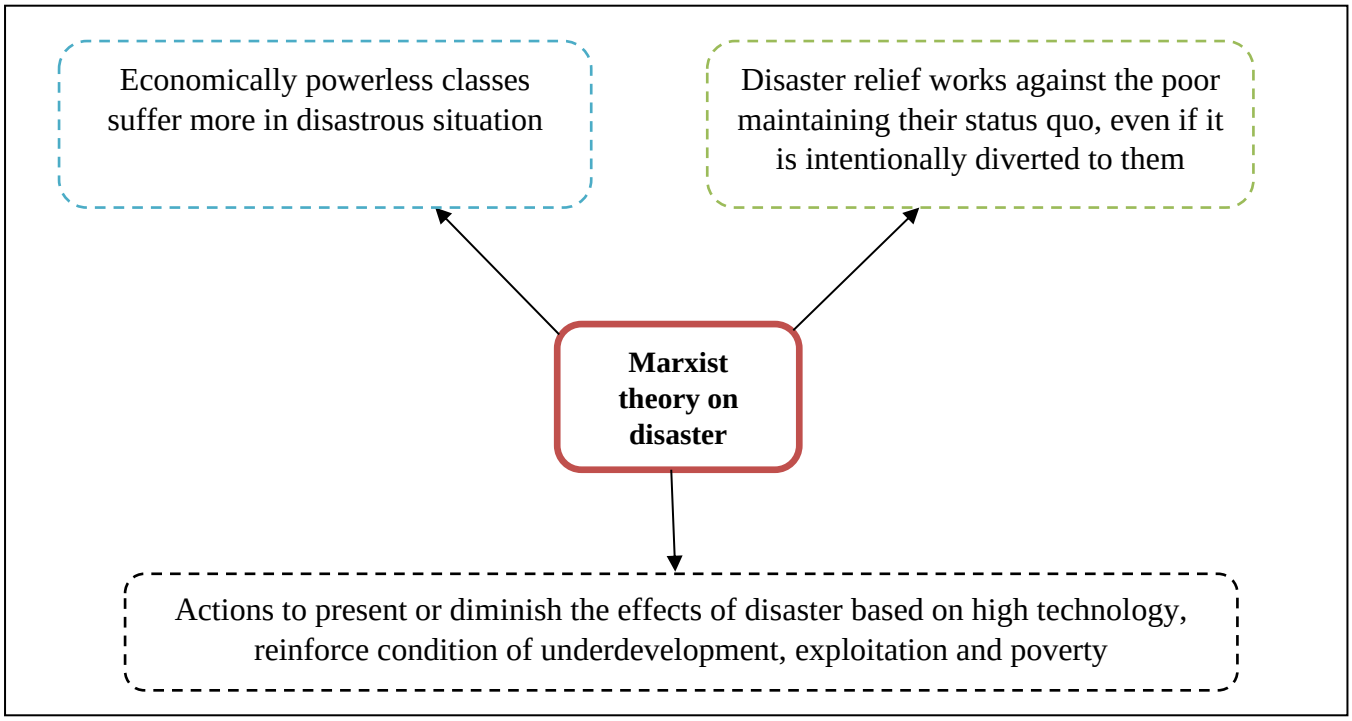


Diagram 3.2.1.: Key postulates of Marxist theory on disaster

Marx and Engels had studied the phenomena of disaster under the capitalist mode of production about 100 years ago from the perspective of relationships between men and nature, men and men, and men and women relationship which is in the context of disaster economies. The disaster occurred in human society is a natural issue and a socio-economic problem with the double attributes of nature and socio-economic. So, the Marxist approach studies disaster with special emphasis on socio-economic and gender phenomena to ensure human right in disaster to eradicate disaster-related vulnerabilities.

3.3 Theory of Vulnerability

While impacts of natural hazards on societies, organizations and people become unable to withstand is called social vulnerability. To this, they are exposed, is one of the dimensions of vulnerability. The potential to be damaged psychologically and/or physically is described as vulnerability. Resilience and vulnerability are always considered counterparties and are also studied as socio-ecological interlinked systems. Social vulnerability emerged as an important concept in most recent natural hazard and disasters discourse (Weichselgartner, 2001). Vulnerability theory on the disaster has two key principles:

1. Social processes and structure define the phenomenon of disaster and causes of disasters. So, no one can understand natural disasters as only geo- or biophysical hazards without accepting the social context where the disaster occurs (Hewitt, 1983).

2. A different group of people living in the same society may show similar exposure to hazard but capacities and abilities to cope with the impact of hazard of these groups may vary based on the resources available to them.

From a structural point of view Hewitt defined vulnerability as, "the human space of dissemination of influence in political organization and communities embedded to the geography of settlements of lands and ecology of endangerment" (Hewitt, 1997).

In contrast to Hewitt (1997), Blaikie et al. (1994) defined vulnerability as the ability to resist, cope with, and recover from the impact of natural hazard and the capacity to anticipate a group or individual. In addition to this, vulnerability also considers ways to measure how much a person's livelihood is at risk by a distinct and distinguishable incident in nature or society (Blaikie et al., 2014).

3.3.1 Disaster and dynamics of social vulnerability

Although considerable research attention has examined different components of biophysical vulnerability and the vulnerability of the built environment (Mileti, 1999), we currently know the least about the social aspects of vulnerability (Cutter et al., 2003). Socially created vulnerabilities are largely ignored, mainly due to the difficulty in quantifying them. Social vulnerability is created through the interaction of social forces and multiple stressors and resolved through social means. While individuals within a socially vulnerable context may break through the "vicious cycle," social vulnerability itself can persist because of structural — i.e. social and political — influences that reinforce vulnerability.

Social vulnerability is partially the product of social inequalities—those social factors that influence or shape the susceptibility of various groups to harm and that also govern their ability to respond (Cutter et al., 2003). It is, however, important to note that social vulnerability is not registered by exposure to hazards alone, but also resides in the sensitivity and resilience of the system to prepare, cope and recover from such hazards (Turner et al., 2003). However, it is also important to note, that a focus limited to the stresses associated with a particular vulnerability analysis is also insufficient for understanding the impact on and responses of the

affected system or its components (Mileti, 1999; Kaperson et al., 2003; White & Haas, 1974). These issues are often underlined in attempts to model the concept.

3.3.2 Vulnerability Model

The Risk-Hazard (RH) model (diagram-1) shows that exposure and sensitivity are considered functional catalysts on the hazard. In this model, hazard is considered a result of chain sequence where the vulnerability has great impact on sensitivity and exposure of the victims/people to the disaster. Another well-acknowledged model of social vulnerability is the pressure and Release (PAR) model.

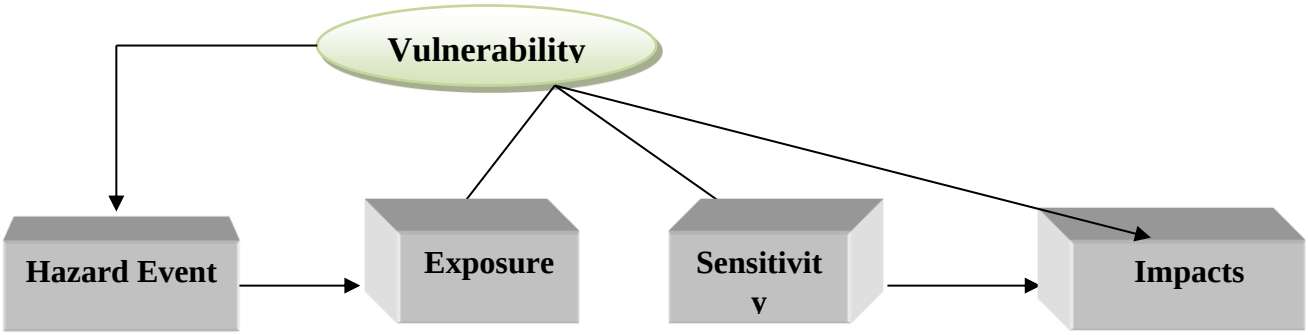


Diagram 3.3.2.1.: RH model (Source: Turner et al., 2003)

3.3.3 Pressure and release (PAR) model

The pressure and release (PAR) model show how vulnerability progress and impacts on disaster. The diagram (**Diagram 3.3.3.1)** it's shown that there is a connection between physical exposures to natural hazards (on right side in diagram) and socio-economic pressures (shown on left side).

Simply the PAR model of disaster is the evaluation of the interrelation of two components – Physical exposure to natural disaster and socio-economic pressure a person or a group of people face in a society. The degree of stress, agitation of vulnerability and likelihood of exposure of the vulnerable group are combined together to explain the Risk of disaster (Blaikie et al., 1994). Following this people's vulnerability increases with the increment of these exposure conditions. The model highlights variations of the vulnerability of people by different underlying causes such as ethnicity of people and social class. This model is usually used to address people facing disaster-related events in community. The model works identifying and varying among three components from social perspective.

A. Root cause
B. Dynamic pressures
C. Unsafe conditions

And these above three components together impact on natural hazards and increase further vulnerability of people. The three components have various subgroups – Political, demographic and economic processes belong to the first group known as Root cause. This highly impacts the proper distribution of resources and allocation of the resources among groups to strengthen their coping strategy. The second component is a combination of political processes and economic status in local circumstances – for example, the migration patterns of a community. The third component is the unsafe conditions where specific form of vulnerability increases based on time, subject and place and is pressured by local economy and physical environment (Blaikie et al. 1994).

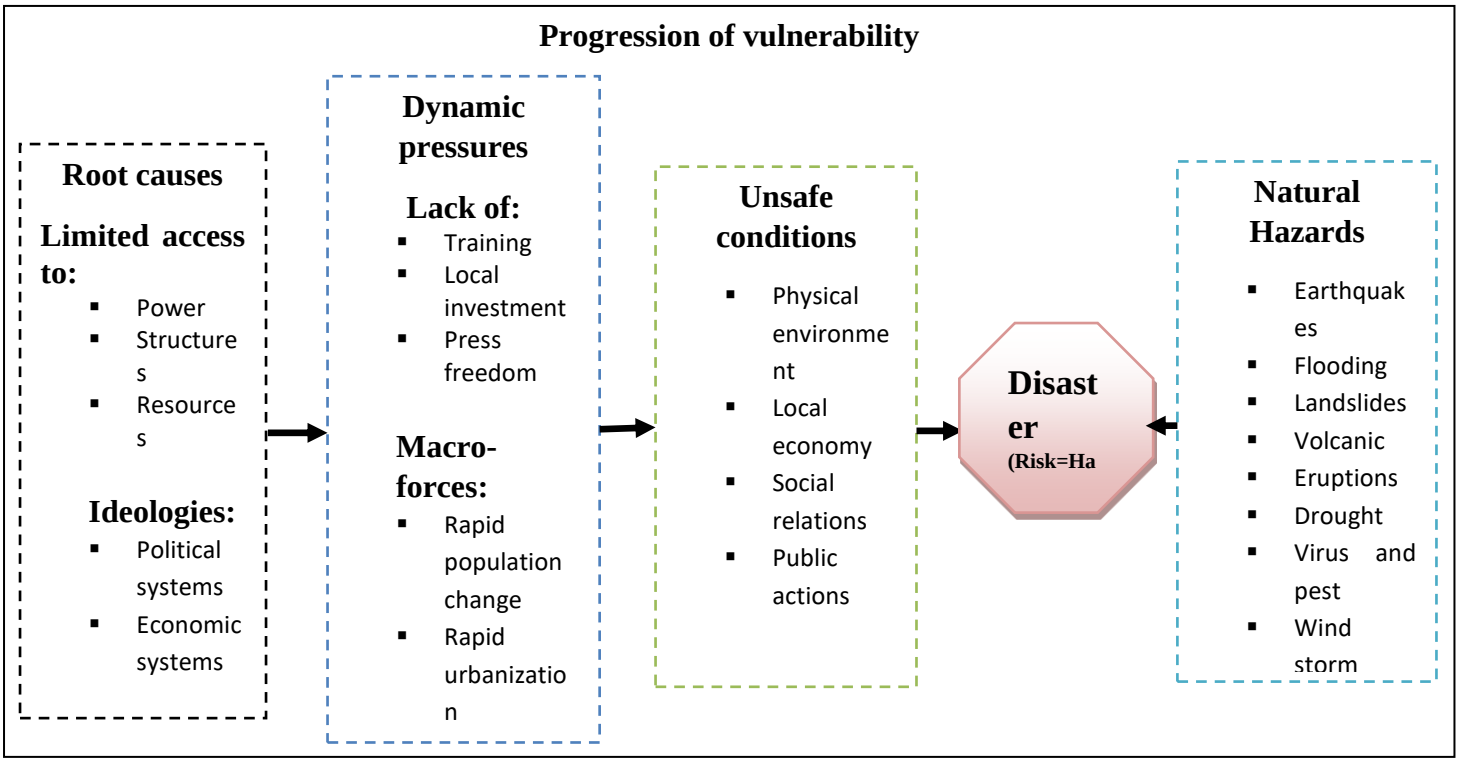


Diagram 3.3.3.1: PAR model (source: Blaikie et al, 1994)

To ensure great sustainability, the PAR model seems inadequately inclusive, although the model clearly emphasized vulnerability (Turner et al., 2003). At first, the model failed to point out the combination of the human environment and susceptibility as of biophysical subsystem (Kasperson et al, 2003). And in second, the model did not work much on the causal order of

hazard structure. Finally, where the HR model incorporated results beyond the analysis system, the PAR model seems to ignore those (Kates, 1985).

3.4 Ecofeminism

A few well-known feminists found there is a strong connection between feminism and ecology and jointly, this concept is called Ecofeminism. Ynestra King (1990) defined this concept as these two concepts of ecology and feminism commit to re-evaluating the existing connection between nature and humans, especially women. Although not only King, there are other theorists and lots of other approaches that tried at their own way to evaluate the correlation between nature and women. Ecofeminism being derived from feminism, share a similar diversity of feminism. Mechant (1996) defined the development of nature and human relationship in ecofeminism is strongly shaped by socialist, cultural and liberal feminism. But western style of theory that proposed a set of preconditions and necessary reasoning to develop a theory is rejected by many ecofeminists (Warren, 2002).

Women are found as close to nature as that of men. This theoretical approach is known as "Ecofeminism". In 1962 Rachel Carson in her book "The Silent Spring," first warned the people of the world to control their consumption of natural resources unless it will harm them. This warning has become true now. We are gradually facing natural disasters, global warming, etc. in an increasing rate. Ecofeminism not only shares the positive inter-dependency between nature and humankind but also tries to show the inhuman and dominating behavior of humans on nature and the role of women to extract out resources from nature. Ecofeminism driving concepts from feminism says that like patriarchal hierarchy and domination women and nature are also being oppressed and dominated. Because nature has been feminized and women have been naturalized and it is not clear to understand where and when the oppression of one ends begins and where the other one ends (Warren, 1991)

Women are considered as 'mother' and men as the 'lord'. Whatever men may do to nature; he may also do to woman. The core of Ecofeminism can be understood from d'Eaubonne's (1974)'s book, '*Le Feminisme ou la mort'* where he identified four core issues of Ecofeminism, they are:

1. Nature's oppression and domination over women is importantly connected.
2. The oppression to nature and to women could be understand through understanding the nature of connections between women and nature.

3. An ecological perspective must be included in feminist theory.
4. A feminist perspective must be included to find solution to ecological problems.

Another prominent Ecofeminist Simone de Beauvoir (1968) identified another connection between women and nature. She said that, like women nature give birth their offspring. So nature like women should take under extensive care (Letablier, 2009). Supporting this thought, Ortner (1981) also said, women's physiology is more involved with nature; humanity's future is being nurtures by woman's body. She also argued that women developed a mothering psyche by her own socialization. So, women are more like to nature than of men (Ortner, 1981).

3.5 Conceptual framework

To ensure the objectives of the study get proper focus and the study reaches its expected conclusion a theoretical framework is needed. A theoretical framework identifies the theory or theories used as the study's base, mentions necessary components of theories, and ensures the main opinions are citied properly. Generalization on observations and how far those findings are interrelated and consistent about set of new ideas and models are main job of using a theory. After formulating the theoretical framework, the researcher has to develop the study's conceptual framework. Symbolic representation of an abstract idea is considered as a concept. It is explained as "intertwined mental perception of observation and knowledge". If we consider conceptual framework as the practical implementation of a theory, then theoretical framework will be the base of the research (Chinn, 1999).

Compared to all other disasters, waterlogging has three parts – causes, consequences, and adaptation. So, the framework consists of three parts where the causes and vulnerability of women induced by waterlogging have been identified, and finally comes the adaptation strategies and/or role played by women to mitigate disaster caused by waterlogging. In addition to other studies on disaster and specially on waterlogging, the current study has explored ecological, economic, cultural and political, cultural factors which contribute to vulnerability of women. The current study aimed to explore the indigenous knowledge of women on disaster governance and enhancement of capacities to live in the changed environment in the study area. The interesting part of the framework is that in every part there are some issues or unavoidable circumstances that create barriers to the adaptation process for women and make the community turn back to the *waterlogging* situation. Cause and impact are vice versa because some cause becomes the impact or vulnerability and the impacts again flourish as causes of

waterlogging. Among the causes of *waterlogging,* some historical, political, environmental, structural, cultural and behavioral issues hamper the ultimate adaptation and management process of *waterlogging*. In impact part, there are some issues that hold back the adaptation process. Among the adaptation strategies taken by government, non-government organizations, or the community itself, some issues have been identified from empirical findings that hamper the sustainable development of the *waterlogging* prone community of the DND embankment area of Narayanganj. As long as the community will not be able to come out from those unavoidable, constant and obstinate issues, the ultimate adaptation or sustainable development will not come into sight, or the community will never get rid of *waterlogging* or live in non-*waterlogging* situation.

The conceptual framework of the study which is derived from the synthesis of selected relevant theories is placed below:

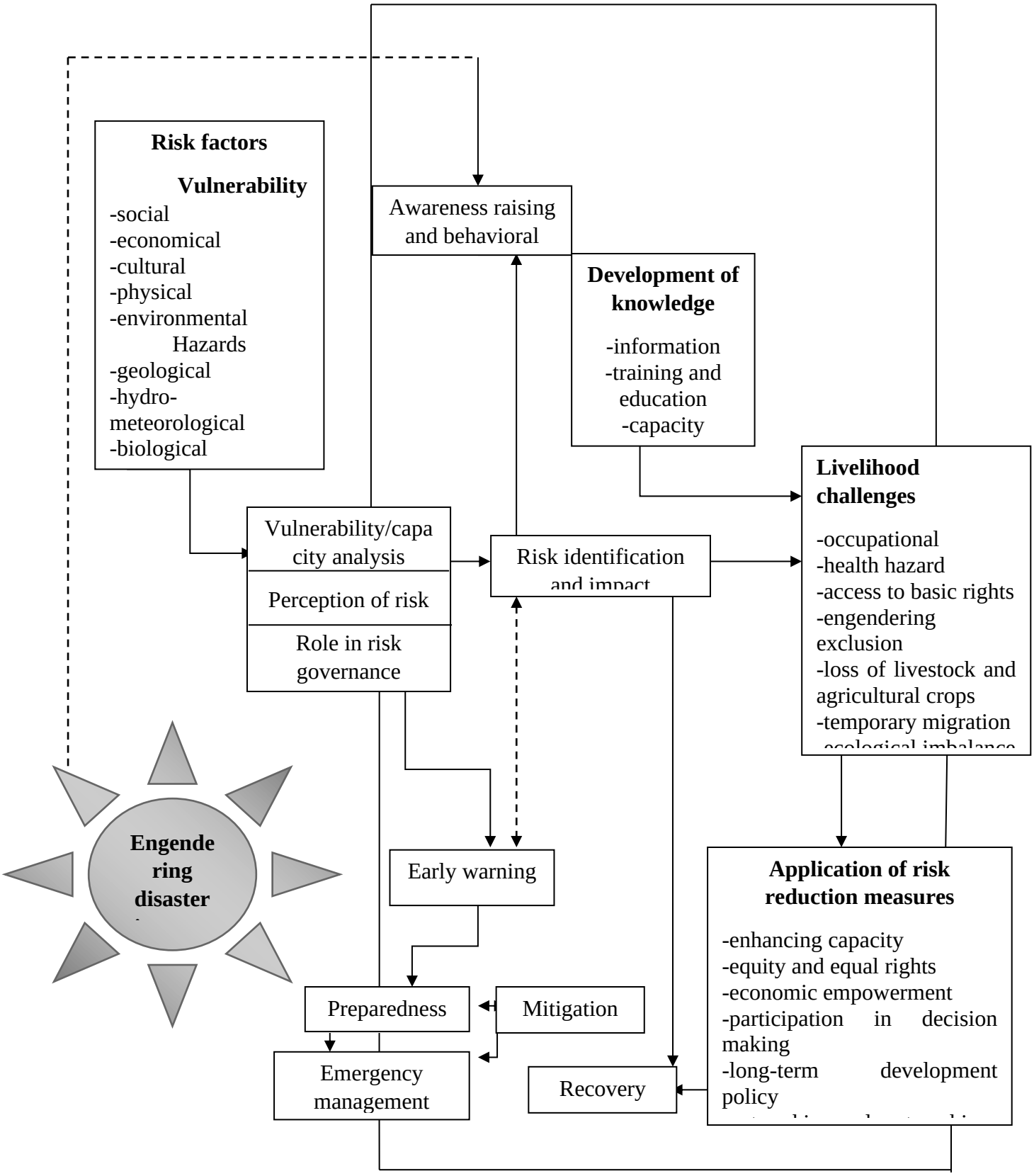


Diagram 3.5.1.: Conceptual framework

Chapter Four
Methodology of the study

This chapter discusses the issues related to methodology of this study such as how the data were collected, what are the techniques of data collection, selection of the research site and how sample design is structured, access to sample population, the variables selection process to measure the development of research question for this study and the research intended phenomena. This is also elaborated how the total designs of the study has been applied in research settings, justification of mixed method, techniques to analysis the data, the problems of the field research, limitations of the study and how the limitations have been overcome to obtain reliable and valid data.

4.1 Methodology

"Having the right knowledge on how to design good research is a half part of social Research. The rest half is how and when to take necessary field note, interviewed data analysis, using practical skills on lay outing questionnaire, accessing historical archives and the way to get cooperation from an interviewee" (Gilber, 2009). Donors and government agencies have conducted a good number of Waterlogging related studies over the last couple of years in Bangladesh. These studies are mainly based on secondary data, methodologically. But, there are questions about the authenticity of those data. Most of the studies on Waterlogging have been conducted on an exploratory basis. The methodology is the best way to help us understand a research process to make it transparent, and guides us to develop strategy, action plan, logical grounding context designing, developing assumptions, rationale and criteria for the study. Methodology also indicates the type of methods planned to use by the researcher in the study. (Silverman as cited in Phellas, 2006). Basically, it is a systematic presentation and analysis that helps to understand why the expected research has been taken and how it characterized the research problem, what categories of data will be collected and the specific methods implemented, the reason behind using certain techniques to data analysis and other correlated group of questions are clarified concerning research problems or study. This study has been conducted by doing a methodological triangulation with a mix of qualitative and quantitative methods to get insight into the gendered dimensions of waterlogging and vulnerability for deductively and inductively building theory related to these particular issues.

4.2 Research Philosophy

Research philosophy has a substantial role in determining the ways and means of conducting the research. The topic and approach the researcher would adopt in research is determined by research philosophy. There are three types of philosophy from the research point of view - realism, interpretivism, and positivism -which has been presented in the following: Positivism plays a significant and most important part in rationalizing theories for which it has to depend on testing. There is no scope for it to provide any wrong impression about the readers. Therefore, there has a strong authority over the study. Realism has a close connection with epistemology, which is relevant to scientific theory. On the other hand, in interpretivism, it is quite natural that there is a differentiation among the people, and research is conducted accordingly with an emphasis on attitude of the people. Interpretivism has strong stress on public as well as the ways and means of interpretation and a general sense of actuality. Interpretivism does not completely scrutinize the truth and the means. Realism may be the mass of mutually positivism and interpretivism among three types.

4.3 Rationale of using Mixed-Method Approach

Blending two original research methodologies – namely quantitative and qualitative data collection methods and analyzing them as a single new methodology is widely known as mixed-method research (Cresswell, 1999).

This mixed method of social research uses both methods concurrently or sequentially collected data. In one or more stages of data collection, both methods may get integrated to ensure a better data collection. (Cresswell et al. 2003). Though there are numerous arguments and debates against considering the mixed method as a separate social research design (Cresswell et al. 2003), this method is very useful and effective in determining the discourses of waterlogging, gender, and vulnerability in the DND area in Narayanganj. For a better understanding of waterlogging, gender relation, gendered vulnerability and changes in daily practices in the DND embankment area of Narayanganj in Bangladesh a mixed method-methodology research design was chosen. Mixed method will be able to discover develop knowledge on particular phenomena to get insight and in-depth information even in the case of some gender-sensitive issues. The quantitative data of this study has been collected using a survey method with a semi-structured questionnaire from women of the study area. For qualitative data collection, Focus Group Discussion (FGD), case study, and Key Informant

Interview (KII) have been used for different group of people with combination of women of different agro group and occupation.

Quantitative tools sometime fail to get the in-depth information, particularly those are sensitive in the context of societal norms and respondents do not feel comfort to answer in the face-to-face survey questionnaire. The forms of vulnerabilities, nature of gender discrimination, violence, local politics, forms of deprivation, local practices, and masculine attitudes etc. could be understood better through a qualitative lens. Application of mix method/triangulation helped better to generate applicable knowledge from this research that is applicable for better planning for the people of the waterlogging prone area. Focus Group Discussion (FGD) and case study with different stake holders and members of different committees as qualitative tool was very effective to get insights and in-depth information on gender sensitive issues and also to have views of men regarding gender relation, gendered vulnerability and changes in practices.

- How do the disproportionate distribution and absence of entitlements to possessions and wealth put women into more vulnerable and inferior conditions?
- What are the institutional/formal practices available in local area which causing unequal vulnerability for women?
- What is the nature of involvement and participation of women with decision making process at family and community?
- Are there any changes in attitudes and local practices due to waterlogging toward women?
- What are the coping and adaptive mechanisms taken by women and girls to mitigate vulnerabilities or possible vulnerabilities caused by waterlogging?
- What are the gendered impacts of waterlogging and women's vulnerabilities?

These questions can be better assumed by elaborating the flow of information and getting information from both male and female of the coastal community. Methodological triangulation/mixed method allowed me as researcher to cross justify the reliability and validity of inquiry and it is not just matter of anticipation. Mixed method was chosen for this study, keeping in mind the nature of research questions and culturally sensitive issues. By using mixed method reliability and validity of the data has been ensured and also, The author has emphasized the elaboration of the range of features are important to be in consideration to evaluate and illuminate observed behaviors and social relations in the field. (Nasreen 1995).

4.4 Study areas

4.4.1 Overview: Bangladesh

Bangladesh a land of rivers geographically located in 20°34'-26°-38' N latitude and at 88°01'-92°41' E longitude and total land for the country is 147,570 sq.km. The country is surrounded by India and a little portion by Myanmar. The southern part of the nation is boarded by the Bay of Bengal.

The sediment of three mighty rivers Ganges (Padma) Meghna, and Brahmaputra for thousands of years gradually built this low-lying delta currently known as Bangladesh. There are more than 310 officially counted rivers in the country which fertilizing the nations land to produce crops. The country has all the three types of land sights – hills, Pleistocene high land and the plain land. Cox's bazar in southeastern part of the nation has worlds the longest sea beach which is about 120 km long. Bangladesh has six seasons but highly characterized by tropical monsoon with rainfall, humidity and high temperatures. Dhaka is the capital of the country and 98% people living in the country and considered as Bengali. As of 2019 there are 163 million people living in the country and among them 90% and Muslims, 0.3% are Buddhist, 0.2% are Christians and 9.5% are Hindu. Its density of population is 1,106/km^2 (Botswana, 2014). Bangladesh is liberal progressive country with ethnic, linguistic and religious diverse. Bangladesh is administratively divided into 08 divisions, 64 districts, 492 upazialls and 4,554 union parishad 87,310 villages and its population growth rate is 1.34% per year (Shahid, 2011).

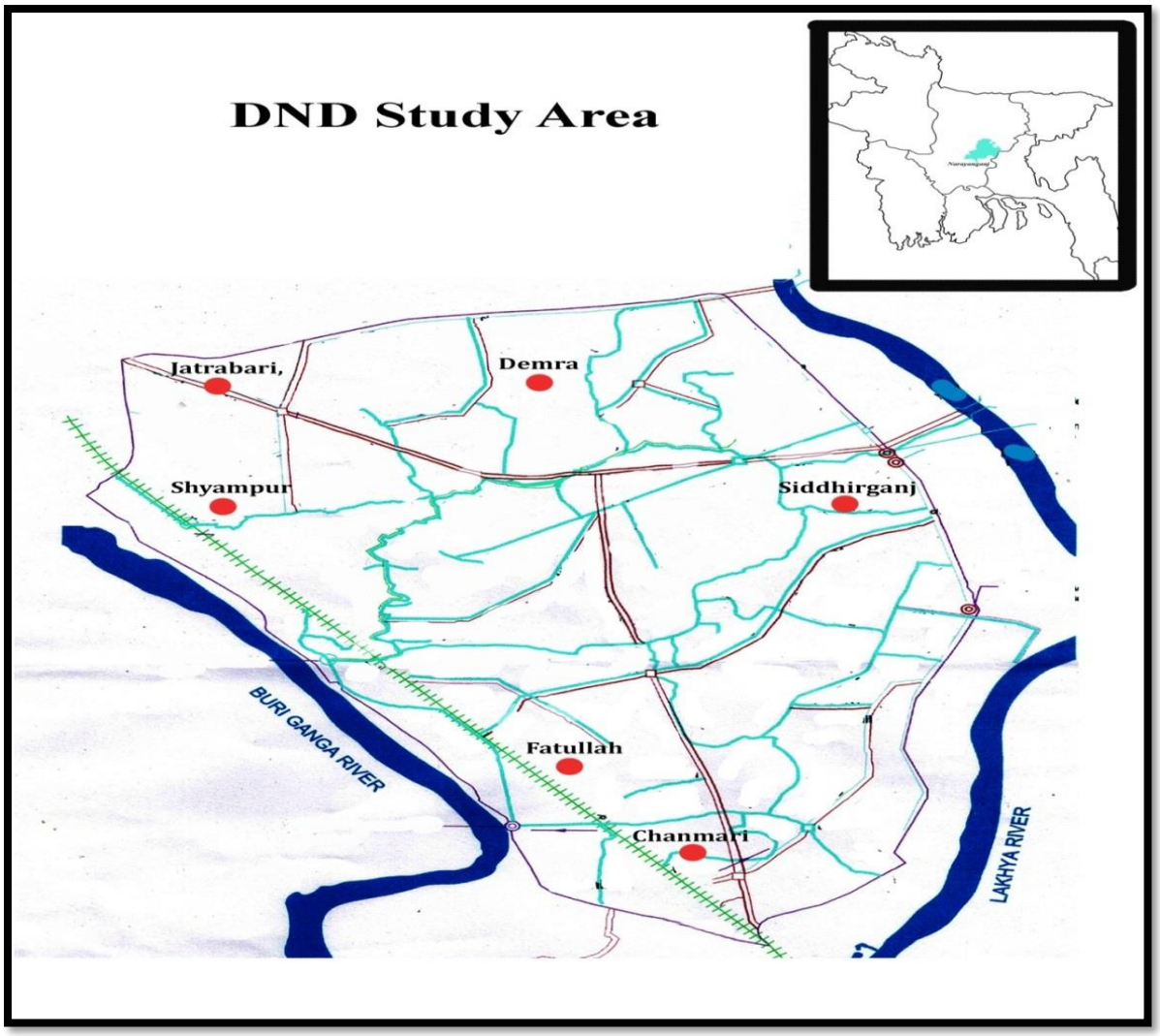
4.4.2 Overview of the study areas

To save Dhaka and Narayangonj from flood water of Buriganga and Shitalaksha River a dam was built by these two rivers and named the project as Dhaka-Narayangonj-Demra project. The project cost 22.9 million taka and it took 6 years to complete in 1968. The project saved 4,860 hectares of land and provided irrigation to 6,070 hectares of land as well with a dual-purpose pumps. The pump is situated in Shimrail and its capacity is about 4.2 cusec. The embankment covered Fatullah and Siddhirganj thana of Narayanganj District and Demra and Kadamtuli and Shyampur thana of Dhaka district. The main components of the project are 31.25 km road cum-flood control embankment, for irrigation canal 55.20 km long canals drainage canal is 45.40km a small 1 km long intake canal with 216 number of flood control structures are in there. The project supplies irrigation water to the area from December to May and control floods other months of the year. This area is originally a low-lying land has an elevation of 2.0 to 2.5m PWD. But the project could not save 4 natural canals out of 5 active natural canals in there.

Only 1 natural canal is active in there. Rest of the canals are now dead due to filling up or encroachment.

Although the project has been considering as one of the successful projects since it's started its operation on 1968 but due to lack of proper maintain and extension of the project its now a thorn in the throat due to extensive waterlogging. The original objective of the project was to ensure flood control and irrigation to agricultural land. But in last 5 decades the agricultural lands turned to unplanned urban and industrial zone with lack of proper drainage system and other urban facility. With a 15% of increment at every year the area is now a habitat for more than 3 million of people and by 2030 the population of this area will be about 5.5 million along with similar extension of industrial activities.

The current study has been conducted in DND embankment area situated in Narayangonj City Corporation of Bangladesh. We purposively selected the villages, namely *Bottola, Sidhirganj, Mouchak, Madaninagar, Fatullah* Railway Station, and *Chasara Railway Station*. The reason behind selecting these villages as sampling points is that the existing literature and the piloting study to finalize questionnaire along with the observation the researcher suggest that, these areas are the most susceptible to waterlogging disaster and the people of these area are vulnerable due to multiple problems and are at higher risk than any other communities in that area. It is mentionable that, before selecting the area of study, the researcher had visited the area numerous times to have informal discussion with community people and gather knowledge about the vulnerabilities. In addition, the researcher also gathers information from formal and informal leaders, women of the study area, school teacher and published articles. However, there was no mentionable spatial variations found while selecting the area or even from the findings of the study.



Map 1: Map of the study area

4.5 Population and sample of the study

The 'universe of units' (Bryman, 2012) for this study for quantitative data was only females who have experienced and affected by waterlogging. Semi structured questionnaire has been used in this study as tool for collecting quantitative data. Data was collected from groups with varying socio-economic, political and cultural and professional status. Participants of this study were purposively selected in this study from the affected family members. A brief overview of study areas has been given below:

Demra Thana

Demra Thana (Dhaka metropolitan) area 19.36 sq km, located in between 23°40' and 23°45' north latitudes and in between 90°27' and 90°31' east longitudes. It is bounded by khilgaon

thana on the north, Narayanganj Sadar upazila on the south, Rupganj and Sonargaon upazilas on the east, Kadamtali, Jatrabari, Sabujbagh thanas on the west. This area consists of a total of 226,679; male 121,805, female 104,874 (BBS, 2011).

Fatullah

Fatullah is located on the southern outskirts of Dhaka, in central Bangladesh. Fatullah Union Males 108,669, Females 97,757.

Name	Status	Population (2011 census)
Fatullah	Union	206,426

Shyampur Thana

Shyampur has a population of 109,333 according to Banglapedia. male 62186, female 47147. Average literacy 65.36%; male 68.0%, female 62.03%.

Siddhirganj

Siddhirganj, is one of the oldest industrial cities of Bangladesh. It is located in the bank of Shitalakshya River, Narayanganj. Total Area, 22.71 km^2 (8.77 sq mi) and total population 256,760 (BBS, 2001).

In this study each household was considered as a sample unit and from each household only one respondent was interviewed. Prior to data collection it was decided to interview approximately 400 respondents by semi structured questionnaire and was supposed to be changed in the total number of respondents depending on the time frame, funding etc. The researcher interviewed 15 years and plus respondents to match with nature and objectives of my study. The total number of respondents, FGD and case study and KII was fair enough for the purpose of the study because the population of the study area is homogenous in terms of their occupation, religion, education, lifestyle, disaster experience etc.

On the other hand, for the purpose of qualitative data a total number 6 Focus Group Discussion (FGD) and 25 case study, 6 Key Informant Interview (KII) has been conducted among waterlogging affected young women, mothers, elderly women and household head female. The venue and the time for Focus Group Discussion were not fixed. Number of participants in FGD ranged between 6-10 female. The participation of the Focus Group Discussion participants was

ensured with the consent of both the participants and guardians or head of households. Participants had total freedom regarding participation and they attended intentionally since they knew the time and venue and they decided whether they will participate in the discussion or not.

4.6 Quantitative methodology

4.6.1 Quantitative data collection techniques: Face to face interview

Data collection and filed work of this study has been collected directly by the researcher with the assistance of two female research assistants. One of the female research assistants was recruited from the local area with an aim to make clear any problem raise for any Bangla question since local female research assistant knows local dialect. Both of the research assistants were trained up and informed details about this study including research objectives. The research field was carried out approximately for fifteen months. Pre-test and orientation of the research and research teams with the community, consultation program with the community people, network and rapport building with the local community etc. has been within the fifteen months' time frame.

4.7 Pre-test/Pilot study

One significant way to check the sequence and significance of questions, aptness of the language is pre-test or pilot study. A pilot survey was done with non-sample similar respondents in Chashara Railway Station, Chashara, Narayanganj of the same DND embankment area using a draft semi-structured questionnaire approved by the Human Ethics Committee (HEC). After conducting pilot test, few questions needed to be changed, withdrawn or included in response to the demands of actual needs of the field respondents. The pilot study assisted to finalize the draft questionnaire and provided opportunities to include necessary new questions. Based on pilot study feedback, the researcher prepared final survey interview questionnaire and got approval from HEC and supervisor. Then, the author translated the final questionnaire in Bangla, native language of the research area. The survey questionnaire was addressed to climate change, disaster, waterlogging gender and vulnerability and was divided into different sub-sections such as socio-demographic characteristics, disaster, women's perception on the impact of waterlogging, women's contribution to disaster risk reduction, and other information regarding women's livelihood, disaster and women leadership, indigenous coping mechanisms and possible solution of the problem. Research assistants were asked to ensure freedom for respondents to answer questions and if respondents like to withdraw amid

of the interview, they could quit that but that has not happened so much because of good relationship with the respondents and for local female research assistants. We tried as less as possible to be disruptive to respondent's everyday lives and we talked with the respondents wherever they were working. However, before getting into interview with a respondent, interviewer took consent of the respondents and signed a consent form prior to interview. The researcher is thankful to the interviewee as they were very patient and provided us necessary time from their daily busy schedule. However, all the face-to-face interviews were conducted at the house of the participants where they could feel comfort.

4.8 Statistical procedure to analysis quantitative data

Data analysis stage incorporates several elements, and the raw data has to be managed to establish whether there are any obvious flaws such as failure to answer accurately (Bryman, 2012). Analyzing data is an elaborate process of reducing raw data into concepts by transcribing, thematic analysis, coding data, writing memos, diagramming and process of application of statistical techniques by computer in order to see what they can say about the research questions and hypotheses (Neuman, 1997; Punch, 2005; Bryman, 2012). In the field, the research assistants were instructed to write short note if there is long answer and opinion and anything interesting from the respondents to avoid any discomfort and boringness of the respondents. Each night after coming back from the field, the researcher sat with research assistants to know their experiences in the field and for data cleaning and fresh for detecting and removing errors. While the closed questions were pre coded and the code number has been fixed after pilot study. The answers to open ended questions were coded at the end of the field research. All open-ended answers has been written separately against each questions and consequently sorted out and matched to the different categories of answer with other to minimize the categories of answers. Once the researcher has sorted out categories for open ended answers then the researcher has broken down the component and was given labels for coding on the basis of the interpretation. To analysis and interpret the coded quantitative data, the researcher used IBM Statistical Package for Social Sciences 17.0 (SPSS) in this study. The author has presented result of the study with the theory and have showed dimensions of relations between variables through descriptive quantitative analysis such as graphs and tables.

4.9 Qualitative methodology

4.9.1 Background and description of qualitative study

Focus Group Discussion (FGD), Key Informant Interview (KII) and case study were conducted in different convenient places including household, social club which is situated in a place that termed by the community people as ***Mor*** (a common place for all for gathering at leisure time) or in a common place where people meet each other and in the houses of the local leader and interviewee. Time for FGD, case study and KII were fixed based on convenient time of the respondents. For case study, we visited respondents in their household, working place and sometimes at neighbor's house. In addition, KII was conducted at municipal office, school and at respondents' home.

All the participants in the qualitative part were female. We had separate checklist for every individual component. Likewise, the quantitative data, we piloted the qualitative data collection guidelines with non-sample participants of the DND embankment area. Based on the findings and feedback of the respondents we added and deleted some questions.

4.9.2 Recruitment and description of qualitative study participants

The researcher contacted participants in person to recruit for FGD, KII and case study. Then, the researcher talked with local community leaders (both elected and non-elected) and explained the significance of the objectives of the study. The purpose of talking with community leaders was not to make the participants biased but to minimize socio-cultural and religious stigma. Thereafter, the researcher met participants in person and described the objectives of the study and the significance of their participants. The researcher also ensured them about the anonymity and other ethical issues regarding participation. The participants were also informed about their freedom of not participating in the study. At the time of conducting focus groups discussions and interviews, the researcher tried level best to avoid any bias like political and gender. The participants were requested and allowed only to discuss the relevant issues in a naturalistic and conversational manner. Each focus group discussion lasted on an average one and half hour and was led by note taker and researcher acted as moderator followed the flow of conversation following the pre-set up written checklist. Discussion in focus groups are usually tape–recorded and then transcribed (Frith, 2000) and in this study discussion was tape recorded in two different digital MP3 player (to avoid technological difficulties and in case of failure of one) and transcribed using Microsoft Windows media Player and then translated from Bengali to English.

4.10 Data collection procedures and techniques

4.10.1 Focus Group Discussion Procedure

Focus groups referred to as ‘alike group interviews’ or ‘likeminded people discussions’ to gather diverse opinions, experiences, beliefs, feelings and attitudes and sensitive issues in unstructured format for the discovery of unanticipated issues and inviting participant to fix their own concern and agenda (Frith, 2000). For qualitative data, this study is based on Focus Group Discussion, Key Informant Interview and case study in the context of shared idea and experience among female of different stages of the community who had experienced the waterlogging in the coastal area of DND embankment Narayanganj.

Purposive sampling strategies were used to choose FGD participants that facilitated understanding of gender, gender relation, and gendered vulnerability in the study area. As part of the participatory approach for qualitative data, the researcher has carried out two focus group discussions with female-headed household, two with women involved in income-generating activities and two with the housewife.

4.10.2 Case study procedure

Case studies have been conducted in this study to give rich information on personal experience, ideology, social structure, and institutions (Plummer, 1983). In case study, respondents have more freedom to describe/discuss their own experience in the context of the larger society. The strength of the case study is that it provides precise and in-depth information because of the close and longer interaction with the respondents. This interviewing technique reveals own experience of the respondents explore self-presentations. Participants also provide life experiences, own interpretations and understanding about social mechanisms compared to past.

The researcher conducted case studies with a structured checklist. In the checklist, the researcher organized the questions into broad topics such as experience in daily life, climate change and natural disaster, impact of waterlogging, women’s leadership in society, role of women in coping with waterlogging, etc. sub-topics were prompted within each topic. Respondents were free to flow from one topic to another even the questions were organized sequentially. The researcher always steered the conversations to the research questions to ensure all interview areas were covered though it was difficult since the qualitative interview is driven both by the respondents and interviewers. Each case study was recorded with the prior consent of the interviewee. After each interview, the researcher checked whether each area has been covered or not! Theoretically, the duration of case study is between 1.5 and 2 hours, if

there is no time constraint for both respondents and interviewer. Even it can last longer significantly with a break at least every two hours (Weiss 1994). Twenty-five of my case studies were between 45 minutes and 1 hour. Research assistants worked hard and tried to conduct interviews in private places where no one could interfere and respondents will feel comport and secure to share sensitive issues and give thoughtful answers.

4.10.3 KII procedure

Key Informant Interviews or KII are usually mentioned as in-depth interviews with such people of the community, group or association who have in-depth information about the research topic (Tremblay, 1957). KII is known as an ethnographic research method (Marshal, 1996).

Key informant interviews provide a great opportunity to gather very useful information from a wide variety of people of the group, including regular residents, professionals, leaders, teachers, and religious personnel who are supposed to have direct information and knowledge about the community. This firsthand information and knowledge could be a great source for understanding ongoing issues in the community and possible resolutions to resolve those issues. One of the key advantages of KII is obtaining key information about the research topic as the knowledgeable person of the community give information (Marshal 1996, Kumar, K., 1989). Before conducting the actual interviews, we tested the structured guideline with non-sampled participants of the study area and modified the guideline based on the feedback of the participants; added some new questions and changed the languages of some of the enlisted questions. We interviewed the local community leader, school teachers (both government and non-government), local union parisad chairman, GO officials, and NGO officials. We interviewed GO and NGO personnel working in the study area on natural disasters, climate change, and waterlogging. We interviewed participants on the causes and consequences of waterlogging in the study area. Women's role as a leader to mitigate vulnerabilities caused by waterlogging with special focus on their indigenous coping mechanisms. In spite of their busy schedule, all the participants were interested in participating in the study. Beforehand the interview we informed them about the research objectives and the importance of their participation. We interviewed them at participants' working place and the duration of the interviews ranged between 40-60 minutes. All the interviews were audio-recorded with the consent of the participants except the executive engineer, Narayanganj City Corporation, Ministry of Local Government. Showing respect to his opinion, two research assistants took note during the interview.

4.10.4 Participant Observation

However, participant observation plays a significant role in developing a relationship among researchers and key informants, stakeholders and gatekeepers. Informal discussions have been made during the field survey. Participants have also lively participated in the discussion. The participant observation method helped.

4.10.5 Qualitative Data Analysis

To analyze qualitative data of this study, the researcher have used axial coding to narrow down the core themes of the thesis in light of research question and. The axial coding is a way to form accurate and comprehensive clarification on phenomena from different magnitudes and environments through relating parallel categories (Strauss and Corbin, 1990; 1998). Strauss and Corbin proposed that, coding and categorizing data are related to (1) cause and effect conditions (2) the phenomenon of study, (3) the context conditions (4) the intervening conditions (5) actions/interactions strategies (6) consequences. Basically, in this study axial coding has been used for qualitative data analysis since it simply helped to condense voluminous qualitative data (Corbin and Strauss, 2008). Moreover, some of the qualitative data has been dealt manually and presented in descriptive mode in this study. Audio tape recordings for focus group discussions, key informant interviews and case study of this study were transcribed and translated from Bangla to English and analyzed verbatim. Based on the written transcripts from audio recordings, categories (eight broad categories considering the research questions) and subcategories were generated based on the research objectives and research questions (Table below) for more precise and complete explanation. However, by axial coding techniques this study focused on socio-cultural, economic, geographical characteristics of the study area, women's vulnerability and underlying causes, vulnerability of female-headed households, access and entitlement to resources, impact of waterlogging on livelihood and women's involvement and participation and vulnerability, changes in local practices, and adaptive capacity and coping mechanisms, engendering waterlogging, and vulnerability. The researcher carefully and attentively read the transcripts to find connection between participant's discussion and research questions. There were blocks of information in the focus group discussion transcripts since the checklist for FGD, KII and case study were divided into different blocks. These blocks of the data were analyzed to discover themes which is termed as subcategory (Strauss and Corbin, 1990, 1998; Corbin and Strauss, 2008) such as impact on education, livelihood and business, migration of male members and vulnerability of women, disaster and health impact, waterlogging and vulnerability of female headed households,

adaptive capacity, coping mechanisms, resilience and women participation. Following this procedure for qualitative data, the researcher explored themes and patterns emerging from the data and incorporated with the quantitative interpretation which strongly bridged between quantitative and qualitative data and enriched the explanations of research findings.

Table 4.10.5.1.: FGD, KII and case study analysis following axial coding procedure

Core themes/Coding Category	Subcategory
Socio-economic and cultural characteristics	**Demographic information:** age, sex, occupation, education, religion, number of family member
	Economic: source(s) of income, monthly family income and expenditure, quantity of land property owned by the family, main earning member of the family.
Impact of the waterlogging on people's livelihoods	Impact on-daily activities, business or income generating activities, education and schooling of children, food security, health care services, cropping, livestock and infrastructure.
Engendering waterlogging	Access/entitlement to resources and properties, involvement with income generating, discrimination in wages, role in decision making, existence of community-based committee for women, dual work burden and unpaid labor, women's hardship in managing household chores, sanitation status of women.
Women's main coping strategy	Indigenous coping strategy, support from family members, support from community members, support from other organization, barriers to initiate indigenous strategy, possible way to resolve problems related to implement initiatives.
Causes of waterlogging	Level- individual, organizational, community.
Recommendation	Recommendation- to mitigate vulnerabilities caused by waterlogging in the study area, to mitigate vulnerabilities of

	women through indigenous coping mechanism, role of stakeholders in reducing vulnerabilities.

4.11 Validity and reliability of the data

Both reliability and validity concerns how concrete measures and indicators are developed to 'maximize the reliability and validity' of the study (Neuman, 1997; 2006). Reliability is essentially apprehensive with the issue of uniformity of measures of concept that involves stability, internal reliability and observer consistency. It tells about an indicator's dependability and consistency (Bryman, 2012). On the other hand, validity is concerned with the truthfulness and trustworthiness of the conclusion and findings that are originated and drawn from the research. In other words, validity is the condition of having really measured what one wanted to measure (Bryman, 2012). Reliability and validity of data collection are fundamentally concerned about competency of measures and this is no doubt is one of the most important concern in social research (Bryman, 2012). However, validity can't be achieved without the research first being reliable. Reliability and validity are key issues in any research project (Cresswell, 2007). This study has taken several steps to maximize reliability and validity of this study. This study has been conducted with the highest effort and careful attention to ensure and to keep up the consistency in the data and explanatory arguments. To maximize reliability and validity of the data in this study, the time of interview has been fixed based on the availability of respondents and the time they have given for interview. Also, the respondents had freedom to withdraw themselves from the interview at any time. Moreover, research assistants were asked to work till they feel comport. There was no target given them to fill up the questionnaire in a day or within a certain time. All research team members were used to meet in a certain place most likely was in local bazar or tea stall working after a certain time for refreshment and to know any problem or experience they have had. The researcher used to do surprise visits to the research assistants without any notice or phone call to ensure the quality of work and data to ensure reliability and validity of the data.

Though the threats to validity are numerous and not always controllable or even perceptible (Blalock, 1985), to maximize the accuracy and credibility of the data, the researcher applied methodological triangulation to verify information within this report. The researcher used to revise every day's data and checked the accuracy of survey findings with FGD; also used to

have an informal conversation in the field with community people following every day about the trend of findings of previous day what have been discussed in a group in the night. The researcher has confirmed and cross-checked several times of some findings with the community residents whenever the researcher doubted the reliability of specific data that the researcher heard from research assistants since complex nature of the social phenomena is just the starting bit of those threats (Blalock, 1985). In order to ensure higher reliability from FGD, audio recorder with the consent of the participants was used. The researcher was actively involved with this study in person in the research site. Prior to the final study, the researcher visited the study area and over the time, achieved ample experience to check the consistency, reliability and validity of the data. Experience of working in the research site for fifteen months in person, was helpful to find issues and concerns on factual occurrences.

4.12 Limitations and Validity Threats

There are number of limitations of this study. Prior to start data collection, the researcher had only some preconceived theoretical idea relevant to research objectives. The research assistants also had no in-depth knowledge about this field. Research assistants were trained up based on the survey questionnaire, FGD, KII and case study guidelines. As a result, they faced some problems while conducting interviews with the respondents and could not get right answer. Though research assistants were asked to call the researcher over mobile, sometimes due to network failure could not reach the researcher at the right time. Also, the respondents were uncomfortable with certain parts of the questions such as sexual content, male domination and patriarchal system contents, roles and responsibilities of the government and municipalities, etc. Survey respondents sometimes avoided answering some questions due to the presence of the male members of the households at home. Same experience we have had during focus group discussion. In the focus group discussion, participants avoided to response some sensitive issues, like responsibilities of the local government and politicization of waterlogging. Sometimes, respondents were accompanied by male members of the family to make sure whether we provided them with any financial assistance or not. In addition, male members sometimes tried to interrupt the respondents' answers. But while interviewing the respondents, other female members very often answered the question on behalf. The research assistants were trained to manage this situation technically.

The researcher was very much context specific since field work cost was financed by the researcher. Also, financial limitations forced the researcher to rush for completing field work

within given time period. Time limitation also forced to much focus on the research objectives. Since this study was much context-specific, this study may not be suitable to other countries and even in other regions of Bangladesh due to different biophysical, socio-economic, and cultural contexts. The researcher was concerned about the rapport and network that have developed with the community. The researcher always felt that rapport and network could be even better since better relationships provide better data though the researcher knew the culture and could use their accent.

To avoid irrelevant issues, the respondents and discussant were requested only to answer the relevant question, give their opinion, and share their experience. In the focus group discussion, many women participants felt uncomfortable sharing the experience involving health problems, exploitation and discrimination between male and female. Research indicated (Naples, 2003; McCorkel & Myers, 2003) that the positionality of the researcher such as gender, class, race etc. has high possibility to impact from development of study question, analysis of the question to presentation of the findings - in short the whole study procedure may be under question. One's social position influences the total gamut of research choices. This may negatively impact the researcher while he/she has been using his/her advantaged position in society. In this regard, we considered that our studying groups and respondents are in higher position (McCorkel & Myers, 2003).

There was also a geographical constraint of the study. Visiting the respondents' households was a real challenge due to water on the road and even at their living rooms. Sometimes, the research assistants experienced problems finding a suitable place to conduct FGD due to an inundated situation.

However, most of the respondents were working class who used to work in order to maintain their family. So, fixing the interview time was another problem for me.

Therefore, the only times the researcher approached the respondents and participants in the late morning and early afternoon were pick time for community people for work. Due to time constraints, some of the group might have been excluded from this research since they were only available late afternoon or in the evening. However, the respondents in the survey study, FGD, KII and case study had diverse backgrounds and education.

Academic background, field of interest and values of the researcher influence the finding of the research. For the researcher, a number of biases and pre assumptions play a significant role

in the research procedure that assumptions and biases come from the professional background, academic background and from future plan of the researcher. As a researcher, my previous experience and my future plan with the expertise on this particular issue have affected this study in many ways. Namely, the researcher believe that the socio-cultural and institutional practices in the traditional society of Bangladesh creating disproportionate vulnerability for women in Bangladesh during the disastrous situation. And, the researcher believe that disproportionate gendered vulnerability could be removed from the society if women are being evaluated rightly on their potentiality and if they get proper scope to utilize their merits. As researcher having preconceived such idea due to previous experiences might limit the objectives of the study to some extent.

4.13 Ethical consideration and confidentiality

Ethical consideration and confidentiality arise at various stages in social research, and the role of values in the research process becomes a concern (Bryman, 2008). The researcher took the ethical issues and values as seriously as possible and tried to give value to the community people's issues in my research settings. However, steps were taken to ensure participation of the respondents and discussants with their freedom, voluntary, well ahead informed, anonymous and confidential. The researcher obtained ethics approval from the Human Ethics Committee (HEC) of the University of Dhaka. Prior to commencement of the study all the participants has been informed about the objectives of the study and that all the information has been retained as the property of the researcher and must not be used for any other purpose except this study unless survey respondents, FGD discussants, KII and case study participants were given consent form. The information sought from the respondents and participants at their convenient time and that must be on a voluntary basis as well as there had freedom for the respondent to quit or withdraw at any time. The participants and local community accepted me warmly, trusted me as researcher and my research assistants. They have helped their maximum and in return, the researcher assured them that what goes in this research will not harm them anyway. To maintain their privacy and to gain faith, the researcher has used an alternative names and numbers of the participants and did not describe their appearances and did not mention any names in the report.

The consent to interview the women has been gained by arranging meeting with the community people since there are cultural barriers and restrictions for women to speak with outsiders. To gain trustworthy relationship with community people and head of household were very important as it influenced the women from the village to assist me with my research work. My

acquaintance with them frequently and for long time helped to build trust. Appointment of four female research assistants helped to collect data from the female respondents and to make the women feeling free to answer the questions. My research notes and questionnaire were locked and protected by password and only my supervisor had access to my raw data.

Data have been collected individually or in pairs. Gender and religious issues have been considered in arranging interview, especially for covering social issues in the least. Another important issue has been considered, and that is' the economic loss of the respondents, who spent time with me rather than their work. A frank discussion has been done with them. Sometimes, some compensations have been made for them, by offering food/drinks to them during the interviews and focus-group discussions (FGDs). Many NGOs have cooperated with us in working in the informal settlements. Special thanks have been given to the GO-NGO officials. Anything sensitive has not been quoted from the respondents without their consent during the field survey. The community has been informed about the findings which have been collected from the field survey. Besides, respondent's names have been changed in this thesis, their privacy are maintained. Finally, the research summary and findings would be delivered to the academic arena after completion of this research, by contributing to academic journals and to the public through newspapers and magazines in due course. Last but not the least, the study will ultimately represent a better understanding of the contemporary status of waterlogging in DND areas. The findings and the recommendations would be beneficial to offer some guidelines for reformulation of waterlogging policy in Bangladesh.

Chapter Five
Presentation and Analysis of Data

5.1 Socio-demographic information of respondents

All the respondents of this study were female. Findings of the study reveal that the mean age of the respondents was 33.2 year (Std. deviation 1.48). However, most of the respondents (35%) belonged to 20-29 years old. In addition, second highest numbers of respondents (21.9%) were between 30- and 39-years age group (Table 5.1.1).

Table 5.1.1. Age of the respondent

Age category(year)	N	%
10-19	53	13.2
20-29	140	35.0
30-39	87	21.9
40-49	64	16
50-59	26	6.6
60-69	19	4.8
70 and above	11	2.8
Mean age (in year)		**33.2**
Std. Deviation		**1.5**
n	**400**	**100**

Figure- 5.1.1 demonstrates the monthly income and expenditure of the respondents. The monthly family expenditure of the respondents ranged between BDT 1000 and 200000. Family expenditure level of most of the respondents was between BDT 3001 and 5000. In addition, 28.7% of the total respondents reported that their monthly family expenditure level was between BDT 5001 and 7000. In contrast, monthly income of the respondents ranged between BDT 1000 and 120000. Over 50 % respondents reported that their monthly income level was 10001 and above. Again, 28.1% respondents said that their monthly income level was between BDT 7001 and 10,000. The difference between the monthly income level as well as expenditure level shows that people of different income groups lived in the study area and were included in this study to explore their experience regarding waterlogging.

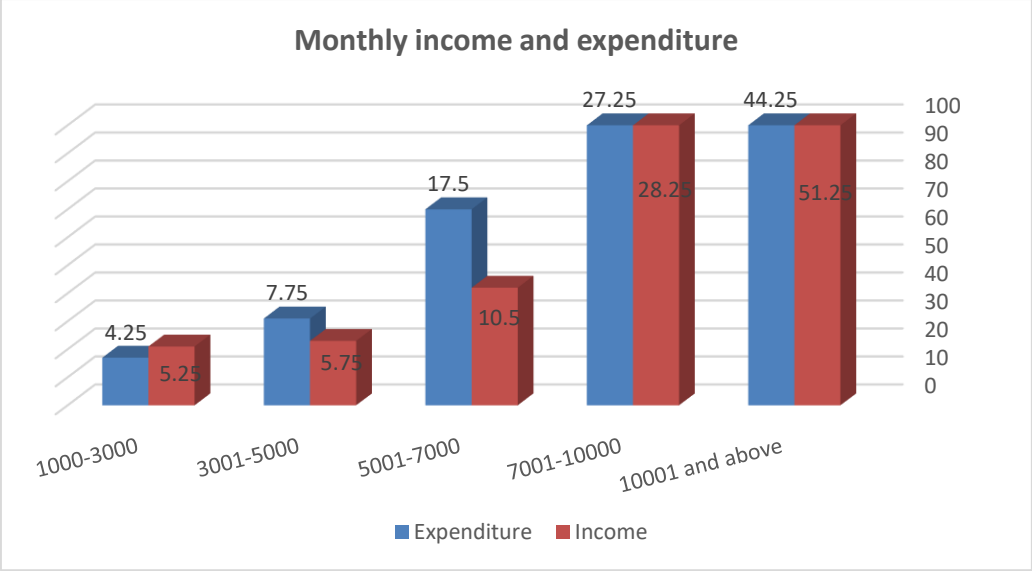


Figure 5.1.1.: Monthly family income and expenditure of the respondents

However, a total 25 case studies were conducted in this study. Four participants from four villages/ward and five from one village/ward were selected from rest of the village/ward. The participants who were apparently worst victims of waterlogging were invited to participate in this study. However, participants were purposively selected considering the objectives of the study. Mean age of case study participants was 30.4 years whereas the average duration of participant's living in the study area was 10.3 years. According to their description, most of the respondents came to the study area in search of work and consequently started living there. All the participants mentioned that waterlogging as the most common and frequent occurring natural disaster in their area. Besides, three respondents experienced flood almost a decade ago. Majority of the participants (44%) mentioned that they had four members in their family. In addition, 36% respondents had five family members. Rest of the respondents, 16% and 4%, had three and two family members consecutively. Nonetheless, out of 25 case study participants, nine mentioned that they were the main earning member of their family. In contrast, nine respondents reported that they also contributed to their family income along with their male counterparts. Furthermore, five respondents mentioned that their husband was the main earning member of their family. According to the description of case study the participants, majority of the houses of their area was semi-structured (semi *pakka*). They also added that the roof of the houses was made up of tin, the fence was made up of bamboo. Three participants mentioned that their house was roofed and fenced with polythene paper.

Findings of survey shows that most of the respondents (38%) resided in semi-*pakka* households (walls were made up of bricks, sometimes with tin, and roofs were made up of with tin). In

addition, respondents resided in *pakka* (building) and *kacha* (made up of thatch and bamboo) was 17% and 31% respectively.

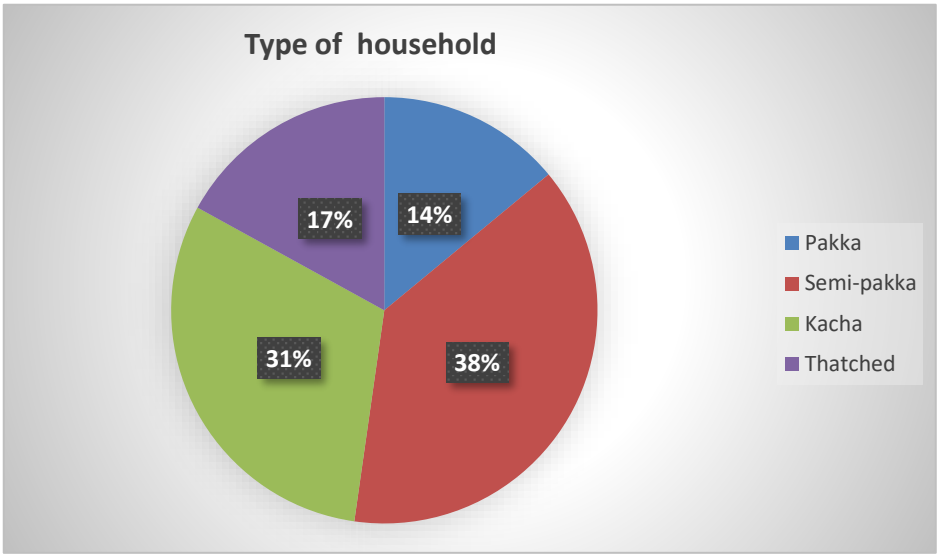


Figure 6.1.2.: Type of household

In addition, findings of the survey illustrate that most of the participants (94.0%) of this study were married. However, 4.0% of the total respondents were widow. Religious composition of the study area shows that a great majority of the respondents (99.5%) were Muslim. Majority of the respondents (76.0%) belonged to nuclear family. Furthermore, most of the respondents (70.1%) were illiterate. The percentage of attending secondary and above higher secondary was 9% and 8% successively (Table- 5.1.2.).

Table 5.1.2.: Socio-demographic characteristics of the respondent

Characteristics	N	%
Marital status of the respondent		
Married	376	94.0
Unmarried	7	2.0
Widow	17	4.0
n	**400**	**100**
Religious status of the respondent		
Muslim	398	99.5
Christian	2	0.5
n	**400**	**100**
Type of family		
Joint family	96	24.0
Nuclear family	304	76.0
n	**400**	**100**

Educational Status of the respondent		
Illiterate	281	70.1
Some primary	23	5.7
Primary	11	2.5
Some secondary	6	1.5
Secondary	36	9.0
Higher secondary	13	3.2
Above higher secondary	30	8.0
n	**400**	**100**
Type of land in possession		
Homestead land	47	32.9
Agricultural land	23	67.1
n	**70**	**100**

Six FGDs were conducted at 4 villages situated under Narayangonj district where a total number of 50 participants participated. All the participants were female. The participants were selected purposively from homogenous group. However, the criteria of making group homogenous were age, occupation and gender identity of the respondents. Occupational status of most of the respondents was housewife. In addition, maid servant and workers of informal sectors were also selected in this study.

Table 5.1.3. : Socio-demographic descriptions of the FGD discussants

Location for FGD	**FGD group**	**Age range**	**Total participants**	**Participants by schooling year**	
				Schooling year	**Participants**
Bottola, Sidhirganj	Female headed households	30-80	10	Sign only	4
				0-5	3
				6-10	3
Bottola, Sidhirganj	Vulnerable women	22-42	9	Sign only	3
				0-5	4
				6-10	2
Mouchak, Madaninagar	Housewife	21-62	8	0-5	2
				6-10	2
				11-15	4
Fatullah Railway Station	Female headed households	18-75	10	Sign only	5
				0-5	3
				6-10	2

Chashara Railway Station	Vulnerable women	32-55	6	0-5 6-10	2 4
Chashara Railway Station	Vulnerable women	30-60	7	0-5 6-10	2 5

Participants of key informant interview consisted of community leader (both formal and informal), government and non-government officials working in the study area and representative of the city corporation. Purpose of the KII's was to explore the factors behind waterlogging in research area and to seek potential recommendations to solve the existing problems.

Table 5.1.4.: Socio-demographic background of KII participants

Participants demographic information			
Designation	**Age**	**Sex**	**Year of schooling**
Community Leader	45	Male	15
Govt. primary school teacher	40	Female	12
CHCP, community clinic	55	Male	15
UP chairman	60	Male	15
NGO worker (accountant)	30	Female	18
Executive Engineer, Narayanganj City Corporation	32	Male	18

5.1.1 Occupational diversification of the respondents

Occupational diversification was observed in the study area (see: figure3). Findings of the study show that majority of the respondents (75%) were housewife. In addition, findings also assert that occupation of rest of the respondents included petty business (e.g., selling ash, mud burner, etc.), factory worker (most of them were readymade garments worker), begging, maid servant, student, rag pickers (locally known as *tokai*) and day labor.

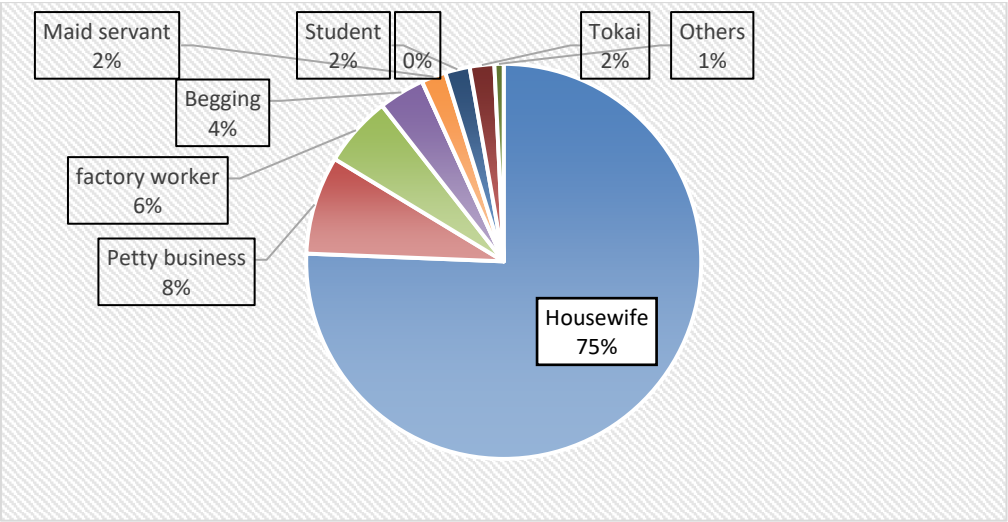


Figure 5.1.1.1.: Occupational status of the respondents

5.1.2 Type of educational institution in the study area

Table-6.1.2.1. shows that there were different types of educational institution in the study area. Majority of the respondents said that there were primary schools in their locality. In addition, 74% respondents said that there was *madrasa* in the study area. Over 54% respondents said that kindergarten in their locality.

Table 5.1.2.1.: Type of educational institution in the study area

Institution	N	%
Primary school	308	77.0%
High school	168	42.0%
College	107	26.8%
Madrasa	296	74.0%
Kindergarten	216	54.0%

*(Multiple responses were taken)

5.1.3 Frequency of natural disaster in the study area

Table-5.1.3.1. illustrates most frequent disasters in the study area. All the respondents said that waterlogging was the most common and frequent natural disaster in their locality. Majority of the respondents (85.5%) also reported heavy rainfall as one of the most common disasters in the study area. In addition, respondents also added cold wave (56.0%) and drought (39.0%) as

frequent disasters of their area. The response of the participants is helpful to understand the geographical features of the study area.

Table 5.1.3.1.: Most frequent disaster in the locality

Disaster	N	%
Flood	64	16.0%
Cyclone	25	6.2%
River bank erosion	8	2.0%
Drought	156	39.0%
Cold wave	224	56.0%
Heavy rainfall	342	85.5%
Waterlogging	400	100%
Drainage congestation	8	2.0%
Tornado	5	1.2%

*(Multiple responses were taken)

5.2 Women's perception about impact of waterlogging

Waterlogging has humanitarian impact on society and its people, viz- challenges in living condition, livelihood problems, health hazards, food and drinking water crisis, social and physical insecurity, unemployment, disruption of education and communication which continues for a several months (Rahman & Debnath, 2015). Waterlogging disrupts social networks and standard of living (Rahman & Debnath, 2015).

5.2.1 Seasonality of Waterlogging

Most of the FGD participants mentioned that waterlogging generally occurred between June/July (Bengali *Ashar*) and September/October (*Ashwin*). Some respondents said that their residential areas were sometimes logged under water for 1 month and sometimes up to 4 months. In addition, some respondents mentioned that waterlogging occurred in their area during mid-summer (May/June) and continued till early winter (November). One of the participants said that water remained in case of sudden and heavy rainfall. Participants from two villages added that waterlogging happened in their area almost every year. Participants from one FGD mentioned that waterlogging used to continue 3-15 days and based on amount

of rainfall sometimes it continued for 3-4 months. In contrast, some respondents said that their area was logged under water al around the year. One respondent said:

> *"Water remains on the road throughout the whole year. It is not always rainwater that causes waterlogging; causes of waterlogging during winter and summer season is improper drainage and discarding non-bio-degradable wastes into drain."*

Table 5.2.1.1.: Waterlogging- seasonality and duration

From	To	Duration (in day)
Mid-summer (May/June)	Mid-autumn (September/October)	30-60
Mid-summer (May/June)	Early winter (November)	30-60
June/July	September/October	30-60
June/July	September/October	90-120
June/July	September/October	7
June/July	September/October	7-15

5.2.2 Sources of information about waterlogging

Table-5.2.2.1. shows the common sources for the respondents to get information about waterlogging. A great majority of the respondents (93.4%) mentioned that they knew about waterlogging from newspaper. In contrast, 33.4% respondents said that they heard about waterlogging from electronic media and GO officials consecutively.

Table-5.2.2.1.: Cross tabulation between familiarity about waterlogging and source of information

	Information source	Heard about waterlogging	
		N	%
Information about waterlogging	NGO workers	45	13.6
	GO officers	111	33.4
	Print media(newspaper)	310	93.4
	Electronic media	111	33.4

*n=350 *(Multiple response were taken)*

5.2.3 Challenges of waterlogging

Table-6.2.3.1. indicates that majority of the respondents (76.5%) faced drinking water crisis. However, residence of most of the respondents (59.5%) was damaged due to waterlogging. During waterlogging moving one place to another was difficult for the respondents.

Furthermore, price hike of daily necessary commodities made people to suffer from food crisis. According to the respondents, they could not attend office regularly due to waterlogging. So, many of them lost their job. Some respondents mentioned about prevalence of vector borne diseases.

Table-5.2.3.1.: Problem faced due to waterlogging

Problems	N	%
Scarcity of pure drinking water	306	76.5%
Sanitation problem	113	28.2%
Prevalence of water borne disease	148	37.0%
Scarcity of animal fodder	64	16.0%
Increase price of cereal food and other essential commodities	218	54.5%
Damage of mud house	238	59.5%
Suffer from chronic malnutrition	32	8.0%
Unemployment	212	53.0%

** (Multiple responses were taken)*

All the respondents participated in case study mentioned that they could not move from one place to another, water entered into their room and their valuable goods were damaged by water, they had crisis of fresh water to drink and take bath and lack of sanitary latrine. Most of the participants (88%) experienced food crisis during waterlogging. They faced problem to cook food (92%). In order to mitigate food crisis and to survive they ate dry foods, like- puffed rice (*muri*) and flattened rice (*chira*) up to 4-5 days. Furthermore, majority of the respondents (80%) reported that they suffered from mental stress under waterlogging condition. One of the participants said:

> *"…what will we do? How will we arrange foods for the family members? What is waiting for us in the future! My husband died ten years ago since then I am the head of this family. Now I am really undone to find any possible solution to survive."*

Furthermore, three respondents reported that their child drown in the water and died.

Table 5.2.3.2.: Problems caused by waterlogging

Problems	N	%
Problem to move from one place to another	25	100
Damage of valuable goods	25	100
Crisis of fresh water(drinking and bathing)	25	100

Lack of sanitary toilet	25	100
Problem to move from one place to another	25	100
Problems to cook food	23	92
Food crisis	22	88
Mental stress	20	80
Unemployment	18	72
Sickness caused by dirty water	15	60
Decrease income opportunities	11	44
Price of necessary goods increase	8	32
Children cannot go to school	7	28
Death of child	3	12

Findings of case studies show that during waterlogging twelve out of 25 participants left their house and took temporary shelter on nearby dam. Besides, four participants said that they took shelter at nearby railway station and school. Three respondents hired alternative house to live during the days of waterlogging. In contrast, six participants mentioned that they did not leave their residence due to emotional attachment with their residence and belongings. One of the participants said:

> *"How can I leave my residence along with my belongings? We have been living here for over a decade. We will stay here till our last breath.*"

FGD participants said that they faced various types of challenges due to waterlogging condition in their locality. Most of the participants mentioned that they suffered from accommodation problem. Some respondents said that they suffered from various types of diseases because of wearing wet clothes for long time. Due to waterlogging, the residents of that area were not able to cultivate crops which in turn caused food scarcity. Furthermore, children could not go to school due to waterlogged condition of the roads. Similarly, people faced problem to move from one place to another due to that situation. Some respondents mentioned that due to that situation they had had frequent accident on the road.

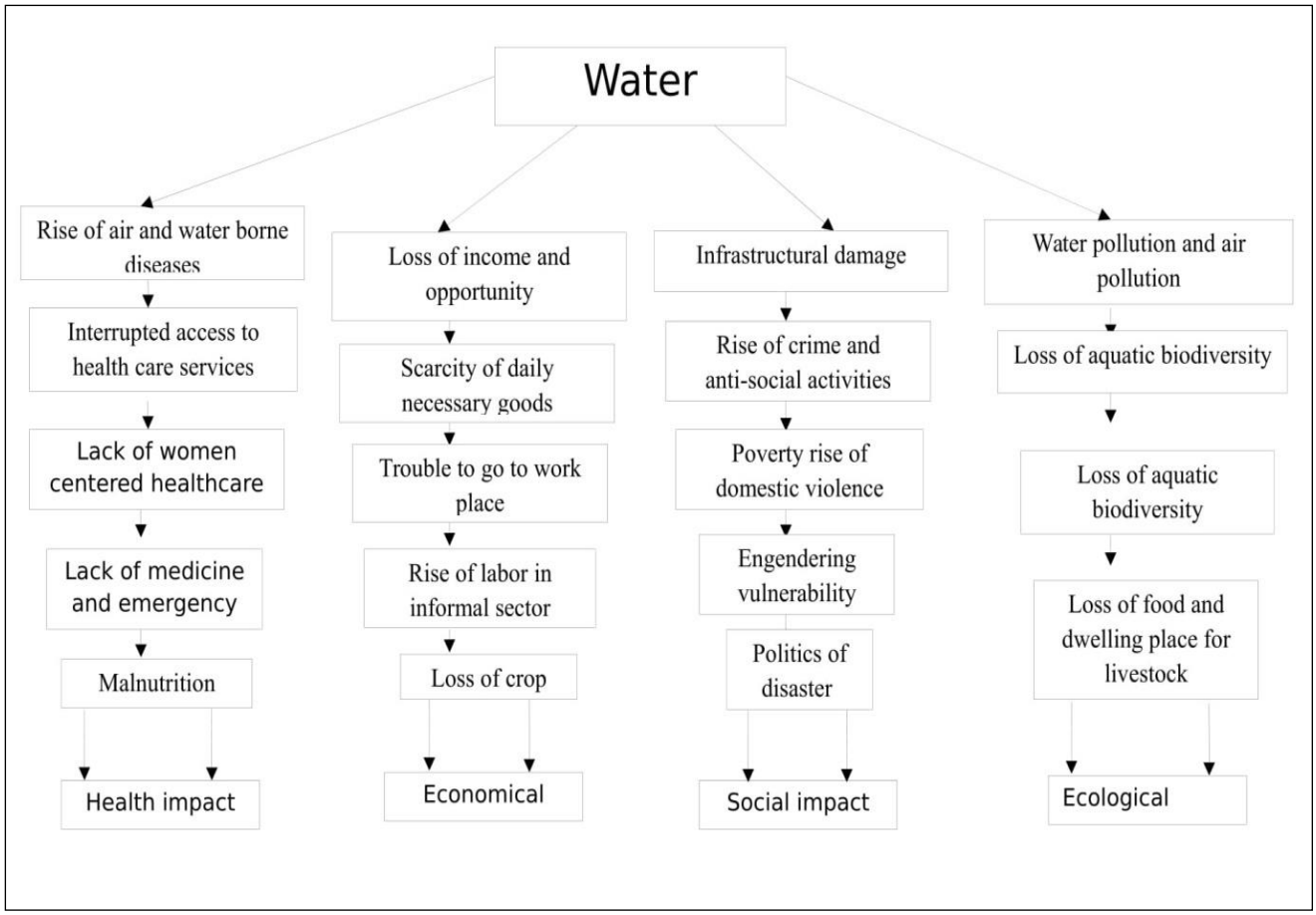


Diagram 5.2.3.1.: Perceived impact of waterlogging

According to a teacher of the local primary school, due to waterlogging they could not open their school approximately for two months. He also said that students could not go to school as the approach roads were inundated during this period. One of the KII participants also added the equipment in the schools were also damaged due to waterlogging.

Findings of survey, shows that waterlogging caused damage of household assets. They said that household assets, especially furniture were damaged. Most of the respondents reported about damage of their bed (42.6%). In addition, 26.6% respondents said that their residences were damaged due to long time waterlogging (Table-5.2.3.3.).

Table-5.2.3.3.: Damage of asset due to waterlogging

Asset	N	%
Fishing net	11	2.3%
Boat	29	6.0%
Bed	205	42.6%
Bicycle	5	1.0%

Radio	9	1.9%
Plough	2	0.4%
Hoe	1	0.2%
Ox-cart	3	0.6%
Television	32	6.7%
Chair	28	5.8%
Cultivable land of crops	4	0.8%
Standing crops	8	1.7%
Residence	128	26.6%
Production unit	8	1.7%
Poultry shade	4	0.8%
Homestead garden	4	0.8%

*(Multiple responses were taken)

5.2.4 Causes of prolonged vulnerability induced by waterlogging

Findings of case study show that the geographical location of the study areas was lower than nearby areas. All the respondents participated in case study mentioned it as the main cause of waterlogging in their locality. They also added that the drainage system of the study area was poor to remove water. Some participants (64%) said that the water absorption capacity of land of their area was lower compared to other areas which lead the land to become inundated. Moreover, the finding of the case study shows that the ponds and ditches of their locality were full of garbage. So, water came from sudden and or heavy rain could not get stored in those ponds and ditches.

Waterlogging induced vulnerability, according to the FGD participants, was prolonged due to several human induced reasons. Most of the participants mentioned that due to lack of water recycling system and maintenance of the drainage system were the underlying causes of vulnerability of the people of the study areas. In addition, majority of the participants reported that due to their gender identity, measured taken by women were challenged by orthodox power structure both within the household and community. They added that women in their society were not allowed to take serious decision regarding their family. One of the participants said:

> *"…although there is women representative in the local government, but it is totally biased and lead by male members. Women who are entrapped in waterlogging have been considered to be the most vulnerable groups due to prolonged waterlogging. If women have to be resilient; they must be empowered in all aspects of life— from mental, social, physical, political, economic, and cultural."*

Table 5.2.4.1.: Contributing factors behind waterlogging

1. Low land compared to adjacent area
2. Nonexistence of drainage system
3. Poor water exhausting capacity of soil
4. Lack of arrangement to remove rain water
5. Lack of awareness among the dwellers
6. Lack of knowledge about scientific water management system

Most of the respondents mentioned that the reason behind waterlogging was low land compared to nearby area. Some respondents said that non-existence of drainage system was a contributing factor behind waterlogging in their locality. In contrast, some respondents said that the quality of soil of their locality was not good enough to absorb water from rain and or from any other sources. However, respondents also mentioned about inadequate arrangement to remove rainwater. Along with the above-mentioned factors, participants also mentioned lack of awareness and knowledge about scientific water management system and its importance in their locality.

Responses of the KII participants showed three key factors behind waterlogging, namely individual activities, social and natural factors and institutional factors. According to the respondents, lack of awareness of the local residents was one of the contributing factors behind waterlogging. Due to lack of consciousness they used to discard solid wastes and polythene into drain which interrupted natural flow of water, especially during rainy season when there was heavy pressure of water flow. In addition, there were members of local power structure who embezzled land and constructed building and business center which was also a barrier for policy makers and administrative bodies to plan for adequate water disposal policy. Participants mentioned some social and ecological factors behind waterlogging in the locality. Those factors involved, excessive rainfall, siltation of canals, population density and expansion of human settlement, lack of water circulation path and residence in the low-lying lands. However, waterlogging was leaded by some institutional factors, viz- improper drainage system, lack of long-term plan, unplanned urbanization and/or construction of roads and highways, wrong physical development policy and inadequate drainage system with low capacity. According to one of the participants:

"The DND embankment was implemented in the mid of 1960s. The main objective of this project was to create flood-free area of 57 square kilometers and to produce crops through canal irrigation project. But after the 80s, there has been a rapid change in this area, and the vast cultivatable land turned to commercial, residential and industrial plots right after this irrigation project. Various industrial units including small-scale industries, brick kilns and garment factories were set up. As a result, unplanned settlement, roads, factories, educational institutions, etc. are now creating a lot of problems in the area."

Moreover, according to some respondents, at the beginning of the project there were several canals including the *Konso* River in the DND embankment area. The canals were used as irrigation project. The *Konso* River and other available canals have already been piled up with garbage and encroached. Due to over pollution, many canals have disappeared. That is why due to rain or during the rainy season the waterlogging is created. According to the description of one of the participants, there was a very effective drainage system which was mainly used for paddy cultivation but now that is 10-15 feet under water level during rainy season. This is so bad in condition that even the existing pump system cannot drain out the water at rainy season.

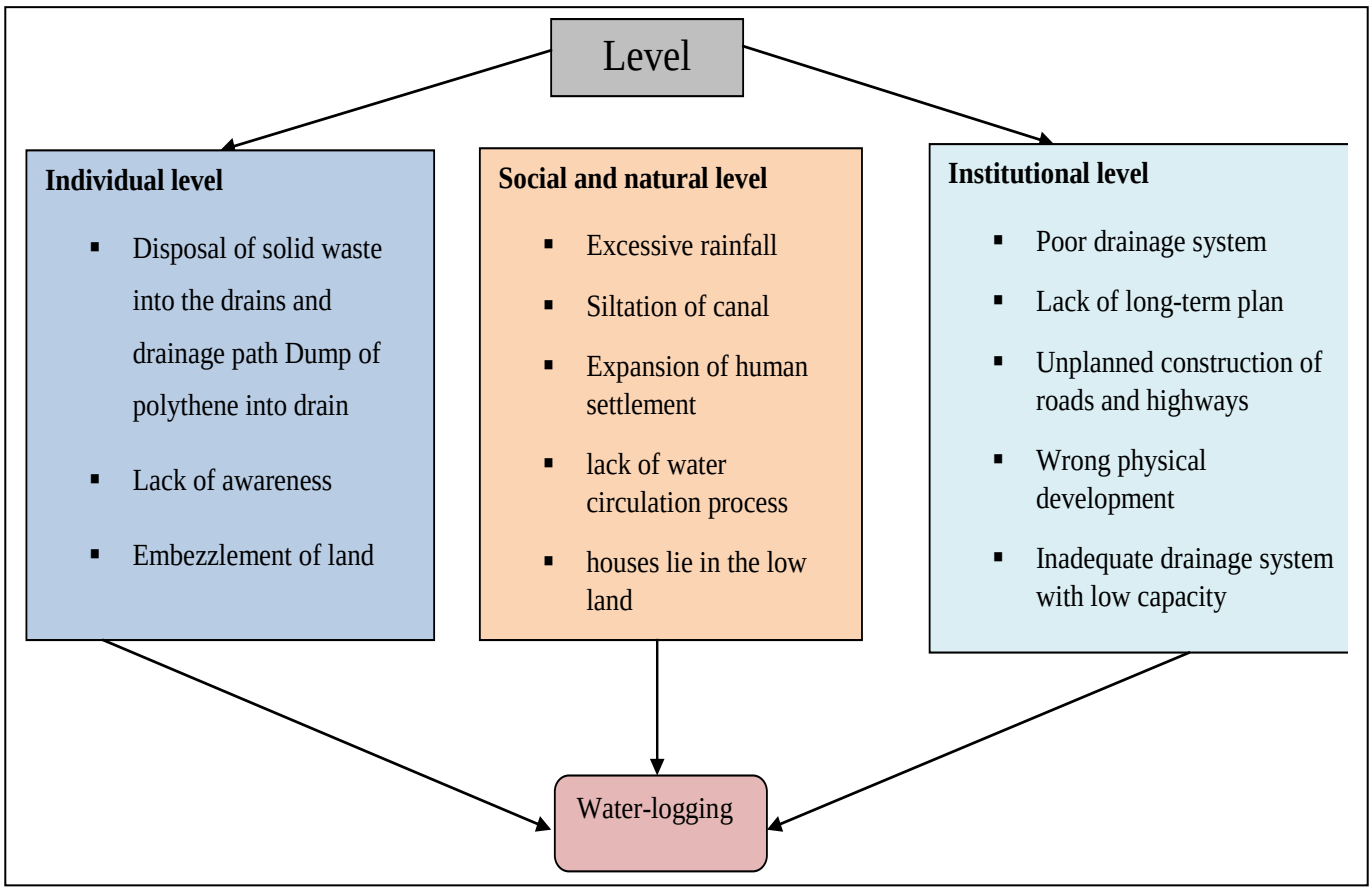


Diagram 5.2.4.1. : Contributing factors behind waterlogging

5.2.5 Social impact of waterlogging

Table-5.2.5.1. demonstrates social consequences of waterlogging in the locality. Most of the respondents (81.8%) said that they did not experience damage of agricultural crops which depicts that the study areas were not predominantly agriculture based. However, a great majority of the respondents (90.8%) said that there were educational institutions in their locality. Approximately 70% respondents mentioned loss of household assets. Moreover, about 90% respondents reported that they had post disaster trauma. Despite the situation, 82.5% respondents said that no effective measures were taken to mitigate waterlogging and related vulnerabilities.

Table 5.2.5.1.: Social impact of waterlogging in the locality

Characteristics	N	%
Damage of crop		
Yes	73	18.2
No	327	81.8
n	**400**	**100**
Existence of educational institution in the locality		
Yes	363	90.8
No	37	9.2
n	**400**	**100**
Loss of asset due to waterlogging		
Yes	270	67.5
No	130	32.5
n	**400**	**100**
Mental pressure due to waterlogging		
Yes	358	89.8
No	41	10.2
n	**400**	**100**
Measures taken to reduce waterlogging		
Yes	70	17.5
No	330	82.5
n	**400**	**100**

5.2.6 Economic impact of waterlogging

According to the respondents (100%) waterlogging was the most devastating natural disaster in respect to economic loss in their locality. In addition, 64.8% respondents mentioned that heavy rainfall also caused economic losses in the study area.

Table 5.2.6.1.: Most economic damage caused by disaster

Disaster	N	%
Flood	30	7.5%
Cyclone	24	6.0%
Riverbank erosion	9	2.3%
Drought	24	6.0%
Cold wave	35	8.8%
Heavy rainfall	259	64.8%
Waterlogging	400	100%

*(Multiple response was taken)

5.2.7 Impact of waterlogging on infrastructure

FGD participants reported that infrastructures of their locality were damaged due to waterlogging. All the respondents mentioned that their roads, culverts and drainage system were damaged due to waterlogging. Besides, over 80% of the total FGD participants reported that their residences were damaged. According to their description, water entered into their living room also. Some participants said that their valuable assets were lost and\or damaged by logged water at their residence. KII participants mentioned that roads and culverts were damaged due to waterlogging. In addition, semi-structured houses were collapsed due to this situation.

5.2.8 Damage of educational institution

Almost all the respondents (98.2%) of this study said that school infrastructures in their area were damaged due to waterlogging. During waterlogging it becomes very difficult for the school going students to attend school as well as for the school authority to continue their activities. Likewise, the finding of this study shows that majority of the respondents (79.2%) said that they faced problem to send their children to school (Table-5.2.8.1.).

Table 5.2.8.1.: Damage of school infrastructure

Damage	N	%
Yes	395	98.2
No	5	1.2
n	**400**	**100.0**
Problem faced by schooling going children		
Yes	313	79.2
No	87	21.8
n	**400**	**100.0**

Table-5.2.8.2. indicates types of damages occurred with the school infrastructure. Most of the respondents (42.0%) said that classrooms were not suitable to conduct class due to waterlogging induced damages. Some respondents (38.3%) said that toilets of the schools went under water and were not use worthy.

Table 5.2.8.2. : Type of damages in school infrastructure

Damage	N	%
Unfit classroom	224	42.0%
Teachers' houses	105	19.7%
Toilets	204	38.3%

*(Multiple response was taken)

5.2.9 Potential future risks of waterlogging

Respondents reported potential future risk factors induced by waterlogging in the study area. Majority of the respondents (89.5%) said that rate of unemployment might increase due to waterlogging. In addition, price hike of necessary commodities (19.25%), increasing rate of poverty (37.5%) may reduce national income (55.0%) (Table-5.2.9.1.).

Table 5.2.9.1.: Future risks of waterlogging

Risks	N	%
Unemployment	358	89.5%
Poverty	150	37.5%
Price hike of necessary commodities	77	19.25%
Reduction of household income	220	55.0%

** (Multiple responses were taken)*

5.3 Source(s) of livelihood during waterlogging

A study conducted in the Dhaka-Narayangonj-Demra (DND) area in 2015 showed that some over 50 percent of businessmen were affected by waterlogging of DND embankment area in the rainy season (Rahman and Debnath 2015). FGD participants of this study mentioned that earning livelihood was difficult for them due to waterlogging. Most of the respondents said that they passed days without doing anything. Some respondents said that male members of their family pulled rickshaw in district town to lead their family. Some respondents said that they tried to get involved in informal sector, like working at others home, doing petty business. However, some respondents worked at garments to earn their livelihood.

Table 5.3.1.: Source of income during waterlogging

1. Passed days without doing anything
2. Rickshaw pulling
3. Temporary job (viz- garments sector, maid servant)
4. Involvement in informal sector (e.g. selling *jhal muri*)
5. Borrowed money
6. Sold land and other asset
7. Begging

However, 10 respondents said that they used to work at others house as maid servant to contribute to their family income. Nine respondents reported that their husbands were rickshaw

puller who used to main their family with that income. Besides, other respondents were involved in petty business, viz- selling mud burner and ash, tailoring, etc.

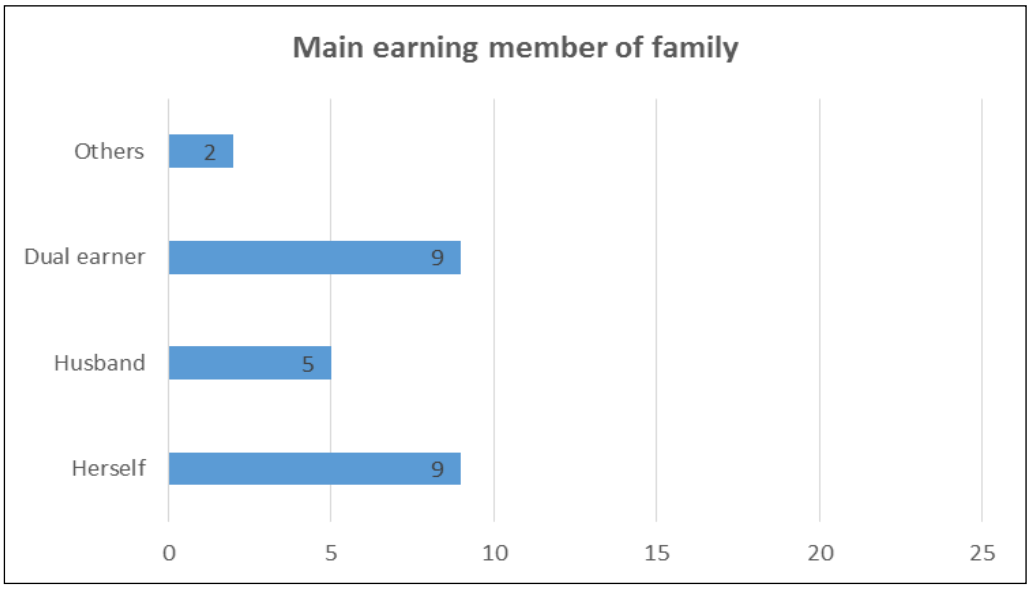


Figure 5.3.1. : Main earning member of family

5.3.1 Waterlogging and forced migration

Natural disaster induced migration is common in all around the world. Findings of this study show that most of the respondents (63.8%) did not migrate due to waterlogging. Majority of the respondents said that they were the permanent resident of that locality, and they did not have any alternative place to shift permanently. So, they could not leave their residence. One of the respondents said that she had to face waterlogging sometimes almost all around the year. So, it was not possible for them to relocate or leave her residence. On the other hand, 43.4% respondents said that they migrated due to collapse of their dwelling place. In addition, distance of relocation ranged between 5km-30km. Findings show that most of the migrants took shelter within 5km from their residence (Table 5.3.1.1.).

Table 5.3.1.1.: Collapse of household due to waterlogging

Collapse	**N**	**%**
Yes	145	36.2
No	255	63.8
N	**400**	**100.0**
Migration due to collapse of residence(*n*=145 of 400)		
Migration	**N**	**%**
Yes	63	43.4

No	82	56.6
Distance of relocation (*n*=63 out of 400)		
Distance	**N**	**%**
5km	38	60.3
10km	11	17.5
20km	9	14.3
30km	5	7.9
N	**63**	**100**

5.3.2 Gendered impact of waterlogging

It is said that disaster is gender neutral; but vulnerability is not. It is empirically verified that women are more vulnerable to disaster. Respondents (35.7%) become more vulnerable during flood and waterlogging than all other disasters. 26.3% respondents said that they were forced to sell their household assets to arrange their livelihood during and after waterlogging.

Table 5.3.2.1.: Women's vulnerability to particular disaster

Factors	N	%
Flood	61	35.7%
Waterlogging	61	35.7%
Cyclone	12	7.0%
Drought	33	19.3%
Crop failure	16	9.4%
Forced to sell personal assets	45	26.3%

*(Multiple responses was taken)

Nevertheless, 76% of the total case study participants belonged to female headed household. All the respondents said that collecting water and sometimes food were the responsibility of the female members of the household. They added that they had to collect water from long distance. According to the responses of the participants they had to cross approximately 2km to collect drinking water during waterlogging. One of the participants said:

> *"..Collection of drinking water is the toughest job during waterlogging. There is no safe drinking water source nearby. There are four members in my family. So, I go to matbor bari(house of informal leaders) three times in a day and collect about 20 liters of drinking water to meet my family need. Male members never help us to collect water as they are always busy with their own work at outside to earn money for family."*

According to the FGD participants, it was tough to cook during waterlogging. Some respondents said that they had to pass some days without having proper meal. Some respondents collected food from their neighbors and relatives. However, most of the respondents said that they purchased food from local market. In contrast, all the respondents collected water from deep tube-well and they considered the water as pure for drinking. Some respondents said that they purchased water from their neighbors based on monthly payment. They added that their neighbors raised water from ground using their water pump. Nevertheless, all the respondents mentioned that they had to collect water from distant places which were laborious for them.

However, findings of case study show that majority of the participants had to collect firewood for cooking. Moreover, some respondents (18) said that they had to contribute to their family income as well as take care of their family members, especially the aged people and the children. Ten case study participants said that they had to struggle to maintain their family when their husbands were migrated outside in search of work. However, all the case study participants said that they had to give more effort compared to their male partners to repair their households at the end of waterlogging. One of the case study participants said:

> *"…when water go away, male members become very busy to search works to earn livelihood. During that time, we work, sometimes almost alone, to repair households, to make home livable."*

Some participants (14) reported that the women of their area took less food compared to their male members. According to their social rituals, they used to take food once their male members (viz- husband, father) had finished their meal. They added that sometimes they had to go without meal if there did not remain anything after male member's eating.

FGD participants also gave similar information about gender based unequal food distribution. Most of the participants mentioned that they tried to feed their male members, aged and children first and used to take food when all of their family members had taken food. To them, it was part of their customs to take meal once all the members had taken food. According to her description-

> *"…We cannot take our food before our male members, especially husband, father-in-law, mother-in-law; it is violation of the social customs. Thereafter, we feed our children. Then we have our own meal if anything remains. Most of the time we eat less compared to our male counterpart. Sometimes we go without taking food if nothing remains."*

Participants also mentioned that they could not take balanced diet due to food crisis caused by waterlogging. Some respondents said that due to waterlogging they passed miserable condition. One of the respondents said:

> *"…during waterlogging condition, we leave our residence and take shelter in safe and high land. Pregnant women and adolescents cannot maintain privacy during their pregnancy and menstruation period respectively. Incident of sexual harassment is also common during this type of crisis moment (waterlogging)."*

Table 5.3.2.2.: FGD participant's view about gender-based experience of waterlogging

1. Gender based unequal food distribution
2. Collection of fuel wood and water was hazardous
3. Departure of male members and dual work burden
4. Women are now tended to be in anti-social activities if the household is female headed.
5. Poverty and exploitation by male members
6. Privacy is completely threatened
7. Sanitation problem for the pregnant women
8. Problem for the adolescent women to practice hygiene during menstruation
9. Sexual harassment
10. Increased women headed households
11. Problem to manage temporary job
12. Vulnerability of poor and physically challenged women

Due to waterlogging male members left their residence in search of work. Majority of the respondents said that departure of their male members pushed them into hardship to maintain their family. According to those respondents they had to take care of their family members as well as their household chores. Some respondents reported that due to poverty, food crisis and financial crisis sometimes women got themselves involved in anti-social activities, viz-prostitution. According to one of the FGD participants women of their area could not take decision to leave their households in spite of such disastrous situation due to not having adequate economic freedom. Even they found it difficult to manage temporary works to support their family economically. Most of the participants mentioned that aged and physically challenged women, specially faced problem to move due to waterlogging.

One of the KII participants said that female became more infected with scabies and other diseases in the study area as they had had frequent contact with water compared to their male counterpart. Moreover, male members remained outside home in search of livelihood which was another reason behind less infected with above mentioned diseases. According to the description of one of the women participants of their area suffered mostly from malnutrition due to food insecurity caused by waterlogging. Some participants said that women headed households faced immense problem to mitigate waterlogging caused vulnerabilities compared to others. Some participants said that gender-based division of labor and/or double work burden and having less resource to fight against the disaster made women more vulnerable. Furthermore, women faced more problems in case of defecation as they could not excrete in open place likewise their male counterparts. Moreover, women became vulnerable to waterlogging because of their inequality of opportunities as compared to men. Their livelihoods likely depended on natural resources threatened by waterlogging. Waterlogging had different impacts on men and women.

5.3.3 Common sources of drinking water during waterlogging

KII participants also said that lack of pure drinking water made people of their area suffer more. People from low-income households collected water from tube-well located at distant places. In contrast, those who had neighbors owning tube-well collected from them. However, people who were not able to collect water from distant places even drunk the polluted water. Some people used to drink water from deep tube-well. Key reason behind water crisis according to one of the participants is poor supply of water in the study area.

5.3.4 Alternative source of drinking water

Drinking water is considered to be one of the most immense problems caused by natural disasters like waterlogging. This study explored alternative sources of drinking water during the disastrous period. Finding of the study (table-5.3.4.1) shows that majority of the respondents (82.2%) used to drink water from deep tube-well and the mean distance of the nearby deep tube-well was approximately 1.5km (ranging between 0.5 km and 3km).

Table 5.3.4.1.: Alternative source of drinking water

Source	N	%
Neighbor's house	56	12.0%
Deep tube-well	384	82.2%
Boiling pond water	27	5.8%

** (Multiple responses were taken)*

5.3.5 Status of sanitation during waterlogging

Along with all other problems sanitation becomes a common problem during waterlogging. Figure-5.3.5.1. shows that half of the total respondents had their own sanitary toilet. In addition, semi-*pakka* toilets were own by 31% respondents. In contrast, 5% respondents were habituated with open defecation and 2% with hanging toilet.

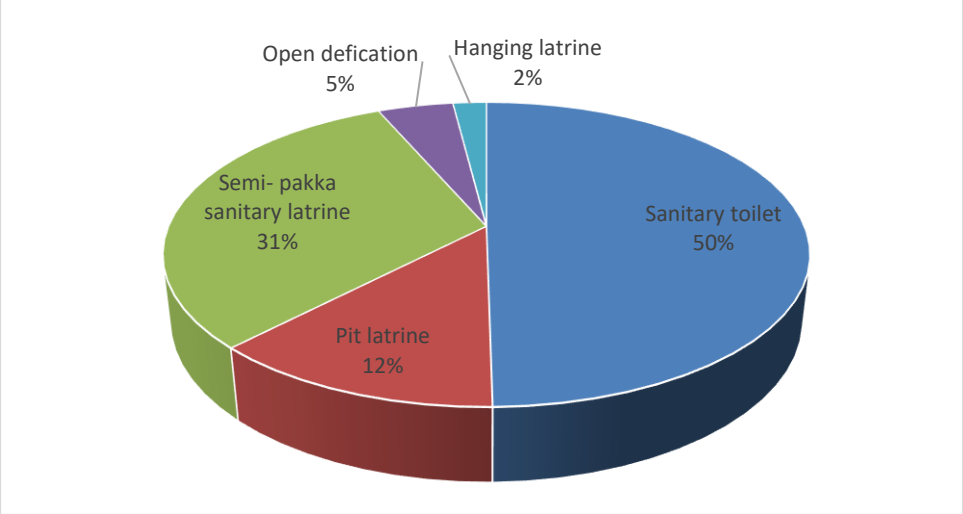


Figure 5.3.5.1. : Type of toilet own by the respondent

Table-5.3.4.1. shows that over 60% participants mentioned that their toilets were damaged by water during waterlogging. Moreover, 37.1% of the respondents who reported about the damage of their toilet said that they shared their neighbors' toilet. Open defecation (32.9%) and hanging toilet (24.7%) was also dominant scenario during waterlogging in the study area.

Table 5.3.5.1.: Status of sanitation during waterlogging

		N	%
Sanitary latrine affected	Yes	249	62.3
	No	151	37.7
	n	**400**	**100**
Alternative toilet		**249 of 400**	
	Neighbors house	87	37.1
	Public toilet	26	11.1
	Open defecation	78	32.9
	Hanging latrine	58	24.7
	n	**249**	**100**

All the case study participants said that their toilets went under water during waterlogging. Majority of the participants (18) mentioned that they had to excrete in open places, like- on the dam, beside road, railway station, etc. Some respondents (5) built hanging toilet with bamboo for temporary use during waterlogging. They also added that the feces went into water directly. According to the description of some case study participants, they went to their neighbor's houses which were far from this waterlogging area. One of the respondents said:

> *"Male members face less problem regarding excreting under open sky, but it becomes difficult for women. Due to lack of sanitation facilities, frequency of women's using toilet is fewer which lead to gynecological diseases (mohilader rog)."*

One of the FGD participants said that there were two toilets for 60 people at their community which was unstructured (*kacha)*. They had to stand in queue to get access there. They added that the physical condition of those toilets was very bad. Some respondents mentioned that their toilets were dirty due to waterlogging. According to one of the respondents:

> *"Toilets become over flooded due to waterlogging. Most of the time we cannot clean toilets because of inundated condition. Besides, number of toilets is inadequate in proportion to dwellers of our slum. Sometimes, we use our living room as loo during waterlogging."*

Some respondents said that they did not have their own toilet and had to use others toilet. In addition, some respondents used to practice open defecation. According to the respondents all the toilets of their locality were affected by waterlogging.

5.4 Health Impact of waterlogging

Findings of the study conducted by Rahman and Debnath showed that waterlogging damages health service networks during waterlogging. Their study showed that 77% of the total respondents of *Dhaka-Narayangonj-Demra (DND) suffered from different types of health problems* (Rahman & Debnath, 2015). Dwellers of the waterlogging area suffered from various types of diseases as the findings of case study suggest. Table-25 demonstrates the status of health care facility in the study area. 64% respondents said that there was no nearby health care center in their locality. In contrast, 36% respondents said that there were health care facilities in their area. Out of those (who reported availability of health care centre), 60.4% respondents said that they had public hospitals in their area and rest of the respondents (39.6%) mentioned about availability of private clinic. However, 66.3% respondents said that the health care facilities of their area were damaged during waterlogging. One of the major aftermaths of waterlogging was health impact. Likewise, findings of this study indicate that a great majority of the respondents' family members became sick during waterlogging. Not only physical sickness but also receiving health care service was also challenge for the respondents; 61.5% respondents said that they faced problem to receive health care service.

Table 5.4.1.: Status of health care facility during waterlogging

	N	**%**
Availability of health care center in the locality		
Yes	144	36.0
No	256	64.0
n	**400**	**100.0**
Availability of health facility in the locality(144 of 400)		
Public hospital	87	60.4
Private clinic	57	39.6
n	**144**	**100**
Damage of health care facility due to waterlogging		
Yes	267	66.8
No	133	33.2
n	**400**	**100.0**
Sickness of family members		
Yes	366	91.5
No	34	8.5
n	**400**	**100.0**
Problem receiving health care services		

Yes	246	61.5
No	154	38.5
n	**400**	**100.0**

5.4.1 Common diseases during waterlogging

All the respondents of this study stated that they suffered from skin diseases and mostly with scabies. Moreover, diarrheal diseases were very common during waterlogging. Majority of the respondents (84.5%) said that they were infected with diarrhea. In addition, 55.0% respondents were also infected with cold and fever during waterlogging.

Table 5.4.1.1.: Common diseases respondents infected with

Disease	N	%
Scabies	400	100
Diarrhea	338	84.5
Cold and fever	220	55.0
Malaria	149	37.25
Measles	58	14.5

*(Multiple responses were taken)

All the case study participants mentioned about scabies (skin diseases) and diarrheal diseases. The respondents opined that the reason behind skin diseases was frequent contact with polluted water. A great majority of the respondents said that they and their family members, especially children suffered from cold fever. In addition, most of the participants said that they had jaundice during this period. One of the case study participants said that they could not boil water for drinking which might have leaded to jaundice. Moreover, gastric, pneumonia and typhoid were also common in the study area as the findings show.

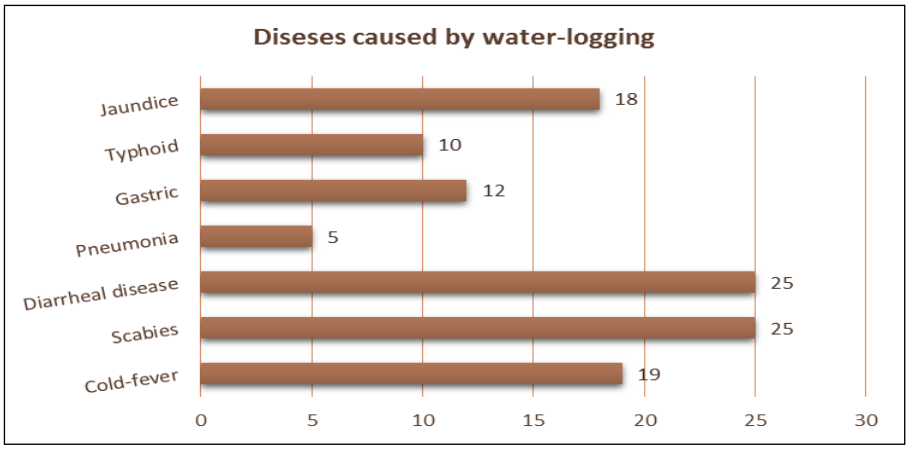


Figure 5.4.1.1.: Health impact of waterlogging

Most of the FGD respondents said that they suffered from various types of diseases, viz- diarrhea, cold, fever, typhoid, malaria, ulcer and pneumonia. Some participants reported that women and girls suffered from skin diseases (e.g., scabies) which were caused by dirty water. Some respondents added that they were affected by gynecological problems due to using filthy water. In addition, premature birth, abortion and still birth were reported alarmingly due to double work burden done by women. Some respondents said that children suffered from cold fever, skin disease and water borne diseases.

Waterlogging induced diseases in the study area involved diarrhea, cholera, scabies, fever, cold, etc. one of the KII participants said that women and children suffer from mental depression due to waterlogging. Another participant said that vector borne diseases, like dengue and Chikungunia spreads out in the locality during and after waterlogging.

5.4.2 Access to health services

All the case study participants said that there was no nearby hospital in their locality. They added that the distance of the nearby hospital was approximately 3-4 km. In addition, treatment they needed was not available at that hospital. Besides, during waterlogging it was difficult for them to go to hospital for health services. All the participants said that they purchased necessary medicines from local pharmacy. According to one of the participants they visited government hospital at Narayangonj in case of any complex health situation, although it was troublesome to go there due to disrupted communication system.

Health facilities of the study were reported inadequate in the study area by the FGD participants. Most of the respondents said that health centers were not available in their area. They added that they had to spend large amount of money to get proper treatment some

respondents mentioned that they were deprived from proper medical services. Some respondents said that health centers were located at a distant place from their residence. So, due to waterlogging they could not go there to seek health services. Furthermore, necessary medical services were not available in health care centers. Moreover, there was lack of trained physician to provide medical service. Most of the respondents mentioned that they purchased medicine from nearby pharmacy in case of sickness caused by waterlogging. One of the participants said that hospital infrastructures were not affected by waterlogging, but it was impossible to reach there. Health services in the locality became a major problem as the participants described. According to the description of a Community Health Care Provider (CHCP):

> *"Satellite clinic, community and union health and family welfare centers cannot not work properly due to waterlogging situation. We cannot go to our working areas regularly and as well as timely. In addition, we do not have any emergency service to provide for the health care receivers."*

5.5 Women's contribution to disaster risk reduction

5.5.1 Women's perception about disaster

Disaster is not a new phenomenon but gradually Bangladesh is becoming the worst victim of it. Yet, over half of the respondents (52.8%) said that they were not familiar about disaster. In contrast 52.0% respondents were familiar with climate change. However, majority of the respondents (93.0) opined that woman were more prone to waterlogging than their counterpart (Table- 5.5.1.1.).

Table 5.5.1.1.: Familiar about disaster

	N	**%**
Familiar about disaster		
Yes	189	47.2
No	211	52.8
n	**400**	**100**
Familiar about climate change		
Yes	208	52.0
No	192	48.0
n	**400**	**100**
Perception about women's vulnerability		
Yes	372	93.0
No	28	7.0
n	**400**	**100.0**

5.5.2 Source of information about disaster, climate change and waterlogging

Table- 5.5.2.1. Demonstrate the sources from where the respondent's got information about waterlogging. Most of the respondents (64.4%) knew about waterlogging from electronic media, viz- radio, TV. Furthermore, some respondents (25.7%) received information from NGO personnel working in the study area. On the other hand, most of the respondents (37.8%) got information about disaster from electronic media. 25.1% respondents said that NGO workers informed them about disaster. In contrast, 9.7% received information from government officials which indicates poor functions of the government administration in disaster management (5.5.2.1). In addition, most of the respondents (37.5%) received information about climate change from NGO workers.

Table 5.5.2.1.: Source of information about disasters

Source of information	Climate change	Natural disaster	Waterlogging
NGO workers	78(37.5%)	85(25.1%)	67(25.7%)
GO officers	27(12.9%)	33(9.7%)	4(1.5%)
Printing media(newspaper)	38(18.3%)	34(10.0%)	22(8.4%)
Electronic media(radio, TV)	65(31.2%)	128(37.8%)	168(64.4%)
Others(specify)	-	59(17.4%)	-

5.5.3 Impact of natural disasters on livelihood

During natural disasters many people become unemployed. Findings of this study demonstrate that a great majority of the respondents (92.5%) opined that increase of poverty was major impact of natural disaster. Over half of the respondents (51.0%) said that during and after natural disaster people lose their job. In addition, 32.0% respondents said that due to natural disaster people lose access to basic services, like- health care services, and help from neighboring people, etc. 23.8% respondents mentioned about malnutrition caused by food scarcity during natural disaster.

Table - 5.5.3.1.: Impact of natural disasters on livelihood

Impacts	N	%
Poverty increases	370	92.5%
Deprivation and inequality increase	30	7.5%
Limited access to financial services	204	51.0%
Malnutrition due to taking less food	95	23.8%
Loose access to some basic services	128	32.0%
Problems in accumulation of physical and human capital	30	7.5%
Rise of child labor and criminal activities	16	4.0%

*(Multiple responses were taken)

5.5.4 Nature of household head and impact of waterlogging

Table-6.5.4.1. shows relation between impact levels of waterlogging on the respondents considering head of the household. Findings of the study show that some over 70% of the total households were female headed in the study area. In addition, most of the female headed household experienced high level of impact caused by waterlogging. Findings of the chi-square test show that there is a significant relationship between type of household head and impact of waterlogging (p=.001***).

Table -5.5.4.1.: Correlation between female headed household and impact level of waterlogging

Impact of waterlogging	Head of the Household		Total
	Male	Female	
High	15 (3.75%)	185(46.25%)	200(50.0%)
Medium	27 (6.75%)	68(17.0%)	95(23.75%)
Low	75(18.75%)	30(7.5%)	105(26.25%)
Total	**117**(29.25)	**283**(70.75%)	**400**(100%)

df= 6, V=0.14, X^2= .000**

5.6 Indigenous coping mechanism

Findings of this study reveal that the women of the study areas rarely took any indigenous coping strategy by their own. They reported that they assisted their male family members to initiate some measures so that they can survive. Respondents reported that the intensity and source of the problem was deep rooted; various socio-political and economic issues made the problem more critical. So, individuals, especially women had very few things to prevent waterlogging.

5.6.1 Sandbags to protect water

Majority of the participants (81.8%) made sandbags to protect their residence from potential damage caused by water. In addition, sandbag was helpful for them to move inside residence and crossroad as well. One of the participants said:

> *"…we fill cement bags with normal sands and make a straight line so that we can cross the road stepping on it. Sometimes we place 8-10 bags of sand one after another to make a type of embankment to protect our house from being waterlogged."*

5.6.2 Polythene bag and gumboot to avoid dirty water

Some respondents (69.5%) wore polythene bag on legs (up to knee) while passing through water and going to market for purchasing daily necessaries. Respondents reported that their children also wore polythene bag during going to school. One of the participants mentioned that some people of their area wore gumboot to avoid contacting dirty water.

5.6.3 Using boat for communication

During waterlogging communication system collapses. It becomes difficult for the residents of the study area to move from one place to another in spite of having urgency, like- attending work for livelihood, visiting market for purchasing daily necessary commodities, going to educational institutions as part of educational attainment, etc. Respondents mentioned that whatever the need was they had to cross ankle-deep dirty water. In order to avoid this some of the respondents of the study area constructed boat to use during waterlogging. Those who did not have rickshaw used to hire rickshaw to go from one place to another, but it was expensive (BDT. 10-20 to crossroad only). Besides, during office hour or rush hour rickshaws were not always available. So, residents of the study area built personal boat for this type of emergency situation. But it was not possible for female to make boat. So, they used to assist the male members of their household for making boat for moving during waterlogging.

5.6.4 Raising height of household and latrine

Respondents raised the height of their toilet considering the waterlogging in their area, although some respondents used to go to nearby jungle for defecation. Some participants raised the height of their yard and houses collecting sand or soil. Majority of the respondents said that they lived as tenant. So, making any change in household patter raised some social coalition. One of the participants said:

> *"…owner of the house does not bear the expenditure of renovations. We are the tenants and this type of expenditure will be waste of our personal money when we will leave this house. Moreover, we spend money so that we can leave peacefully."*

5.6.5 Floating garden

Residence of the study area make floating garden to meet the family demand as well as sell in the market to make money. Only a few respondents (9.1%) made floating garden during waterlogging to harvest vegetables during waterlogging (Table-6.6.5.1.). During the monsoon season, the heavy rain cause waterlogging and people cannot grow crops. Floating garden is a practical solution to this problem where people in the waterlogging area can build a floating garden and cultivate vegetable and crops in there. The people build the floating garden on collected hyacinth covered with soft mud. This hyacinth with mud works like a raft and people cultivate vegetables and crops on this. But this raft has a limitation that the farmer needs to build a new raft after each cultivation, although the leftover of the raft can be used as fertilizer in the field. One of the participants said:

> *"There are five members in my family. During waterlogging the demand of vegetables are met from this floating garden (jol khet). Floating garden is very helpful for us as we can get the vegetables within a shortest time and fulfill family need. Besides, we can earn money selling those to nearby market."*

Table – 5.6.5.1.: Women's indigenous coping strategy

Coping strategy	N	%
Wear polythene bag on legs to avoid skin disease	278	69.5
Making dam with sand bag	327	81.8
Make bridge with bamboo	387	96.8
Make boat for transportation	54	13.5
Go to nearby field or jungle for defecation	172	39.1
Raise the height of latrine with mud or woods	56	12.7

To boil the pond water branches of trees are stored to use as firewood	40	9.1
Establishing floating garden	40	9.1
Taking shelter in refugee camps	132	30.0

5.6.6 Raising height of woven and cot

Majority of the respondents said that they raised their beds so that they could live in their room avoiding water. According to one of the participants, they put three bricks under each leg of their cot to keep that above water. She also added that raising height of the bed allowed them to live in the room but sometimes they had to live with insects, like snake. Majority of the respondents made fireplace with bricks to continue cooking. Along with raising height of cot, participants also raised height of their oven using 2/3 bricks under each leg. Thereafter, they used to cook sitting on the bed. Some respondents (8) said that they stored dry food (e.g., puffed rice, flattened rice, biscuit, etc.) to eat during waterlogging. Some respondents said that they used to save a little amount of money every month so that they can spend during this type of disastrous situation. However, considering the difficulties of cooking a great majority of the participants used to cook once in a day and ate those foods throughout the day.

5.6.7 Raising livestock on roof top

One of the participants said in the past they could raise chicken, duck and even cattle in their household which in turn contributed in their family income, specially a source of pocket money for women. But due to regular waterlogging, participants could not raise livestock not only for lack of space but also due to want of fodder. Moreover, some respondents mentioned that they made small wooden boxes to store chicken and duck on top of their tin shed house. One participant said her monthly average income from selling eggs ranged between BDT.1000-1500. She could pay her children's monthly tuition fees or buy necessary goods for her family with the money.

5.6.8 Taking additional clothes

A 27 year old security guard at a shopping complex was wearing old and torn clothes instead of her official uniform. It was found she has been using the same cloth instead of the official uniform for several days. To find out the reason behind this, she said, most of the area is under water with dirty water mixed from sewerage. So, she gets wet while she go back to her home

from office and if she use the uniform it will get dirty in the dirty water. So, to save her uniform, she has been using her old clothing instead wearing the uniform for last four days. Most of the participants said that their children also carried extra clothes to save their school uniform.

5.6.9 Massaging mustard oil

Most of the participants said that they used to massage mustard oil on their bodies, mainly from feet and up to waist to protect their body from skin diseases. Moreover, mustard oil also helped as a protection against mosquito.

5.6.10 Community based measures to mitigate vulnerability

Women of the study area tried to initiate some measures for mitigating vulnerability induced by waterlogging. Majority of the FGD participants mentioned that they raised sandy mud to make dam to prevent waterlogging although these measures did not work at all. Some respondents said that they did not do anything except trying to survive with the changed environment. However, according to some respondents, the intensity of changes in geo-physical contexts appears to be very overwhelming in the backdrop of women's current vulnerability. All the participants recommended construction of drain to ensure flow of water. They also suggested constructing safe shelter for their children. However, some respondents reported the necessity of repairing old and broken drains and culverts.

Majority of the KII participants reported that people of the study area left their residence for their relatives' house and/or high land during waterlogging. Some respondents lived on the top of their roofs whereas some respondents mentioned about making temporary women with bricks and put those on their bed as their kitchen and/or cooking places were not useable. One of the participants used small boat during waterlogging to move from one place to another.

5.6.11 Effectiveness of indigenous coping strategy

Figure-5.6.11.1. shows the effectiveness of coping strategy taken by women in their study area to mitigate waterlogging caused vulnerability. Most of the respondents (59.2%) said that their coping mechanisms did not work properly due to intensity of the problem.

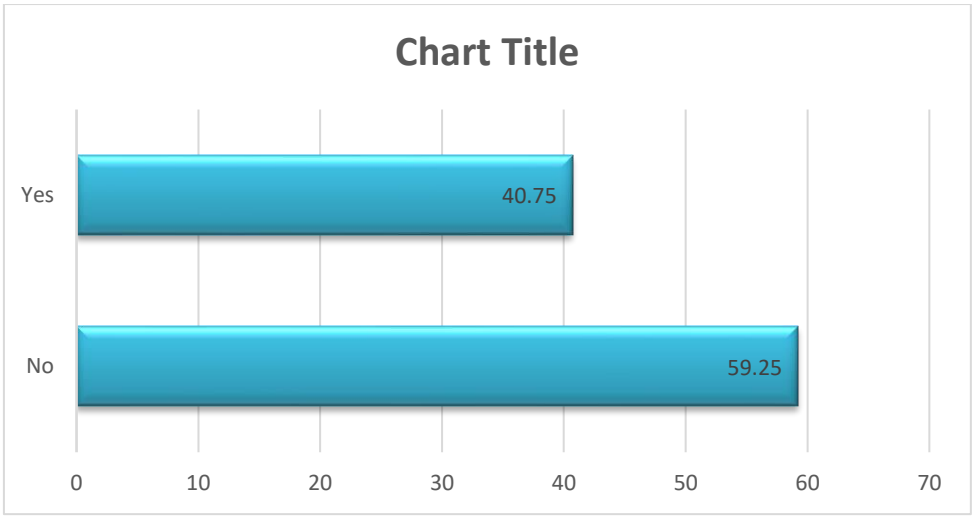


Figure 5.6.11.1.: Effectiveness of indigenous coping strategy taken by women

5.6.12 Women's participation in adaptation measures

Despite the intensiveness of the problem some women participated in adaptation measures. Most of the respondents (49%) worked for raising awareness among their neighbors. Some respondents shared information about waterlogging and way to mitigate vulnerability. Rest of the respondents shared their own experience about waterlogging.

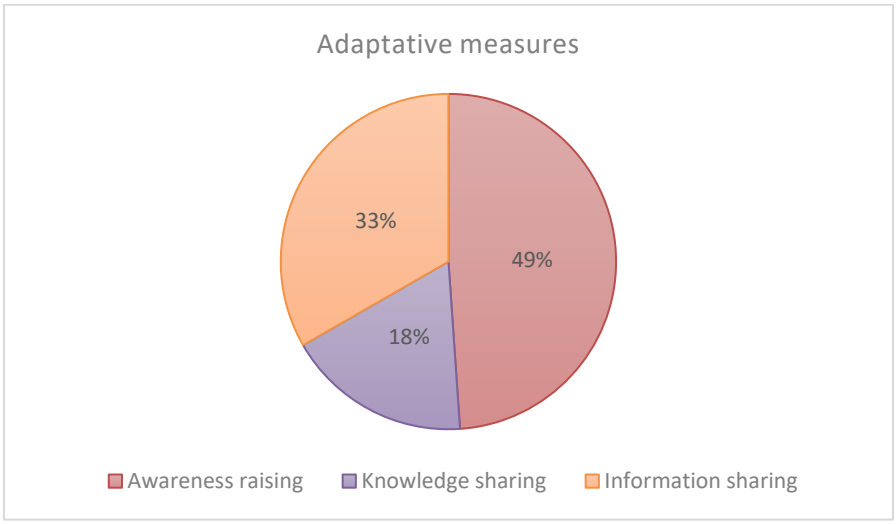


Figure 5.6.12.1. : Women's participation in adaptation measures

Most of the respondents (71.0%) received fund from different organizations to cope with the changed situation caused by waterlogging. Moreover, most of the respondents (70.8%) said that they had raised fund by themselves for mitigating vulnerabilities caused waterlogging.

Table 5.6.12.1.: Organizational fund for adaptation

Organizational fund	N	%
No	116	29.0
Yes	284	71.0
N	**38**	**100**
Fund raising		
No	117	29.2
Yes	283	70.8
N	**38**	**100**

5.6.13 Women's leadership role in the society

Women are almost half of the total population of Bangladesh. In addition, women are considered to be the best household managers, even during disastrous situation. So, women's leadership is very important to mitigate the vulnerabilities induced by all sorts of disasters. Findings of the study show that during normal time 15.8% women can play their leadership role within and outside their family. More specifically, they can contribute as a decision maker both inside and outside their family. Rest of the women said they could play their roles as a leader neither inside home nor outside home. One of the participants said:

> *"…male leaders, especially religious leaders, aged person and elected members of the local government are members of the community-based committee. The main role of this committee is to ensure peace and harmony in society; in case of any emergency, they sit at mosque where female are not allowed to enter."*

In contrast, during disastrous situation, women's role as a decision maker becomes predominant in the society. Findings of this study show that a great majority of the respondents (90.5%) could play their role as a decision maker during disaster which was almost adverse compared to normal time. Possible reasons might be temporary migration of male members in search of work and/or absence of male members in the family.

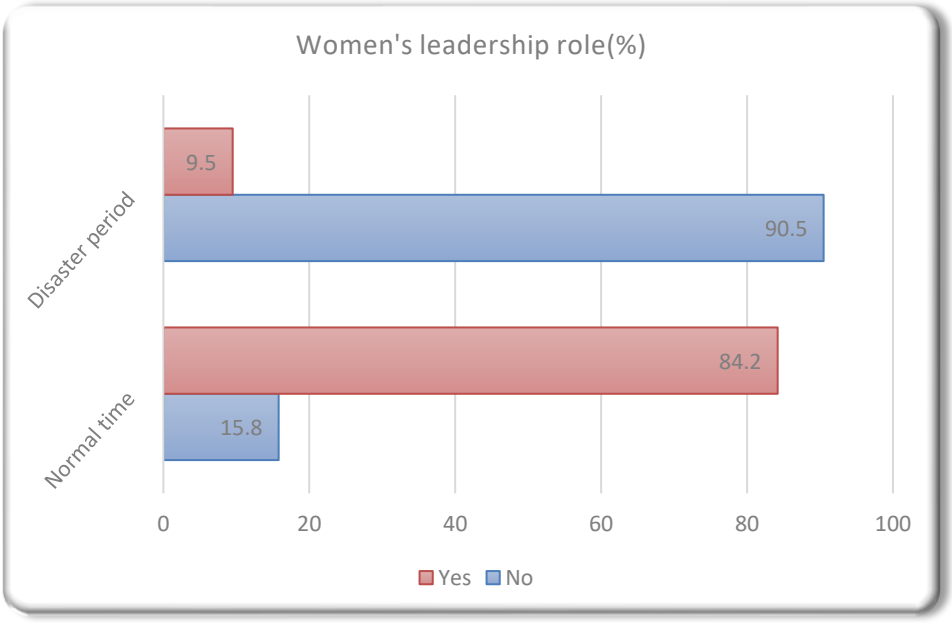


Figure 5.6.13.1.: Women's leadership role in the society

5.6.14 Organizational measures to mitigate vulnerabilities

KII participants reported that few measures have been taken by concerned authorities of GO and NGO. Chairman of the local union council mentioned that they got approval for constructing small drains to remove water, although the plan was under processing. In addition, under direct supervision of union council pump plantation plan was implemented to mitigate waterlogging induced vulnerabilities. In addition, executive engineer of the concerned city corporation said that they initiated canal digging project to ensure proper water flow. Nonetheless, City Corporation allocated fund for construction of roads and culverts. City Corporation also got approval of fund from executive committee of National Economic Council (ECNEC) to block and reconstruct roads suitable to mitigate waterlogging. Moreover, all the participants said that NGOs provided latrines in their area, although the quantity was inadequate.

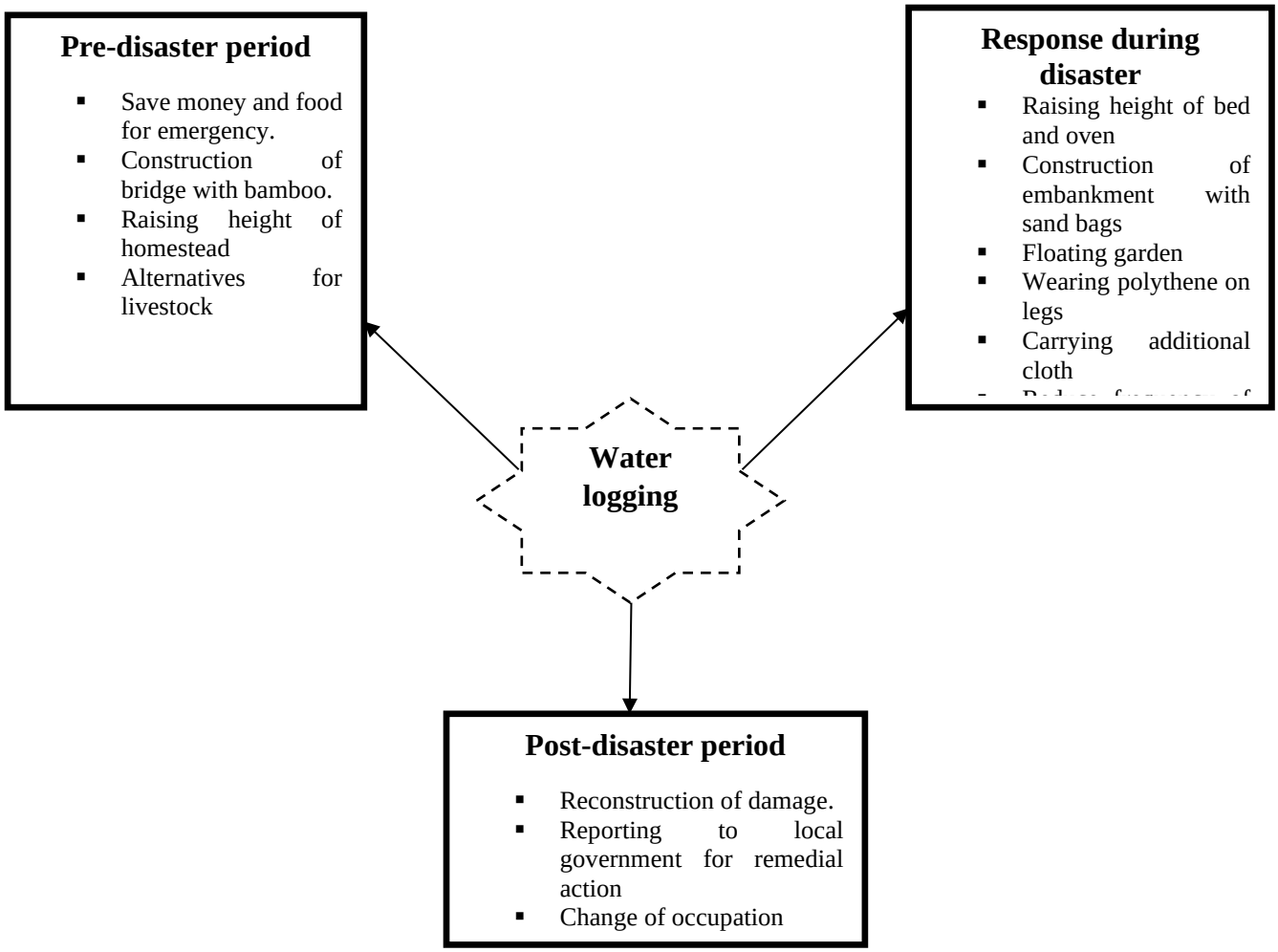


Diagram 5.6.14.1.: Indigenous coping strategy for waterlogging

5.7 Recommendations to mitigate vulnerability caused by waterlogging

Based on lived experiences respondents mentioned their recommendations to manage and/or reduce waterlogging in their area. A great majority of the respondents (96.2%) recommended cleaning the drains of their locality to ensure proper flow of water. Again, 94.8% respondents focused on cleaning the sewerage drains regular basis. Majority of the respondents (77.5%) also emphasized on engaging local community people in the process of managing waterlogging in their locality. They added that women from the local community should have active participation in the decision-making process. Some respondents (64.5%) mentioned about raising awareness about discarding wastes into particular place (dustbin). Some respondents suggested cooperation within and between institutions and organizations to make comprehensive plan for reducing vulnerabilities of the local people. In contrast, some respondents (61.0%) said that long term policy is required to reduce waterlogging instead of short term or temporary solutions.

Table - 5.7.1.: Recommendations to reduce waterlogging

Recommendation	Response	
	N	%
Natural drainage canals for rapid water discharge	171	42.8
Taking actions against illegal encroachment of low-lying areas	204	51.0
Taking actions against unplanned buildings in wetlands	211	52.8
Ensuring regular cleaning of the drains	385	96.2
Controlling disposal of domestic and industrial solid wastes into drain	229	57.2
Taking long term measures	244	61.0
Cleaning sewerage drains regularly and adequately	379	94.8
Several new canals have to excavate for drainage	77	19.2
Raising awareness about waste disposal	258	64.5
Relief materials and implement rehabilitation projects	242	60.5
Increasing coordination between GOs and NGOs	246	61.5
Increase community engagement	310	77.5

All the participants participated in case study opined that due to the deep rootedness of the problem measures taken by group of people or from personal sphere is not able to resolve this problem. In contrast, majority of the people of this area are outsiders; they have hired residence here to live temporarily. So, they might not be interested to spend money for the development of the locality. Moreover, they do not have the ability to spend money. In these circumstances, they recommended GO and NGOs assistance to resolve the situation through developing drainage system. They also recommended raising the height of the locality compared to nearby areas.

According to all the FGD participants the area where they were living was low land. So, in order to mitigate waterlogging, it was necessary to raise the level of land so that water may not enter into. Some participants said that it is necessary to ensure proper water flow through maintenance of drainage system. Majority of the participants recommended to have assistance

of the GO and NGOs to build effective drainage system. They also suggested keeping those drains clean so that water could move easily instead of being logged.

KII participants emphasized on collaboration between key stakeholders (i.e., GOs, local representatives, department of public health and local communities) to formulate and implement a comprehensive waterlogging mitigation policy. According to them, to ensure sustainable management of urban system coordination is needed between public and private sectors. In addition, they recommended setting large pipes to enhance water supply. Participants also focused on changing conventional drainage system to avoid unwanted obstruction of water flow. Some participants suggested digging pond for drinking water reservation. Some respondents thought it was important to set up two/three pump houses at different suitable location to minimize the adverse impact of waterlogging. However, all the respondents opined to make public aware about the impact of waterlogging and to take necessary measures from community level. Existing literatures on waterlogging suggests restoring natural drainage system through canals for rapid water discharge proper measures are needed to check anomalies in the drainage system and restoring where necessary (Rahman and Debnath 2015). Moreover, in our informal observation we found in a single day the project area produce about 500 metric tons of wastage but there is hardly and good management system noticed to dispose it properly.

Chapter Six
Discussion

Disaster and gender issue is indeed a complicated and mystifying issue which deserves research from a diversified perspective. In particular, socio-cultural, political and economic causes of exclusion of women are seen here and at the same time it is found that adverse shocks such as natural disasters destroy social system. In this research, women's vulnerability, adaptation strategies and barriers of adaptation have been examined. In this concluding chapter, the theoretical implications, relevance of literature with empirical findings and finally the conceptual framework of the study with pragmatic findings are placed by doing a brief review of the study.

6.1 Summarizing the findings

Although women try their level best for the sustenance of their household, but a little attempt has been taken to document the women's experiences related to disaster vulnerability and their attempts of risk reduction in Bangladesh (Nasreen, 2012).

Unplanned development and lack of proper maintenance is the reason of waterlogging. Rainwater in the city area needs proper drainage system to flow out from the city to nearby rivers or water body. Natural and planned canals including water body like lake or ponds are the main means to drain out this rainwater at rainy season. But due to un-planned construction and encroached, filled up or diverted water body or canals create obstruction to the natural flow of rainy water and cause severe waterlogging in the city. This waterlogging not only create suffering to the people's daily life, but also directly impact on economic, social, physical and environmental development. The people living in this area have a paralyzed life due to the waterlogging and their sorrows have no bounds. The government although take some initiatives to solve the waterlogging at the rainy seasons but those are not even close to meet the needs. Rather government should take comprehensive and priority based corrective action and plans it such a way that can solve the waterlogging problem in upcoming years as well. Destruction of natural drainage system and water bodies along with ignorance of taking necessary and proper action gradually pushing the city toward a slow death of its hydraulic system. Sustainable development of the city is highly connected to the city's sustainable drainage system. The drainage system is like a blood vain to the city without which the city won't sustain for long. If the drainage system does not perform smoothly, it won't cooperates other utility

services to work properly, because all these utility systems are interconnected and interdepended. And a sustainable drainage system must include proper management of its surface water's flow and reserving other water resources. To ensure a sustainable drainage system and other utility systems a comprehensive coordination is needed among urban development authorities (e.g. water management authority, road development authority, urban development authority etc.) and public and private sectors. With the successful empirical data, this study leads to better understanding of the disaster, climate change, waterlogging, gender and vulnerability discourse and women's role in disaster risk reduction. This study gives a better understanding about how gender and gender relation interconnects with other socio-economic, cultural, religious local practices and affect vulnerability, coping and adaptation mechanisms of the women in the DND embankment area, Narayanganj, Bangladesh. This study also gives a better understanding about how vulnerability during disastrous time becomes disproportionate for gender and why women are disproportionately vulnerable though disasters are gender neutral.

Further this study finds that women are also agents of changes and put decisive contribution if societal attitudes become flexible to women. Study reveals that changes and improvement in daily practices and works are manifested in the urban area. It is revealed that women contribute remarkably to the family but not significantly in community due to socio-cultural and behavioral trends. More importantly key findings can be utilized to develop more equitable and gender friendly policies. It is important for both policy makers and practitioners to take gender issues into consideration to ensure vulnerable women can cope and adapt better with disaster in the urban area. However, the findings of the study already presented in table, charts and graphs in previous chapters, so the key arguments will be discussed here to draw a conclusion. This chapter starts with a discussion of the findings of this study in light of the major research questions and sub-topics then research and policy implication, limitations and suggestion for further study are discusses in the context of experiences the reseatrcher have had during field work.

Women in this study had less knowledge about proper disaster risk reduction. They were more dependent on traditional belief on 'fate' and believed that measures taken from individual level would not be effective to reduce vulnerabilities. More precisely, they surrendered to the nature and almighty and passed their lives. It was tough to distinguish between knowledge of the participant of the study area but based their activities related to disaster management, perceived knowledge about disaster management it can be said that participant of Shiddirganj,

Narayanganj were more proactive compared to other areas. The possible reason behind this might be the duration and frequency of waterlogging was higher there. Nonetheless, women of the study area mentioned that they assisted their male family members to prepare for disaster risk mitigation (e.g., preparing floating garden to meet the demand of vegetable during disaster, wearing polythene bag and gumboot to avoid contact of water, reducing number of cooking times, construction of bamboo made bridge, etc.) but in conclusion it can be said that the measures were not enough to protect themselves from the impact of waterlogging. Proper training on disaster risk reduction and awareness rising is suggested for the participants. However, in broader sense the major reasons behind women's vulnerability during waterlogging were associated with economic, political, cultural and behavioral. To begin with the explanation of the economic reasons, the findings of the study show that the monthly family income and expenditure of the participants ranged between BDT. 1000-10,000 and above but it does not prove the women's access to that amount. Only 25% of the total respondent had their own income and 5% of those respondents said that they could spend their income according to their will and necessity. So, these findings suggest that lack of women's entitlement is one of the key reasons behind their vulnerability. On the other hand, lack of women's participation in political activities and decision-making process made them to stay behind the development process. Both male and female have to play significant role to ensure women's participation in decision making process. Male or dominant persons of the society will have to give the space for women to take part in discussion about social development and implementation of their opinion will give them the opportunity to participate in the future. But the finding of the current study has revealed that women did not participate in decision making process and male also did not ask them to participate. GOs and NGOs can reduce this gap through formulating women friendly disaster management policy. In addition, GOs and NGOs patronization in training and awareness rising can increase women's participation. Moreover, women should be trained on rehabilitation and reconstruction activities so that they can repair the structural damages by themselves. Most importantly, cultural and behavioral factors keep women behind the disaster management process. Traditional social norms hinder women to work like a man. In addition, women's traditional dress code also makes women vulnerable during waterlogging as the findings show. Overall, lack of long-term development policy and unplanned urbanization are also liable for waterlogging and vulnerability of the inhabitant of the DND embankment area.

In addition, the patriarchal society, positionality of women, gender norms and roles their needs, perception about risks, risk level, susceptibilities, and abilities are different in contrast to their male counterpart (Azad, 2013). Moreover, established gendered division of labor determines and/or restricts socio-economic, political and cultural opportunities for women in Bangladesh (Nasreen, 2000). Besides, low level of educational attainment also deters women to receive equal opportunities compared to men of the same society (Islam and Sultana 2006). Frequent disaster, poverty, low level of educational attainment leads to women's involvement in informal sectors, although women's economical involvement remains unrecognized and unpaid within and outside family, child marriage, sexual abuse, domestic violence, prostitution, dowry and many other social problems (Azad, 2013).

Women and girls in developing countries, especially in semi-urban slum areas occupy several hours in a day to collect water and manage it in household (Aggarwal & Punhani, 2015). Rapid growth of urban slums, increasing rate of natural disaster leaded by climate change, changing gender roles and redefining household roles, women are most likely to spend shared proportion of time in meeting their practical needs during waterlogging. Pre-planned gender-based education; skill development and income gap are contributing factors behind gendered vulnerability. It is therefore very important to explore the inclusive robust capacity and role of urban women to face the challenge of rapid urbanization and climate change. Vulnerabilities to disaster are not however, equally distributed all over the world because of variation in economy, culture, development process, settlement process, politics, resource management etc. which is certainly putting an increasingly a segment of people at higher risks than others.

There are many research has been conducted on waterlogging and especially on DND embankment area but the current study is especially focusing on role of women in DND embankment area to reduce disaster risk. This study also aims to know specifically impact of waterlogging on women so that potential recommendations might come out through this study find out root causes. In addition, this study has also explored women's role as a disaster manager in different phases of disaster, more especially waterlogging. Finally, in this study, the researcher has explored gendered inequalities in terms of distribution of socio-political and economic opportunities so that identification and reduction of those disparities might contribute to sustainable disaster risk reduction.

The sufferings of thousands of residents in DND area is a known issue. It is necessary to take an urgent action to find a solution to the problem. As well as improving the drainage system,

the canals to be retrieved. We expect that authorities will take steps to reduce the sufferings of DND embankment area.

6.2 Relevance of previous literature with empirical findings

The following section depicts the extent to which literature is relevant with the field study. Most of the research findings are consistent with existing literature. However, there have been some improvements in gender role over the last few years.However, the socio-demographic background of this study show that respondents came from diversified socio-economic background.

Several studies have been conducted on waterlogging and women's vulnerabilities, but this study is different in that sense it has explored women's vulnerabilities in the urban area. To keep pace with world rapid urbanization is taking place in Bangladesh. The rate of urban growth in Bangladesh is now approximately 35% which is one of the fastest growth (Kamal & Dev, 2018) rates in the world. Findings of the study show that average age of the respondents' is 33.2 years. According to the national census report 2011, majority of population in Bangladesh is young and belongs to the age group 25 years (Samad, 2015). Monthly family income and expenditure level of most of the respondents is 10001 and above which denotes the middle-class socio-economic status of the respondents. In recent time Bangladesh is titled as lower-middle income country in terms of its socio-economic status. Bangladesh has USD 1324 as per capita income in 2014-15 (Bangladesh Bureau of Statistics, 2013; Ministry of Finance, 2015: xvii). According to Karl Marx, economically powerless class suffers more in disastrous situation. Apparently, it seems Marxist economic determinism is not true for the respondents of this area but the key question is whether women have access to family income or not! In addition, does a woman earn the livelihood of her family or not!

Findings of the study show that 94.0% of the total respondents were married and they belonged to nuclear family. A rapid shape-shifting is seen in the conventional family structure in Bangladesh and lots of literature also supported this (Chowdhury, 2016, May 14; Samad, 2015) (Adnan, 1993; Kabeer, 1994). According to BBS (2013) literacy rate in Bangladesh is approximately 65% but the findings of this study show the illiteracy rate in the study area is still 70.1%. This finding clear depicts the socio-economic backwardness of the study area. Illiteracy, lack of skill and awareness of the inhabitants of the study area might be some other confounding factors behind the vulnerabilities of the participants. Most of the participants (67.1%) reported that their family had ownership of agricultural land. Still now, over 80% of

the people in Bangladesh is involved in agriculture and related occupation. So, the findings of this study show that the participants are still dependent on traditional modes of income and waterlogging is a threat for their income and opportunities. This study has revealed that only 6% of the total respondents were factory worker and 8% had petty business. In contrast, 75% of the total respondents were housewife.

According to the participants diversified educational institutions are available in the study area but due to long-term waterlogging regular functions of the educational institutions are hampered. Students cannot go to school. Although infrastructures of the schools do not damage mostly but approach roads get inundated. Findings of the study suggest that the type of natural disaster is different compared to cyclone prone coastal belt or flood prone northern Bangladesh (Hossain & Islam, 2000; Khalil, 1992; Khan, 2012). A great majority of the respondents of this study said that waterlogging and heavy rain is the most frequent disaster in their area. According to them sudden and untimely heavy rain caused waterlogging in their area. Although existing literature is aligned with this data but findings of this study also suggest that during dry season and winter season some of the areas in DND embankment area become inundated with domestic and industrial liquid wastes. So, management of industrial wastes and domes water is important for effective management of waterlogging in the study area. Existing literature on waterlogging in DND embankment area shows waterlogging creates humanitarian crisis in living condition, health care system, food and drinking water crisis, social and physical insecurity and social networks (Rahman & Debnath, 2015).

Early warning system is considered to be the fundamental of disaster risk management system (Grayman, 2001). Only a few years ago there was no such technology to forecast waterlogging but the recent invention of real-time remote monitoring of water quality can predict the movement of water with the use of sensors and water flow level. Waterlogging and early warning system has already been developed and in place in different cities in the world (Huang, 2017; Liu, 2014). The invention discloses an early warning and emergency responding device and method for waterlogging of separation-system rainwater pipe networks and belongs to the technical field of urban construction administration and maintenance. According to the device and method, a technique, based on coupling of a GIS (geographic information system) technique and an online monitoring system, for performing early warning and emergency response on waterlogging points of the separation-system rainwater pipe networks according to an optimized rainstorm intensity formula is developed; the device and method is applicable

to newly-built and improved separation-system rainwater pipe networks of new and old cities. Rainstorms are the major meteorological disaster in DND embankment area in Narayanganj because heavy rainfall leads to flooding and urban waterlogging and other derivative disasters. The findings of this study show that there is no such waterlogging early warning system in the study area. Approximately 12% of the total respondents said that they were not aware about the concept waterlogging although they were experiencing it. A great majority of the respondents who knew about waterlogging received information from print media (93.4%).

Findings suggest that majority of the participants (approximately 76%) suffered from want of drinking water. In addition, unemployment and damage of mud made households were also reported. Again, respondents reported spread of water and air borne diseases, damage of agricultural crops, malnutrition among the mother and children, damage of household assets, including fishing net, bed, furniture, etc. Anisha and Hossain (2014) conducted a study in Teknaf found unemployment problem, unhealthy environment, and damage of infrastructure as the major impact of waterlogging. However, the study of Hossain (2013) suggests that infrastructural damage, loss of business and spreading of diseases were the impacts of waterlogging in a pourasava named chalna which is located in Khulna, Bangladesh. Causes of prolonged waterlogging are almost similar with existing literature (Anisha and Hossain, 2014; Hossain, 2013; Rahman and Debnath, 2015). Findings suggest that low lying land, inadequate drainage system, encroachment of land, lack of awareness among the dwellers are reasons behind the waterlogging and related vulnerabilities of the participants. In addition, this study has also showed that lack of long-term planning and politicization of vulnerabilities are also liable for the waterlogging and vulnerabilities. For precise understanding of case and consequences of the problem the discussion has addressed the levels (e.g., individual, social and natural and institutional) related with impact and vulnerabilities. A study conducted by Rahman and Debnath (2015) in Dhaka-Narayangonj-Demra (DND) reported unplanned urbanization as the root cause of waterlogging in the study area. Multiple contributing factors are found behind waterlogging in the area. Most common reasons are the existing river's natural flow has been changed, riverbed's increased in height due to sediment deposit and finally it's carrying less water to sea, and the sluice gates are hardly maintained by the authority (Onneshan 2006). Post-traumatic stress disorder (PTSD) is a common post disaster psychiatric disorder which is caused wide range of mental and physical trauma resulted from disaster (Neria, 2008; Galea, 2005). The current study has revealed that 89.8% of the total respondents were suffering from PTSD. They reported that unemployment, loss of household assets,

temporary migration of male members and tension about upcoming days made them worried and some of them were found suffering from depression.

Literatures on economic impact of waterlogging suggest that it damages the normal business activities of the people of the affected area (Rahman & Debnath, 2015). In addition, disruption of traffic system, loss of working hour, increase of construction cost and increase of treatment cost area some other economic impact of waterlogging (Alom, 2014; Khan, 2017). One of the major impacts of waterlogging is the disruption of educational activities. A study conducted in the *Dhaka-Narayangonj-Demra (DND)* area showed that 68% of the total educational institutions were damaged due to waterlogging (Rahman & Debnath, 2015). 98.2% respondents of this study said that school infrastructures in their area were damaged due to waterlogging. During waterlogging it became difficult for the school going students to attend school as well as for the school authority to continue their activities. Likewise, the finding of this study shows that majority of the respondents (79.2%) said that they faced problem to send their children to school. Furthermore, teachers of those schools in the study area reported that class rooms and toilets were not use-worthy during waterlogging.

Along with all other damage economic loss make women more vulnerable as per the participants reported. Literature shows inhabitants of the study area incurred huge amount of economic loss every month due to the disastrous situation (Alam, 2014, August 30; Azad, 2015, September 11; Rahman & Debnath, 2015). Findings of this study suggest that women of the study area used to borrow money from their neighbors, some of them involved in temporary job. Some participants also asserted that temporary migration of male members during waterlogging made women to become more vulnerable. Findings of case study have revealed that 9% of the total respondents belonged to female-headed household. In addition, 9% respondents contributed to their family income along with their male members. So, this is a significant change in terms of women's participation in workforce and contribution to family income.

Empirical evidence shows that disaster and migration have strong correlation. People of the disaster prone and affected area migrate temporarily and sometimes permanently due poverty, landlessness, search of livelihood, crop failure, livelihood insecurity, damage of agricultural crops and assets (Lein, 2000; Alam, 2016; Gray, 2012). Previous studies on waterlogging showed rural–urban migration but the scenario of this study is a bit different. Most of the

participants mentioned that they did not migrate during waterlogging because they were the permanent resident of that area. They added that that they had no other place to go except their dwelling place. Findings of the study show that most of the participants of this study temporarily migrated to nearby place, like railway station, embankment and so on.

Originally disaster response system is originated from military institutions and no doubt that intuitions were male dominated. So, all the fields of disaster response is highly male domination oriented and activities, management traits, internal promotions etc in the response system is often male domination oriented as those are developed and misattributed by and to males. Although a few studies show some positions in disaster response and in leadership positions need masculine traits, but definitely those studies lack capability of women in the same position. Still male domination and stereotype in management is practiced in disaster response (Enarson, 2010). This study has gathered evidence that promotion to women in certain disaster management role, depending on their strategic decision can bring advantage to fight against natural disaster (Ha-Redeye, 2006).

Existing gender roles including daily activities of women in household sectors and in society always disrupts and get reshaped by disaster than that of male. Traditional role and responsibility of bringing water or firewood, collecting daily vegetables and substance for family and managing other chores of a family always belong to women and whether it is a disaster or not – women have no way to opt. out of the responsibility (Bradshaw, 2015; Dominey-Howes, 2016).

Findings of this demonstrate that women of the study area are at more risk of disasters like flood and waterlogging. Participants have reported that they had to pass long time with wet clothes. In addition, during waterlogging cooking became one of the most difficult tasks at household. In order to mitigate the vulnerabilities, they had put bricks under woven to make the woven high. Some participants fixed their women on the bed to avoid contact of water. Findings show that women used to cook once instead of two or three times to reduce the pressure and pain of cooking.

In developing nations most of the time disasters put an obstacle and limit access of people to main food/crops and this finally result in significant malnutrition to the people. Women, old, aged people, pregnant and lactating women, children and particularly vulnerable people with

low nutrition become more vulnerable at speedy break out of malnutrition base diseases e.g. diarrhea and measles (Coil, 1999; Hossain, 2013).

Existing literature also suggests that women specially the female-headed households are more at risk of malnutrition (Sapir, 1993). A significant number of respondents of the study area belong to female headed household. Moreover, Bangladesh is a traditional country where particular social norms make them more prone to vulnerability during disaster. Traditionally women take their meal once all the members especially father and mother-in-law, children and husband take their meal. Participants of this study reported the same issue. They added that sometimes they had to go without food due to not having enough food. And most of time they used to eat less compared to normal time and that is due to shortage of food. During waterlogging privacy of female members become threaten due to living at railway station and open places like this. Some participants mentioned about being abused by male members of their neighboring people. Pregnant and lactating women suffer for want of proper sanitation problem during disaster as the findings show. In addition, physically challenged women face extreme problem during waterlogging. They cannot move through knee deep water.

Half of the total respondents mentioned that they had sanitary toilet but during waterlogging they could not use their toilet. During these periods they used to build hanging toilet for temporary use. Some people shared their closest neighbors and relative's toilet during this time. However, evidence of open defecation has also been mentioned by the respondents. National and international studies on disaster and sanitation problem reported same difficulties for women (Sundari, 2003; Assar, 1971).

Health status is a key indicator of human well-being, but during disaster it is mostly disrupted and disadvantaged group of the society especially women, aged and elderly people become worst victim. Physically, mentally and emotionally they are affected (Sundari, 2003). Sexual and reproductive health risks increase for women during disaster (Nasreen, 1995; 1998; 2010). Findings of this study has revealed that all the inhabitants of the study area suffer from various types of health problems, like water borne disease, scabies, vector borne disease, etc. but during waterlogging they could not go to hospital for treatment. Respondents used to go to Narayanganj city to get treatment from government hospitals and private clinics. Participants added that the hospitals in their locality did not have the capacity to serve the affected people during disaster. They also said emergency health care facility should be available at nearby

place during disaster, because during waterlogging they could not move to hospital due to the inundated situation.

Perception of women about climate change, natural disaster and women's vulnerability show that a great majority of the respondents are aware and agree about engendering nature of disaster and more specially waterlogging. Awareness and information about waterlogging is one of the major preventive majors for the waterlogging people. Findings of this study show that most of the people had awareness about waterlogging and disaster, but comparatively fewer participants had information and awareness about climate change. In addition, most recognized source of information has been identified as electronic media, viz- radio, TV, etc.

Findings of the study show that there is a significant relationship between female-headed household and impact of waterlogging (df= 6, V=0.14, X^2= .000***). Majority of the female-headed household reported that waterlogging had high and medium level of impact on their livelihood. Head of the households had to take care of their own as well as other members of their family. In addition, evidence of sexual harassment, problem to get involved in temporary job were also reported.' some participants mentioned that being a female they could not migrate to other place for temporary job and even could not pull rickshaw likewise their male counterpart.

To build a disaster resilient community, contribution of indigenous knowledge and skill are found very useful in terms of theory and practices (Mavhura, 2013; Ye, 2009). This study has explored women's natural survival approaches along with disparities in their capability to manage during disaster and more especially with waterlogging in four waterlogging prone villages of Narayanganj city corporation, Bangladesh. Findings suggest that women of the study area could rarely take any indigenous coping mechanism. More importantly, socio-cultural background, nature of the disaster neither permitted them to take effective preventive measure nor was measures taken from individual level fruitful. Participants reported that actions from governmental and non-governmental authority were required to reduce their vulnerability. Moreover, women of the study area used to assist their male partners to build floating garden to meet the demand of vegetables, sandbags to move inside home and crossroad, preparing boat and bridge made up of bamboo, etc. Some participants used to wear polythene bag and gumboot up to their knee to avoid scabies and other skin diseases. Some respondents massaged mustard oil for protecting skin disease and mosquito. Some working women used to carry alternative clothes with them to wear after arriving at their working place.

Some respondents raised the height of their residence, woven, cot and toilet thinking about the vulnerabilities related to waterlogging. However, all the participants said that it was very difficult for women to mitigate vulnerabilities through indigenous coping mechanisms due to the complexity and deep rootedness of the problem. In addition, multiple stakeholders (e.g., GOs, NGOs, community members, and so on) are involved with this process an action taken from individual levels become ineffective due to lack of resource, funding and awareness of the community people. Moreover, existing purdah system and patriarchal social structure creates obstacles against women's participation in community-based disaster management process. Approximately 60% of the participants reported that their indigenous coping mechanism were not effective to prevent waterlogging. They also suggested interventions to make women aware and capable for disaster management. All the participants of this study mentioned that there was no single community-based organization for women in their society to work on disaster management and train up community people on disaster governance. Women used to share information about their duties during waterlogging as a member of the society. All the participants shared their knowledge with their neighboring people so that others could survive fighting against the disastrous situation. Findings of this study show that women's role as a disaster manager within family become more active during disaster compared to normal situation, but lack of organizational support and training did not allow them to work outside home.

6.3 From theory to practice

The author used theory theoretical approaches on disaster and women's vulnerability. Association between theory and empirical data has been discussed in this section. Marxist approach on gender and disaster asserts that disaster induced vulnerability is highly influenced by political power lines and economic conditions. This novel approach also says people who are not wealthy, minority group of the society (includes, gender-based inequality, politico-cultural and religious minority, race and ethnicity-based minority, etc.) and marginalized people opt to live in geographically vulnerable areas and live in substandard housing. Member of these groups are less capable to fight against adverse effects of natural disasters. Findings of this study suggests that 75% of the total respondents' area housewife and they do not have any permanent source of income. In addition, they do not have equal access to spend the family income compared to male counterpart or main earning member of the family. In contrast the rest of the respondents had their own source of income, but they also did not have their

economic freedom. Findings have revealed that the working women had to show honor towards decision of their male family members, like-husband, son and sometimes father-in-law. Moreover, almost all the participants said that they did not have political right in that sense they had their female representative in local government but women representative could not give their decision in any formal forum. More specifically, women's position in society as well as in family is still ornamental. Their representativeness with their participation denotes a step forward but real development would be ensured with their active participation both in economic as well as in political arena. Findings of the current study show that most of the residents of DND embankment area did not have any other place to live in or they were bound to live in this area due to their low level of income and socio-economic status. A great majority of the respondents lived in slum and nature of their housing was semi-structured (*adha-pakka*). So, this finding is also aligning with Marxist proposition about marginalization and vulnerability.

Findings of the study have revealed some mal-practices, like-politicization, and encroachment of land and illegal construction of building in wetland. Industries were built in agricultural land and industrial wastes were dumped in the drain which disrupted the natural flow of water. As a political economist Karl Marx focused on rise of capitalism and inequalities in the society. Profit maximization is the key objective of the capitalist society. Owner of the industries exploits not only their fellow labor but also the environment through polluting air, water and other natural sources. So, this principle of Marxist approach is also true for the women of the study area.

Finally, Marxist approach emphasized on bringing equality in relief distribution, disaster rehabilitation and reconstruction. Women's indigenous knowledge should be utilized for better disaster governance.

According to vulnerability theory people become vulnerable when they fail to withstand adverse consequences of stressors and shocks from multiple sources. Exponents of this theoretical background classified type of vulnerability which includes both physical and psychological vulnerabilities; existing social process and structure can make people vulnerable to any particular situation. Role of women in reducing disaster risk and vulnerability can also be explained from the analysis of vulnerability theory. Social structure of the DND embankment area is not favorable for women to fight against waterlogging and other natural calamities. They are exposed to as well as societal natural hostility. Approximately 90% of the women participants reported that they were in a psychologically disturbed situation due to dual

work burden during waterlogging. Not only their psychological disturbance, but they also had lots of physical challenges and most of them were due to their sexual and gender identity. Vulnerability approach says though disaster affects all the people in the society but there lies a varying impact for women. Findings of this study has revealed that during waterlogging women faced health related vulnerabilities and suffered from various types of diseases induced by disaster. But majority of the women could not get proper treatment due to not having adequate health care services in the local hospital and clinics. Women raised the height of their women by putting bricks under the stand of the woven. Women suffering from malnutrition had to eat less food due to traditional social norms. During waterlogging it was difficult for both men and women to move through knee and sometimes waist deep water, but women had to face major difficulties because they stay at home most of the time. Furthermore, women of the study area reported various types of sexual and reproductive health related complications due to wearing wet clothes for long time. Moreover, it's solely seen as women's responsibility to collect drinking water from even distant places and ensuring food supply (purchasing or collecting) for the family member.

Social vulnerability is deep-rooted in gender-based inequality and this proposition of the vulnerability theory is true for the participants of this study. According to the findings of this study women had limited and in some case no access to power structures and resources. They could not give their opinion for social reconstruction and waterlogging mitigation process. In addition, they could not use social resources and even family resources without permission from male members of the society and thus their vulnerability increased during waterlogging situation. Moreover, existing political systems and ideologies of the politician were patriarchal in nature. Majority of the participants mentioned that social problems of their society were discussed at mosque where male representatives could participate only and based on their opinion measures were taken. This finding proves women's positionality in the society and family. Besides, women in the study area faced wage discrimination compared to their male counterpart.

Dynamic pressure is required for reducing women's vulnerability and enhancing their capacity if we want them to play effective role during disaster. Due to not having proper training on disaster governance, lack of local investment on women's capacity building and weak role of media makes women to be vulnerable during disaster. In contrast, in order to change the situation, we need to improve the above-mentioned conditions through dynamic pressures from

multiple stakeholders. Nonetheless, there are some macro forces, like- rapid urbanization and population growth and deforestation, etc. are involved with the feminization of disaster. So, it is necessary to necessary steps to control these forces so that women can play their role as an effective leader during disaster. In spite of making dynamic pressures unhygienic physical environment, fragile local economy, poor social capital and lack of public action make women vulnerable during disaster and finally due to the above-mentioned factors make women vulnerable during all sorts of natural disaster.

There are number of factors which are involved with natural disaster and women's vulnerability. More precisely, it is a chain of social, environmental, political and economic system and collapse and/or dysfunction of any of one of more component (s) make people vulnerable. And as a vulnerable group by all respect women become the worst victim of natural disaster.

Finally, Ecofeminism approach is another approach which is useful to show the relationship between roles of women in disaster risk reduction. Ecofeminists have re-constructed the relationship between mankind and nature. 'Women's position in the society lies very close to nature compared to men' and it is considered to be the key proposition of Ecofeminist theory. Theorists of this approach argues that due to this closest position woman can either play the best role to protect the environment and human being or can become the worst victim depending on the circumstance. If women get the proper socio-physical condition they can be very good leader in disaster risk mitigation.

Exponents of this approach also argue that human-being, especially men dominate the environment to lead a comfortable and luxurious standard of living but do not consider the capacity and tolerability of nature. As a result, when nature reaches to its edge in terms of its tolerability, global warming, heat and cold waves, cyclone, tornado, flood, waterlogging and other natural disaster occurs. Likewise, men dominate the females in the society and rarely allow them to perform their leadership role. Traditional social structure and patriarchal mentality hinders women to come forward and play their role during disaster. Findings of this study also show the gap between male and female's participation in leadership role. So, resolution of the gender gap and their functions will make nature protected from evil actions of men.

Moreover, women and nature always compared as a resemblance to each other in respect to their nature of giving birth of their offspring. In other word, women and nature nurture the future of the earth in their body. In addition, women's place is confined in domestic arena and more like to an infant or animal. Women's ability and right of decision making is most of the time ignored. This proposition of ecofeminist approach is also true for the current study.

6.4 Explanation of the conceptual framework

The conceptual framework is drawn from the theoretical discussion and also a model was developed. The summary of theoretical framework with empirical findings is placed below.

From the field survey it is found that waterlogging occurs for various reasons. Among these some are identified as adamant causes for those the people are not being able to come out from waterlogging situation and years after years are remaining in inundated situation. It can be classified as historical, natural, structural, and behavioral. If we see the trend of waterlogging it can be seen that they are facing generation wise environmental vulnerability. The number of illiterate respondents found approximately 70% in this study. Over 67% respondents had agricultural land but less than 10% people depend on agriculture for their livelihood due to inundated situation. So, the traditional occupation of the respondents is abolishing gradually. In addition, as a part of the tradition, all women specially housewives maintained strict *purdah* and were not allowed to work outside. Although the situation has already changed to a large extent but still, they are allowed to do some specific works, not all type of works. So, occupational status also makes women economically vulnerable in the society. Findings of the current study shows that women suffer a lot for want of job opportunities during and after waterlogging. In addition, people who are involved in job in formal sector also face challenge to attend office or his/her other workplace. From the historical point of view, DND embankment was constructed to safeguard the area from flood, but the malpractices have turned it into a tool to preserve waterlogging.

Naturally physical (malnutrition) and intellectual (mental) underdevelopment drives the community. As a result, education status is very low and a feeble generation is again producing another week generation. From historical point of view, DND embankment was constructed to protect people from flood but in course of time malpractices and dysfunction of the project tools have preserved regular waterlogging for the inhabitants. Being part of traditional society percentage of working women is fewer compared to men. Although the situation is changing gradually but still there lies a clear gap between numbers of working men and women. Findings

of this study show that Women who were involved in income generating activities experienced difficulties to go to their workplace passing inundated situation. From the survey, lack of alternative work, for instance, people engage in service are almost absent or working as overseas employee is nil. So if we consider the historical cases it helps to preserve waterlogging situation. If we consider the record of natural disaster in current years by the respondents prove how adamant the cases are. From the structural point of view highly stratified society, impact of capitalism, half of the population (especially women) are out of income generating activities, corruption etc. have come out from survey. From the cultural or behavioral points many malpractices existing in waterlogging area those helps to keep the community in waterlogging situation. For instance, not involving women in disaster management process, women's lack of participation in political processes and lack of empowerment of women, etc. make vulnerable and cannot play their role as a disaster manager. However, due to poverty and lack of income generating opportunity domestic violence increases as the findings of this study show.

Disaster early warning is one of the key issues related to reduction of disaster induced vulnerabilities. Findings of this study have revealed that there is no such early warning system in place to make people aware about the upcoming waterlogging. So, respondents said that they could not take adequate preparation. They opined that if they had the early warning system they could take necessary preparation, like- gathering food and drinking water for emergency period and safeguard the valuable assets of their household. Nonetheless, raising awareness among the community members, provide adequate training is also necessary for women to enhance their capacity to mitigate disaster risk.

The conceptual framework is developed in such process to identify causes of waterlogging, then impact and finally identified adaptation process. The endeavor was to identify the adamant causes, constant negative consequences and harmful issues that hamper adaptation process as well. Through this process, the researcher tried to identify not only to clear picture of waterlogging situation but also tried to make clear why the adaptation process will become dysfunctional, or the community will remain in waterlogging situation rather come out of waterlogging situation through adaptation towards sustainable development.

Chapter 7
Conclusion

The thesis aimed to evaluate the role of women in disaster risk reduction in the DND areas using a mixed-method study. Further, the study emphasized the consequences of waterlogging on women, their role in risk reduction, the awareness-building mechanism to reduce damages caused by waterlogging, and finally major coping strategies people adopt for sustainable risk reduction with an extensive focus on women.

Chapter One discusses the background, rationale and objectives of the study. The chapter mainly presents a brief background of Bangladesh by focusing on major disasters and causes of frequent disasters. The chapter discusses that Bangladesh is one of the world's most climate-vulnerable countries due to its geographical location. Locational context influences the massive river system and its constantly unpredictable flows, soil conditions, the agriculture sector, and the livelihoods of millions of people. The chapter went on to reflect on the historical background of DND project. Also, it focused on defining the connection of disaster and women by separating the gender roles of males and females during the disaster. It argues that men and women have diverse roles to fulfil in society. Men and women have socially defined roles, obligations, and opportunities that regulate their relationships. In addition, there are gender-specific disparities in consumption habits, lifestyles, and resource availability. These affect how women tend to be more vulnerable during a disaster. The chapter mentioned objectives and research questions at the end.

The second chapter is named Literature review. The chapter reviews prior researchers' work on related topics that are pertinent to the study. The majority of the research focuses on disasters, climate change, and water scarcity in a variety of settings, with the goal of describing gendered disaster vulnerabilities and indigenous coping mechanisms used by people on a worldwide scale. Upon discussing relevant literature, the researcher identified the research gap and selected possible areas of contribution. This research gap facilitated the construction of research objectives and research questions.

The third chapter entails a theoretical framework and conceptual framework to assess how gender relations, socio-demographic factors such as resource access and entitlements, literacy,

positionality, religion, patriarchy, local social norms and practices, and other factors contribute to women's disproportionate vulnerability. The study used several eminent theories like Marxism, feminist theory among others to design the study's theoretical framework. The study also adopted various models (i.e., PAR model) to comprehend the research findings in a better way. In the end, the researcher developed a comprehensive conceptual framework by integrating various concepts and theories. A detailed discussion of the conceptual framework in accordance with the findings is placed in chapter six.

Chapter four discusses the detailed methodology of the study. The researcher discussed research philosophy, the rationale of selected methodology, data collection approaches, the field of the study, data collection process, sampling distribution, ethical issues, data analysis approach etc. among other topics.

Chapter five analyzed collected data using proper approaches. The chapter includes socio-economic data of the respondents, types of disaster people encounter, people's perception of waterlogging, challenges during waterlogging, causes of waterlogging, the social impact of waterlogging, key risks in the study areas, forced migration due to waterlogging, the vulnerability of women, health impacts, key strategies people adopt during waterlogging, distinct community coping strategies, women's leadership, etc. The chapter presented data in the table, figure, diagram format and selected verbatim responses of the respondents in interviews.

Chapter Six focused extensively on discussing the findings in accordance with theories, literature and frameworks to comprehend the uniqueness of the study and contribution to the body of knowledge. Firstly, the chapter provided a brief summary of the findings of the study. Secondly, it has contrasted the findings with existing literature. Thirdly, the chapter discusses the findings in line with the theories mentioned in chapter three. It discusses whether the findings support the theory or not very briefly. Lastly, the chapter explained the conceptual framework in accordance with the findings.

Chapter Seven concludes the study by briefly overviewing the chapters. The chapter also discusses key findings and provided some recommendations. The thesis ended with guiding the future researcher for possible areas of study related to the topic.

7.1 Significant Findings

The waterlogging system in the DND area made women living in the area more vulnerable than women living in other areas of the country. This study differs from existing studies in that other studies are mostly rural in nature, but this study specifically focuses on the waterlogging produced by the DND embankment. Although the study area is a suburb, it lacks practically all of the modern facilities that should be provided in a city. Although some of the houses have gas and electricity, owing to waterlogging, even modern facilities hardly decrease the risk to their lives.

Women in this geographical area afflicted by man-made disasters have evolved distinct coping mechanisms that they use to save their children and families. In this study, this new mechanism for saving families and children may be termed "coping strategy for urban poor." Existing research reviewed for this study found general coping mechanisms for women, but this study found a distinct "urban coping mechanism for poverty-stricken women." These urban poor women use their coping strategy as a group. For example, while working as a break breaker at a break company, they bring their children with them. In other circumstances, these women keep their 8/10-year-old children inside their houses with a bamboo-made door, allowing the children to see the outside world but preventing them from going outside on their own.

In water-logged areas, an elderly and wise woman occasionally leads an association, and she interacts with 10/12 families in the area on a regular basis to jointly build a coping mechanism. They assist one another by lending money, fuel wood, or rice when necessary. While this group of women goes to work, one of their family members, often adolescent girls, is left at home to take care of all the houses in the area. She also cooks for families in some conditions. The children of these urban poor women are enrolled in a local government school for general education. The majority of schools give pupils with tiffin. This benefits disadvantaged women in two ways. For first off, the children are fed a healthy and nutritious diet, and they are also safe while at school. Some impoverished families work as cobblers and construct sandals for their children out of the old shoes of their customers. Customers can purchase these rebuilt shoes from the cobbler.

This research produced few unique findings, which are as follows –

1. An embankment that was established to protect people from disasters itself produced disaster due to the unplanned nature of development that took place in the DND area which comply with the existing theories of Disaster and Development where it is argued

how development creates new disasters. However, it also indicates how disaster governance is critical to any effective disaster risk reduction measures which resemblance the Sendai Framework Disaster Risk Reduction (SFDRR) priority number 3 (three). It also found out how, the context of particular disaster is not only exacerbated by unplanned urbanization but also due to the dynamic pressure which include hikes in the land prices in the sub-urban areas in the developing countries which again ties back to the Pressure and Release Model (PAR) shown in the theoretical framework chapter.

2. Women were found to live in a highly patriarchal and male dominate society which limit their chance of getting engaged in any decision making let alone joining the community decision making process. While the finding is similar to many of the existing literatures, Nasreen (2008) argued that the burden of coping during a disaster heavily falls on women. However, in this case women were found to undertake any pro-active measures or coping measures to adapt with the disaster. Rather they solely depend on the decision making of the male counterparts for them. Therefore, even a crisis could not impact the gender roles and relations in the society which was found otherwise in many literatures.
3. DND area although unplanned, has access to many modern amenities of urban areas. Those amenities could not alleviate the impact of waterlogging disaster. The respondents were found to follow traditional coping methods like raising the plinth of the house or latrine, using boat etc. which is surprising.
4. Female Headed Households (FHH) are affected the most during this disaster, which also indicates lack of access to resources, assets and decision-making process which conforms to the findings from other literatures as well.
5. It was also observed that, despite experiencing this disaster for quite some time, no pro-active measures were undertaken by the government or community people. All the measures that were being undertaken while carrying out the study are mostly known as coping mechanisms.

7.2 Recommendations

1. Long-term planning for natural water discharge is required instead of artificial and short-term and initial resolution of the problem. Most often authority of the City Corporation and local government try to find out solutions which is not sustainable in nature but that is waste of money and leads to long-term vulnerability.

2. One of the major findings of the current study is the encroachment of low-lying lands of the DND embankment area. In addition, unplanned building construction in wetland is also a threat for the inhabitants of the study area. The implementation of all types of law is needed. Unlawful attitude in public and private life makes the community life miserable. Sometimes member of the local government does nepotism and allow their closest people to build temporary and sometimes permanent buildings in wetland. Lack of transparency and accountability of the local government and politicization and corruption hampers development indeed.
3. A great majority of the respondents reported that almost all the drains of the DND embankment area cannot function properly due to disposal of domestic and industrial garbage into drain. Furthermore, drains area not cleaned regularly. As a result of the negligence of the authority natural flow disrupts and causes waterlogging. So, the distinctive authority should monitor and ensure cleanliness of the drains.
4. The cycle of Disaster Management needs to be identified and practiced in community life in urban area. Especially waterlogging should get priority from GO and NGO side. Moreover, community-based committee should form where participation of women should be ensured as they are almost half of the total population and historically proved themselves as good disaster manager.
5. Local and community based informal job opportunity should be created to reduce poverty level of the DND embankment area and enhance capacity of the people to mitigate disaster induced vulnerabilities.
6. Awareness rising about proper waste disposal is required.
7. People who are dependent upon agriculture should be trained about alternative cropping to reduce food scarcity.
8. GOs and NGOs should focus on community engagement so that community people can take care of their own assets and reduce waterlogging.

7.3 Limitation of the study

In spite of some groundbreaking findings, this study has some limitations. One of most major difficult tasks was to manage interview schedule from the respondents. Although majority was the respondents were housewife, but they were busy with their household chores. In addition, sometimes socio-cultural restrictions created barrier for women to disclose gender sensitive

information, like- domestic violence, dowry, social conflict, economic status of the family and so on. Like all other social studies, respondents had their response biases. Besides, reported data does not always represent the actual scenario. Nonetheless, the researcher along with the research assistants tried our level best to overcome all sorts of biases and checked and re-checked validity of the data.

7.4 Suggested themes for future research

Despite many successes in fighting waterlogging, challenges are still ahead, and the need for further research in this field is on the rise. The future task on this field can exclusively focus on:

1. Sexual and reproductive health of women and adolescents.
2. Implementation of government safety net to empower women to fight against natural and manmade disasters.
3. Impact of waterlogging on female migrants.
4. Informal labor sector and old age security of waterlogging affected community.
5. Socio cultural malpractices and women vulnerability of DND embankment area.
6. Drinking water management and women's vulnerability in waterlogging prone area.
7. Agricultural revolution and waterlogging alleviation: problems and weakness
8. Strengthen NGO role in capacity building of women in DND embankment area.
9. Waterlogging and health risk of women.

Reference

Adnan, S. (1993). Birds in a cage: institutional change and women's position in Bangladesh'. *Women's position and demographic change*, 285-319.

Alam, G. M. (2016). An assessment of the livelihood vulnerability of the riverbank erosion hazard and its impact on food security for rural households in Bangladesh. *School of Commerce, University of Southern Queensland, Australia*.

Alom, M. M., & Khan, M. Z. H. (2014). Environmental and social impact due to urban drainage problems in Dhaka City, Bangladesh. *International Journal of Engineering and Advanced Technology (IJEAT) ISSN*, 2249-8958.

Anik, S. I., & Khan, M. A. S. A. (2012). Climate change adaptation through local knowledge in the north eastern region of Bangladesh. Mitigation and Adaptation Strategies for *Global Change*, 17(8), 879-896.

Anisha, N. F., & Hossain, S. (2014, December). A case study on waterlogging problems in an urban area of Bangladesh and probable analytical solutions. In *2nd International Conference on Advances in Civil Engineering* (Vol. 26, p. 28).

Alexander, D. E. (1998). Flood and drought perception: A review and comparative cultural perspective. *Bangladesh floods: views from home and abroad, Dhaka: University Press Limited*.

Alam, H. (2014, August 30). 50,000 suffer in DND waterlogged area. The Daily Star. Retrieved from http://www.thedailystar.net/50-000-suffer-in-dnd-waterlogged-area-39305(Retreived March, 24, 2017).

Ahmed, S. M., Husain, A. M., Sattar, M. G., & Chowdhury, A. M. R. (1998). A quick assessment of flood losses and postflood rehabilitation needs in BRAC's programme areas'. *Experiences of deluge: flood*, 1-29.

Akhter, F. (1992). Women are not only victims. *From Crisis to Development: Coping with Disasters in Bangladesh (Dhaka: University Press Limited)*.

Alam, E., & Collins, A. E. (2010). Cyclone disaster vulnerability and response experiences in coastal Bangladesh. *Disasters*, *34*(4), 931-954.

Alam, G. M. (2016). An assessment of the livelihood vulnerability of the riverbank erosion hazard and its impact on food security for rural households in Bangladesh. *School of Commerce, University of Southern Queensland, Australia*.

Alom, M. M., & Khan, M. Z. H. (2014). Environmental and social impact due to urban drainage problems in Dhaka City, Bangladesh. *International Journal of Engineering and Advanced Technology (IJEAT) ISSN*, 2249-8958.

Alwang, J., Siegel, P., & Jørgensen, S. (2002). Vulnerability as Viewed from Different Disciplines, Paper prepared for the International Symposium 'Sustaining Food Security and Managing Natural Resources in Southeast Asia: Challenges for the 21st Century, Chiang Mai, 8–11 January 2002: mimeo.

Alston, M. (2015). *Women and climate change in Bangladesh*. Routledge.

Arora-Jonsson, S. (2011). Virtue and vulnerability: Discourses on women, gender and climate change. *Global environmental change, 21*(2), 744-751.

Ariyabandu, M. M., & Wickramasinghe, M. (2003). Gender dimensions in disaster management. *Colombo: ITDG South Asia Publication*.

Ayers, J., & Forsyth, T. (2009). Community-based adaptation to climate change. *Environment: science and policy for sustainable development, 51*(4), 22-31.

Azad, A. K., Hossain, K. M., & Nasreen, M. (2013). Flood-induced vulnerabilities and problems encountered by women in northern Bangladesh. *International journal of disaster risk science, 4*(4), 190-199.

Azad, M. A. K., & Khan, M. M. (2015). Post disasters social pathology in Bangladesh: A case study on AILA affected areas. *Sociology and Anthropology*, *3*(2), 85-94.

Azad, R. (2015, September 11). DND area: 2m people live with water. *The Independent.* Retrieved from http://http://www.theindependentbd.com/magazine/details/15282/DND-area:2m-people-live-with-water.

Aizer, A. (2010). The gender wage gap and domestic violence. *American Economic Review, 100*(4), 1847-59.

Assar, M. (1971). Guide to sanitation in natural disasters. Geneva: WORLD HEALTH ORGANIZATION

Blaikie, P., Cannon, T., Davis, I., & Wisner, B. (2014). *At risk: natural hazards, people's vulnerability and disasters*: Routledge.

Babugura, A., Mtshali, N., & Mtshali, M. (2010). Gender and climate change: South Africa case study. *Heinrich Böll Stiftung Southern*.

Baden, S., Green, C., Goetz, A. M., & Guhathakurta, M. (1994). *Background report on gender issues in Bangladesh* (Vol. 26). University of Sussex. IDS.

BBS (2013). Monitoring the Situation of Vital Statistics. Dhaka: Bangladesh Bureau of Statistics, Planning Division, Ministry of Planning, Government of the People's Republic of Bangladesh.

Blaikie, P., Cannon, T., Davis, I., & Wisner, B. (2014). *At risk: natural hazards, people's vulnerability and disasters*. Routledge.

Bari, F. (1998). Gender, disaster, and empowerment: A case study from Pakistan. *The gendered terrain of disaster: Through women's eyes*, 1-8.

Begum, S., & Sen, B. (2009). Maternal Health, Child Well-Being and Chronic Poverty: Does Women's Agency Matter?. *The Bangladesh Development Studies*, 69-93.

Bolin, B., & Kurtz, L. C. (2018). Race, class, ethnicity, and disaster vulnerability. In *Handbook of disaster research* (pp. 181-203). Springer, Cham.

Bradshaw, S. (2002). Exploring the gender dimensions of reconstruction processes post-hurricane Mitch. *Journal of International Development*, *14*(6), 871-879.

Bradshaw, S. (2015). Engendering development and disasters. *Disasters*, *39*(s1).

Bradshaw, S. (2015). Engendering development and disasters. *Disasters*, *39*(s1).

Cannon, T. (1994). Vulnerability analysis and the explanation of 'natural'disasters. *Disasters, development and environment*, *1*, 13-30.

Chowdhury R. Abida (2016, May, 14). The changing Bangladeshi family. *The Daily Star.* Retrieved from: http://www.thedailystar.net/online/celebrating-shape-shifting-families-1224184(April 07, 2018).

Chinn, P. L., & Kramer, M. K. (1999). Theory and nursing integrated knowledge development.

Coil, C. (1999). The epidemiology of malnutrition in disasters. *Nutrition Noteworthy*, *2*(1).

Conway, T., & Norton, A. (2002). Poverty, risk and rights: new directions in social protection. *Development Policy Review*, *20*(5), 533-703.

Cutter, S. L., Boruff, B. J., & Shirley, W. L. (2003). Social vulnerability to environmental hazards. *Social science quarterly*, *84*(2), 242-261.

Chaity, J.A. (2017, October, 20). Every year, under-5 mortality comes down by 5.5%. *The Dhaka Tribune.Retrieved from http://www.dhakatribune.com/health/2017/10/20/five-mortality-reduces-5-5-annually-bangladesh/*

Chant, S. (2008). The 'feminisation of poverty'and the 'feminisation'of anti-poverty programmes: Room for revision?. *The Journal of Development Studies*, *44*(2), 165-197.

Chisamya, G., DeJaeghere, J., Kendall, N., & Khan, M. A. (2012). Gender and Education for All: Progress and problems in achieving gender equity. *International journal of educational development*, *32*(6), 743-755.

Delisle, V. C., Beck, A. T., Dobson, K. S., Dozois, D. J., & Thombs, B. D. (2012). Revisiting gender differences in somatic symptoms of depression: much ado about nothing?. *PLoS one*, *7*(2), e32490.

Demetriades, J., and Esplen, E. (2008). The gender dimensions of poverty and climate change adaptation. *Ids Bulletin*, *39*(4), 24-31.

Denton, F. (2002). Climate change vulnerability, impacts, and adaptation: Why does gender matter?. *Gender & Development*, *10*(2), 10-20.

Dankelman, I. (Ed.). (2010). *Gender and climate change: An introduction*. Routledge.

Dursun, G., & Demet, A. (2010). Temporary Housing, Vulnerability and Survival Strategies. *Women's Encounter with Disaster*, 138.

d'Eaubonne, F. (1974). *Le féminisme ou la mort* (Vol. 2). P. Horay.

Enarson, E. P. (2000). *Gender and natural disasters*. Geneva: ILO.

Enarson, E., & Meyreles, L. (2004). International perspectives on gender and disaster: differences and possibilities. *International Journal of Sociology and Social Policy*, *24*(10/11), 49-93.

Enarson, E. (1998). Through women's eyes: A gendered research agenda for disaster social science. *Disasters*, *22*(2), 157-173.

Engels, F. (1993). *The condition of the working class in England*: Oxford University Press, USA.

Evans, S. E., Davies, C., & DiLillo, D. (2008). Exposure to domestic violence: A meta-analysis of child and adolescent outcomes. *Aggression and violent behavior*, *13*(2), 131-140.

Fisher, S. (2010). Violence against women and natural disasters: Findings from post-tsunami Sri Lanka. *Violence Against Women*, *16*(8), 902-918.

Fothergill, A., Maestas, E. G., & Darlington, J. D. (1999). Race, ethnicity and disasters in the United States: A review of the literature. *Disasters*, *23*(2), 156-173.

Fordham, M. (2003). Gender, disaster and development. *Natural Disasters and Development in a Globalizing World, Routledge, London*, 57-74.

Galea, S., Nandi, A., & Vlahov, D. (2005). The epidemiology of post-traumatic stress disorder after disasters. *Epidemiologic reviews*, *27*(1), 78-91.

Gray, C. L., & Mueller, V. (2012). Natural disasters and population mobility in Bangladesh. *Proceedings of the National Academy of Sciences*, *109*(16), 6000-6005.

Grayman, W. M., Deininger, R. A., & Males, R. M. (2001). *Design of early warning and predictive source-water monitoring systems*. American Water Works Association.

Gokhale, V. (2008, October). Role of women in disaster management: An analytical study with reference to Indian society. In *The 14th World Conference on Earthquake Engineering October* (pp. 12-17).

Government of Bangladesh. (2012). S*tanding Orders on Disaster*, Dhaka: Disaster Management Bureau.

Gwimbi, P. (2007). The effectiveness of early warning systems for the reduction of flood disasters: some experiences from cyclone induced floods in Zimbabwe. *Journal of sustainable development in Africa*, *9*(4), 152-169.

Ginige, K., Amaratunga, D., & Haigh, R. (2009). Mainstreaming gender in disaster reduction: why and how?. *Disaster Prevention and Management: An International Journal*, *18*(1), 23-34.

Gaillard, H., García-Muse, T., & Aguilera, A. (2015). Replication stress and cancer. *Nature Reviews Cancer*, *15*(5), 276.

Guha-Sapir, D., Vos, F., Below, R., & Ponserre, S. (2015). *Annual disaster statistical review 2011: the numbers and trends*. Centre for Research on the Epidemiology of Disasters (CRED).

Habiba, U., Shaw, R., & Takeuchi, Y. (2012). Farmer's perception and adaptation practices to cope with drought: Perspectives from Northwestern Bangladesh. *International Journal of Disaster Risk Reduction*, *1*, 72-84.

Ha-Redeye, O. (2006). Engendering" change in disaster response: increasing women in leadership roles. *Gender and Disaster in Canada: New Thinking, New Direction. Sydney, Nova Scotia: Cape Breton University*, 53-60.

Hossain, M. S. (2013). WATERLOGGING PROBLEMS IN URBAN AREAS OF BANGLADESH AND SOLUTION WITH ANALYTICAL APPROACH. Retreived from: https://www.researchgate.net/profile/Shahadat-Hossain-17/publication/280527335_WATER_LOGGING_PROBLEMS_IN_URBAN_AREAS_OF_BANGLADESH_AND_SOLUTION_WITH_ANALYTICAL_APPROACH/links/55b75ccf08aed621de045cfc/WATERLOGGING-PROBLEMS-IN-URBAN-AREAS-OF-BANGLADESH-AND-SOLUTION-WITH-ANALYTICAL-APPROACH.pdf

Hossain, G. A., & Islam, M. N. (2000). Water Resources Management in Bangladesh *Building Partnerships* (pp. 1-10).

Huang, Z. Y., Peng, T., Zhang, H. Y., & Yao, W. L. (2017, August). Study of risk and early warning index of rainstorm waterlogging in Wuhan City. In *IOP Conference Series: Earth and Environmental Science* (Vol. 82, No. 1, p. 012048). IOP Publishing.

Huq, S., & Alam, M. (2003). Flood management and vulnerability of Dhaka City. In *Building Safer Cities: The Future of Disaster Risk*. Washington DC: World Bank.

Holguín-Veras, J., Jaller, M., Van Wassenhove, L. N., Pérez, N., & Wachtendorf, T. (2012). On the unique features of post-disaster humanitarian logistics. *Journal of Operations Management*, *30*(7-8), 494-506.

Hemachandra, K., Amaratunga, D., & Haigh, R. (2018). Role of women in disaster risk governance. *Procedia Engineering*, *212*, 1187-1194.

Hewitt, K. (Ed.). (1983). *Interpretations of calamity: From the viewpoint of human ecology*. Routledge.

Hewitt, K. (1997). Regions of Risk: Hazards, Vulnerability and Disaster. London: Addison Wesley Longman.

Hunt, J., Lateef, S., & Thomas, H. T. (2007). *Gender action plans and gender equality results: rapid gender assessments of ADB Projects (Synthesis report)*. Asian Development Bank. http://hdl.handle.net/11540/2556

Islam, N., & Sultana, N. (2006). The status of women in Bangladesh: Is the situation really encouraging. *Research Journal of Social Sciences*, *1*(1), 56-65.

Irfanullah, H. M., Adrika, A., Ghani, A., Khan, Z. A., & Rashid, M. A. (2008). Introduction of floating gardening in the north-eastern wetlands of Bangladesh for nutritional security and sustainable livelihood. *Renewable agriculture and food systems*, *23*(2), 89-96.

Ikeda, K. (1995). Gender differences in human loss and vulnerability in natural disasters: a case study from Bangladesh. *Bulletin (Centre for Women's Development Studies)*, *2*(2), 171-193.

Ishaq-ur-Rahman, M. (2012). *Responding Natural Disaster in Bangladesh through Alternative Education.* Proceedings of 3rd International Conference on Environmental Aspects of Bangladesh [p. 111-113].

Kabeer, N. (1991). Gender dimensions of rural poverty: analysis from Bangladesh. *The Journal of Peasant Studies*, *18*(2), 241-262.

Kabeer, N. (1994). Re-examining the" Demand for Children 'hypothesis in the context of fertility decline in Bangladesh,'. *Poverty Reduction and Development Co-operation, Centre for Development Research Working Paper*(6).

Kamal, A. H. M., & Dev, P. (2018). Engendering Social Exclusion: Evidence from Slum of Narayangonj City Corporation of Bangladesh. *Global Journal of Human-Social Science Research*. 18(1).

Khalil, G. M. (1992). Cyclones and storm surges in Bangladesh: some mitigative measures. *Natural Hazards, 6*(1), 11-24.

Khan, S. R. (2012). Cyclone Hazard in Bangladesh, Background Information on the Storm Surge Modelling.

Khan, M. M. H. (2017). Analysis of Causes and Impact of Waterlogging in Khulna City of Bangladesh.

Kher, J., Aggarwal, S., & Punhani, G. (2015). Vulnerability of poor urban women to climate-linked water insecurities at the household level: A case study of slums in Delhi. *Indian Journal of Gender Studies, 22*(1), 15-40.

Kett, M., Stubbs, S., and Yeo, R. (2005). Disability in conflict and emergency situations: Focus on Tsunami-affected areas. *International Disability and Development Consortium Research Report*.

Khondker, H. H. (1996). Women and floods in Bangaladesh. *International Journal of Mass Emergencies and Disasters, 14*(3), 281-292.

Kahn, M. E. (2005). The death toll from natural disasters: the role of income, geography, and institutions. *Review of economics and statistics, 87*(2), 271-284.

King, Y. (1983). The Eco-feminist Imperative. In Caldecott, L and Leland, S (Eds.) *Reclaim the Earth: Women Speak Out for Life on Earth*. London: The Womens Press

Killian, L. M. (1956). *An introduction to methodological problems of field studies in disasters* (No. 8). National Research Council.

Laist, D. W., & Shaw, C. (2006). Preliminary evidence that boat speed restrictions reduce deaths of Florida manatees. *Marine Mammal Science, 22*(2), 472.

Lambrou, Y., & Piana, G. (2006). *Gender: The missing component of the response to climate change*. FAO

Liu, Y., Du, M., Jing, C., & Cai, G. (2014, September). Design and implementation of monitoring and early warning system for urban roads waterlogging. In *International Conference on Computer and Computing Technologies in Agriculture* (pp. 610-615). Springer, Cham.

Leduc, B. (2009). Guidelines for gender sensitive research. *November, ICIMOD*.

Le Masson, P., Hatchuel, A., & Weil, B. (2016). Design theory at Bauhaus: teaching "splitting" knowledge. *Research in Engineering Design*, *27*(2), 91-115.

Lein, H. (2000). Hazards and'forced'migration in Bangladesh. *Norsk Geografisk Tidsskrift*, *54*(3), 122-127.

Letablier, M. T., Luci, A., Math, A., & Thévenon, O. (2009). The costs of raising children and the effectiveness of policies to support parenthood in European countries: a Literature Review. *HAL Open science*.

Lippmann, A. L. (2011). Disaster preparedness in vulnerable communities. *International Law and Policy Review*, *1*(1), 69.

Mark, O., & Chusit, A. (2002). Modeling of urban runoff in Dhaka city. *Asian Institute of Technology (AIT). Thailand*.

MacDonald, R. (2005). How women were affected by the tsunami: A perspective from Oxfam. *PLoS Medicine*, *2*(6), e178.

MacGregor, S. (2010). 'Gender and climate change': from impacts to discourses. *Journal of the Indian Ocean Region*, *6*(2), 223-238.

Matin, N., & Taher, M. (2001). The changing emphasis of disasters in Bangladesh NGOs. *Disasters*, *25*(3), 227-239.

Mavhura, E., Manyena, S. B., Collins, A. E., & Manatsa, D. (2013). Indigenous knowledge, coping strategies and resilience to floods in Muzarabani, Zimbabwe. *International Journal of Disaster Risk Reduction*, *5*, 38-48.

Mileti, D. (1999). *Disasters by design: A reassessment of natural hazards in the United States*. Joseph Henry Press.

Ministry of Finance (2015). *Bangladesh Economic Review 2015* (in Bangla). Dhaka: Economic Adviser's Wing, Finance Division, Ministry of Finance, Government of the People's Republic of Bangladesh.

Morchain, D., Prati, G., Kelsey, F., & Ravon, L. (2015). What if gender became an essential, standard element of Vulnerability Assessments?. *Gender & Development*, *23*(3), 481-496.

Mowla, Q. A. (2010). Role of water bodies in Dhaka for sustainable urban design. *Jahangirnagar Planning Review*, *8*, 13-30.

Mercer, J., Dominey-Howes, D., Kelman, I., & Lloyd, K. (2007). The potential for combining indigenous and western knowledge in reducing vulnerability to environmental hazards in small island developing states. *Environmental Hazards*, *7*(4), 245-256.

Merchant, C. (1996). *Earthcare: women and the environment*. New York: Routledge, Inc..

Morrow, B. H. (1999). Identifying and mapping community vulnerability. *Disasters*, *23*(1), 1-18.

Nasreen, M. (1995). Coping with floods: the experience of rural women in Bangladesh. *Unpublished Ph. D. dissertation. Messey University, New Zealand*.

Nasreen, M. (1998). Women in disaster: an analysis of division of labour and survival strategies in disaster. *Dhaka: Academic Publishers*.

Nasreen, M. (2000). Development, Women and Gender in Bangladesh: From Theory to Practice. *Social Science Review, The Dhaka University Studies, Part-D*, *17*(2), 16-26.

Nasreen, M. (2004). Disaster research: exploring sociological approach to disaster in Bangladesh. *Bangladesh e-journal of Sociology*, *1*(2), 21-28.

N Nasreen, M. (2008). *Violence against women during flood and post-flood situations in Bangladesh*. ActionAid Bangladesh.

Nasreen, M. (2010). Rethinking disaster management: Violence against women during Floods in Bangladesh. *Women's Encounter with Disaster, eds. Dasgupta, S, Ismail Siriner, Partha Sarathi De*, 232-244.

Nasreen, M. (2012). Women and girls: Vulnerable or resilient. *Institute of Disaster Management and Vulnerability Studies, University of Dhaka, Dhaka-1000*.

Nawaz, F. (2009). Critical factors of women entrepreneurship development in rural Bangladesh. Bangladesh Development Research Working Paper No. 5, Available at SSRN: https://ssrn.com/abstract=1403411

Neria, Y., Nandi, A., & Galea, S. (2008). Post-traumatic stress disorder following disasters: a systematic review. *Psychological medicine*, *38*(4), 467-480.

Ortner, S. B., & Whitehead, H. (Eds.) (1981). *Sexual meanings: The cultural construction of gender and sexuality*. CUP Archive.

Paolisso, M., Ritchie, A., & Ramirez, A. (2002). The significance of the gender division of labor in assessing disaster impacts: A case study of Hurricane Mitch and hillside farmers in Honduras. *International journal of mass emergencies and disasters*, *20*(2), 171-195.

Paul, S. K., & Routray, J. K. (2010). Flood proneness and coping strategies: the experiences of two villages in Bangladesh. *Disasters*, *34*(2), 489-508.

Pachauri, R. K., & Reisinger, A. (2007). IPCC fourth assessment report. *IPCC, Geneva*, 2007.

Pelling, M. (2011). Urban governance and disaster risk reduction in the Caribbean: the experiences of Oxfam GB. *Environment and Urbanization*, *23*(2), 383-400.

Peacock, W. G., & Ragsdale, A. K. (1997). Social systems, ecological networks and disasters: Toward a socio-political ecology of disasters. *Hurricane Andrew: Ethnicity, gender, and the sociology of disasters*, 20-35.

Pyles, L., and Lewis, J. S. (2010). Women, Intersectionality and Resistance. *Women's Encounter with Disaster*, 77.

Rahman, K. A., & Debnath, S. C. (2015). Waterlogging and Losses in Ecosystem: A Case Analysis on DND Embankment, Bangladesh. *International Research Journal of Interdisciplinary & Multidisciplinary Studies (IRJIMS)*, 27-33.

Rashid, S. F. (2000). The urban poor in Dhaka City: their struggles and coping strategies during the floods of 1998. *Disasters*, *24*(3), 240-253.

Rashid, S. (1998). The poor in Dhaka city: their struggles and coping strategies during the flood. In Ahmed, S and Ahmed, H (Eds) *Experiences of deluge: flood* 1998.

Rouse, J. W. (1994). J, Haas RH, Schell JA, Deering DW (1974) Monitoring Vegetation Systems in the Great Plains with Erts. In *Third Earth Resources Technology Satellite-1 Symposium* (Vol. 1, p. 309).

Rodriguez, L. C. (2010). Gender-biased social vulnerability on disasters and intersectionality. Dasgupta, S, Ismail Siriner, Partha Sarathi De *(eds). Women's Encounter with Disaster.* Frontpage Publications Ltd, 62-76.

Sabur, A. A. (2012). Disaster management system in Bangladesh: An overview. *India Quarterly*, *68*(1), 29-47.

Saha, C. K. (2015). Dynamics of disaster-induced risk in southwestern coastal Bangladesh: an analysis on tropical Cyclone Aila 2009. *Natural Hazards*, *75*(1), 727-754.

Saito, Y. (2014). Progress or repetition? Gender perspectives in disaster management in Japan. *Disaster prevention and management*, *23*(2), 98-111.

Sharmin, Z., & Islam, M. (2013). Consequences of climate change and gender vulnerability: Bangladesh perspective.

Shahid, S. (2011). Impact of climate change on irrigation water demand of dry season Boro rice in northwest Bangladesh. *Climatic change*, *105*(3-4), 433-453.

Shahid, S., & Behrawan, H. (2008). Drought risk assessment in the western part of Bangladesh. *Natural Hazards*, *46*(3), 391-413.

Shah Alam Khan, M. (2008). Disaster preparedness for sustainable development in Bangladesh. *Disaster Prevention and Management: An International Journal*, *17*(5), 662-671.

Gaillard, H., García-Muse, T., & Aguilera, A. (2015). Replication stress and cancer. *Nature Reviews Cancer*, *15*(5), 276.

Khondker, H. H. (1996). Women and floods in Bangaladesh. *International Journal of Mass Emergencies and Disasters*, *14*(3), 281-292.

Le Masson, V. (2016). *Gender and resilience: from theory to practice*. BRACED Working Paper. London: Overseas Development Institute.

Leduc, B. (2009). Guidelines for gender sensitive research. *November, ICIMOD.*

Morchain, D., Prati, G., Kelsey, F., & Ravon, L. (2015). What if gender became an essential, standard element of Vulnerability Assessments? *Gender & Development*, *23*(3), 481-496.

Islam, N., & Sultana, N. (2006). The status of women in Bangladesh: Is the situation really encouraging. *Research Journal of Social Sciences*, *1*(1), 56-65.

Rahman, K. A., & Debnath, S. C. (2015). Waterlogging and Losses in Ecosystem: A Case Analysis on DND Embankment, Bangladesh. *International Research Journal of Interdisciplinary & Multidisciplinary Studies (IRJIMS)*, 27-33.

Warren, K. J., & Cheney, J. (1991). Ecological feminism and ecosystem ecology. *Hypatia*, *6*(1), 179-197.

Warren, K. (2002). Response to my critics. *Ethics and the Environment*, *7*(2), 39-59.

Killian, L. M. (1956). *An introduction to methodological problems of field studies in disasters* (No. 8). National Research Council.

Engels, F. (1993). *The condition of the working class in England*. Oxford: Oxford University Press.

Mavhura, E., Manyena, S. B., Collins, A. E., & Manatsa, D. (2013). Indigenous knowledge, coping strategies and resilience to floods in Muzarabani, Zimbabwe. *International Journal of Disaster Risk Reduction*, *5*, 38-48.

Ye, Z. W., Xu, Y. P., & Xu, J. T. (2009). Flood changing trend and flooding mechanism in Lixiahe region, Jiangsu, China. *Sci Geogr Sin*, *6*, 880-885.

Galea, S., Nandi, A., & Vlahov, D. (2005). The epidemiology of post-traumatic stress disorder after disasters. *Epidemiologic reviews*, *27*(1), 78-91.

Gray, C. L., & Mueller, V. (2012). Natural disasters and population mobility in Bangladesh. *Proceedings of the National Academy of Sciences*, *109*(16), 6000-6005.

Grayman, W. M., Deininger, R. A., & Males, R. M. (2001). *Design of early warning and predictive source-water monitoring systems*. American Water Works Association.

Ha-Redeye, O. (2006). Engendering" change in disaster response: increasing women in leadership roles. *Gender and Disaster in Canada: New Thinking, New Direction. Sydney, Nova Scotia: Cape Breton University*, 53-60.

Hossain, M. S. (2013). WATERLOGGING PROBLEMS IN URBAN AREAS OF BANGLADESH AND SOLUTION WITH ANALYTICAL APPROACH.

Hossain, G. A., & Islam, M. N. (2000). Water Resources Management in Bangladesh *Building Partnerships* (pp. 1-10).

Huang, Z. Y., Peng, T., Zhang, H. Y., & Yao, W. L. (2017, August). Study of risk and early warning index of rainstorm waterlogging in Wuhan City. In *IOP Conference Series: Earth and Environmental Science* (Vol. 82, No. 1, p. 012048). IOP Publishing.

Ishaq-ur-Rahman, M. *Responding Natural Disaster in Bangladesh through Alternative Education*. Paper presented at the PROCEEDINGS OF INTERNATIONAL CONFERENCE ON ENVIRONMENTAL ASPECTS OF BANGLADESH.

Kabeer, N. (1994). Re-examining the" Demand for Children 'hypothesis in the context of fertility decline in Bangladesh,'. *Poverty Reduction and Development Co-operation, Centre for Development Research Working Paper*(6).

Kamal, A.-H. M., & Dev, P. (2018). Engendering Social Exclusion: Evidence from Slum of Narayangonj City Corporation of Bangladesh. *Global Journal of Human-Social Science Research*.

Khalil, G. M. (1992). Cyclones and storm surges in Bangladesh: some mitigative measures. *Natural Hazards*, *6*(1), 11-24.

Khan, S. R. (2012). Cyclone Hazard in Bangladesh, Background Information on the Storm Surge Modelling.

Khan, M. M. H. (2017). Analysis of Causes and Impact of Waterlogging in Khulna City of Bangladesh.

Lein, H. (2000). Hazards and'forced'migration in Bangladesh. *Norsk Geografisk Tidsskrift*, *54*(3), 122-127.

Liu, Y., Du, M., Jing, C., & Cai, G. (2014, September). Design and implementation of monitoring and early warning system for urban roads waterlogging. In *International*

Conference on Computer and Computing Technologies in Agriculture (pp. 610-615). Springer, Cham.

Neria, Y., Nandi, A., & Galea, S. (2008). Post-traumatic stress disorder following disasters: a systematic review. *Psychological medicine*, *38*(4), 467-480.

Rahman, K. A., & Debnath, S. C. (2015). Waterlogging and Losses in Ecosystem: A Case Analysis on DND Embankment, Bangladesh. *International Research Journal of Interdisciplinary & Multidisciplinary Studies (IRJIMS)*, 27-33.

Samad, M. Marriage in Changing Family Pattern of Bangladesh: The Present Trends.

Sapir, D. (1993). Natural and man-made disasters: the vulnerability of women-headed households and children without families.

Sundari, S. (2003, December). Quality of life of migrant households in urban slums. In *Proceedings of the Third International Conference on Environment and Health, Chennai, India* (pp. 15-17).

Shamsuddoha, M., & Chowdhury, R. K. (2007). Climate change impact and disaster vulnerabilities in the coastal areas of Bangladesh. *COAST Trust, Dhaka*.

Skinner, E. (2011). Gender and climate change: Overview report.

Saul, B. (2012). The security risks of climate change displacement in Bangladesh.

Sen, A., & Dreze, J. (1989). *Hunger and public action*. Oxford: Clarendon Press

Smith, Joel B., Stephen H. Schneider, Michael Oppenheimer, Gary W. Yohe, William Hare, Michael D. Mastrandrea, Anand Patwardhan et al. "Assessing dangerous climate change through an update of the Intergovernmental Panel on Climate Change (IPCC)"reasons for concern"." *Proceedings of the national Academy of Sciences* 106, no. 11 (2009): 4133-4137.

Stewart, M. G. (2003). Cyclone damage and temporal changes to building vulnerability and economic risks for residential construction. *Journal of Wind Engineering and industrial aerodynamics*, *91*(5), 671-691.

Tawhid, K. G. (2004). Causes and effects of waterlogging in Dhaka City, Bangladesh. *TRITA-LWR Master Thesis*.Teitelbaum, M. S. (1975). Relevance of demographic transition theory for developing countries. *Science*, *188*(4187), 420-425..

Tong, R. P. (2013). *Feminist thought: A more comprehensive introduction*. Westview Press.

Turner, B. L., Kasperson, R. E., Matson, P. A., McCarthy, J. J., Corell, R. W., Christensen, L., ... & Polsky, C. (2003). A framework for vulnerability analysis in sustainability science. *Proceedings of the national academy of sciences*, *100*(14), 8074-8079.

Van Aalst, M. K., Cannon, T., and Burton, I. (2008). Community level adaptation to climate change: the potential role of participatory community risk assessment. *Global environmental change, 18*(1), 165-179.

Warren, K. J., & Cheney, J. (1991). Ecological feminism and ecosystem ecology. *Hypatia, 6*(1), 179-197.

Warren, K. (2002). Response to my critics. *Ethics and the Environment, 7*(2), 39-59.

Wilson, J., Phillips, B., and Neal, D. M. (1998). Domestic violence after disaster. *The gendered terrain of disaster*, 115-122.

Weichselgartner, J. (2001). Disaster mitigation: the concept of vulnerability revisited. *Disaster Prevention and Management: An International Journal, 10*(2), 85-95.

Wiest, R. (1998). A comparative perspective on household, gender, and kinship in relation to disaster. *The gendered terrain of disaster: through womens eyes*, 63-S0.

Ye, Z. W., Xu, Y. P., & Xu, J. T. (2009). Flood changing trend and flooding mechanism in Lixiahe region, Jiangsu, China. *Sci Geogr Sin, 6*, 880-885.

Appendix I:

The Role of Women in Disaster Risk Reduction in Bangladesh: An Empirical study on waterlogging in Dhaka Narayanganj Demra(DND) area

Survey Questionnaire

Section A. Personal information of the waterlogging people

1.1 Name of the respondent : .....

Address :……

Village :.....

Post Office :.....

Police Station :.....

District :.....

Mobile : ……

1.2 Sex

□ Male(1) □ Female(2)

1.3 Age (Approximate): .....

1.4 Occupation: .....

1.5 Educational Qualification: .....

1.6 Marital Status: .....

1.7 Religion:

(A)Muslim(1) (B) Christian(2) (C)Buddhism(3) (D) Hindu(4)

1.8 Type of Family:

□ Joint(1) □ Nuclear(2)

1.9 Members of the family: .....

1.10 Information of the members:

No	Name	Age	Sex	Education	occupation	Marital status

Code:
Respondent's identity (Relation): Self=1, Husband=2, Daughter=3, Son=4, Father=5, Mother=6, Sister=7, Brother=8 , Daughter in law=9, Son in law=10,other (Specify)=11
Sex: Female=1, Male=2
Age: 41-45 years = 1, 46-50 years =2, 51-55 years = 3, 56-60 years=4, Over 60=5
Education: Illiterate =1, Read only=2, Primary = 3, Secondary=4, Higher Secondary=5, Above (Specify)=6
Occupation: House wife=1, Government service =2, Nongovernment (NGO) service=3, business = 5, Farmer =6, Fishermen/women = 7, Day laborer=8, Student=10, Doctor=11, Rickshaw and other pullers=12, other (specify) =9
Marital Status: Married=1, Unmarried=2, Widow=3, Divorced=4, Separated=5, others (specify) =5

1.11. What is the monthly expenditure (gross) of your household? --------BDT

1.12. What is the monthly income (gross) of your household? ……BDT

1.13 Which type of house are you living?

(A)Pucca(1)
(B) Semi-pucca(2)
(C)Katcha(3)
(D) Thached(4)
(E) Others (Specify)(5)

1.14. Amount of land you possess?..... (in decimal)

(A)Homestead land,(1)
(B)Agriculture land,(2)
(C)Pond ,(3)
(D)Vegetable Garden(4)
(E) Homestead Forest(5)

Section B: Women's perception on the impact of Waterlogging

2.1. Have you heard about waterlogging?

□Yes(1)□ No(2)

2.2. If yes, from where have you been informed about waterlogging? (Multiple Responses are possible)

(A)NGO workers.(1)
(B) Government officers (2)
(C) Printing media (Newspaper)(3)
(D)Electronic media (Radio, TV)(4).
(E) Others (Specify (5)

2.3. Due to waterlogging, which types of problems are created in your locality? (Multiple Responses are possible)

(A) Scarcity of pure drinking water.(1)
(B) Sanitation problems (2)
(C) Prevalence of different types of water borne disease (3)
(D) Scarcity of animal fodder (4).
(E) Increase prices of cereal food and other daily essential commodities (5).
(F) Damage of mud houses (6).
(G) Suffer from chronic malnutrition (7)
(H) Unemployed (8)

2.4. Which sort of problems can be arrived from waterlogging? (Multiple responses are possible)

(A) Unemployment (1)
(B) Poverty (2).
(C) Inflation (3).
(D) Reduction of national income (4)

2.5. What is your common source of drinking water?

(A).Protected well (1).
(B)Unprotected well (2)
(C)River (3)
(D)Spring (4)
(E)Supply water (5)
(F) Pond water (6)

2.6. Was the main source of water affected due to waterlogging?

□Yes □No

If yes, what are the alternative sources of water?
(A) Neighbor house
(B) Deep Tub-well
(C) Boiled water from pond

2.7. What type of sanitary facilities do you have?
(A)Sanitary Latrine (1) (B) Pit latrine (2) (C) Semi-Sanitary (3) (D) Open Space (4) (E) Hanging Latrine (5)

2.8. Was your sanitary facility affected by the waterlogging?
□Yes (1) □No (2)

If yes, what is the alternative?
(A) Neighbor's toilet (1) (B) public toilet (2) (C) open space (3) (D) hanging (4)

2.9. Did the household experience crop damage during the waterlogging?
□Yes □No

2.10. Are there any educational institutions in your area?
□Yes □No

If yes, types of institutions
(A) Primary (B) High School (C) Vocational (D) College (E) Madrasa
(F) Kindergarten
2.11. Did the house lose/subject to damage any property, asset or resources due to waterlogging?
□Yes □No

If yes, then, what are those resources?
(A)Fishing net
(B)Boat
(C)Bed
(D)Bicycle
(E)Radio
(F) Plough
(G) Hoe
(H)Ox – Cart
(I)Television
(J)Chairs
(K)Cultivable land of crops
(L)Standing crops
(M)Residential homes
(N)Production unit

(O)Fishing project
(P) Poultry shade
(Q)Grocery shop
(R)Homestead garden

2.12. Do you feel any mental pressure after being affected with waterlogging?

□Yes □ No

2.13. Is any steps taken for removing waterlogging in your village?

□Yes □ No

Section-C: women's contribution to disaster risk reduction

3.1 Do you know about Disaster?

□Yes □No

If yes, then

(A) NGO workers (B) Government officers (C) Printing media (Newspaper) (D) electronic media (Radio, TV)

3.2. Do you think women are more vulnerable due to disaster?

□Yes □No

If yes, then what are the causes of these vulnerabilities?

(A)Flood (B) Waterlogging (C) Cyclone (D) Draught (E) Crop failure (F) forced to sell personal assets

3.3. Have you heard about climate change?

□Yes □ No

3.4. If yes, from where have you been informed about climate change? (Multiple Responses are possible)

(A) NGO workers. (B) Government officers (C) Printing media (Newspaper) (D) Electronic media (Radio, TV). (E) Others (Specify)

3.5. What types of disasters occur in your locality? (Multiple Responses are possible)

(A) Flood (B) Cyclone (C) River bank erosion (D) Drought (E) Cold wave (F) Heavy rainfall (G) Waterlogging (H)Drainage Congestion (I) Tornado

3.6. Which types of disaster cause more economic losses? (Multiple responses are possible)

(A) Flood (B) Cyclone (C) River bank erosion (D) Draught (E) Cold wave (F) Heavy rainfall (H)Waterlogging

3.7. Was there any damage to school infrastructure due to disaster?

□Yes □No

If yes, what kind of damage?

(A) Classroom blocks (B) teacher's houses (C) Toilets

3.8. Did any of the school going children in your household experience any disruption in attending due to disaster?

□Yes □No

3.9. Is there any health facility in your area?

□Yes □No

If yes, then what types-

(A)Public Hospital (B) Private Clinic

3.10. Was there any damage to health facilities due to natural disaster?

□Yes □No

3.11. Was there any disruption in access to health care services due to disaster?

□Yes □No

3.12. Did any of the household members get sick during disaster?

□Yes □No

If yes, what kind of sickness-

(A)Diarrhea (B) Cough (C) Malaria/Fever (D) Measles

3.13. Did your house collapse due to disaster?

□Yes □No

3.14. Did the collapsing of the house force you to relocate to a new area?

□Yes □No

If yes, the distance of relocated house—

(A)5 km (B)10 km (C)20km (D)30 km (E)40 km (F) more than 100 km

3.15. What are the main coping strategies that you employ during disaster?

(A) To go to nearby field or jungle for defecation purpose

(B) To increase the ground level of latrine with mud or woods

(C) Branches of trees are stored to be used as firewood for boiling pond-water

(D) To overcome livelihood difficulties during extreme waterlogging through establishment of floating gardening

(E)Taking shelter to refugee camps

3.16. Are the above coping strategies effective?

□Yes □No

3.17. Have you taken part in any adaptation measures for reducing the impact of disaster in the community?

□Yes □No

If yes, then

(A) Awareness rising (B) Pestering (C) Knowledge sharing (D) Information sharing (E) Training

3.18. What are the impacts of natural disasters on life and livelihood?

(A) Poverty and deprivation

(B) Causing inequalities
(C) Limited access to financial services
(D) Reducing consumption and have a decreasing shock in other household
(E) Losing access to some basic services
(F)Reversals in accumulation of physical and human capital
(G) Perhaps an increase in child labor and criminal activities

3.19. Are you a decision maker in your family and also in the society?

□Yes □No

3.20. Do you have any leadership in your society about before and after natural disaster?

□ Yes □No

If yes then,

3.21. Have you got any fund from any organizations for the adaptation?

□Yes □No

Section D: Other information

4.1. What is your alternative livelihood option?

……
4.2. Do you have any access nearest shopping centre?

□Yes □ No

If no, then- how do you go there…….

4.3. Are you doing any service?

□Yes □ No

If yes, then
(A) Government (B) Non government (C) NGO

4.4. Who gives the fund for taking the adaptation measures in your family?

1= done with own money
2= take loan from relatives and neighbors
3= Micro credit from NGO

4.5. What kinds of steps should be taken according to you?

1= natural drainage canals for rapid water discharge
2=taking actions against illegal encroachment of low-lying areas

3= taking actions against unplanned buildings in wetlands
4= ensuring regular cleaning of the drains
5= controlling disposal of solid wastes into drain
6= taking long term measures
7= cleaning sewage drains regularly and adequately
8=new several drainage canals have to be excavated
9=raising awareness about waste disposal
10= relief materials and implement rehabilitation projects

Appendix-II: Qualitative interview guidelines

The Role of Women in Disaster Risk Reduction in Bangladesh: An Empirical study on waterlogging in Dhaka Narayanganj Demra (DND) area

Case study guideline

1. Are you a permanent resident of this area?
2. How long have you been living in this area?
3. Have you ever faced disaster in your life?
4. If yes, how many times have you faced disaster?
5. Please mention the common disasters of your area.
6. Have you ever faced waterlogging?
7. What are the common reasons of waterlogging in your area? (probe details)
8. Have you ever faced any difficulties to mitigate disaster induced vulnerabilities as women?
9. If yes, please tell us the type of difficulties you have experienced?(probe details)
10. How did you manage the problems? (please ask details)
11. Who is the main earning member of your family?
12. (if respondent is the main earning member), can you play the role of decision maker in your family/contribute in the decision making process both inside and outside family ?
13. If yes, what type of role do you play as a decision maker in your family?
14. What type of role do you play during disaster in your family? (ask details about the role she play)
15. Have you ever faced any difficulties while playing this type of roles?
16. If yes, how did resolve the problem(s)? (ask details about the measures she took)
17. Have you ever received any assistance from anyone? (if yes, ask details about the person or organization and type of assistance she received)
18. Have you ever played any role to mitigate vulnerabilities caused by waterlogging(both inside and outside family)?(if yes, ask details)
19. What do you do for livelihood during waterlogging that you usually do not during normal time?

20. During waterlogging how do you go to nearby market for purchasing your daily necessary commodities?(probe; type of transport they use).
21. Is there any organization (GO or NGO) in your area that work on waterlogging?
22. If yes, what do they do to mitigate waterlogging? (ask details)
23. Do you have any involvement with those organizational measures?
24. If yes, do you get opportunity to contribute in decision making there?
25. Do those organizations provide any financial assistance to mitigate your vulnerabilities?
26. What type of measures you prefer to take in order to reduce waterlogging and related vulnerabilities.

The Role of Women in Disaster Risk Reduction in Bangladesh: An Empirical study on waterlogging in Dhaka Narayanganj Demra(DND) area

Key Informant Interview guideline

Name of interviewee/s:

Designation:

Organization:

1. How would you describe the impact of the waterlogging on people's livelihoods?

2. What are the main coping strategies? If any, that people of the district/ community adopt?

3. Was there any disruption in the access to health facilities? If yes, provide details of the disruption.

4. What are the common water sources in the community?

5. Did the affected households experience any water accessibility problems?

6. What are the three main types of sanitary facilities used mostly in the district?

7. What type of infrastructure (road, bridges/ culverts) is available in the district?

8. What was the impact on the infrastructure?

9. Was there any disruption in learning due to waterlogging?

10. Did the communities experience crop and livestock loss due to waterlogging? Explain by giving details of losses and estimate population affected.

11. What was the impact of waterlogging on people's houses? (Explain in details)

12. What are the roles of your organization for the management of waterlogging in your area?

13. What are the main reasons for waterlogging in the City?

14. Does your organization have any activities related to waterlogging?

    i) If yes, which activities?

15. Is your organization able to perform/manage all these activities properly?

16. What is the lacking of your organization to manage the activities related to waterlogging?

17. What is your suggestion to enhance the management system of waterlogging related activities that can help to reduce the problem?

The Role of Women in Disaster Risk Reduction in Bangladesh: An Empirical study on waterlogging in Dhaka Narayanganj Demra(DND) area

Focus Group Discussion (FGD) guideline

1. Do you face any waterlogging in your area of living?
    i) If yes, when (period/season of the year)?
    ii) How long the water remains stagnant in the catchments area?
2. What are the main reasons for such waterlogging in your area?
3. What type of problems you used to face during the period of waterlogging?
4. What are the main sources of livelihood for most households in the locality?
5. What are the main sources of income?
6. What are the main sources of food?
7. What are the common water sources in the community?
8. What percentages of the commonly used sanitary facilities were affected by the waterlogging?
9. What was the impact on the infrastructure?
10. Was there any disruption in the access to health facilities? If yes, provide details of the disruption.
11. Was there an increase in disease outbreak/ incidents due to waterlogging? Explain giving details of major health problems and age groups affected).
12. What are the underlying causes of vulnerability on the district/ community? Elaborate.
13. What are the main coping strategies if any, that people of the district/ community adapt?
14. Do you think the waterlogging problem in your area can be solved?
    i) If yes, how?

Appendix III: Photos from the field

Photos 1: Waterlogging and household in the study area

Photos 2: Sufferings of the community people

Photos 3: KII and informal observation at school

Photos 4: Case study and FGD with community people

Photos 5: Conducting KII interview regarding DND area with current Narayanganj city mayor physician Selina Hayat Ivy

Photo: Professor MAHBUBA NASREEN, PhD
Director and Professor
Institute of Disaster Management and Vulnerability Studies
Former Professor in Sociology
University or Dhaka