APPLICATION OF SCIENTIFIC AND INDIGENOUS KNOWLEDGE FOR FLOOD MANAGEMENT IN NORTHWEST BANGLADESH

A Dissertation for the Degree of Master in Disaster Management

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Dedicated to

My

Mother and Father

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Abstract

The present study tries to identify the Indigenous practices of the rural communities. It also focuses to assess their economic condition in relation to livelihood practices. Local people Participation in the research process has ensured by Focus Group Discussion, Informal Interview. Most of the peoples don't have any scientific knowledge to coping with flood. The people of Kurigram district passing their life to cultivated land, Domestic animal, grazing land and wet land are the major natural resources. The peoples of the rural area face flood & river bank erosion almost every year. They have some traditional knowledge by which they are able to cope up with this situation.

In my study I tried to find out the existing indigenous knowledge that has been practice by the people for anticipating flood and coping mechanism during flood situation. The project looks at how communities can bring together their own indigenous knowledge and experiences, which might include birds, insects or plants, in order to support local adaptation to during flood. I also tried to find out the practices regarding house, agriculture, health. Most of the rural people they have no academic knowledge but they are living with flood by using their own mechanism for many years in this area. As a result they have a very good capacity which we called indigenous knowledge. With this they are able to reduce vulnerabilities. The thesis then identifies why the region is known for its seasonal food insecurity (Monga) and reason behind the high incidence of poverty.

This thesis discussed about that both scientific and their own local knowledge is used properly to inform policy and decision-making at all levels. This thesis emphasizes the integration of scientific and indigenous knowledge for flood management. Finally I recommended some of my findings of Kurigram district for further study.

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List of Acronyms

IK	Indigenous Knowledge
FGD	Focus Group Discussion
KII	Key Informant Interviews
EI	Expert Interview
HH	House Holds
PRA	Participatory Rural Appraisal
BV	Base Village
SV	Satellite Village
NGO	Non-Government Organization
BBS	Bangladesh Bureau of Statistics
BWDB	Bangladesh Water Development Board
MoDMR	Disaster Management Bureau and Ministry of Food and Disaster Management.
ITK	local technical knowledge
RPK	Rural People's Knowledge
EOC	Emergency Operations Centre
FFWS	Flood Forecasting and Warning system
GoB	Government of Bangladesh
UNISDR	United Nations International Strategy for Disaster Reduction
UNDP	United Nations Development Program
FAO	Food and Agriculture Organization
IPCC	Intergovernmental Panel on Climate Change

CHAPTER 1
INTRODUCTION

1.1 Introduction

Bangladesh is one of the most flood prone countries in the world which is situated in south Asian sub-continent. The country has about 130 million populations with an area of approximately 147,000 sq km. It is one of the highly dense populated countries and every year different flood types and magnitudes occurs because of its unique topography and geographical location. At least eight extreme flood events occurred affecting about 50- 70% of land area during last fifty years. Due to the floods economic loss was huge, e.g. in two consecutive floods of 1987 and 1988 flood damage was estimated at US$ 2.2 billion and in 1998 flood damage was estimated at US$ 2.8 billion. Flood management in Bangladesh is, therefore, perceived as an indispensable component of poverty reduction initiatives.

1.2 Background of the Study

Bangladesh is one of the most vulnerable countries to natural disasters in the world. Bangladesh is crisscrossed by a strong river network of three major rivers – the Padma, the Brahmaputra, and the Meghna – and their tributaries, numbering about 230 (Hossain, 2013). Climatically it is situated in humid tropical zone. This unique location makes it prone to flood vulnerable (Disaster Management Bureau, 2008). Disaster reduction is both possible and feasible if the sciences and technologies related to natural hazards are properly applied (UNISDR, 2002). Science and technology help us to understand the mechanism of natural hazards of atmospherically, geological, hydrological, and biological origins and to analyze the transformation of these hazards into disasters. Scientific knowledge of the violent forces of nature is made up of an orderly system of facts that have been learned from study, experiments, and observations of floods and other disasters. Major progress has been made in the development of global meteorological models and their application to large scale weather prediction (Shaw *et.al*, 2014).

In this digital world, although disaster related news is disseminated very fast but in most of the cases, disaster affected people did not receive humanitarian assistance immediately. Many people in the disaster prone areas of Bangladesh depend on indigenous knowledge to cope with the extreme climate event such as flood, cyclone and drought. Until government or non government assistances reach to a disaster affected area, disaster affected people find out their own ways in doing things, survive on their own mechanisms. The United Nations already considers indigenous knowledge within Priority 3 of the Hyogo Framework for Action, which focuses on education and knowledge (ISDR, 2008).Historical records tell that the people of Bangladesh have faced disastrous situations through extending their mutual cooperation with their indigenous knowledge from time immemorial. So there are ample scopes to identify indigenous coping mechanism against disaster from rural Bangladesh societies. Flood is a

common hazard that happens almost every year in different magnitude. The scientific intervention may reduce their vulnerability to flood. It is important to undertake such research integrating scientific and local knowledge for flood management.

This research is the about the people living in two of the most vulnerable flood prone areas of Bangladesh – Lalmonirhat and Kuriggram district. The Districts are located in the Tista and Brahmaputra river basin. Beside their chronic poverty and hunger, frequent natural disasters particularly flood and river erosion further add to the uncertainties in their life. Yet, the people have developed their local knowledge to predict flood and mechanisms to cope with exceptional circumstances caused by the floods (Alam. Khurshid. 2006). the way people deal with such flooding may change over time. Then the vital question for Bangladesh remains unanswered: whether any public and private policy contributes to enhance integration of scientific and local knowledge to coping with flood? This research also goes into a deeper analysis of such questions.

1.3 Profile of the Study Area

The Kurigram district is located in the north-west part of Bangladesh in the reach of the Teesta Meandering Floodplain and is criss-crossed by a number of major rivers, namely the mighty Brahmaputra, Teesta and Dharala (see Figure 2). Typical for this country, Kurigram exhibits a flat topography with little gradient from north to south. The Kurigram district belongs to the recently constituted Rangpur division, and is bordered northward by the Indian states of West Bengal and Assam. It has an area of about 276.45 km2, which is divided between nine Upazilas (sub-districts), two municipalities, 73 Union Parishads (local govern-ment institutions at the lowest tier), 647 Mouzas, and 1,907 villages. Kurigram Sadar Upazile, the sub-district chosen for the fieldwork for this case study, has 11 Union Parishads, one municipality, and 256 villages. The total population of the Upazila, ac-cording to the census in 2001, was about 0.26 million, of which 51 per cent were male and 49 per cent female. The population density in 2001 was 935 people per km2, and has increased to about 1,000 people per km2. The current literacy rate is believed to be about 40 per cent. Around 30 per cent of the farmers are landless (TAS, 2006)

1.4 Geography the Study Area

Kurigram District is located in the northern region of Bangladesh along the border of India. The population is 2,069,273 (2011 national population census). This district is surrounded by Cooch Behar district of India in the north, Gaibandha district of Bangladesh in the south, Assam state of India in the east and, Lalmonirhat and Rangpur districts of Bangladesh in the west. Weather of the Kurigram district is bit different from the middle or southern part of Bangladesh. During summer, temperature is higher and during winter is lower than middle or southern part of Bangladesh. The average maximum temperature is about 32-33 degree Celsius when average minimum temperature is about 10-11 degrees. Heavy rainfall is usually observed during the rainy season like other parts of Bangladesh and the average annual rainfall is about 3000 mm. Several

rivers are flowing through the heart of this district. The major rivers are Brahmaputra, Dharla, and Tista with minors are Dudhkumar, Phulkumar, Gangadhar, Jinjiram etc. Three northern subdistricts (namely thana or upazila)of this district (Nageshwari, Bhurungamari, and Phulbari) are recently connected by a beautiful bridge over the Dharla river with the main land of the district.

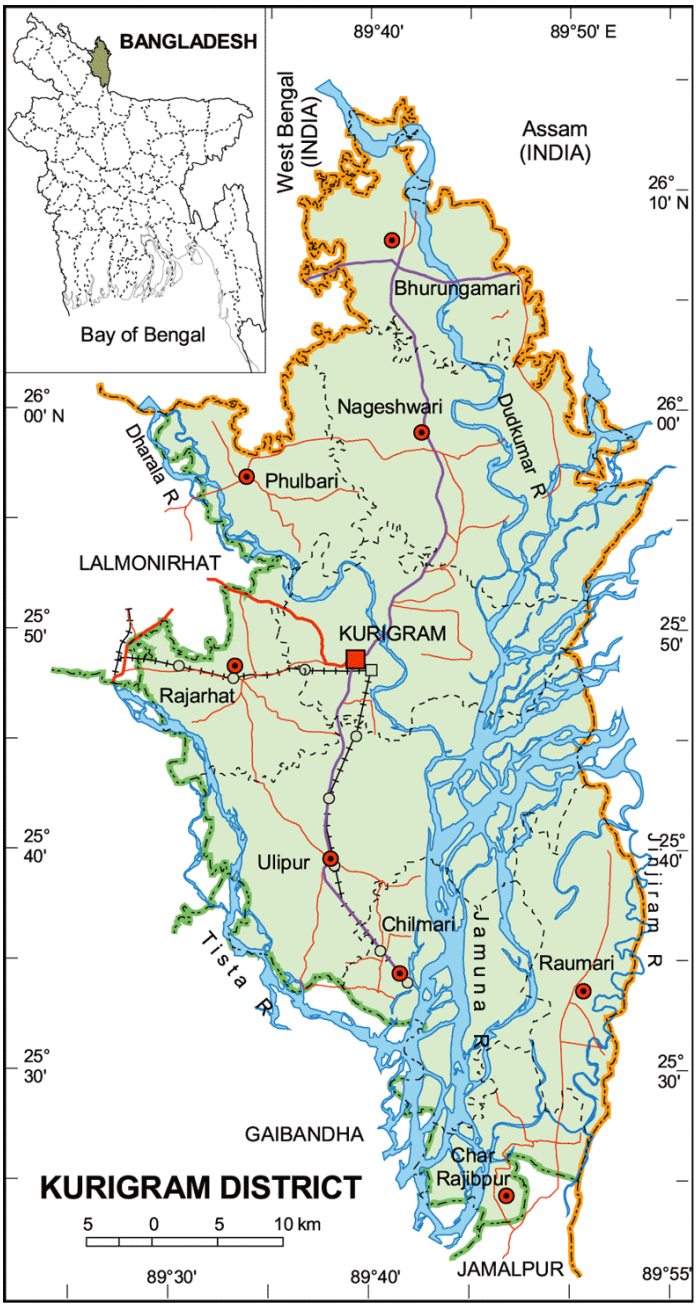


Figure 1: Administration Area Map

1.5 General Objective

The general objective of the study is combining the indigenous knowledge of flood disaster risk management with scientific techniques in the selected rural coastal communities with the view to developing adaptive response strategies to flood disaster.

1.6 Specific Objective

The specific objectives include the following:

I. To examine and document current existing adaptation strategies and practices at various levels of community to flood management.
II. Identify contribution of indigenous knowledge to local population to management of northwest Bangladesh.

1.7 Research Questions

What are the potential scientific and indigenous knowledge used for flood management in Bangladesh?

1.8 Limitations of the Research

Although this research part of the paper was completely prepared, but some limitations were observed. Availability of information, easy access to primary data and information, finding right people for additional guidance, unable to take intensive interview of the local char people due to ongoing Hood in the northwest part of the country, are some to name a few.

CHAPTER 2

REVIEW OF LITERATURE

2.1 Introduction

Bangladesh is heavily influenced by the annual monsoon, and therefore also experiences very high rainfall variability. While the northeast receives over 5,000 mm rainfall annually, the central-western region hardly receives 25 percent of that annually (FAO/UNDP 1988). June to September is the monsoon season when about 80 per cent of the rainfall occurs (Ahmad, 2000). However, local run-off is overwhelmed by the huge run-off generated in the greater Ganges Brahmaputra-Meghna basins, to form the second largest outfall into the ocean through the Lower Meghna River.

Since the 1990s, local and indigenous knowledge has received increasing attention in the fields of natural resource management, disaster risk reduction, and climate change adaptation. In the disaster risk reduction field, the 2004 Indian Ocean earthquake and tsunami has been recognized as a turning point, when specialists and scientists began to show interest in such knowledge. However, local and indigenous knowledge is yet to be included in policies on disaster risk reduction or climate change adaptation, and the wealth of documented knowledge and practices have not led to increased efforts to make use of this knowledge to enable communities to increase their resilience.

2.2 What is a disaster?

We use the term disaster often in our everyday lives. It seems that anything from missing the bus to a lost football game can be a disaster. At the same time we constantly see and hear events such as earthquakes, nuclear accidents or environmental degradation being described as disasters. What then is a disaster? A disaster can be defined as an event that occurs when a disaster affects a vulnerable Population or area.

Disasters are often portrayed using the following equation:

*Disaster = disaster * vulnerability*

As this equation shows, the two key elements to a disaster: disaster and vulnerability.

2.3 Form of disaster

Disasters come in a number o f forms:

- Natural disasters. These include hydro meteorological (Cyclones, floods), geological (Earthquakes, volcanoes) and biological (Epidemics, locust swarms).
- Technological disasters (Gas leaks, industrial accidents, bridge or building collapses).
- Environmental disasters (Sea level rise, desertification, and climate change).

A disaster alone will not cause a disaster. Disasters have to impact on a population or area before they can have disastrous effects. For example, a tsunami traveling over open-ocean is not a

disaster, but when it strikes a population located on a coastline, the results can be disastrous (Rashid, 1995).

2.4 A diversity of disasters

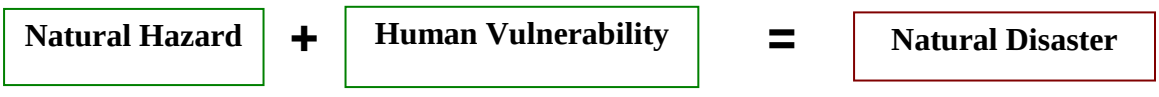
Disasters come in all shapes and sizes. This briefing focuses on natural disasters - those that are weather related or geophysical in origin. Yet some natural disasters are partly human-induced, such as storms or droughts influenced by global warming or landslides caused by deforestation. The disasters associated with them reflect a complex interplay between these disasters and factors leading to human vulnerability and are anything but natural. Moreover natural disasters cannot be considered in isolation from other disaster types. Their interactions with epidemics human impacts on the environment, including technological disasters, and conflict is also of critical importance (Hutton *et. al* 2005).

2.5 What is Knowledge?

Knowledge is defined by the Oxford English Dictionary (Trumble, 2007) as information and skills acquired through education or experience or an awareness or familiarity gained by experience of a fact or situation. This can then be divided further into scientific knowledge and indigenous knowledge. While the former is generally understood to involve western technology or techniques, there exists no concise definition of the latter. Indigenous knowledge is referred to in a number of ways including, but not limited to local knowledge, traditional knowledge indigenous technical knowledge peasants knowledge traditional environmental knowledge and folk knowledge (Sillitoe, 1998). To summaries relevant literature indigenous knowledge is considered to be a body of knowledge existing within or acquired by local people over a period of time through accumulation of experiences society-nature relationships community practices and institutions, and by passing it down through generations (Brokensha *et al*., 1980; Fernando, 2003; Sillitoe, 2000).

2.6 Knowledge & Disaster Management

In order to improve disaster management one must first understand the components of a disaster and how they interact with knowledge systems (both expert and local). Disasters arise out of the interaction between a natural hazard and human vulnerability. In other words; natural disasters cannot arise simply out of natural forces but must interact with social organizations to result in disaster a normative concept.



Clearly the natural physical and social sciences provide valuable knowledge regarding hazards and vulnerability, but disasters have a social component comprised of norms, values and perceptions (Rodriguez, *et al* 2004). As a society then, and especially as policymakers attempting to mitigate natural disasters, we must gain a comprehension of the social context of natural disasters that goes beyond the empirical, beyond technological fixes and predictive capacity. Scientific expertise is one tool by which we may understand these components, but what other knowledge systems may prove useful?

2.7 What is Indigenous Knowledge?

Indigenous knowledge, accumulated though generations of living in a particular environment, belongs to and is sustained by communities. According to Van der Bleik and Van Veldhuizen (1993), indigenous knowledge consists of ideas, experiences, practices and information that have been generated locally or generated elsewhere, but have been transformed by local people and incorporated into the local way of life.

2.8 Indigenous Knowledge & Disaster Preparedness

We document local knowledge on disaster preparedness. Case studies on local knowledge exist in several fields of study, but usually the links between local knowledge and disaster preparedness are not explicitly made. An assessment of the available literature reveals the absence of a framework through which they may be linked. So there is no better way than to hear from the mouth o f local people about their knowledge on natural disaster preparedness.

2.9 Why Indigenous Knowledge?

The interaction between western conventional science and local knowledge is not new and the history o f the sciences demonstrates that those two knowledge systems have often been more intertwined than separated. What is new is that local knowledge including indigenous knowledge and practices and knowledge systems are now more widely acknowledged. Much of the literature on local and indigenous knowledge is dispersed in various fields including anthropology, geography, natural resources management, rural sociology, urban planning, and engineering. However, local knowledge and practices have been barely explored in disaster literature in general and even less in literature on disaster preparedness. Until recently much focus was directed towards relief aid, but this is now slowly changing.

An example comes from the impact of the 2004 tsunami in South Asia. Following the disaster, the media especially reported how some communities managed to save their lives and property using local knowledge through the ability to identify early warning signals of the tsunami from local songs and observed changes in animal behavior patterns. The failure o f relief aid following 13 the 2004’s tsunami is now largely attributed to a general misunderstanding o f people's needs and practices. However, even if implementing organizations acknowledge the existence and importance of local knowledge and practices related to disaster preparedness, there is little documented evidence of their inclusion in disaster preparedness planning (Hutton and Haque 2005).

2.10 Indigenous Knowledge versus Scientific Knowledge

One manner in which we may improve our ability to explore the social context of natural disasters is to incorporate greater local knowledge. People's own experiences and understandings of previous disasters will influence their uptake of scientific knowledge and may lead to issues of trust with the scientific and policy communities. Integrating technical information with real-world perceptions will surely add to the useful capacity of knowledge in disaster management for all of society.

But Indigenous knowledge can also play a leading role in the contribution of knowledge to disaster management. A fragmented approach dominates the established paradigm of expert scientific knowledge. Although science does attempt a systematic view of disaster through a reductionist exploration of prevention, preparedness, response, and recovery, science tends to focus on human vulnerability (Rodriguez *et al.* 2004). Indigenous knowledge influences range from personal experience, knowledge, personality, culture, and access to resources, social status, and future expectations.

2.11 The challenge of incorporating indigenous knowledge

Scientific knowledge is global in nature whereas indigenous knowledge is considered local. However, as with scientific knowledge, indigenous knowledge is dynamic in nature, continually influenced both by internal creativity and experimentation, and by has a contact with external systems (Flavier *et al.,* 1995). Knowledge's both scientific and indigenous, are intertwined with power and human relationships including social, political, technical and economic elements. Indigenous knowledge is oppressed in a number of ways as a result of the marginalization, exploitation, powerlessness, cultural imperialism, violence and denial of existing knowledge placed upon its bearers. All of these forms of oppression can occur simultaneously or independently of each other, but all contribute to the suppression of indigenous knowledge in a society where the scientific culture is dominant.

Indigenous knowledge is based on diachronic observations accumulated over generations of detailed observation and interactions with local ecosystems (Dekens, 2007a). Their knowledge is more qualitative and geographically specific in contrast to scientific knowledge, which is normally based on synchronic observations, tending towards the quantitative and more general in nature (Dekens, 2007a). However, too often indigenous knowledge is hidden and dismissed by the tendency of scientific knowledge to deny the importance of the other.

However, the ability of indigenous populations, such as those in Kurigram, northwest Bangladesh, to survive environmental hazards is evidence of the applicability of indigenous knowledge. In order to engage indigenous knowledge productively in development, Agrawal (1995) argues that there is a need to move beyond the dichotomy of indigenous versus scientific

and work towards building bridges across the indigenous and scientific divide. The distinctions between indigenous and scientific knowledge is potentially ridiculous and that it makes more sense to discuss multiple domains and types of knowledge with differing logics and epistemologies (Agrawal, 1995). This is observed among indigenous communities in villages, who have constantly adapted and developed their knowledge over centuries, intertwining this with outside knowledge where necessary, thus creating multiple forms of knowledge.

The local communication system (indigenous method) then took over with local runners taking the message out to other community members in the local language. Hence, there is a need for a participatory process in which indigenous knowledge is shown to have value and is kept within the community. In an attempt to meet these challenges the framework presented below has focused on the use of participatory techniques within a given community to integrate both indigenous and scientific knowledge within disaster risk reduction.

2.12 Identification of indigenous and scientific strategies

Identifying both indigenous and scientific strategies used both in the past and in the present to cope with intrinsic factors affecting vulnerability. It is essential that strategies and/or knowledge used in the past are identified alongside present day strategies because an earlier strategy may emerge as relevant and beneficial. For example, the villagers in Kurigram districts identified that their indigenous land management strategies used in the past had helped reduce their vulnerability, whereas the strategies implemented today have contributed to their vulnerability. This is especially true with regards to landslides, as implementation of the 'western scientific' way has contributed to destabilizing the ground and the soil, resulting in further landslides.

2.13 Identification of indigenous strategies

1. Community to establish groups consisting of a balanced representation of elders, youths, women, minorities (e.g. ethnic minorities) and disabled to look at indigenous strategies used to deal with the hazard in both the past and present. Groups to consider different knowledge areas such as land use planning, building methods, environmental strategies, food strategies, social linkages, and other areas identified in collaboration with the community.
2. Triangulate data with whole community and with associated stakeholders to establish/identify strategies that may be used, of which the community may have been unaware

2.14 Framework integrating indigenous and scientific knowledge

The framework is a process by which indigenous and scientific knowledge may be integrated to reduce the vulnerability of indigenous communities to environmental hazards. The framework is not identifying new knowledge but rather identifying how existing knowledge can be integrated to enhance the ability of indigenous communities to reduce vulnerability levels to environmental

hazards. The framework provides is to circumvent such a situation, enabling indigenous people to reach a consensus regarding ways to approach their vulnerability to environmental hazards. The desired outcomes of this process consist of: a) Reduced vulnerability to environmental hazards, b) Increased collaboration among stakeholders, and c) Organized disaster risk reduction planning. The framework is a process by which a researcher and community collaboration using participatory techniques to reach a desired result. Participatory techniques in the context of disaster risk reduction have often been utilized in the form of capacities and vulnerabilities analyses—that is, determining the strengths and weaknesses of a community. While in itself a useful analysis, the process does not seek solutions but rather identifies which strengths need to be built upon.

Hence, for the purposes of this research, community has been defined as a group of people sharing common ideals, resources, environment and aspirations while living in the same geographical location. For this study, the process framework represents the main processes or steps that are taken in order to reach a point at which the indigenous community concerned can identify an integrated strategy incorporating indigenous and scientific knowledge that would best reduce their vulnerability to environmental hazards. As a process framework, guidance to completion is on a step-by-step basis in a linear fashion. Local and indigenous knowledge is the key to increasing the resilience flood risk communities to hydro-meteorological hazards and the impacts of climate change. However, it has yet to be fully harnessed by scientists, practitioners, and policy-makers. Such knowledge needs to be integrated with science and technology before it can be used in policies, education, and actions related to disaster risk reduction and climate change adaptation.

CHAPTER 3
RESEARCH METHODOLOGY

3.1 Introduction

This chapter will be focusing on the methodology used conducting the research. While describing the methodology I have gone into details where step by step process has been written down. Here the data used are mainly primary data collected from the field area. However some secondary data related with district and state are also used. The primary data were collected by using certain methods which includes

3.2 Methodology employed

The research activities considered qualitative primary and secondary data collection in a bid to find answers to the research questions raised above. Three main methods were employed in the research for objectives, each of which is characterized below: surveys, participatory research and Focus Group Discussion (FGD), and Expert Interview (EI). The information collected through fieldwork has been complemented. However, further analysis is necessary to obtain a more complete picture of the interrelations of different factor he survey reveals a qualitative picture of the population in the study area.

Methods	Advantage	Disadvantage	Expected Outcome
FGD	To understand overall perception and clear understanding of knowledge	Not Found	Wealth ranking, well being ranking, livelihood risk analysis.
KII	Become more Reliable source	Not Found	To know usability of the knowledge
EI	Analysis of Knowledge	Not Found	In-depth Research Knowledge sharing
PRA	More participatory and different people perception can be understood	Not Found	Avoid gender, wealth, age, occupation biasness

Table 1: Methods of data collection

A total of 271 people are found in 53 House Holds (HH), which represents a population size of about 5.12 people per HH. This is slightly higher than the current national HH size (4.8). Infants and children constitute about 34 per cent of the population, with a slight bias towards girls (36

per cent girls, 34 per cent boys). While 47 per cent of the subject population is single, about half are married. Divorcees and separated groups are found to be negligible at 0.3 and 0.1 per cent, respectively. About 97 per cent of the population was present in their HHs while the survey was conducted.

To avoid gender bias in our findings, in 29 cases either the head of HH or his wife was interviewed. Before deciding to do this, several villagers were asked whether wives are usually well informed about HH resources allocation and decision-making. All of them confirmed and some added that wives are often even more informed about HH affairs than the men. For the 25 women selected who were not heads of HH, no formal criteria were used. In the selection of participants for PRA sessions, gender, age, wealth status and occupation (e.g., farmers, fishermen, etc.) were taken into consideration. In two different locations, a total of 14 FGDs have been conducted involving 168 participants.

3.3 How the information has been collected?

Collecting information on indigenous knowledge related to disaster preparedness involves four major steps:

1) Understanding the nature of indigenous knowledge,
2) Understanding how indigenous knowledge is being (or not being) produced, used, transmitted, and adapted,
3) Understanding the four pillars of indigenous knowledge on disaster preparedness; and
4) Understanding the wider context, that is the linkages between indigenous knowledge, disaster management, sustainable livelihoods, and poverty reduction.

This thesis is described as a qualitative research. From the very beginning my supervisor guided me to work on a topic which wills emphasis on the relationship among the local knowledge and disaster preparedness in the flood prone area of Bangladesh. And he also insisted to do this research in a qualitative way. Whether I went to the flood prone areas and try to observe them and their livelihood pattern for two days to have close relationship with them. After five days 7 interviewed them with open ended discussion. I also arranged few' group discussion separately (male group, female group, mixed group, elder group). Few of the discussions went for more than hour. I played the part as 10 moderators but not as typical facilitator. If they were out of track too much only then I tried to take them back into the discussion. After collecting the data summaries those and submitted to my supervisor. I also took pictures of few coping mechanisms and their livelihood system for better understanding.

3.4 Mapping of the Study Areas

The research in Bangladesh focused on the Kurigram district, since the livelihoods of the majority of its population are still dependent on agriculture, and the agriculture there is largely dependent on the available rainfall. Moreover, the region is known for its seasonal food

insecurity and high incidence of poverty. In addition, since Kurigram is an area susceptible to flooding and riverbank erosion, its sensitivity to climate variability and change is likely to be very high. Moreover, the study region was found to be adequate for the development of appropriate adaptive responses that help to foster the security of people living in the greater Rangpur region. It was decided that four to five villages would be selected for the study: one should be chosen as the Base Village (BV), where more in-depth research would take place additionally three Satellite Villages (SV) were selected, where comparative results would be generated.

Debarikhola was chosen as the base village, while the satellite villages were jatrapur, jhunkar char and Doalipara. Efforts have been made to select study areas, including BV and SVs, where both flooding and erosion are observed as climate-induced hazards. The BV Jhunkar char is a typical agricultural-based village, representative of the Kurigram district. It is slight to moderately vulnerable to flooding. Both jatrapur and jatrapur are subject to riverbank erosion. Doalipara is quite a stable locality, and does not face severe erosion. More detailed information about the Kurigram district, the BV, where all research methods were employed, and the three SVs, where selected methods were employed to gather evidence, are described in Section

Figure 2.Flood Impact in Agriculture sector

3.5 Primary Sources of Information

In addition to field survey, interviews of organizational respondents, professionals working there, and many published unpublished data of NGOs and development agencies have been utilized in this study.

3.6 Expert Interviews

A total of 18 EIs were conducted, of which three were held at national level, four at district level, five at sub district (Upazila) level, and nine at community (local) level. The experts were mostly people who worked in organizations and institutions involved in environment, agricultural production and socio-economic development or having vast practical knowledge on the issues covered under the study. Emphasis was given to involve those who had in-depth knowledge of the research site. The interviews were semi-structured. A topic list was used with questions about climate variability, livelihood, food security, human mobility and the interplay between these themes. The EIs were usually held with individuals, on a one-on-one basis at times, which suited the experts' availability.

Figure 3: Key Informant Interviews (KII) with Community People

3.7 Participatory research and focus group discussions

The qualitative data collection processes included Focus Group Discussion and Expert Interviews (EI). A variety of participatory action research tools were employed during the field activities; for instance: transect walk, resource mapping, wealth ranking, well-being analysis, seasonality calendar, livelihood risk analysis, timeline analysis, Venn diagram, mobility mapping and FGDs about coping with flood. A consistent set of such tools from participatory research approach (PRA) were used in the BV, while parts of the set were implemented in the three SVs. During semi-structured EIs the experts expressed and shared their understanding regarding the nexus between rainfall variability, flood susceptibility, production systems, and the livelihoods of common people, food insecurity and migration.

The narratives from the EIs have been included in the analysis to reveal the dynamics of the various elements discussed through the objective of the research. The PRA consisted of group work in sessions of two to three hours where a group of respondents reflected on various aspects of flood (variability and change over a considerable period of time – say up to 30 years), livelihoods, food security, coping and adaptation strategies, migration destinations, etc. Group numbers would help assess relationships between variables, but it did not attempt to establish causality among those variables. Researchers were obliged to make changes in sites selected for research when they arrived in the field, taking time away from research.

The interviewees as well as FGD participants had little information on local climatology and production systems over a 20 to 30 year period. It took five to six days to figure out that the farmers in that location could provide only limited information regarding the nexus between rainfall variability, agricultural production and food security, and migration. Such a twist in the field research activity took away valuable time, making it difficult for the research team to modify the plan and get things accomplished in time.

However, the poor farmers in those field locations graciously spent valuable time on providing information in a series of interactions, and this enabled the study team to complete both the quantitative as well as qualitative data collection. The questionnaire had its own limitations.

Figure 4: Focus Group Discussion (FGD) With Community People

3.8 Social mapping

It was done in participation with the villagers. It revealed certain information like the settlement pattern, types of the houses, total no of household, the ethnic composition and demographic profile, source of income of the households, areas of important places like schools and temples, the village path, cultivated areas, safe areas to evacuate during the flood etc.

Figure 5: Community Social Mapping

3.9 Observation

The trend of observation used in the present study was quasi participation observation which is mid-way between participant and nonparticipant observation. The activities and interaction between the villagers were observed from a distance since accepting an outsider as a part of them was difficult. Hence maintaining the position of a researcher, observations were done by remaining at the periphery. However, their activities, interaction between people, behavior of neighbors towards each other, behavior of family member and behavior of the people at various places. All these observations helped in bringing out a vivid picture of the kind of life they live in the present time.

Figure 6: Social Observation Study Area

3.10 Group discussions and interviews

For this purpose an interview guide was used where a list of questions were structured beforehand and attempt were made to capture history of the community, condition of the environment in the past and present, changes in the population, changes in the economic practices, the present political scenario, social stratification of the community, number of family in each category, profile of natural hazards and disasters that have affected the community, the most destructive disaster according to the memory of the people, types of disasters that have occurred, periods of occurrence of disasters, numbers of families affected, type of the assistance they got from external agencies, traditional/indigenous knowledge on economic practices, social institutions and social practices, religious activities and festivals, division of labor between the family member, traditional knowledge about the prediction of weather, rain and flood and traditional knowledge on the other technologies which could mitigate and hence enhance the resilience of the community to hazards.

3.11 Transect Walk

Volunteers walked through the village along with the main road and gained a general understanding of the area by seeing and attentive hearing. They have prepared a sketch of the study area for selecting their starting and end point for the questionnaire survey.

Figure 7: Community Transect Walk

3.12 Social and Institutional Network Analysis

Discussions were held randomly with selected local people both male and female regarding various social institutions and their activities, local people‘s perceptions, relations and inferring about the functioning of these institutions. All the discussions were held in a small group in tea table meeting and some are in yard gossiping.

3.13 Social and Risk Mapping

Local people prepared a map of social resources and risk through the facilitation of the volunteers. Gender balance was carefully maintained during the drawing of the map. These maps

are extremely useful in understanding vulnerabilities, risks and natural resource management according to the local people.

Figure 8: Social and Risk Mapping of the Area

3.14 Livelihood Analysis

Livelihood analysis tool was used to understand the livelihood pattern in the study areas and the available natural, social and individual resources. It also provides significant information regarding the social structure and power distribution of those particular areas. Moreover, it identified the impact of disasters on the livelihoods of the local community.

Figure 9: Community Livelihood Analysis

3.15 Historical Profile

Historical profile reflects the comparisons of the past events and future scenarios and the likely impact on key sectors such as livelihood, risks, vulnerabilities, coping capacities, etc. The historical profile was done by aged people as it bases past to the future direction.

Figure 10: Historical Profile or Propensity of Flood

3.16 Secondary Data Collection

Secondary information was collected from several upazila and union level government departments and agencies. Other than that relevant information was collected from sources such as research studies and documents, scholarly journals, information from specialized websites, and government and non- government research and policy documents, published books, websites, national and international organizations, Government Offices like Bangladesh Bureau of Statistics (BBS), Bangladesh Water Development Board (BWDB), Disaster Management Bureau and Ministry of Food and Disaster Management. Most of the scientific information and flood management

3.17 Data collection Instruments

My primary data collection method was in-depth, open-ended interviews, for which I used an interview guide that I had prepared. Key informants provided supplementary data. The use of the interview guide indicated that there was some structure to the interviews, even though they were treated as conversations during which the interviewer drew out detailed information and comments from the respondents. One way to provide more structure than in the completely unstructured, informal conversational interview, while maintaining a relatively high degree of flexibility, is to use the interview guide strategy (Rubin & Babbie, 2001, pp. 407). More structure eases the researcher's task of organizing and analyzing interview data. It also helps readers of the research report judge the quality of the interviewing methods and instruments used. Additional data collection methods were non-participant observation of organization/community conditions and processes and reviews of documents related to the communities, organizations, and projects included in the study. Archival research included both electronic (i.e., Internet-based) and hard-copy issues of newspapers in addition to minutes and reports of meetings, letters, and similar documents.

3.18 Data Analysis

The analysis of interview transcripts and field notes was based on an inductive approach geared to identifying patterns in the data by means of thematic codes. Inductive analysis means that the

patterns, themes, and categories of analysis come from the data they emerge out of the data rather than being imposed on them prior to data collection and analysis (Patton, 1980, p. 306). The grounded theory method was employed in my study. A grounded theory is one that is inductively derived from the study of the phenomenon it represents. That is it is discovered, developed, and provisionally verified through systematic data collection and analysis of data pertaining to that phenomenon (Strauss & Corbin, 1990, p. 23). Further a constructivist-interpretive paradigm (Denzin & Lincoln, 1994) underpinned my study. In line with this approach the investigator's interpretation of events and situations involving local community actors provided the building blocks for theory construction. A constructivist-interpretive paradigm produces substantive-formal theory grounded in the research (Denzin & Lincoln, 1994; Glaser & Strauss, 1967). Substantive theory is developed for a substantive or an empirical area of inquiry; formal theory is developed for a formal or a conceptual area of inquiry. Data were analyzed using the constant comparative method (Glaser & Strauss, 1967; Strauss & Corbin, 1990) whereby line sentence and paragraph segments of the transcribed interviews and field notes were reviewed to decide what codes fit the concepts suggested by the data. The interview data were given more weight in the analysis than were the non-participant observation and the document reviews. Each code was constantly compared to all other codes to identify similarities differences and general patterns. My dissertation contained a detailed description of the coding process. In sum, data were reduced and analyzed by means of thematic codes and concepts in a three-level process. Themes gradually emerged as a result of the combined process of becoming intimate with the data, making logical associations with the interview questions, and considering what was learned during the initial review of the literature. At successive stages themes moved from a low level of abstraction to become major, overarching themes rooted in the concrete evidence provided by the data. These emerging themes together with a substantive-formal theory of development-focused collaboration became the major findings of my study.

3.19 Sampling

Qualitative research such as mine, which stressed in-depth investigation in a small number of communities, uses purposive sampling as opposed to random sampling. Because the emphasis is on quality rather than quantity, the objective was not to maximize numbers but to become saturated with information on the topic (Padgett, 1998, p. 52). I specified the criteria used to select sites for the study which included manageability in terms of the number of sites accessibility of the community and the residents (i.e., prospective respondents), and the willingness of respondents to speak freely with the interviewer.

This paper presents a process for integration scientific and indigenous knowledge. Therefore, indigenous knowledge is discussed first then the scientific knowledge shares with integration process. Most of the scientific information has been taking from secondary data with scientific in practitioner's aspects. In spite of documentation, and validation of local and indigenous knowledge, then selected information used for integration with scientific knowledge. It is imperative that using local and indigenous knowledge for disaster risk reduction.

CHAPTER 4

FLOOD MANAGEMENT OPTION USING INDIGENOUS AND SCIENTIFIC KNOWLEDGE

4.1 Indigenous knowledge

Indigenous knowledge is the knowledge held collectively by a defined community. Through this study the researcher has sought to bring out the wisdom of community in combating flood in their local context. The wisdom of the community is very much relevant and useful to reduce sufferings from flood. Due to its geographic characteristics, Bangladesh is a flood prone country and every year the country has-been experiencing flood of different magnitudes. So community people practice their traditional wisdom to reduce severity of flood as well as their suffering. Through this study it has been tried to identify these sort of knowledge in the two flood prone districts Kurigram.

The ICSU Study Group considered instead traditional knowledge, which is a cumulative body of knowledge know-how practices and representations maintained and developed by peoples with extended histories of interaction with the natural environment. However, Awori (1991) differentiated between indigenous and traditional knowledge, where the former is an original form of knowledge that cultures have developed organically out of need.

As noted, there are numerous definitions of indigenous knowledge, with some scholars emphasizing the generation of the knowledge by original inhabitants of the place while others consider it knowledge transformed and incorporated by locals into their way of life, irrespective of origin. What is common to all definitions is that this knowledge mostly remains undocumented, embedded among people in various forms cultural practices, customs, traditions, religious and spiritual beliefs, rituals, ceremonies, folk stories, folk songs, legends and proverbs. Indigenous knowledge differs from modern scientific thought in several ways as briefly presented in the table that follows

Table 1: Indigenous Knowledge Differs From Modern Scientific Thought in Several Ways

Aspects/ Factors	Modern Scientific Knowledge	Indigenous Knowledge
How approached	Compartmental	Holistic
How communicated	Written	Oral tradition
How taught	Lectures and theories	Observations and experience

4.2 The Nature of Indigenous Knowledge

Despite the aforementioned problems, the consensus and debate in relation to Indigenous Knowledge (IK) has moved on greatly during the past two decades. Since Paul Richards first groundbreaking works, the interactions of actors and the institutional setting within which such information is placed has been analyzed, scrutinized and debated from every possible angle. For reasons outlined above, the original focus of the populists was with attention concentrating on

local people's knowledge and abilities in agricultural production (Richards 1985). In recent years, this perspective has been expanded to consider indigenous knowledge as cultural knowledge producing and reproducing mutual understanding and identity among the members of the farming community, where local technical knowledge (ITK), skills and capacities are inextricably linked to nontechnical ones (i.e. cultural, ecological and sociological factors (Moock and Rhoades, 1992). As a consequence ITK has become part of rural people's knowledge (RPK).

This shift has involved the development and/or modification of methodologies for examining and supporting local knowledge, with parallel changes occurring in professional attitudes and behavior towards local people's capacities, practices and values (Scoones and Thompson, 1994). The resultant stream of research has led to the development of a multitude of terms such as local knowledge, traditional knowledge, indigenous knowledge, community knowledge, resource users' knowledge, rural people's knowledge and farmer's knowledge which are frequently used interchangeably. The correctness of such interchanges is beyond the scope of this report and one which many view as unnecessary. Common to all terms is that they denote knowledge developed and held at grass roots level or by rural people.

The days when the debate whether IK is misguided, unscientific and wrong are gone: rather the discourse and over the last half a decade or so the debate has centered on the ability and means by which information from different epistemologies can contribute together to produce sustainable management strategies. Chambers (1992) stated that there was much overlap between popular and scientific knowledge. Fairlead (1993) also felt that farmers' knowledge is more empirical and dynamic than he imagined. Others however, (Scoones and Thompson, 1994) are less convinced by the similarities. In what represents an excellent critique of the debate surrounding IK, they point out that attempts to bend or integrate local knowledge into existing scientific behavior incorrectly assumes that IK represents an easily definable stock of knowledge which can be easily extracted and incorporated into proposed management plans and procedures. Attempts to remove IK from the web of meaning and influence in which it arose and attempt to fit it into the constrictive framework of western scientific rationality are likely to lead to significant errors in interpretation, assimilation and application. They go on to make the point that IK, like scientific knowledge, is always manifold, discontinuous and dispersed, not singular, cohesive and systemized. It is never fully unified or integrated in terms of a logical system of classification or categorization. Whilst there are plenty of examples which suggest the latter half of the statement is something of a generalization, what is clear is that the interplay between the knowledge of different individuals and institutions means a multidimensional analysis of rural livelihoods is essential if we are to maximize livelihood resource strategies.

4.3 Indigenous knowledge based practices

As this study is primarily concerned with disaster coping practices, a distinction was made between knowledge as understanding of subject or situation, and practice as application or performing an activity. The study looked exclusively at the application of local knowledge and did not explore knowledge without any resulting action. For example, events like frogs croaking or ants shifting their eggs to a new place, perceived as forecasting heavy rains or flood, where there was no indication that these had triggered any action relating to saving life or asset, were not considered for replication. Furthermore, in order to determine the indigenousness of a practice, four criteria or distinguishing features, developed through consultation with key stakeholders (e.g., community representatives and disaster management practitioners associated with the communities)were applied. These include the following. Traditional practice –It is an established or inherent way of acting in the community; widely accepted and integrates with broader cultural traditions. Additionally, the practice may have recently evolved, but has already been. Indigenous Knowledge Integrated into the local culture in ways that ensure its continuity and reproduction.

- Experience based -It is empirical rather than theoretical and has evolved as a consequence of practical engagement in everyday life, irrespective of the origin of the knowledge, local or otherwise. It has been developed by the community through experimentation and experiences and is transmitted through demonstration and replication.
- Communally trusted -It is a community developed practice informally applying intimate understanding of the environment. Its efficacy and dependability are not validated by scientific methods; nevertheless, the community continues to rely on these beliefs to get desired results from their application.
- Reliant on locally available resources-Materials and tools as well as skills required are readily available within the community. Often, necessary resources come from recycling and by products of household materials.

4.4 Indigenous knowledge about anticipating rain & floods and coping strategies

As flood is an annual phenomenon among the villager, they have rich amount of knowledge regarding prediction of rain and flood. Some of the indicators are the behavior of the animals and change in the environmental condition. Thus by observing and interpreting environmental warning signals, they manage to prepare themselves for the impending flood. People already find a safe place for themselves and the cattle and also preserving foods and firewood. With this skill of identifying the signs, people have been coping with flood.

4.4.1 Environmental signals

a. When there is heavy rain for ten to fifteen days continuously, flood is expected. Many a times the water level of the river rises even when there is no rain in the village and the nearby areas but when it rain in the higher mountainous region. So, when we see black cloud and its roaring sounds of clouds, flood is expected.

b. When the soil become very moist and wet, it is expected that flood will be coming soon, when the nearby gutters and drains are filled with water, the water is sure to enter the houses. When the level of water increases and it starts entering the courtyard of the house, people start taking their livestock to the higher and safer places.

c. The direction of the wind also indicates the coming of rain, when the wind is blown from east to west, sweeping the cloud towards western direction, people predicts that the level of the river water will increase.

d. The weather becomes very hot and humid before it rains, at this time body becomes hot and sticky.

Figure 11: Black Cloud as a Mark of Environmental Signal

4.4.2 Animal behavior

- The villagers are keen observer of the animal behavior. Certain behavior of the animals like reptiles, birds and insects are used for the prediction of rain and flood. Some of the indicators are
- When snakes starts to roam around the homestead areas, people start to expect flood.
- The croaking of frog in a certain unusual manner. Frogs start to croak continuously for about a month before the flood and croaking stops only when the level of water rises.
- When ants start moving to higher places like trees carrying their eggs, flood is expected very soon.
- When the pelican birds start flying south to north, rain is expected in the coming days. When the bird fly from north to south, rain stops falling in the next day or so even if it has been raining for quite some days.
- Other than the pelican birds, when other species of birds which are not usually seen the village and the neighboring areas are seen in the village, people knows that it is raining in the higher mountainous places. Thus, people expect flood due to rise in the level of the water in the river. When these birds start moving away from the village, people predicts the coming of rain. Usually the bird Koyal (cuckoo) is easily sighted in the village and its sound can be heard every morning and night. When these birds move away from the village, people come to know that rain is coming.

Figure 12: Animal Behavior Notice

4.4.3 Community response to floods

As the villagers have been experiencing flood every year, people have developed their system of anticipation, preparation, coping and recovery. In all these overlapping systems of response, people have heavily depended on their indigenous knowledge. Consequently, every flood experiences have enriched their knowledge which could be applicable in mitigating the flood risk.

4.4.4 Preparing for the flood

The villagers have been experiencing flood every year so preparation starts as soon or before the rainy season starts. Families try to store as much food as they can. Women of the house prepare to store foods and firewood.

Figure 13: Storing Food Items at Higher Places during Floods

The capacity to store food depends entirely on the economic condition of the family. However, those who could not afford by themselves borrow from the moneylender to buy food items.

Figure 14: Storing Cook Materials at Higher Places during Floods

Enough fodder for the cows are stored in the higher and dry places. Male members of the family are responsible for collecting fodder for the cows and they usually go to the river bank for collecting fodders. (See Role of family members during flood)

Figure 15: Machan for Storing Cow Dung Cakes and Firewood

Most of the time cow dung cakes are made and dried so that it could be used during the flood. Women of the family start grinding flour, buy pulses and salts, storing vegetables.

Figure 16: Machan Built Inside the House to Keep Utensils and Valuable Items

Most of the household also have permanent elevated platforms to stores valuable items.

4.4.5 Coping during the flood

In fact, preparation measures helps in successful coping during the flooding. The local technology of building Machan and lifting the Khatiya or the charpai by tying with rope on the beam which supports the roof are the concrete coping strategies. The portable Chulla, Pihan and Takkat (the wooden platform seen the picture) are indispensible tools for coping with flood.

Figure 17: Coping Mechanism during Flood.

“During the flood we usually do not stay inside the house, for the fear that it may break, so we put the Khuta at the open space adjacent to the house. Then the whole family sits and sleeps on the Khuta. Cooking is also done on the Khuta.” (Said Krisno,age 74)

The other coping strategies are basically related with the behavioral change. People generally deviate from the normal behavior. They eat foods that take less time to cook. Sometimes, they take only one meal a day or cook for both day and night together at once. When the tube well is inundated they use the flood water for cooking and drinking. Sometimes people eat only corns

and spend the whole day."Sometimes I do not eat anything for the fear of going to toilet in public. When the water level is high and water run with high speed, it is not safe to go at far off places."(Said Ruprani Devi, age 20).Thus people cope with flood by changing their normal behavior pattern. At such time having swimming skill also adds to their coping capacity because in the village people rely only on two boats. According to the villagers, locally made rafts do not works as the water is very wavy and flows with high speed.

4.4.6 Recovery after the Flood

Relief and recovery work start as soon as the water recedes. According to the villagers, they have not been getting enough relief material from the external agencies. Sometimes, government use to distribute rice and sugar but the amount is not sufficient. Few years back, an NGO distributed six hundred rupees and a big plastic sheet for each and every household. This was the only remarkable relief material, the villagers has ever received. Now the NGO has stopped working in the village. As, the villagers are not getting enough help for recovery, they had to bring themselves back into the normal condition. Soon the whole routine of daily life continues with men folks starting to look out for job opportunity to earn money and women on the other hand resume to their duty of looking after the domestic chores and the children and if there is an opportunity to earn money, they never miss to grasp it. All the wears and tears and destruction caused by the flood water are gradually attended.

4.4.7 Local Practices for Protecting Life and Assets

Selecting Crops for Cultivation Considering Rainfall Patterns and Temperature

The Local farmers in the village of Jhunkar char select crops for cultivation considering temperatures, types of clouds and speed and direction of winds. If they notice any significant changes in weather patterns, they select crops that they believe to be more suitable for the changing conditions rather than following the traditional crop cycle.

For example, if local farmers notice a delayed winter or relatively warmer weather during early winter, they opt for crops that cope better with such conditions, choosing masur and kheshari pulses over wheat. Similarly, if there is no rain or fewer rains at the beginning of the traditional rainy season, farmers.Cultivate local varieties of aush and aman rice that has greater tolerance to drought conditions, instead of the usual high yielding varieties of rice this practice is widely popular among the farmers in the Tetulia village of the Jhunkar char Union.

4.4.8 Collecting Rain water Using Plastic Sheets

The People of Jhunkar char use rainwater for drinking. During the monsoonal months, they construct a structure made of bamboo poles and plastic sheets to catch rainwater.

To do this, they secure together four bamboo poles, forming a rectangular shape, with one side about afoot higher than the other. Rectangular plastic sheets then tied to the four corners of the poles. When it rains, containers are placed to collect water caught by the plastic sheet. The people Jhunkar char have been using this process as a means of harvesting rainwater for a long time.

Figure 18: Collecting Rain Water Using Plastic Sheets

To keep stored rainwater free of insects Because of high salinity in ground and surface water, the people of Jhunkar char under Kuriggram Districts use rainwater for drinking, collecting it in the rainy season and storing it for use during the dry season. However, within a short period, insects begin to breed in the water. To prevent this from happening, some keep two or three Kai fish in the container to eat insects and keep the water clean. This practice, learned from elders, is practiced in the villages of Jhunkar char.

Figure 19: Keeping Kai Fish (Climbing Perch) In Water Containers to Preserve Rain Water

This practice may successfully remove insects or worms from stored water, but does not ensure water quality. Although economic costs are negligible, replication of this practice is not desirable. Investigation and experimentation to add element to ensure water quality only subsequently, consider replication that could be done through raising awareness and public education

4.4.9 Applying Raw Turmeric to Water Contains to Preserve Rainwater

The people of Jhunkar char in Kurigram districts use rainwater for drinking, collecting it during the rainy season and storing it for the dry season. Within a short period of time, insects begin to breeding the water. To prevent this, some place a paste made from two or three pieces of raw turmeric wrapped in a clean cloth into the water container. This practice has been observed in the villages of Jhunkar char under Kurigram districts as well as in many others.

Figure 20: Applying Raw Turmeric to Water Contains to Preserve Rainwater (Source: BARC)

This practice may reduce insect or worm presence in stored water, but does not ensure water quality. Economic costs are negligible. Before this practice is promoted, further investigation to determine its effectiveness to ensure safe water is required.

4.4.10 Storing Jute Stalk son Raised Platforms Covered with Plastic Sheets to Preserve as Cooking Fuel

The people of Jhunkar char under Kurigram district keep jute stalks in heaps on raised plat forms and wrap them with plastic sheets. Typically, people erect a platform approximately two feet high, made of bamboo. They store jute stalks on it in a way that the upper ends of the stalks are on one side and the lower end son another. It creates a slope on the top of the heap. Then, they wrap the stack with a plastic sheet. Jute stalks stored in this manner do not get wet during rains or flooding. This practice has been seen in the villages of Jhunkar char. The local people learned it from their elders. This practice is extremely effective and economically viable. Thus, replication of this practice is highly desirable.

Figure 21: Storing Jute Stalk Son Raised Platforms Covered With Plastic Sheets to Preserve As Cooking Fuel

4.4.11 Laying Bricks in a Row to Prevent Damage of Plinth Area by Rainwater Falling from Roof's edge

To prevent plinth area erosion caused by rainfall. The majority of families in Jhunkar char under Kurigram district typically place a row of bricks around the foundation of their homes in the area where rainwater falls from the roof. Water falls on to the bricks instead of the house's plinth area, preventing damage.This practice is very common in the villages of Jhunkar char. Local people have been applying it for a long time.

Figure 22: Laying Bricks in a Row to Prevent Damage of Plinth Area by Rainwater Falling from Roof's Edge

4.4.12 Using Social Relationships to Acquire Food Aid in Times of Crisis

To ensure food security in times of crisis through the use of social relationships Food scarcity is normally experienced during periods of hazard, with many families suffering from lack of food. Most households in the Debarikhola village of Jhunkar char attempt to overcome this by sharingand exchanging food with each other. Typically, affected families receive support from neighbors and relatives who are relatively well off. In order to preserve this tradition, villagers maintain amicable relationships with neighbors and relatives and try to build social bonds. This

practice is common in the villages of Jhunkar char as well as in Kurigram district.

Figure 23: Using Social Relationships to Acquire Food Aid in Times of Crisis (Source: BBS)

This practice reasonably addresses food scarcity experienced by households during times of distress due to disaster, and economic costs are negligible. Therefore, replication of this practice is highly desirable.

4.4.13 Dropping Fish Food in Specific Part of Pond When Flooded Due to Heavy Rains

To retain fish stocks in flooded ponds. During floods, shrimp farmers fix net fences around ponds to prevent shrimp from escaping. But when rising water breaches the fence, they drop food, especially wheat chaff, coconut oilcake and cooked rice, in specific spots of each pond, thus attracting fish and keeping the min the pond. This practice has been observed in Vandarkot Union of jatrapur Upazila,Kurigram.

Figure 24: Dropping Fish Food in Specific Part of Pond When Flooded Due To Heavy Rains(Source: BBS)

This practice has the potential to reduce risks of asset losses. Although its efficacy is uncertain, its comparative economic costs are negligible. Replication of this practice is desirable when other options have been exhausted.

4.4.14 Planting Sunflower Seeds in the Field without Plowing

To minimize expenses and delay in cultivating crops following a flood. Generally, farmers plough and prepare lands in order to sow sunflower seeds in the Bengali month of Agrahayana (corresponding with late fall). However, if they have previously planted aman rice, they do not get adequate time to prepare the land for sunflower cultivation, since the aman harvesting period coincides almost exactly with the sunflower seeding period. To overcome this difficulty, some farmers in Jhunkar char under Kurigram district. Grow sunflowers using ano-till farming technique, sowing sunflower seeds just after harvesting the rice. They still apply fertilizers and insecticides and irrigate the field as required. This practice has been observed in the Katiarampur village of Jhunkar char under Kurigram district. This method of sunflower cultivation could potentially help to offset the delay in preparing land for cultivation caused by flood. Other crops, such as local varieties of rice and pulses, could also be grown using this method

Figure 25: Planting Sunflower Seeds in the Field without Plowing (Source: BARC).

This practice reduces the cost of agricultural production; therefore its comparative economic cost is negligible. Replication of this practice is highly desirable.

4.4.15 Growing Medicinal Plants on Homesteads

To ensure availability of medicinal plants for treating illnesses caused by hazards. Many people in the jatrapur Upazila,Kurigram district use herbs and medicinal plants such as such as Tulsi, Patharkuchi and Neem—to treat illness caused by local hazards. To ensure their availability, they are grown on homesteads, alongside other vegetables in kitchen gardens or planted along homestead borders. Mainly, household women carry out this practice, which is found in almost every area of Lohagara Upazila.

Figure 26: Growing Medicinal Plants on Homesteads

This practice successfully ensures availability of desired medicinal plants. Replication of this practice is highly desirable.

4.4.16 Setting Fish Traps (Gorabushna) in Small Channels to Catch Fish during Flood

To supplement the meeting of nutritional requirements by catching fish in channels during floods. People in the jatrapur Upazila area catch fish in the Brahmaputra river channel. During high tide, locals place small traps made of bamboo rings and net (called gorabushna) into the water stream. Although this method does not capture large quantities of fish, the small amount of fish caught helps people in the region to meet their daily needs for protein. This practice has been observed in the Jhunkar char area of Ulipur upazila.

Figure 27: Setting Fish Traps (Gorabushna) In Small Channels to Catch Fish during Flood

This practice reduces nutritional deficiency at the family level, and the comparative economic cost is negligible. Replication of this practice is highly desirable.

4.4.17 Growing Vegetable Seedlings in Suspended Pots (Aeroponic Gardening)

To minimize the effects of seasonal inundation and salinity on homestead vegetable gardens. People in Debaria of Ulipur Upazila are not able to grow vegetables on their homesteads because the land remains extremely moist due to seasonal inundation at the beginning of the planting season. If they wait for the land to dry, the delayed crop is damaged by increased salinity that occurs during the later part of the year. To overcome these obstacles, village women grow vegetable seedlings in suspended pots. They use discarded items such as coconut shells, plastic bottles and earthen ware pots, fill them with soil and manure and sow vegetable seeds, especially eggplant, chili and bitter gourd. Normally, they hang these pots on tree branches and take them inside when it rains. When seedlings are ready for transplantation and the land becomes dry enough, the seedlings are planted in the backyard garden. In this way, villagers are able to save their crops from salinity intrusion. This practice, applied primarily by women, is common in Ulipur Upazila.

Figure 28: Growing Vegetable Seedlings in Suspended Pots (Aeroponic Gardening)

This practice reduces risks to homestead gardening effectively produces seasonal vegetables, and its comparative economic cost is negligible. Replication of this practice is highly desirable.

4.4.18 Mixing Turmeric with Breast Milk to Treat Common Colds in Infants

To treat coughs and common colds in infants. The women of Pankharchar village in Itna Union under Ulipur Upazila feed infants a mixture of breast milk and raw turmeric to cure coughs and colds. Women prepare a paste from raw turmeric and mix with breast milk in small bowl, and

then feed it to babies. This practice is observed in Pankharchar village under Ulipur Upazila. Usually, this practice is passed down from mothers and grandmother

Figure 29: Mixing Turmeric with Breast Milk to Treat Common Colds in Infants (Source: BARC).

This practice may produce positive results, though its effectiveness is not scientifically proven. The comparative economic cost is negligible. Replication of this practice should be conditional, so that it does not put the baby at risk.

4.4.19 Housing technologies

Majority of the houses are built with thatch roof and thatched wall. The roof is made of long grass called Phuj (imperata cylindrica linn). This grass is generally grown at the river bank. Only few houses in the village are made up brick. There are also some houses which are made up of mud wall with thatched roof.

4.4.20 Indigenous adaptive housing technology

Since the village experience flood every year and the amount of rain during the rainy season is quite heavy, living in a mud house is not considered safe among the villagers. According to the villagers, the best type of house to protect them from the flood water is houses made up of brick and cement. But, at this time, when people could hardly afford a two time meal, building a brick house is beyond their imagination. But there are only few brick houses in the village where their near and dear ones take shelter during the flooding.

Figure 30: Housing Patterns In Jhunkar Char,Kurigram

For those who do not have a place to refuge, they had to stay in their house or rather the hut. At such a time living in a mud house is very dangerous because mud can melt down easily when exposed to water for few days. On the other hand, one needs to repair it after the flood. Considering such facts and economic condition people now prefer to stay in houses made up thatched wall. Such type of house are safer and do not crumble down easily. The walls are not easily destroyed even if exposed to water. And on top of that the walls and roof are portable and can be reused if one wants to shift to other places.

Figure 31: House Being Built On Elevated Plinth and Cemented Boundary

Not only in changing the housing technology, people are also trying to elevate their house as high as possible. And if they can afford, they try to make an embankment of the foundation of the house with cement and brick in order to prevent erosion during the flood**.**

4.5 Perception among the of the community people

1. God is angry with us, most of us follow the norm of the society and nobody tries to break it. We pray to the every possible god, but the situation is worsening day by day.
2. We should thank to the god that, even though we are suffering a lot, there has not been much casualty due to flood in the past decades.
3. We still strictly follow all the rituals associated with the festivals, every adult man and women keep fast during the Navratri for 9 days which is held twice a year, even the young children keep fast if they want to. We try to maintain the rituals in all the festivals as far as possible. Not only in the festivals but also every Sunday, every adult female of the family do Prayer and keep fast on this day. Nowadays this is not more in practice among the younger generations.

4. The village was a business centre at one time because it was suitable for the goods to be transported by boat. It was an advantage to be near the river. It Indigenous Knowledge for Disaster Risk Reduction in South Asia has provided a lot of wealth to our ancestors but now the river has taken it back again
5. We pray to the Allah, a day has never gone by without praying to the goddess. Everyday whenever we go out to collect fodder for the animals from the riverbank, we pray to her for our safety.
6. Now we relaying on our skill and knowledge because neither the god nor the government is helping us
7. Most of us cannot afford to give education to our children and those who have read up to secondary level with great support from their parents are roaming around the village unemployed. So, it is better to teach them to learn labor work.
8. As for the indigenous agricultural practices, we have good knowledge about variety of crops. At one time, there was moisture in the soil and everything whatever was planted produced good yield but now once the flood water recedes, the soil become very dry.
9. At the present condition, we can grow watermelon at the sand deposits at the river bank but nobody grows because, nobody wants to take risk and one has to keep vigil throughout day and night. It may tempt people to pluck unnoticed and there is always a possibility of conflict.
10. We can also plant bamboo trees as it is a very important raw material for building houses and other material objects. But we cannot plant it in large scale because the homestead area is very small and if planted near the houses, it is very dangerous as it attracts lots of snakes. We also cannot plant at agricultural land because there is not much land left for planting crops.
11. Now we grow those crops which can resist the flood water or those which grow during the dry seasons and plantation is only for subsistence because there is not much land left for surplus production to gain profit.
12. Most of us relay on chemical fertilizer as soil fertility has decreased but those who cannot afford still relay on indigenously made manures from cow dung.
13. Before planting any crop, we pray to god and after the harvest of crops, we offer to the god. In fact, before venturing to any new project we always take the name of the Allah.
14. Even though we pray to Allah, he is neither helping us nor the government official, we have come to know that government has provided enough support material but it does not reach to the villagers. Not only the relief materials are reached here, but also exact amount of ration and kerosene is never given. These are given less than the exact amount that also in the higher price
15. At one time there use to lots of trees at the bank of the river but flood has taken all of that. Even the biggest trees are washed away by the flood water. Now there are still some mangroves near the river.

16. Before the situation of the flood was not this worse. It has worsened due to the opening of dam from Nepal.
17. The flood water is very intense and wavy so the raft made up of banana trees and bamboo does not work. So, people manage with two boats in the village, one is owned by the Rafiq and another one is owned by Raja.
18. We have this knowledge that the situation can be improved if cemented embankments of the river is made or we could keep heaps of stone near the river bank. But we do not have enough resource of our own to do that. That is why we are saying only the god and government can help us.
19. We rely on our beliefs about prediction of rain and flood because this the only way for us. The government people do not inform about the opening of dam.

4.6 Perceptions among the women of the community

1. No matter how much prayer we do or how much fast we keep, flood never stops to come but we are still carrying on with the hope that it will be better someday but every year the situation has worsen.
2. The river has become our enemy; it has taken away our land, house, peace of mind and everything.
3. Now everything is in the hand of the God whether he relief us or not. The other one is the government, if they provide enough support, we will able to improve our livelihood.
4. Now we pray to give enough strength to us and our family members to face the problems.
5. Today women have started working in agricultural field. At one time women usually do not work outside the house. Women are paid Rs 30 -35 per day as wage for the labor.
6. At one time women did not learn to swim. We are also less privileged in learning to swim because we do not go to play at the river. Now most of us have learnt to swim and we also encourage other women to learn swimming. Indigenous Knowledge for Disaster Risk Reduction in South Asia
7. We also try to know about home remedies for the minor illness like cold, fever, pain in the throat etc because there is no proper treatment centre in the village. And whatever we know we try to share with others.
8. We actually do not have much to save but whatever we could, we try to buy jewelleries which we can always sell at the time of need.
9. Now the younger generation is moving out of the village to earn money, it is very risky to go out and earn but we cannot stop them because there is limited opportunity in the village. Some of them have migrated for good but it is hard to live in cities because we don't have no one to relay on. But in the village when we don't have anything to eat, we

can always ask the neighbors. So, here no one gets to sleep with empty stomach. But in the city, the day you don't earn, you have nothing to eat.

10. During the flood we face lots of problem, there is no proper place to relief oneself of the natural calls. Sometimes we do not eat for two three days for the fear of defecating in the public and it is not safe to go far and isolated place when it has been inundated by water.
11. Even though we face lot of problems and sorrow due to flood, we console ourselves that it not alone us who is suffering but there are also many other more villagers and people of neighboring village who are also suffering.
12. When the flood water was surrounding us from all the side, we sat saliently praying to the god to let the water recede as soon as possible so that we could move back to our normal life and earn more.

4.7 Perception among the educated people

1. We cannot wholly discard our indigenous beliefs and practices. Most of the time when our elders says it is going to rain, it always rain.
2. We also cannot belief blindly on any superstitious things. Once, a saint came to our village, he was called 'Akhete Baba'. One of his hand was lifted up and he show that he has divine power. He used to remove ghee (purified butter) from his Lotta (a brass jug with handle to carry water). He promised that he can stop the coming of flood and remove all the sorrows of the villagers. All the villagers prayed to him and lots of money was offered to him. But it was of no use, the flood came the next year itself.
3. No matter how scientifically developed we are, the villagers always follow the agricultural calendar used by our ancestors.
4. The education system in the village is very poor, so it is difficult to compete with other in matters of searching job.
5. Support from the NGOs and government agencies are very poor. So, the intervention of the external agencies is very much required in order to improve the economic condition of the people
6. When the people are struggling to earn two time meal, there is no way people can think of building an embankment
7. There are food crops like sugarcane which can resist the flood water and which also give enough profit. Such kind of crop can be grown more but, people fear that there won't be enough land for cultivating food grains for consumption.
8. The education level of the villagers is very low and on top of the political organization of the village is powerless. So far, the villagers have not been receiving any pension scheme neither for the old age nor the handicap people.
9. News about the opening of barrage is usually given the district level officials but it never reaches the village. We only come to know when the water level rises.

4.8 FLOOD MANAGEMENT USING SCIENTIFIC KNOWLEDGE OPTION

Bangladesh tries to deal with flood and disaster with structural and non-structural measures. Systematic structural measures began by implementing flood control projects in sixties after the colossal flood of 1963. Non-structural measures have introduced in seventies. Flooding is a natural phenomenon, which cannot be prevented. Complete flood control is not in the interests of most Bangladeshi farmers. The flood control measures and policies should be directed to mitigation of flood damage, rather than flood prevention. Resources should be allocated to help people adopt a life style that is conformable to their natural environment.

4.8.1 Techniques for preventing flood damage can be classified as structural and non-structural approaches:

Flood Mitigation

1. Structural measures

- Embankments
- Hydraulic Structures

2. Non-structural measures

- Flood forecasting and dissemination
- Flood preparedness, etc.

Measures to cope with floods	Structural	Non-structural
Classification	Extensive • Reshaping of land surface • Protection from erosion • Delay of runoff processes • Increase of inflation • Urban works Intensive • Levees, dikes, floodwalls • dams and reservoirs • floodways and diversion works • polders and fills • drainage works	Regulation • Zoning • coding Floods defense • Forecasting • warning • flood proofing • Evacuation • Relocation Insurance • Governmental • Private • Mixed

Advantages	• Runoff delay and increase infiltration • Flood attenuation • Downstream discharge control • Ground water control	• No significant environmental change • improve organizational relation in the area • effectively in the dealing with flood impacts and damages
Disadvantages	• Reduction of floodplain fertility • High potential of ecological impacts • morphological changes • land subsidence	• Raise of poverty value and invasion of floodplains • Higher level of insurance covered needed
Improvement priorities	• Reforestation • Erosion control • soil conservation • Retention Ponds • Impacts mitigation of reservoirs • Construction of Platforms and polders in floodplains	• Institutional and legal frameworks • Improvement of insurance system and coverage's • Forecasting warning system

Table 2: Classified as structural and non-structural Flood Mitigation approaches

4.8.2 Flood Management by Structural Measures

Structural option provided some benefits specially increase in agricultural production at earlier period but some adverse effects were observed later on. Notably, the construction of high embankment along the both banks of the rivers in some cases resulted in rise in bed levels due to siltation causing obstruction to drainage. In the coastal areas, although the construction of polders prevented salinity intrusion, but resulted in restriction of the movement of the tidal prism, sedimentation of tidal rivers and obstruction to the gravity drainage. Another important impact on agriculture was found that the farmers in most cases opted for production of cereal crops, especially HYV rice enjoying a flood free situation rather than going for crop diversification. Structural measure caused many adverse effects on the aquatic lives especially on open water fisheries

Structural flood control measures reduce flood hazards by controlling the flow of water in rivers and streams. National and regional highways and railways, to the extent feasible, have been raised above flood level. Raising feeder and rural roads will be determined in the context of disaster management plans.

4.8.3 River maintenance and erosion control

River maintenance through dredging is also going on in a limited case due to the high cost. Efforts are continued for erosion control on medium and small rivers.

Figure 32: River maintenance and erosion control Intervention

4.8.4 Flood control and drainage project

Flood control and drainage structures have also been provided in major cities to make the cities flood free. Flood Management by Non-Structural Measures Introduction of non-structural option i.e. Flood Forecasting and Warning System I Bangladesh started from early ‘70sand contributed to the improvement of the capacity for flood preparedness and mitigation/minimization of flood losses. Other non-structural measures are discussed in the following.

4.8.5 Floods cum Cyclone Shelter:

School buildings are so constructed that they can be used as flood-cum cyclone shelter especially in the coastal zone with highest risk of flood and storm surge. These structures are not intended to change the flood regime, and therefore, considered as no-structural measures of flood management.

4.8.6 Function and Form of Flood Embankments

In order to manage flood management systems to achieve optimum performance, it is important to understand the nature and potential variability of typical flood embankments. This section

introduces the generic components of a flood embankment and reviews how these may vary from site to site. The embankment structure providing the mass obstruction against flood water. The

bottom of either the outward or inward embankment faces. The embankment face exposed directly to water to varying degrees.

4.8.7 Surface protection

Surface protection sometimes termed 'revetment'. A protective layer covering part or all of any embankment face. The protective layer may be natural (e.g. grass), manmade (e.g. concrete) or a combination of different materials.

4.8.8 Drainage ditch

Also known as soke ditch or delph ditch, they are typically found close to the outward toe of the embankment to drain any seepage and control water levels through the embankment. Larger delph ditches may exist as a result of borrow areas used for embankment construction (embankment material taken directly from the ground behind the bank).

4.8.9 Fluvial flood defense

The purpose of flood embankments is to constrain and direct the passage of floodwater along a river valley or water course.

4.8.10 River channel

Where the in-bank carrying capacity of a river channel has been enhanced through the construction of flood embankments along both banks.

4.8.11 Two-stage channel

Where the flood capacity of a river channel has been enhanced through the construction of flood embankments along both banks, but at least one of the embankments has been set back from the river channel to incorporate part of the floodplain. During flood conditions water will flow along both the river channel and the contained section of floodplain. This offers the advantage of increased flood carrying capacity whilst allowing secondary use of the floodplain (e.g. farming, recreation etc) and maintaining normal flow within the defined channel.

Perched channel where the flood capacity of a river channel has been enhanced through the construction of flood embankments along both banks but the river channel and / or water level typically remains higher than local ground level. This occurs where river channels and flood embankments have been progressively raised over long periods and / or ground levels have dropped – as is typical in the Fens in East Anglia through consolidation of peat.

4.8.12 Setback or secondary (retired) defenses

Flood embankments may be located a significant distance away from the river channel. This can occur intentionally, when the floodplain is very large and primary defenses close to the channel are known to overtop, or unintentionally where the river may have meandered significantly over the years and earlier defenses are left remote from the current position of the river. In addition, flood embankments may also have been constructed to control and regulate flood water on the floodplain. Where additional embankments have been constructed, it can become difficult to determine the true flood defense line since it may not be immediately obvious which embankments is the current robust line and which are not.

4.8.13 Reservoirs

Reservoirs may be constructed for a number, or combination, of reasons including flood attenuation, water supply, recreation and power generation. Reservoirs are created by retaining water behind an impermeable barrier of some type. This function is no different to that performed by a flood embankment and the transition from fluvial flood embankment to embankment dam can be gradual. Between the two extremes (i.e. 0.5m flood embankment to a 30m high embankment) are storage ponds holding water for farmland, ponds, ornamental lakes, boating lakes etc. Also, some reservoirs only operate during extreme flood conditions, since they are designed to retain floodwater during an extreme event in order to prevent worse flood conditions further downstream. During dry or normal conditions these reservoirs may store no water at all, and are often referred to as wash land reservoirs.

4.8.14 Flood detention reservoirs

A method for controlling (attenuating) floodwater passing along a river valley is to restrict the passage of the floodwater and store the excess water. The storage area is often created through the use of flood embankments. Such storage areas may be a meter or several meters deep, but only used during flood events. Flood detention reservoirs are therefore normally empty for long periods. There are two normal locations for a detention reservoir to contain river flooding: (1)on the line of the river with a dam across the river, or (2) off-line with a bonded basin adjacent to the river. Some of the latter types of reservoir have the outlet controlled by manually operated penstocks to release floodwater. Flood detention reservoirs have a low-level culvert, which is permanently open and through which low river flows discharge. In the event of a large storm the

reservoir fills, as the inflow exceeds the outflow. Water eventually may discharge over a spillway near the crest of the reservoir. These structures are designed to retain water temporarily, and their failure could result in uncontrolled escapes of water. Thus they are considered to be within the ambit of the Reservoirs Act 1975. It has been argued that, since Statutory Instrument (SI) 1985 No 177 (ICE, 2000) indicates that the reservoir capacity excludes any provision for flood storage; a flood retention reservoir should not be included in the Act. However, the SI makes the exclusion in the context of reservoir overflows, not of reservoir purpose. This

argument is, therefore, considered unlikely to be sustainable if put to legal test, although there is no known case on the matter. Since flood retention reservoirs, just as any other large raised reservoirs, can prove a hazard to public safety, they should be as falling within the ambit of the Act.

4.8.15 Non-Structural Mitigation

Non-structural mitigation practices pursued by the GoB focus on (1) preparedness and possibilities for action to reduce risks and losses, and (2) better coordination mechanisms between all actors involved (GoB, NGO and community people at the grass-roots level) during all phases of disaster. Such practical measures under the recently completed project: "Support for Disaster Management" involve the following.

i) Legislation, Policy and Planning the Disaster Management Legislation (Act) and the Clear and Comprehensive National Policy on Disaster Management and National Disaster Management Plan have already been drafted and are now under consideration of the GoB.

ii) Training and Public Awareness the Disaster Management Bureau (DMB) has conducted 447 training courses, workshops and seminars attended by government and semi-government officials of different levels, as well as various stakeholders. In addition, the DMB has developed Disaster Management training modules and has supported the arrangement of disaster management training workshops

iii) Institutional Arrangements The GoB has taken a number of significant steps for building up institutional arrangements from national to union levels for effective and systematic disaster management.

1. Naming of the Ministry of Relief and Rehabilitation as the Ministry of Disaster Management & Relief (MDMR)

2. Establishment of Disaster Management Bureau (DMB) in 1993

3. Establishment of Council and Committees at the national, district, upazilla and union levels

4. Establishment of Emergency Operations Centre (EOC) Warning Systems

In Bangladesh there are two warning systems: flood warning and cyclone warning.

4.8.16 Flood Warning Systems

Flood warning has been in a state of continuous development since 1972. There was a significant improvement in the Flood Forecasting and Warning system (FFWS) with the introduction of the

hydrodynamic super model MIKE 11 and an increase in the number of real-time monitoring stations to 30. With such modernization, FFWS yielded a successful result during the devastating flood of 1998.

4.8.17 Cyclone Warning System

The existing cyclone warning has two signal numbers inherited from British India. In line with growing need, the warning signals were simplified and made specific and easily understandable in June 2002. The modified system is now under consideration by the GoB. Non-structural techniques for preventing flood damage are based on acceptance of flooding as a natural process that cannot be completely controlled. Because flooding is only a problem when floodwaters interfere with human activities, non-structural approaches focus on altering human behavior. Non-structural techniques include floodplain management, stream corridor protection, flood proofing of existing structures, removing flood-prone development, storm water management, watershed management, flood warning, and flood response.

4.8.18 The limitations of structural flood control measures include the following:

- No area is completely protected. Flood control structures are designed to protect known flood hazard areas up to a certain limit.
- Structural projects alter the dynamics of hydrologic systems and can have adverse impacts beyond the areas they were designed to protect.
- Once development has occurred within protected areas, additional development may be attracted to adjoining unprotected lands, with a net result of increased flood risks.
- The sense of security provided by structural flood control projects can lead to complacency about non-structural methods of flood damage reduction.
- Dikes, dams, storm sewers, and channel modifications require ongoing maintenance. Failure to provide such maintenance may result in catastrophic flood losses. (Read a newsletter article entitled, Who Takes Care of Flood Control Levees?)
- Some flooding problems are not conducive to structural solutions.
- Land acquisition and construction costs for structural projects can be prohibitively high.

One of the best ways to prevent flood damage is to keep flood-prone areas free from development. Undeveloped buffers along rivers, streams, and lakes allow for fluctuations in these dynamic hydrologic systems with minimal damage to human activities. In addition to reducing the potential for flood damages, preserving floodplain lands as open space greatly enhances the naturally beneficial functions that floodplains provide.

CHAPTER 5

CONCLUSION

Indigenous knowledge is the knowledge held collectively by a defined community. Through this study the researcher has sought to bring out the wisdom of community in combating flood in their local context. The geographic location of Bangladesh at the convergence of three vast river systems, as well as a cyclone prone coastline, renders it one of the most vulnerable countries in the world to the threats of climate change. Local communities are heavily reliant on rain-fed agriculture as a source of food and income, and crop yields are particularly vulnerable to the variability in weather associated with climate change. In order for them to adapt to future climate change, it is imperative that both climate science and their own local knowledge is used properly to inform policy and decision-making at all levels. To tackle this problem this project will focus on two main areas. The researcher looks at how communities can bring together their own indigenous knowledge and experiences, which might include birds, insects or plants, in order to support local adaptation to flood management in northwest Bangladesh.

The wisdom of the community is very much relevant and useful to reduce sufferings from flood. Due to its geographic characteristics, Bangladesh is a flood prone country and every year the country has-been experiencing flood of different magnitudes. So community people practice their traditional wisdom to reduce severity of flood as well as their suffering. Through this study it has been tried to identify these sort of knowledge in the flood prone districts kurigrame.

Despite the high population density and nagging poverty, Bangladesh has made noticeable strides in economic development over the past two decades (since early 1990s). Surely many poor Bangladeshis have been rehabilitated and mainstreamed in the formal economic sectors, as the economy of about 150 million people has been growing at a rate of about 6 per cent per annum (PC, 2010). The growth, coupled with advancements in social development and governance, will continue to create economic opportunities for poor and extremely poor people to take advantage of migration to improve their livelihoods and their food security. However, the government must create avenues so that people's exposure and sensitivity to climate-related risks are reduced through adequate disaster risk reduction programmes and poverty alleviation strategies. To this end, the adaptive capacities of the poor and extremely poor, not only in the Kurigram district but also across the nation, need to be enhanced through targeted interventions – predominantly by the government and complemented by NGOs and other non-state actors. Taking note of the evidence presented in this study of the implications of rainfall variability for people's food security and subsequent migration, the development strategy of Bangladesh needs to strengthen people's adaptive capacities and provide more economic opportunities within and outside of agricultural activities. Improved food security and increased welfare for the rural poor can be achieved through structural and policy changes that enhance agricultural productivity, off-farm employment and investment productive assets.

A questionnaire for semi structured interview and checklist for focus group discussion were developed as part of study tools. Considering the objectives of the study appropriate methodologies were applied for field survey. Based on the need felt and request from the researcher some local NGO officials extended their support voluntarily for data collection and validity checking of data. Reliability and validity of data has been ensured through funnel analysis process of participatory rapid appraisal techniques. Data were compiled, analyzed and made interpretation by the researcher through repeated discussion with the supervisor of the study.

It was shown that the rural poor are already directly affected by the local manifestations of climate change. If the variability of rainfall further increases in the future, local people's lives are likely to be even less secure and they might face times of food shortage and hardship more frequently. In this context, seasonal or temporal labor migration within Bangladesh seems to be an adequate practice that helps affected families to cope with the immediate effects of rainfall variability, such as a reduced harvest and lack of food. Moreover, migration can be seen as an appropriate strategy to adapt to the vagaries of nature by diversifying one's livelihood and thereby reducing one's own dependency on rain-fed agriculture. Nevertheless, the Bangladeshi people should not be left alone in their struggle to sustain their livelihoods and secure their food security under changing circumstances. Early and necessary adaptation steps need to be taken at the national and regional levels in order to reduce people's vulnerability to rainfall variability and other climate change-related risks. These local and regional efforts, however, need to be complemented in the global political arena by long-due adequate steps towards reducing CO2emissions. The farmers and day laborers, the men and women, the elderly and young in the Kurigram district can work towards reducing their own vulnerability. Most of the responsibility, however, lies in the hands of Bangladeshi policymakers and the global leadership. There is sufficient scope to take on this sort of study on flood hazard in other part of the country. It is essential and the demand of the time to enrich storage of knowledge in this field. Many local indigenous knowledge on different hazards stay behind stretch among our community people.

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Appendices

Questionnaire for Focus Group Discussion

As a part of my Master of Disaster Management (MDM) thesis at the BRAC University, This focus group discussion conducting to collect information in particular topics. The dissertation topic is "application of scientific and indigenous knowledge for flood management in northwest Bangladesh". Your participation in this study is completely voluntary. There are no foreseeable risks associated with this thesis. However, if you feel uncomfortable answering any questions, you can withdraw from the thesis at any point. It is very important for us to learn your opinions.

Part A

Q1.What is the main hazard of your locality?

Q2.How often does it occur?

Q3. What about its intensity?

Q4.What is the reasons that have led or will lead to Flood Risk in your region?

a. Climatic event

b. Disaster caused by human actions

c. Enhancement of the legislation

Part B

Q5. What is the source(s) of the water which caused the flooding in your area?

Q6 what percentage of your area was impacted?

- ☐ No developed area impacted
- ☐ Less than 25% of developed area impacted
- ☐ Less than 50% of developed area impacted
- ☐ Less than 75% of developed area impacted
- ☐ Over 75% of developed area impacted

Q7. How would you characterize the area impacted?

Predominant ownership type:

- ☐ Public
- ☐ Private

Predominant land use:

- ☐ Residential
- ☐ Commercial
- ☐ Industrial
- ☐ Agricultural
- ☐ Non-profit
- ☐ Government
- ☐ Education
- ☐ Industrial

Q8.What has been the economic impact of this flood event on your community?

- ☐ No economic impact
- ☐ Low direct and/or indirect costs
- ☐ Low direct and high indirect costs
- ☐ High direct and low indirect costs
- ☐ High direct and high indirect costs

Part C

Q9.Do you adopt any special technique to cope with this disaster? (If yes) what are the techniques?

Q10. How did you learn about the Indigenous Knowledge?

Q11.Is it cost effective (Money, time, labor)? (if yes) How?

Q12. Do you observe any early warning system before floods?

Part D

Q13.Do you think this IK and coping strategy is replicable to other location/area?

Q14.What could be the technique to promote this IK and coping strategy?

Q15.Who could be the potential stakeholder for the promotion of the IK and coping strategy?

Q16.What kind of communication materials could be used for the promotion of the IK and the coping strategy?