Challenges in Adopting Floating Bed Cultivation in Waterlogged Areas: A Case Study from Southwest Bangladesh

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Abstract

The construction of embankments under the Coastal Embankment Project (CEP) initiated in 1960s, has gradually created waterlogging in southwest Bangladesh. The situation has become worse with frequent floods. As a result marginal poor farmers have become landless and jobless during the waterlogged period. This study focuses on initiatives taken by NGOs (non-governmental organizations) for promoting floating cultivation as an alternative cultivation practice among poor farmers. The aim of this study is to explore how the adoption of floating bed cultivation is taking place among poor farmers in waterlogged areas of southwest Bangladesh and, how it is perceived amongst them.

This research adopted the 'case study' methodology. It is based on field-work carried out in the village named *Chandra*. The *Chandra* village is located under *Trimohini* union in *Keshobpur* upazila of *Jessore* district. Snowball-sampling procedure was used to find the respondents for the five groups of the study. The five groups of people include poor farmers of ongoing projects, poor farmers from previous projects, poor farmers without experience of floating cultivation, agricultural landowners, and experts and organizers of projects related with floating cultivation. . All together 27 research participants were selected.

The study found that floating bed cultivation introduced by the NGOs is found not adequate to develop a sustainable solution for the poor farmers to cope with adversity. The research did not find any individual initiative of practicing floating bed cultivation within the village. All the floating bed practitioners were the beneficiaries of the NGOs. And, after finishing the project most of them did not continue the practice. The research illustrates that though the floating bed cultivation projects hold potentials to create income opportunities, other complicated issues remain as challenges in adopting the practice. The research identified the challenges of floating bed cultivation as risk and uncertainty, hardship, complexities, and incompatibility with the existing farming system. Furthermore, climatic variability, emphasis on incentives rather than the agricultural practice, incompatibility with the geographical settings, limited NGOs efforts, landlessness and limited access to resources remain as the barrier for the adoption of floating bed cultivation in the study area. This research recommends that more involvement of the government and civil sector with long term planning

are necessary to develop sustainable solutions and income opportunities for the poor in waterlogged areas.

Declaration of Originality

I, Shantanu Kumar Saha, declare that this dissertation submitted to the higher degree committee of Ritsumeikan Asia Pacific University for the degree of Doctor of Philosophy in Asia Pacific Studies, apart from the help recognized, is my own work and has not been submitted in any form for another degree or diploma at any university or other institute of tertiary education. Information derived from the published and unpublished work of others has been acknowledged and referenced appropriately.

Acronyms and Abbreviations

ADB	Asian Development Bank
AEO	Agricultural Extension Officer
APEIS	Asia-Pacific Environmental Innovation Strategies
BADC	Bangladesh Agricultural Development Corporation
BBS	Bangladesh Bureau of Statistics
BWDB	Bangladesh Water Development Board
CEP	Coastal Embankment Project
CIA	Central Intelligence Agency
DAE	Department of Agricultural Extension
DCI	Direct Calorie Intake
DMB	Disaster Management Bureau
EPWAPDA	East Pakistan Water and Power Development Authority
FAO	Food and Agriculture Organization
FAP	Flood Action Plan
FCD	Flood Control and Drainage
FCDI	Flood Control Drainage and Irrigation
FFWC	Flood Forecasting and Warming Centre
FY	Fiscal Year
GDP	Gross Domestic Product
GoB	Government of Bangladesh
IFRC	International Federation of Red Cross

IGES	Institute of Global Environmental Strategies
IPCC	Intergovernmental Panel on Climate Change
IRRI	International Rice Research Institute
LGED	Local Government Engineering Department
MoEF	Ministry of Environment and Forest
NAPA	National Adaptation Programme of Action
NGOs	Non Government Organizations
TK	Traditional Knowledge
TRM	Tidal River Basin Management
UAO	Upazila Agriculture Officer
UNDP	United Nations Development Program
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
USDA	United States Department of Agriculture
WB	The World Bank
WCED	World Commission on Environment and Development
WRDS	Wetland Resource Development Society

Glossary of Bengali Terms

Aman	Rice crop transplanted in the monsoon and harvested in November/December
Aus	Rice crop transplanted in January-February and harvested in May
Ashar	Bengali month (mid June – mid July)
Aswin	Bengali month (mid September – mid October)
Barsha	The normal rainy season
Bazar	Village market
Beel	Seasonal or perennial water body, lowest part of a depression
Bonna	Flooding above the normal level
Boro	A rice crop usually planted in November – December and harvested in April – May. High yielding boro required irrigation
Choitra	Bengali month (mid March – mid April)
Char	A sand bar which is formed within a river or estuary
Falgun	Bengali month (mid February – mid March)
Gheer / Gher	A form of pond made by raising the level of its border
Hat	Open market organized once or twice weekly
Jamuna	Local name of river Brahmaputra
Jari gan	Traditional song performed by a group of singers.
Kacha	Non-structural/concrete
Khal	Canal

Kharif	A cropping season
Khas	Ownership of lands belonging to the government. The Government can lease or donate these lands
Mahal	A track of government *khas* land
Pacca	Concrete
Padma	Local name of river Ganges
Poush	Bengali month (mid December – mid January)
Rabi	A cropping season (November-May). Usually vegetables, pulses and boro rice are grown during rabi season
Rickshaw	Three-wheeled vehicle like bicycle with seats attached behind the driver
Thana	The smallest administration unit of Bangladesh
Taka	The currency in Bagladesh
Union	Sub-division of upazila
Union Parishad	Lowest level of local government
Upazila	Sub-district. In the mid 1980s all *thana* were renamed upazillas. They were renamed thanas in 1991
Van	Local means of transport, usually used in rural areas to carry passengers or materials. This vehicle is usually a tricycle
Vasoman Chash	Bengali name of floating bed
Zila	District

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Chapter 1: Introduction

1.1 Context of Development Initiatives

Broadly speaking, development can be reflected in many ways, ranging from economic growth, agricultural and technological progress, to improved quality of life in relation to literacy and social mobility. In particular, economic development may seek to transform the rural into urban areas by formulating policies for establishing more industries to diversify economic activities as well as agricultural modernization to enable proficient use of ecological resources (Chan & Parker, 1996). However, looking at many developing countries' experiences in relation to Bangladesh, economic growth tends to generate a wide range of serious problems such as environmental degradation due to embankment construction in coastal areas for creating more income generating activities, unorganized diffusion of innovative agricultural practices such as floating bed cultivation, and most importantly resource depletion through shrimp cultivation. Moreover, the increasing occurrence of disasters throughout the world is commonly identified as one of the major challenges to undertake development initiatives in mostly developing countries due to their limited access to resources, poor infrastructure,

and limited scope of innovative agricultural practices (Burton *et al.,* 1993, United Nations, 1994 as cited in Chan & Parker, 1996: 313).

There is an increase in the frequency of extreme weather events since the late twentieth century, mostly in low lying coastal zones already beset by poverty and underdevelopment (IFRC, 1999, IPCC, 2001 as cited in Uyigue & Agho, 2007; Pender, 2008). As a consequence the amount of land for agriculture is shrinking, raising the prices of food products and causing instability in the agricultural sector, and thereby, jeopardizing economies that depend on farming. The marginal and small-holder farmers who make up the majority of the rural population in most developing countries have been adjusting to both short-term and long-term climate change consequences. Different technological innovations and research related to agricultural improvement have been supportive for the farmers. These have helped them to cope with adverse situations as well help in the development of agricultural sector in both developing and developed countries (Chhetri, 2007). Furthermore, various types of programs and projects are implemented by different developmental organizations in areas affected by extreme climatic events in developing countries in order to support farmers.

Considering the prospects as well as problems of those multidimensional programs, a more critical perspective has arisen questioning the effectiveness of those initiatives. Such programs tend to offer little improvement, and in some cases no improvement have been observed. Many development or adaptation programs and projects are criticized for taking top-down approach (Grenier & Wismer, 2000). As a result of that a critical question arises: why is there little improvement or sometimes no improvement? Such questions have also been raised with the diffusion of floating bed cultivation as part of agricultural development in Bangladesh. The intention of this research is to investigate those underlying challenges of adopting an indigenous cultivation practice by poor farmers as an alternative livelihood in an area affected by waterlogging.

1.2 Background of Research

Bangladesh is one of the well-known examples of nations facing climate change related problems (Pender, 2008). Waterlogging is a serious problem that started in the 1960s in some areas of Bangladesh after the initiation of the Coastal Embankment Project (CEP) to prevent salinity intrusion for the betterment of this area (Kibria, 2006). Modification of landscapes due to human intervention is

another cause of waterlogging which becomes worse with the occurrence of flood. In addition, Bangladesh has about 50 percent wetland and some of this wetland has become vulnerable to waterlogging due to human intervention (Haq et al., 2005).

Along with the waterlogging issue, Bangladesh with 150 million people (BBS, 2011), has one of the highest population densities in the world. The geographical position, low land to the east of the Indian peninsula has made the coastal parts of Bangladesh vulnerable to natural disasters. In addition, the increase of natural disasters in Bangladesh is creating intense challenges that add to the already overburdened socio-economic poverty, increasing landlessness, poor infrastructure, and a high rate of unemployment, low level of literacy, and poor governance.

Between 1970 and 1998, Bangladesh suffered 170 large scale disasters. There were eight major floods between 1974 and 2004 of which many are considered to be at a size expected only once in every 20 years (Pender, 2008). Besides, Bangladesh is very vulnerable to flooding as one-thirds of Bangladesh is only 6 meters above sea level (Rahman et al. 1999 as cited in Pender, 2008; MoEF, 2008; Ahmed, 2009). With the rise in the flood frequency in Bangladesh many

people are affected each year. There have been flood mitigation measures (embankment construction and relocation of vulnerable people), but most have been ineffective due to the economic and social situation in the country (Rahman et al., 1999 as cited in Pender, 2008; Ahmed et al. 1999; MoEF, 2008; Ahmed, 2009). Like any other disaster, floods affect the economic, social and environmental conditions both at micro and macro levels in Bangladesh. The monetary losses from floods are constant realities in Bangladesh, since Bangladesh suffers from annual flooding (Mirza & Ahmad, 2005). On average, annual floods inundate 20.5 per cent area of the country, and this can reach as high as about 70 per cent during an extreme flood (Mirza, 2002: 127). As Bangladesh is an agricultural country, 60 percent of the people depend on agriculture for their livelihood (MoEF, 2008). Subsequently, the effect of flood on the agricultural sector of Bangladesh is detrimental as the sea level rise inundates the croplands of coastal areas. Heavy rainfall during the monsoon period and huge water flows from rivers damage harvests. Moreover, some areas remain waterlogged for a long time after the flood, making farming difficult.

Natural disasters as well as human interventions for agricultural profit have placed serious challenges on the lives of the farming population. The

challenges become far more complex as the farming sector already faces high pressure for increasing food demand for its huge population along with land and water resource depletion problem. As a result, Bangladesh is steadily losing the farming population that has been the mainstay of a largely agricultural economy (Pender, 2008).

In order to address the underlying challenges of losing the farming population, different organizations have tried to promote alternative livelihood and farming practices for poor farmers. Floating bed cultivation practice has been promoted as part of such efforts in some parts of the flooded and waterlogged areas of Bangladesh. Floating cultivation is a traditional alternative farming system from southern Bangladesh. In this practice, farmers use their submerged lands for crop production. Crop can be grown on the water in floating bed of water-hyacinth, algae and other plant residues with no additional water, nutrients, or chemical fertilizers being needed. Moreover, the cultivation bed can be recycled as organic fertilizer for the next season in the crop field. This cultivation practice holds ample opportunities in those wetland areas (Haq *et al*., 2002; Haq *et al*., 2004; APEIS, 2004; Irfanullah *et al.* 2007; Islam & Atkins, 2007; Saha, 2010). However, limited academic research has been done so far on topics related

to challenges in adopting the floating bed cultivation in other waterlogged areas. Most publications appear as output of projects run by NGOs. They are full of praise of the practice with no comparative analysis of the issues faced in different areas. Consequently, more in-depth research needs to be carried out in order to explore the underlying challenges in adopting floating bed cultivation among poor farmers in waterlogged areas of coastal Bangladesh (Irfanullah, 2013).

1.2.1 Flood and Waterlogging Condition of Southwest Region of Bangladesh

The extent of waterlogging in southwest Bangladesh is huge. About 80 percent of the area is prone to waterlogging for a long period of time. In any year of severe flooding waterlogging becomes a year round phenomenon. *Beel Bakar* which is one of the largest *beel*s in the south-western region is situated near *Chandra* village. This water body is the combination of another 26 *beels* (oxbow lakes). So, when there is even a moderate rainfall, this area goes under water. Due to longer and large scale flooding in 2006, local people suffered waterlogging problem for 9 to 12 months. In the south-western region the realization of the waterlogging problem by the local people had begun in 1985. The rain water is the main cause of waterlogging in this area. The rain water from another 26 *beels* is drained through the area. As the depth of the river beds had already risen due to

the construction of embankments, the water cannot be drained during heavy rain fall. The high river water level makes the area waterlogged. The severity of waterlogging has increased with the passage of time with some break in those years when rainfall is low. Waterlogging has changed the pattern of land use in the study area.

1.2.2 The Origin of Waterlogging Problems in Southwest Region

The entire southwestern Gangetic region comprising of Jessore, Faridpur, Barisal and Khulna has been shaped by alluvial deposits of the Ganges-Brahmaputra-Meghna river system (Haq, et al., 2002: 8). These rivers carried massive silt and when this silt load could not proceed any longer, it settled down to form the low wetlands. In this process low wetlands arose to eventually become a part of the main land (ibid.). However the banks of the rivers became higher than the adjacent land and formed a series of depressions between their courses. Consequently, the water flow from the north to the south (in Bangladesh the rivers flow from north to south) was disrupted. And the siltation rate in the low lands gradually became less than on the bed of the river. This turned lowlands into wetlands with the river bed being higher than the surrounding land. Later they were named *beels* or *jheels*.

Before the 1960s the area was productive in terms of agriculture except for the problem of salinity intrusion at high tides, floods and cyclones. During this period, the East Pakistan Water and Power Development Authority (EPWAPDA) undertook the Coastal Embankment Project (CEP) to protect salinity intrusion for the betterment of this area (Kibria, 2006).

Under the CEP, 92 polders, 4,000 km dams and 780 sluice gates were constructed which resulted in tremendous increase in agricultural production until the 1970's (Uttaran, 2000-2002*).* But gradually its negative effects fell upon agriculture, economy and environment. Before implementing this project local people built temporary dams for preserving water for rice cultivation and after harvesting the crops, they demolished the dams to let the water into the cultivable land.

The project had both positive and negative implications. When the project was implemented, it opened a new opportunity in the production area, which was positive at that moment. Later it led to the waterlogging problem in the mid 1970's. The local people changed their land use pattern from paddy cultivation to fish cultivation to adapt to the waterlogged situation. Migration to urban areas and to India increased and the long tradition of the family unit was

destroyed due to waterlogging. Water became locked inside the polders, submerging the land and houses. This situation continues to the present day.

1.3 Problem Statement

Bangladesh has of late witnessed a marked rise in the frequency of natural disasters in the form of tropical cyclones and floods. Like the other regions of Bangladesh with chronic natural disasters, coastal areas have adapted multifold measures to address the risks of floods, droughts and cyclones over generations. In relation to the multifold measures, farmers across the coastal region have made some changes in their cultivation systems, as well as different modifications in cropping patterns. More specifically, in areas of south and southwest coastal Bangladesh where flood has noticeable impacts on agriculture, both in a positive and negative ways, farmers have made some changes in their cultivating patterns such as growing different indigenous and high-yielding varieties of rice and other crops, which tend to be compatible with local flooding and rainfall conditions (MoEF, 2008). Since the poor farmers of southwestern Bangladesh have been suffering due to the waterlogging problem for a long time, they also have gone through certain transition. However, in some areas of southwest coastal

Bangladesh, agricultural modification has shown success with the local people exhibiting remarkable ability to withstand nature's destructive powers whereas in other areas some non-government organizations have provided assistance.

In southwest region of Bangladesh, floating bed cultivation was introduced as part of development initiatives by NGOs. This research found research reports on the floating bed cultivation in the southwest region. Most of those reports recommend floating cultivation as a positive practice of agricultural adoption. This research found no article on the consequences of introducing this cultivation practice in southwest region. From this perspective, this research intends to explore the consequences as well as the underlying challenges of floating bed cultivation for agricultural adoption in waterlogged areas. The thesis not only explains the existing knowledge of diffusion of an innovation but also analyses the five attributes of innovation such as relative advantage, compatibility, complexity, triability, and observability, (as pointed out by Rogers, 2003), with empirical evidence.

1.4 Research Objectives

This research has adopted three objectives. First, it describes the dynamics of adoption of the floating bed cultivation among poor farmers given their limited access to resources in waterlogged southwest coastal Bangladesh. Secondly, it describes the perception of the different stakeholders about the relative advantage, compatibility, complexity, triability, and observability of floating bed cultivation. And lastly, it explores the underlying challenges of adopting floating bed cultivation in waterlogged areas in southwest coastal Bangladesh.

1.5 Research Questions

The aim of this thesis is to explore the underlying challenges of adoption of floating bed cultivation among poor farmers in waterlogged areas of southwest coastal Bangladesh. Using empirical evidence, it analyzes the major attributes of floating bed cultivation as an innovation in waterlogged areas. The following questions are raised to address the aims of research in this thesis:

i. Why and how is floating bed cultivation being adopted among poor farmers in waterlogged areas of southwest coastal Bangladesh?

ii. How do poor farmers perceive floating bed cultivation as an innovation in waterlogged areas of southwest coastal Bangladesh?

iii. What are the underlying challenges of adopting floating bed cultivation by poor farmers in waterlogged areas of southwest coastal Bangladesh?

1.6 General Hypothesis of the Thesis

Transfer of a technology or diffusion of an innovation is not the ultimate solution for a particular problem. The sustainability of that innovation in the new context is important. Even though an innovation may have an advantage, it may not get adopted. The question of 'why some farmers lagged behind in adopting an agricultural innovation' encouraged Professor Everett Rogers to start researching on diffusion of innovation. He used a few cases to examine the diffusion of an innovation in a new context. Rogers (2003) described the unsuccessful case of water boiling campaign in a Peruvian village. Despite the positive effect of boiled drinking water to prevent infectious diseases, the project was relatively unsuccessful. After a two year long water boiling campaign on that village only 17 housewives could be persuaded to boil water. Then a social health worker

made another attempt to persuade the housewives to boil the drinking water. Her attempt was relatively successful. She managed to encourage about five percentage of the population. The reasons behind the relative failure of the campaigns were traced party to the local cultural beliefs. Rogers (2003) mentioned that the local culture and environment were the main factors behind the failure of that initiative.

Likewise, Fischer (2004) mentioned about a case regarding the challenges of diffusion of seed potatoes in the upper swat valley of Pakistan. The project (Kamal Integrated Development Project) was initiated in 1981 by the Swiss government in cooperation with the Pakistan Agricultural Research Council. The project did not sustain beyond the initial year as the model plots were not consistent in their yield. That development project tried to influence people to make their cultivable plots according to the suitability of particular type of potatoes. However, a local person became successful in growing different varieties of potatoes suitable for different situation of that area. He did not try to change the cultivable plots but rather focused on adopting the potato for the land available. Fischer (2004) mentioned that the project did not consider the local

geographical context of the area, instead it focused on the scientific approach for increased production.

Most of the researches conducted on the non-adoption or discontinuation of an innovation found that in general an innovation does not continue when a newer approach serves the same purpose or the adopters become 'disenchanted' with its performance (Rogers, 2003). Other factors mentioned include the lack of personal commitment, political commitment (sources of funding), political and cognitive processes, and unfavorable conditions (Scheirer, 1990). Sometimes, the stakeholders were less informed about the effectiveness of the innovation and as a consequence they gave less importance to the program (Scheirer, 1990). Scheirer, (1990) in her study on adoption and discontinuation of a dental cavities prevention innovation (Fluoride Mouth Rinse Program at School) mentioned that the program did not continue because of political and cognitive processes. She also mentioned about lack of cosmopolitan, less contact with change agents and fewer financial resources (referring to Rogers, 1983) work for the discontinuation of an innovation.

There are many challenges to development initiatives mentioned by different researchers. According to Sorensen, (2000), opportunistic behavior of

individuals is one of the challenges of rural development. He states that "the risks of opportunism is one of the causes that inhibit productive investments necessary to promote economic growth and wealth creation in poor rural areas" and "the different players face risks of opportunistic behaviour by other players" (p. 7). The most common challenges of development initiatives are nepotism, patronage, interest only in receiving training allowance and unearned income (Ololajulo, 2011).

Erickson (2003) and Middleton (2008) reported about the challenges of rehabilitation projects of pre-Columbian raised field agriculture in Peru and Bolivia. Raised fields are elevated platforms of earth that were used for farming purposes in Andean region of Puno (present day Peru and Bolivia) during the Tiahuanaco civilization, because those areas were marshlands and were prone to flood. The archaeological excavations found that this kind of agricultural platforms were constructed and used by the farmers at some point before 1000 BC to produce food. This raised field agricultural practice was sustained for about two thousand years. However, this practice was abandoned later and the platforms were converted into pastures. Again after 1981 when it was revealed through archaeological investigation and agronomic experiments that raised field

agriculture could resolve many of the problems of those areas at high altitude, different governmental and nongovernmental organizations started promoting raised field rehabilitation programs under different developmental projects by providing funds and assistance. Furthermore, during that time various national and international media over-praised the cultivation and tried to promote the practice as a solution for the rural poverty in the Andes valley and elsewhere. However, by the 1990s the cases of abandonment of recently rehabilitated fields started began to be noted leading to criticisms about the appropriateness and sustainability of the practice as well as the effectiveness of the raised field related projects. The farmers' initial adoption of raised field farming as well as their continuous maintenance of the fields was first praised as a good indicator of successful adoption. The productivity of the raised field agriculture was relatively high and the fields were capable of providing sustained yield under good management. However, the practice was not sustainable among the farmers of that region, despite the technological appropriateness and economic profitability of the practice. Through his research Erickson (2003) found that the adoption of raised field agriculture during the project time had little connection with technological appropriateness and economic profitability of the practice. Erickson (2003)

mentioned that many of the farmers participated in the rehabilitation of raised field projects to receive incentives. The organizations that worked for the promotion of raised field agriculture provided food, wage, seeds and/or tools as an incentive to the farmers and that that incentives had a negative effect on the continuation of the raised field agriculture. He also mentioned that the projects gave less importance in understanding the social and cultural aspects of the raised field agriculture, rather the projects put more emphasize on the technology. According to Erickson (2003) the most important factor that worked behind the discontinuation of the raised field agriculture was the differences in the social, political and ecological environment during the rehabilitation time as compared with the time the raised fields were first constructed and used. Besides, Erickson (2003) also mentioned about other factors that worked behind the discontinuation of the raised filed agriculture, like – "labor demands, traditional fallow cycles, crop genetic loss, competition with livestock, land tenure issues, limited NGO knowledge of the technology, misuse of incentives, political unrest, and emphasis on communal farming rather than on the individual farmer" (Erickson, 2003: 190).

Based on the above discussion it is reasonable to assume that transfer of technology and its adoption by a potential adopter would not be a simple process. Based on the evidence from various perspectives, this research proposes a general hypothesis as follows:–*even though floating bed cultivation has obvious advantages, there will be challenges in adopting this cultivation practice*.

Moreover, the diffusion of a new practice is mostly evident with "technological innovations". In contrast, floating bed cultivation is an indigenous cultivation practice and the concept 'indigenous knowledge' refers to the uniqueness of a practice to a culture or society. It depends on local experience, resource and technology, and improves over time across many generations. Most importantly, it is location specific or site specific. If an indigenous knowledge (indigenous cultivation technique) is location specific and unique to a certain area, how compatible it would be in a new setting? What will be the consequences? Will it be sustainable with a top-down approach in adapting to and coping with climatic variability?

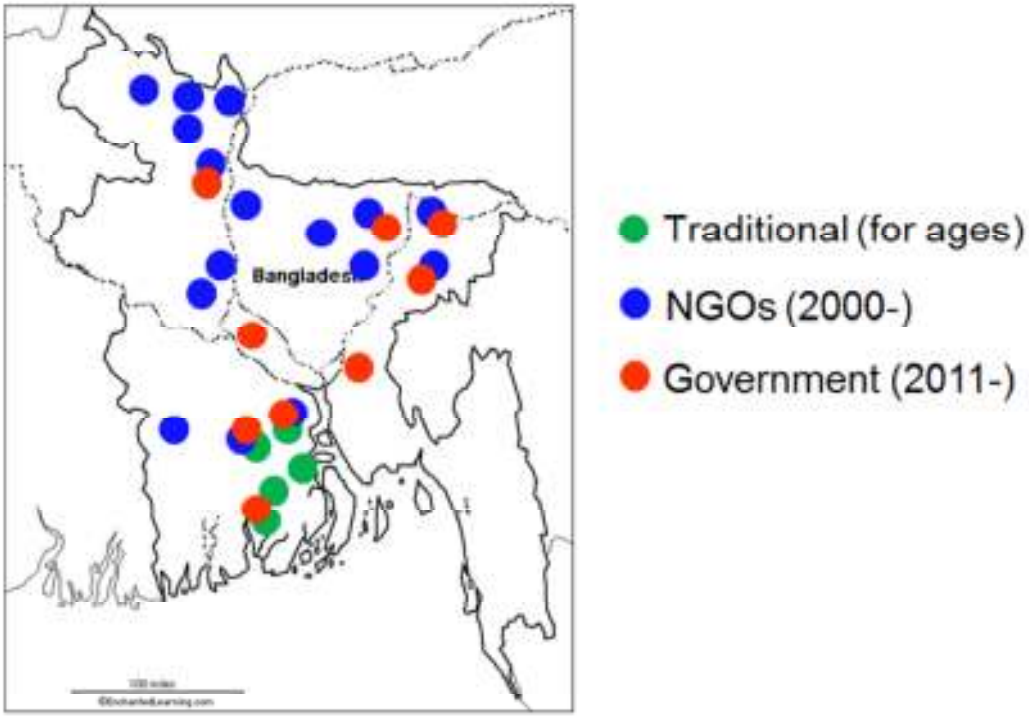
1.7 The Rationale for Choosing 'Floating Bed Cultivation' as a Technology

This research is interested about floating bed cultivation as it is the most popular adaptation practice in Bangladesh. Besides, it has also received international attention. Floating bed cultivation of Bangladesh is being referred to as a "climate celebratory", "development sensation", and "mass fascination" (Irfanullah, 2013). Basically, floating bed cultivation is an ancient agricultural practice of vegetable and seedling production in the southern part of Bangladesh. Since, some parts of southern Bangladesh remain under water for about six to seven months in a year, local farmers in those areas have developed this indigenous type of soilless cultivation. The farmers of these areas have been practicing this cultivation technique for more than a century (Haq *et al*., 2002; Irfanullah *et al*. 2007; Islam and Atkins, 2007). However, floating bed cultivation received huge local and international attention as an adaptation technique over the last decade. The United Nations Framework Convention on Climate Change (UNFCCC) has listed floating bed cultivation as one of the long-standing coping strategies into their local coping strategies database. UNFCCC (2014) mentions that floating bed cultivation is an environmentally sustainable way of adapting to flood and waterlogged problems. The government of Bangladesh also

incorporated floating bed cultivation as one of its adaptation projects (MoEF, 2005). The second national communication of Bangladesh to the United Nations framework convention on climate change also referred floating bed cultivation as one of the household level adaptive strategies (MoEF, 2012). Bangladesh also recommended floating bed cultivation to the Food and Agricultural Organization of the United Nations (FAO) as an adaptive option for the resilience of people in southwest part of Bangladesh in the face of the waterlogging problem (FAO, 2015). In 2013, the Government of Bangladesh started a 3 year project in eight districts to promote floating bed cultivation for climate change adaptation with a budget of US$ 1.6 million (Irfanullah, 2013). Besides, different local and international developmental organizations also have been promoting this cultivation practice in different areas of Bangladesh. The projects on floating bed cultivation by local and international NGOs covered diverse programs like – participatory natural resource management to improve poor people's livelihoods program, solution to the waterlogging problem for the vulnerable people program, the improvement of the nutritional status of the extreme poor program, capacity building programs and poverty alleviation programs throughout Bangladesh. The following map shows the location of the areas where floating bed cultivation is

being practiced in Bangladesh. Table 1.1 lists the major floating bed cultivation related projects in Bangladesh.

Figure 1.1: Map Location of floating bed practicing areas in Bangladesh



Source: Irfanullah, 2014.

Table 1.1. List of major floating bed cultivation related projects

Organization	Area	Objective	Year
IUCN & BCAS (Bangladesh Centre for Advanced Studies)	The wetlands of south-central Bangladesh, near the area where it is traditionally practiced	Participatory natural resource management to improve poor people's livelihoods	2000
CARE	The south-western region	To tackle water-logging	2002-2005
CARE & IUCN	The north-eastern wetlands of Bangladesh, locally called *haor*	To improve the nutritional status of extreme poor *haor* dwellers, particularly during the difficult monsoon season	2005 - 2009
Practical Action	The north (Gaibandha)	To introduce a useful option in the monsoon months for the river-eroded families living on the embankment by the River Jamuna	2005
BCAS (Bangladesh Centre for Advanced Studies)		To improve the community-based adaptation to climate change	2006
Practical Action	Four northern districts of Bangladesh		2010−2012

Government's agricultural extension wing	In 40 sub-districts of 8 districts all over the country	For climate change adaptation.	3-year project funding [US$ 1.6 million project] was approved in 2013

Source: Author (data collected from Irfanullah, 2013)

Furthermore, the number of research publication on floating bed cultivation has also increased. The authors are defining floating cultivation in different ways. They are considering it as a solution to the waterlogging problem for the vulnerable people (Haq *et al*., 2004), a way of capacity building and poverty alleviation (Anonymous, 2006), a way of improving the nutritional status of the extreme poor (Irfanullah *et al*. 2007), a tool of participatory natural resource management to improve poor people's livelihoods (Rahman, 2011). However, the limitations of this cultivation practice in a new local context have not been researched in depth yet (Irfanullah, 2013). Moreover, floating bed cultivation is a unique case to study as it is not a problem specific technology produced through R&D. Rather floating bed cultivation is a local practice that it is being considered as a solution for the problems of other areas.

1.8 The Research

Southwest Bangladesh is primarily considered as the major case of this research. This area has been suffering from extensive waterlogging condition since the 1980s (Haq, 2006). This area is "located in the coastal zone, and is significantly influenced by tidal effects" (Adri & Islam, 2010). Different organizations have tried to promote an alternative livelihood and farming practice for the poor farmers of the area. This cultivation practice is being practiced in some parts of flooded or waterlogging affected areas of Bangladesh.

Within the greater southwestern Gangetic region, this research particularly focuses on the areas under Jessore District[1]. Jessore District has 8 *Upazilas* namely, Abhaynagar, Bagherpara, Chaugachha, Jhikargachha, Keshabpur, Jessore Sadar, Manirampur and Sharsha. The research area is incorporated within the *Kapotakhha* flood plain, which is bounded by *Bhairab* river to the east and *Mukteshwari* river to the west.

[1] Bangladesh is divided into 7 Divisions and the divisions are divided into 64 Districts (Zila). Furthermore, for the purposes of local government, the districts are further divided into Upazilas (Sub-districts). However, the smallest rural administrative and local government unit in Bangladesh is called the Union and each union is made up of several villages.

1.9 Significance of the Research

The significance of a study can make important contribution to a specific field as well as to the academic world. Glatthorn and Joyner (2005) mention that "a significant study makes an important contribution to the field in one of the following ways: tests a theory; contributes to the development of theory; extends existing knowledge; changes prevailing beliefs; suggests relationships between phenomena; extends a research methodology or instrument; provides greater depth of knowledge about previously studied phenomena" (p. 19). The intention of this study is not only to explore the five attributes of Roger's innovation theory, but also to critically examine the underlying challenges of considering floating bed cultivation as part of an agricultural adoption strategy in waterlogged areas. Undoubtedly, understanding those underlying challenges offer better insights about floating bed cultivation practice among poor farmers as well as contribute to extending both the theoretical and practical knowledge on diffusion of innovation for agricultural adoption in adverse situations. It is claimed that the analysis is grounded in factors like natural and socio-economic constraints. This makes the study a robust effort of analyzing empirical data from the field, through a case analysis approach by using a clearly defined methodology. Thus, the academic

significance of this research lies in the extension of existing knowledge, and developing theoretical explanations behind observed phenomena. This research seeks to understand the condition and challenges for a particular adaptive practice used in Bangladesh, and through this, it aims to offer an extension of the knowledge base regarding adaptation in a changing world. Thus, this thesis project puts forward the existing knowledge of agricultural adoption in adverse situations as well as their relationship with access to resources as to address vulnerability and food security aspects among poor farmers. And most importantly, this study will use a case study research methodology to provide a greater depth of knowledge with empirically grounded experiences. As more and more land will be submerged in the near future, the future of the world lies in adapting sustainable and environment friendly solutions such as floating cultivation.

It is also believed that this research has a strong practical potential as well. By working on analyzing how indigenous farming techniques can offer sustainable solutions for developing countries like Bangladesh, as well as finding out the causes behind success and failure for implementing this adaptation technique i.e. floating cultivation in the flood affected areas, it can be assumed that outcomes of this research act significantly for promoting sustainable

development, especially with respect to the agricultural sector. It also serves as an important case study material for countries and regions affected by similar problems. On an administrative and social level, this research identifies key areas where more assistance is needed, and offers a model for state and institutional roles in furthering this practice. The findings have an important contribution for policy formation at various levels, beginning from local level efforts in Bangladesh to international assistance programs targeted at developing countries.

Furthermore, the consideration of floating bed cultivation as an innovation in a new setting is absent so far in floating bed cultivation practice related papers, and this research demonstrates the methodological aspects by conducting an empirically grounded research work. Most published materials on floating bed cultivation show that usually the projects on floating bed cultivation in Bangladesh are designed and implemented by NGOs, and as a result question the neutrality of the outputs as indicated in those published reports. Therefore, this in-depth study addresses dimensions like diffusion of this practice, challenges for its diffusion, farmer's perceptions, and sustainability of this practice, ultimately providing an insight that will assist practitioners as well as future research.

1.10 Organization of the Research

The introductory Chapter 1 covers the background of the study, states the research problem, research objectives and the context of the study. The chapter discusses the significance of the study. Chapter 2 provides a literature review. It presents relevant concepts to make the study robust as well as provide a background for the analysis. The chapter includes a discussion on one of the indigenous cultivation practices in Bangladesh. The research site in Chapter 3 presents the demographic and other socio-economic information about the study location. Chapter 4 discusses the research process, techniques and tools used for data collection as well as the data analysis approaches. Chapters 5 and 6 present the research findings following the patterns of first describing the study, and then presenting the findings under leading themes about the case. Chapter 7 concludes the study and provides some relevant recommendations.

Chapter 2: Literature Review

2.1 Introduction

This chapter discusses the literature related to the objectives of this thesis. As this research aims to explore the challenges of floating bed cultivation practice among poor famers, this chapter brings together the existing literature on the concepts that help to understand the context of research as well as the theories that would help the analysis. The chapter is organized into three sections as follows. Section 2.2 briefly discusses the concept of 'sensitizing' (a term coined by the American Sociologist Herbert Blumer in 1954) to provide a background of the literature reviewed in this thesis. Then, it reviews the literature on hazards and disasters and their effects on the poor people who live in the disaster prone and waterlogged areas. This review is expected to strengthen the context of the study by showing the challenges that are faced by people during natural disasters. In addition, it would shed light on the indigenous techniques such as the floating bed cultivation, which is a major objective of this thesis. Section 2.3 reviews the innovation theory in the context of floating bed cultivation. Section 2.4 outlines previous researches on floating bed cultivation followed by a detailed description of the procedure of

floating bed cultivation in Bangladesh. The next section outlines the research gaps in empirical literature especially in the context of Bangladesh. Finally, Section 2.6 provides a brief summary of the discussion made in this chapter.

2.2 Sensitizing to the Context Specific Literature

The concept of 'sensitizing' is coined by the American Sociologist Herbert Blumer in 1954 to make a connection between theory and the empirical world in social science research. Sensitizing is researcher's perception, experience or ideas that help to build a social problem for investigation. Then, sociologist Charmaz (2003) advances the view of sensitizing asserting that they (sensitizing concepts) offer "ways of seeing, organizing, and understanding experience". In addition, he says that sensitizing deepen the researchers' perception; help to find the ground for analysis. He states that sensitizing "provides starting points for building analysis, not ending points for evading it. Furthermore, he refers sensitizing as the "background ideas that inform the overall research problem" (Charmaz, 2003 as cited in Bowen, 2006). In the context of this study, where the understanding of the challenges in adopting agricultural innovation demands both theoretical positioning and practical knowledge of the field, the sensitizing concept is of

particular importance to investigate a wide array of scholarly literature and to make analysis grounded to the research objectives.

In essence, in the field of qualitative social science research, especially when dealing with the problems of pro-poor cohort in the third world countries and their challenges in adopting to the innovations in agricultural practices, 'the sensitizing concept' is likely to serve well (as a starting point as well as an interpretive device) to clearly delineate the inherent empirical complexity of the problem itself (Glaser, 1978; Padgett, 2004; Patton, 2002; as cited in Bowen, 2006). Given the importance of sensitization concept in a qualitative research, this chapter discusses extant literature and seeks delineating possible connections of the diffusion of innovative practices within the context of hazards, grassroots' accessibility to adequate resources and the practices of indigenous knowledge.

2.2.1 Challenges of Agriculture in the Context of Floods

'Hazards' are mostly viewed as a natural event that may cause enormous loss to the human-ecological interaction. Hazards may create serious impact on the human-ecological interaction system by causing injuries and deaths of men and animals, causing diseases, and making people socially disoriented. In addition,

hazards damage properties and cause severe economic losses (Wisner, et al., 2004; Smith & Petley, 2009). Hazards could be diverse in origin and their impacts on the human-ecological interaction system could also be multifaceted. "Some groups are more prone to damage, loss and suffering" (Wisner et al. 2004: 6). Besides, the impacts of hazards and the rate of recovery of hazards also vary by households and the development level of human-ecological interaction system (Wisner, et al., 2004: 83-84).

Notably, there is a difference between hazard and disaster. Disasters occur when (1) a significant number of people experience a hazard which causes severe damage in their livelihood system, and (2) they do not have sufficient capacity or unable to take necessary measures to cope with the potential negative consequences brought by hazards. As Smith and Petley (2009) notes, "disasters are social phenomena which occur when a community suffers exceptional levels of disruption and loss due to natural processes or technological accidents" (p. 13). Smith and Petley (2009) further define disaster as, "an event, concentrated in time and space, that causes sufficient human deaths and material damage to disrupt the essential functions of a community and to threaten the ability of the community to cope without external assistance" (p. 14). Likewise, the United Nations

International Strategy for Disaster Reduction (UNISDR) defines disaster as "a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources" (ISDR, 2009: 9).

It is important to note that flood is considered as the most common type of disaster. Wisner et al. (2004) notes that, "in many parts of the world, floods are also a normal and an essential component of agricultural and ecological systems, as they provide the basis for the regeneration of crops, plant and aquatic life, and of livelihoods derived from them" (p. 175). Furthermore, riverine floods are normally restricted to flood plains where events over thousands of years make the land fertile for agriculture (Wisner et al., 2004: 175). Arguably, rivers are an important producer of livelihood as they are used for multiple purposes like transport, trading and fishing, and thus, attract people to build communities alongside their banks. Most importantly, in rural areas, most people's livelihoods are related to river as they either earn their living by fishing in the river or use the water for irrigation.

Ironically, though rivers are a vital source of opportunities (resources), they are hazardous too. Rivers become dreadful when they bring floods and disrupt and destroy assets and livelihood of riverbank dwellers. Flood hazard can make "some people down in terms of assets, others sideways, and leaving a few with enhanced endowments and livelihoods" (Wisner et al., 2004: 192). Flood has huge negative effects on agriculture as well as on the farming population. While sudden floods can damage the standing crops, a prolonged waterlogging (because of floods) affects subsequent normal planting or the planting of a 'catch crop' that aims at recovering some of the losses". Besides, "large land-owners do not use labours when their fields are flooded. This situation, eventually, generates a loss of paid employment which is disastrous to families that largely rely on such income-earning opportunities (Wisner et al., 2004: 193).

In addition, flood tends to create a negative effect on the food availability and food security. Poor people, women and children are the vulnerable group to food security during floods due to several factors such as improper transfer of climate adaptation funds, weaknesses in the food distribution system, and lack of coordination between different sectors (Douglas, 2009). FAO (2008) notes that food insecurity could be a serious issue in coming decades, especially in the

developing countries due to localized high population growth rates, poor socio-economic capacity and continued natural resource degradation. FAO (2008c) further notes that "agriculture, rural livelihoods, sustainable management of natural resources and food security are *inextricably linked* [italics added] within the development and climate change challenges of the twenty-first century" (p. 1). By the same token, Burke & Lobell (2010) argue that climate changes may reduce agricultural productivity in climate vulnerable countries, and in effect, this may induce higher food prices and decrease the income of poor people of these countries which is inextricably bound up with food insecurity. In this context, FAO suggests that, "communities must protect themselves against the possibility of food-shortage emergencies through appropriate use of resources in order to preserve livelihoods as well as lives and property" (FAO, 2008b). This is especially important for Bangladesh, as it is one of the disaster prone countries in the world with a large number of poor people.

2.2.2 Vulnerability Challenges for Poor People

Vulnerability refers to the potential for casualty, destruction, damage, disruption or other form of loss in a particular element' (Alexander, 2000: 13). Singh (2003) argues that vulnerability is an intuitive multidimensional concept that is difficult to quantify. Sing, in his book "*Assessing human vulnerability to environmental change: concepts, issues, methods, and case studies"*, cites different perceptions of vulnerability by different scholars and organizations. Food crisis is marked as vulnerability by Food and Agricultural Organization (FOA) whereas the Intergovernmental Panel on Climate Change (IPCC) defines "vulnerability as the extent to which a natural or social system is susceptible to sustaining damage from climate change". He also notes that humans are vulnerable when they are exposed to hazard by external activities like climate change which restrict their access to opportunities. The concept of vulnerability also has a connection with the coping capacity of the people to reduce the risk from the exposure (Singh, 2003).

Within the discourse of hazards, disasters and vulnerability research, the work developed by Wisner, Blaikie along with two of their other colleagues is being considered as a classic literature of recent time. In their book '*At Risk*', they

tried to highlight the significance of the human factors for disasters. They argue that a disaster cannot be totally explained or understood only through extreme natural events. They focused on human vulnerability as a critical element of disaster. By vulnerability they mean "*the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard* (an extreme natural event or process)" (p. 6). There are different factors that create vulnerability. According to them, two different forces work together to intensify the disastrous outcomes. They state that the natural process cause geographical hazards, whereas the socio-economic process creates human vulnerability. Finally, these natural and socio-economic processes combine together to trigger disasters.

Principal to the central argument is the premise that human beings create vulnerability through their normal life process. They argue that the danger or vulnerability of 'normal' life couldn't be segregated from the risk of a natural hazard while undertaking an analysis or understanding the disaster impacts. This vulnerability affects and in turn is affected by social, economic and political processes of the society. This vulnerability is intertwined with hazards and enhances the development of disaster impacts. Vulnerability differs in different

degrees due to different hazards on different people. Vulnerability also affects the coping capacity and resilience of the society. In essence, the people who are more vulnerable will be affected easily and suffer more by any extreme event. On the other hand, these vulnerable people also cannot reconstruct their livelihood. They become more vulnerable and remain at more risk for the subsequent disaster.

Generally, humans are not equally exposed to hazards. The effect of a disaster does not affect everyone evenly; some households suffer more than others. On the other hand, coping capacity, reconstruction of livelihoods also vary from household to household. In this regard, Wisner et al. (2004) explain that humans do not have access to resources uniformly. Social, economic and political processes control humans' access to resources such as assets, income, knowledge and information. Besides, there are also variations in income opportunities. Some income opportunities do have high access qualifications whereas others do not have. Income opportunities with high access qualifications provide the highest returns. Besides, there are other income opportunities, which are less demanding, oversubscribed and poorly paid, such as casual laboring.

Based on "level of access to resources and therefore to income opportunities", Wisner et al. (2004) categorize the 'Access profile' of households

into two and they are 'Good-resource profile' and 'Limited access profile'. Households with 'Good-resource profile' have "better access to information, cash, rights to the means of production, tools and equipment, and the social networks to mobilize resources from outside the household". They are less vulnerable to hazards, and they might avoid disaster (p. 84). On the other hand, there are people with very little choices and limited access to resources. These households with 'Limited access profile' have limited "income opportunities" to choose a secured livelihood under adverse conditions. This cluster of people cannot recover quickly from a disaster. Besides, various forms of discrimination also occur in the allocation of welfare and social protection (including relief and resources for recovery) during the distribution among different social groups.

2.2.3 Challenges of the Poor People to Cope with Adversities

When an extreme event or disaster disrupts the 'normal life' process of human beings, they first suffer and then absorb the shock. Precisely, the disaster affected people try to organize resources of whatever they have and attempt to reconstruct their livelihoods. In this situation, adaptations, coping strategies and access to safety become necessity for the people. Since the extreme events like natural

hazards and disasters happen more frequently, a number of studies have been conducted on how best to deal with these adversities. Researchers also outlined different explanations for causes of disasters and proposed various solutions to cope with them. Within this vast scholarship, it is noticed that the researchers have used diverse set of terminology and categorized them into their own ways. This diversity can also be seen for the literature on adaptation and coping.

The term 'coping' and 'adaptation' are sometimes misleading due to their use in different academic discourses. Both 'coping' and 'adaptation' are being referred as counteractions against extreme events, hazards, disasters or climate change. But, according to Osbahr, et al., (2008), "there is a major distinction made in many accounts of hazard and livelihood risk between coping and adaptation. The distinction is most often made in terms of the time scale along which each occurs. *Short time scale* actions are portrayed as 'coping' with change, whereas *long time scale* actions are portrayed as 'adaptation' (p. 1952). Notably, the concept 'Adaptation' and 'Mitigation' are commonly used to "represent response to the climate change and variability" (Smit, Burton, Klein, & Wandel, 2000). For example, Nobuo Mimura refers mitigation as "one of the two countermeasures of global warming and climate change", whereas 'adaptation' is referred as

"measures to increase preparedness for the adverse effect of climate change" (Mimura, 2010: 131).

Adaptation is also used in many scholarly works and policy discussions related to climate change. For example, the Intergovernmental Panel on Climate Change (IPCC) defines the term adaptation as "an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderately harm or exploits beneficial opportunities" (FAO, 2008b, p.3). Besides, Rahman (2008) notes "adaptation is being better prepared or adapting to climate change, not fighting it, but *learning to live with it*" [italics added] (as cited in Pender, 2008: 43). But Smithers and Smit (1997) argue that there is no common understanding of what is meant by the term 'Adaptation' (p. 130). They state that the concept of adaptation is related to the long term climate change, and these adaptations are embedded in somehow structured or designed adaptation like building construction, transportation systems, agriculture, and leisure activities among others (Smithers & Smit, 1997:130 -131). Likewise, Smit, Burton, Klein, and Wandel, (2000) also argue that adaptation can be in the form of technology, economic, legal, and institutions (Smit, Burton, Klein, & Wandel, 2000).

By contrast, "coping is the manner in which people act within the limits of existing resources and range of expectations to achieve various ends" (Murphy & Moriarty, 1976). In general, this involves the capacity to use resources in an unusual, abnormal and adverse situation (Wisner et al., 2004: 98). Besides, Wisner et al. (2004) refer coping as a series of adaptive strategies to preserve needs as high up as possible in the face of adverse circumstances. Wisner (2004) mentions different types of coping strategies such as preventive strategies, impact-minimizing strategies, building up stores of food and saleable assets, diversifying production, diversifying income sources, development of social support networks etc.

With respect to the coping strategies, the developed countries are placed in a relatively more secured position than the underdeveloped countries. This is because developed countries can limit the potential losses adopting sophisticated coping strategies when they are exposed to many environmental hazards. In this case, Japan can be an example. Japan is a developed country and it is exposed to more natural hazards. However, Japan is more capable of reducing the losses due to its sophisticated coping strategies. On the other hand, many African countries are vulnerable to natural hazards because of their limited resources and lack of

coping strategies (Smith & Petley, 2009: 11). In this regard, Bohle, Downing and Watts (1994), and Downing et al. (1997) state that, "the possibilities for adaptation as well as its impacts are surely different in the rich and poor countries and for different groups and places within countries" (as cited in Kates, 2000: 6). Moreover, "within countries the ability to adjust and people's access to adjustments reflect existing divisions between rich and poor, powerful and powerless, ethnic or gender-favored and ethnic or gender-denied" (Kane & Yohe, 2000).

As a final point, although the poor may develop hazard-adaptation practices to reduce their disaster vulnerability, poverty is generally believed to heighten such vulnerability. Researchers suggest that poverty reduction policies and programs designed to nurture hazard-resistance amongst the poor are important for sustainable development. However, lack of resources and proper information along with the organizational incapacity makes the coping strategies of the poor constrained. Sometimes, it adversely affects the key characteristic of local and indigenous knowledge and coping strategies. Besides, the ignorance of local knowledge and local needs followed by inadequate involvement of local

communities and other stakeholders makes some adaptation projects fall short of their goals (Srinivasan, 2004; Mallick & Jilan, 2006).

2.2.4 The Role of Indigenous Knowledge in Coping or Adaptation

Historically, most of the people whose livelihoods are linked to agriculture are shown to have propensity to cope with the inconsistency of climate change in autonomous ways (FAO, 2008b). But, now anticipatory and planned adaptation have become an urgent concern because in recent years the speed of climate change has increased and so does the conditions which the local people are not accustomed to tackle. To address this issue, IPCC states that adaptation can either be anticipatory or planned and to some extent autonomous as well (FAO, 2008b). Besides, adaptation needs to be *location specific* as vulnerabilities are mostly local [italics added] (FAO, 2008b). Srinivasan (2004) argues that "climate change is a global phenomenon while adaptation is largely *site-specific*. As site-specific issues require site-specific knowledge, indigenous bottom-up strategies are likely to be more successful than the top-down approaches in adapting to and cope with climate change. Indeed successful adaptation activities are often built upon local knowledge" (Srinivasan, 2004: 5). Helmer (2007) states that the local people are the real experts given their knowledge on climatic changes and traditional

responses to cope with them. Similarly, IGES (2008) suggests that the developing countries of Asia should emphasize their indigenous knowledge and local coping strategies and use them in local adaptation plans. Srinivasan (2004) also notes, "during the past decade the world has witnessed at least 10 international declarations emphasizing indigenous knowledge, starting with Agenda 21 by the Rio Earth Summit in 1992 where local knowledge was mentioned as many as 166 times" (Srinivasan, 2004: 5).

Unlike the wealthy and advantaged developed countries, developing countries do not that have enough resources (in line with money, technology, and people with skills and knowledge) to combat any hazard or disaster. Still today, the rural people of developing countries do not receive the benefits of modern information system or technologies. In consequence, they apply their indigenous techniques to counter those problems. Khan and Sen (2000) assert that the rural people of developing countries mainly use local and traditional knowledge for managing disasters, natural resources and other activities as well.

Notably, a rich body of scholarships has defined indigenous knowledge using different terminologies although they refer to the same phenomena. The most common synonyms for the indigenous knowledge are "indigenous

knowledge system, indigenous technical knowledge, ethnoscience, local, traditional, people's knowledge, people's science, and village science" (Atte, 1989 as cited in Ramos 2001). According to Atte (1989), indigenous local knowledge is a form of shared environmental knowledge, beliefs, rules and techniques that are used for productive activities" (as cited in Ramos 2001). Kotschi, Waters-Bayer, Reinhard, & Hoest, (1989) views indigenous knowledge as a low cost external input system because this knowledge can be derived from the locally available energy and materials (as cited in Ramos, 2001: 19). Srinivasan, (2004) states a list for the alternative names of "Local Knowledge" which are: "folk knowledge, traditional knowledge, indigenous knowledge, traditional environmental knowledge, indigenous traditional knowledge, indigenous agricultural knowledge, farmers' knowledge, rural people's knowledge, peasants' knowledge, ethno-science, etc." (p. 4). Chambers (1983) considers indigenous knowledge as a "*powerful asset and social capital*" for those counties which are vulnerable to climate change (as cited in Srinivasan, 2004: 11). Likewise, Richards (1985) defines indigenous knowledge as "local knowledge constructed upon a foundation of local skill and initiative, local research and problem solving, in a given culture and society" (as cited in Musiiwa, 2002).

World Bank (1990) further reinforces that indigenous knowledge are local knowledge which is unique to a given culture or society. Phillips & Titilola (1995) also consider indigenous knowledge as a unique knowledge to a given culture or society.

However, development of indigenous knowledge is not a short term job. It actually comes through years of experience and by solving problems on a trial and error basis (Naimir, 1990; McClure, 1989). For example, Thrupp (1989) points out that indigenous knowledge (adaptive skills of local people) is derived from *many years of experience*, and passes through family members over generations. Similarly, Khan and Sen (2000) argue that indigenous knowledge is derived from the people living in close contact. In other words, it is the *hands-on-experience* that is transmitted from generation to generations through *oral tradition* (Khan & Sen, 2000: p.141). Srinivasan (2004) notes that indigenous knowledge is both dynamic and complex, and is based on experiences often tested over centuries of use, and entails many insights, perceptions and intuitions relating to local culture and the environment" (Srinivasan, 2004: 4). In sum, the main characteristics of indigenous knowledge system are as follows (OTA, 1988: 4 as cited in Ramos 2001: 19):

- They strive to reduce risk, even if this means obtaining less than maximum yield.
- They depend on local technology.
- They depend on biological processes and renewable resources.
- They involve low cash cost, but relatively high labor cost and labor productivity.
- They are adapted to local cultures and environments although social and ecological systems are showing increasing strains under growing pressure.

2.3 Sensitizing to the Diffusion of Innovation Specific Literature

The first part of this section presents a review of Professor Everett Rogers's diffusion of innovation theory. The second part describes literature related to diffusion of agricultural innovation.

2.3.1 Diffusion of Innovation

Innovation can be viewed as a new idea, knowledge, technology, method, device, product or even a new process that serves as a better solution for accomplishing an object. According to Mele (2005), "innovation is a new way of doing things by applying technical, methodological or organizational knowledge. This knowledge may come from several factors such as farmers, NGOs, public and private sectors or it can be acquired through extension, media, research, experience or any other sources. By contrast, "communication" is a process of sharing information between two or more individuals for mutual understanding

(Rogers and Kincaid, 1981 as cited in Rogers, 2003). However, diffusion takes place when a new idea or innovation is communicated to the members of a social system through certain channels over time (Rogers, 2003). In other words, diffusion can be seen as a process of *Social Change*. Diffusion can take place spontaneously or in a planned way. It also could be centralized and decentralized as a system. In the centralized diffusion system, the head of R & D usually takes decision for innovation and diffusion, whereas in the decentralized diffusion system, new ideas are generated from the practical experience of certain individuals in the client system (Rogers, 2003). It is to be noted that a new idea or innovation takes a longer period to spread and get widely adopted by a society.

'Diffusion' has been studied since the late 19th century when diffusion was viewed as a single generalized concept not interlocked only with biology, chemistry or physics. The classical diffusion model is applied to understand the process of socioeconomic development of a country. The diffusion framework is widely used to evaluate the impact of development programs in agriculture, family planning, public health, and nutrition. Diffusion studies further cover the rate of adoption of various innovations in different social systems, usages of

innovation in communication channels and their consequences on human life (Rogers, 2003).

The theory of "diffusion of innovation" was developed by Everett Rogers in communication studies. He consulted different diffusion studies from a number of fields to develop the 'diffusion of innovation' model. Since 1960, his model has been used by many disciplines. His model postulates that in a social system, some people take the risk of adopting innovations which influence the others. He argues that diffusion of innovation is a "general process" which is not bound to any specific discipline or place or culture. Professor Rogers identified nine major diffusion traditions which are anthropology, early sociology, rural sociology, education, medical sociology, communication, marketing, geography, and general sociology. Besides, he identified four main elements that work in the diffusion of a new idea. They are: innovation, communication channels, time and the social system (context). Regarding innovation, Rogers focused on the 'newness' of an idea, practice, or object. He argues that an idea, practice, or object could have been discovered earlier but it is an innovation to an individual until it is discovered or introduced to him. However, a drawback of his model is that "most

of the new ideas that diffusion has analyzed are technological innovations" (p. 12).

Furthermore, Rogers (2003) mentions five attributes of an innovation to determine the rate of adoption of an innovation. They are (1) relative advantage, (2) compatibility, (3) complexity, (4) trial-ability, and (5) observability. Rogers asserts that an individual will adopt an innovation when he finds it advantageous to him. Precisely, the higher is the advantage of innovation, the higher is the rate of its adoption. According to Rogers (1995), the attributes are important explanation of the rate of adoption of an innovation. He mentioned that "most of the variance in the rate of adoption of innovation, from 49 to 87 percent, is explained by this five attributes" (Rogers, 2003: 221).

However, if an innovation is not consistent with existing values, past experiences, and needs of potential adopters, the adoption is likely not to be smooth and rapid. Likewise, if an innovation is complicated as well as difficult to understand and use, the adoption process tends to be slow. Furthermore, the option of giving the trial may subsequently allow the adopter to learn by doing. In addition, the chance of adoption increases when someone observes a positive result of an innovation. Most importantly, receivers may adopt the innovations

more rapidly that have "greater relative advantage, compatibility, trial-ability, observability, and less complexity" compared to other innovations.

The diffusion model also focused on the importance of peer-peer conversations and peer networks. However, 'Uncertainty' is an important aspect of diffusion model. People always want to avoid risk and uncertainty. People prefer something over others when they hear about that from someone they know or have trust on that person. Arguably, the mass media may work well for creating knowledge on an innovation but for changing or making a positive attitude towards a new idea, interpersonal communication works more effectively.

The Rogers diffusion model considers time of innovation adoption in three dimensions. Firstly, the innovation-decision process that starts with the knowledge of an innovation and continues until the final decision is taken about the success of innovation. Rogers (2003) conceptualizes five steps in the "innovation-decision process". They are: (1) knowledge, (2) persuasion, (3) decision, (4) implementation, and (5) confirmation. Secondly, time dimension rests on the adopters themselves meaning that who adopt new ideas relatively earlier as compared to other members of the social system. Based on the innovativeness, the adopters are categorized as innovators, early adopters, early

majority, late majority, and laggards. Lastly, the time dimension is associated with 'the rate of adoption' of innovation. The rate of adoption is the relative speed with which members of a social system adopt an innovation. The rate of adoption is "measured by the length of time required for a certain percentage of the members of a system to adopt an innovation" (Rogers, 2003; p. 23).

Importantly, the social system is important in the diffusion process as diffusion occurs within the boundary of a social system and the social structure of the system affects the rate of adoption in several ways. Rogers (2003) defines social system "as a set of interrelated units that are engaged in joint problem solving to accomplish a common goal" (p. 23). He also states that individuals, informal groups, organizations, and/or subsystems could be the members or units of a social system. Notably, even though an individual is a member of a social system, his/her individual characteristics can affect the degree of innovativeness and the rate of adoption as well. Rogers (2003) mentions about roles of opinion leaders and change agents who influence and affect the diffusion process. In addition, besides the nature of the social system, social norms may have important influence and effect on diffusion. Thus, understanding the social structure and social norms are important because this knowledge helps in reducing uncertainties

in innovation meaning that whether the innovation is appropriate for a particular society or what sorts of initiatives, modifications, or changes to be taken to make the diffusion fast and effective.

Once the diffusion process is completed, a decision is taken as to whether the innovation will be adopted or rejected. It is usually expected that the innovation results will be desirable, direct and anticipated, although some unanticipated consequences may occur. Rogers (2003) mentions three types of consequences which are: desirable versus undesirable consequences, direct versus indirect consequences, anticipated versus unanticipated consequences. Desirable consequences are observed when an innovation functions smoothly, whereas undesirable consequences occur when it becomes dysfunctional. On the other hand, direct consequences happen to the individual or to the social system as a direct and immediate response to the innovation. But, the second-order result of the direct consequences is considered as indirect consequences. Finally, when the changes are recognized and intended, they are considered as anticipated and vice versa. Importantly, "the undesirable, indirect, and unanticipated consequences of innovations usually go together, as do the desirable, direct, and anticipated consequences" (Rogers, 2003; p. 449).

In fact, consequences are the important part of the diffusion process. However, there are very few researches on the consequences of diffusion of an innovation. Rogers (2003) reports that among the diffusion related publications only 4% are conducted on the consequences of innovations. This is equally true for studies on the relative success of the change agents in the case of diffusion of an innovation. Rogers (2003) mention several reasons why consequences have not been studied adequately thus far. They are (1) "change agencies have overemphasized adoption per se, assuming that the consequence will be positive"; (2) "the usual survey research methods may be inappropriate for investigating consequences"; and (3) "consequences are difficult to measure" (Rogers, 2003: 410). Nevertheless, the final point is that "invention and diffusion are but means to an ultimate end: the consequences that result from adoption of an innovation" (Rogers, 2003: 436).

2.3.1.1 The Innovation Decision Process

Decision concerning an innovation does not happen instantly. The potential adopters take the decision of adopting or rejecting an innovation through a series of different actions over time. In this regard, Professor Everett Rogers proposed a

decision model that encompasses knowledge, persuasion, decision, implementation and confirmation. The model is briefly discussed below.

The Knowledge Stage

The innovation decision process starts with knowledge stage where an individual either gets exposed to an innovation or seeks for information about the innovation based on his need. Perceived needs or problems of an individual can create the ground for seeking the knowledge about an innovation to solve that particular problem. But, the need for an innovation is not the only factor that starts the innovation decision process. Sometimes an innovation can also create a need for it. In the case where an innovation creates a need, change agencies play a vital role in pointing out the existence of that innovation to their clients. In the knowledge stage, at first an individual wants to know about innovations, then he wants to know how these innovation works and why are they important. Knowing about an innovation leads to the development of an attitude to that innovation (Rogers, 2003).

The Persuasion Stage

In the persuasion stage an individual develops either a favorable or unfavorable attitude towards an innovation after knowing about a new idea. In this

stage, an individual seeks more information about the perceived attributes of an innovation. Rogers (2003) mentions that the perceived attributes like relative advantage, complexity and compatibility of an innovation play an important role in developing a favorable or unfavorable attitude towards that innovation at this stage. The potential adopters try to understand the future positing of that innovation considering his current situation. At this stage, the potential adopters try to get evaluation information about the innovation to reduce the uncertainty as well as to avoid the undesirable consequences (Rogers, 2003).

The Decision Stage

In this stage, an individual takes the decision whether to adopt an innovation or to reject. Adoption is the decision taken by the individual after the full use of an innovation. However, the decision to reject the innovation happens when he or she does not want to adopt the innovation. Most commonly, potential adopters like to give a trail before taking the final decision of adoption. After giving a trail if an individual finds certain degree of relative advantage from that innovation, he or she then moves to the decision about the adoption of that innovation. In this case, the change agencies often create the opportunity for the

potential adopters to try the innovation, and thus, it helps the potential adopters to take the decision after giving the trail. However, the decision of rejection of an innovation can happen at any time or any stage in the innovation decision process. An individual can take the decision of discontinuing of an innovation even after adopting that innovation. Rogers (2003) mentions two types of rejection that take place in the innovation decision process. They are active rejection and passive rejection. Active rejection happens when an individual decides not to adopt the innovation after considering adoption of that innovation (including its trail). On the other hand, passive rejection or non-adoption occurs when an individual never really considers the adoption of an innovation. Most commonly, the innovation decision process follows a sequence of knowledge – persuasion – decision. However, based on some social settings certain innovations can take the sequence as knowledge – decision – persuasion (Rogers, 2003).

The Implementation Stage

The implementation stage starts when an individual stars using the innovation. The knowledge, persuasion and decision stages are mostly mental stages, whereas the implementation stage is a practical one. This stage also

involves certain degree of uncertainties such as how to use an innovation, what sorts of problems to be encounter and how to solve them. An adopter still needs information about the innovation at this stage. In this stage, client agencies or client agents assist the adopter by providing technical assistance or information to the use of innovation. Rogers (2003) mentions that the implementation stage may be the terminal stage in the innovation decision process for many individuals. However, this stage may continue for long period of time depending on the nature of innovations (Rogers, 2003).

The Confirmation Stage

At this stage, an adopter tries to review or evaluate the decision of his or her decision based on the positive or negative performance of the innovation already adopted (Huckett, 2010). Rogers (2003) mentions that taking the decision to adopt an innovation or implementing it for use is not the terminal stage in the innovation decision stage. An individual also "seeks reinforcement for the innovation-decision already made, and may reverse this decision if exposed to conflicting messages about the innovation" (p. 189). Continuation in use of the innovation happens when the adopter gets overall benefit from that innovation. On

the other hand, the adopter might also discontinue the use of that innovation at this level if the circumstances of the adopter change, for example – in the case of changes in the economic condition of the adopter or in the case of arrival of a better option or technology (Huckett, 2010). Rogers (2003) mentions about two types of discontinuance – replacement and disenchantment. "Replacement discontinuance is a decision to reject an idea in order to adopt a better idea that supersedes it" (Rogers 2003: 190). On the other hand, disenchantment discontinuance refers to the "decision to reject an idea as a result of dissatisfaction with its performance" (Rogers, 2003: 190). Rogers (2003) further mentions that, "the discontinuance of an innovation is an indication that the new idea may not have been fully routinized into the ongoing operations of the adopter at the implementation stage of the innovation-decision process" (Rogers, 2003:191). It is argued that individuals with less formal education, lower socioeconomic status, and less contact with the change agents are the high discontinuers. Furthermore, limited resources of the individuals also inhibit adoption because it might not fit well into their limited financial position.

2.3.2 Diffusion of Agricultural Technologies in the Context of Climate Change

The literature review of this part endeavors the different aspects of ease and difficulties harnessing the innovative technology across farming communities, and how these innovations flow from the biotechnology lab to the agricultural managers and across the communities as well.

Lybbert and Sumner (2012) describe that the development and effective diffusion of new agricultural innovations largely depend of their adaptability by the farmers affected to climate change. Therefore, diffusion is not only about adapting to a new technology. It is rather a process of subtly adapting to climate change onslaughts. This is much needed in the resource constrained developing countries where "agricultural productivity remains low; poverty, vulnerability and food insecurity remain high; and the direct effects of climate change are exponential, (Lybbert & Sumner, 2012). The process of transferring agricultural innovations across geographies is often subject to more locally based constraints. The most binding constraints occur at the receiving end of adoption by the local poor farmers who neither possess bounty of resources (i.e., information, finance, political capital) nor get attracted to and become comfortable to the use of new technologies due to such resource constraints. Therefore, to facilitate effective

diffusion and eliminate the constraints, both the private and public sectors need to play more proactive roles. In this regard, Lybbert & Sumner (2012) and Kebede et al. (1990) suggest evaluating three major considerations, discussed below, while dealing with diffusion of agricultural technologies.

Innovation considerations

With reference to Alston et al. (2009), Lybbert and Sumner (2012) argue that innovations in agricultural technology remain a bit under-nourished due to lack of public investment in agricultural research and development. This lack of interest in innovation again cascades in the local field level and significantly reduces local capacity of innovative practices, thereby slowing down the overall food production-chain, as is seen in the case of Africa, India, China and Brazil (Alston et al., 2009; Lybbert & Sumner, 2012). Secondly, excessive state intervention, control and bureaucracy in the agricultural sector also inhibit the culture of innovative practices in many developing countries.

Transfer considerations

Even though there are innovations from the community, in some cases, those 'orphan crops' suffer from immobilization because private farms often do

not communicate such innovations to the outside world (Masters, 2005). Although, on principle, many developing countries may get benefits from global agricultural advancements, the limited local capacity and the lack of practice of nourishing new technologies frequently hinder capitalization of such global innovation stocks (Lybbert & Sumner 2012). Besides, issues with intellectual property rights discourage private sectors to initiate transferability leading to cross-scale diffusion because of lack of bio-safety measures prevalent in developing countries (although probably not the case for floating bed cultivation). However, as suggested by Lybbert and Sumner (2012), the intermediary organizations may help to bridge the gap through successful negotiation of partnerships, preferential licensing terms, or other means of cooperation to facilitate information to poor farmers and to uphold a transfer culture of new agricultural knowledge and practices.

Access and Use Considerations

Lybbert and Sumner (2012) further argue that even if an innovation is made available to the farmers in poor countries, several factors imped access to and use of these new technologies. For example, existence of a poorly functioning

market mechanism jeopardizes the adoption process of new technologies by the poor farmers. In addition, dysfunctional and unresponsive state-behavior often discourages the private sectors to take the innovations to the farmers' doors. Furthermore, a good coordination among markets, institutions mobilizing innovations and innovations themselves is essential to protect an innovation. However, it is hard to manage all these actors especially in developing countries as the market and environment induced hazards are highly uncertain in those countries. Even though the institutions and the markets are able to become flexible to the changing contexts, weak and ill political environment may impose further challenges to the use of innovation. Notably, the third world agro-based society also constantly tries to embrace the fruits of modernism which, *inter alia*, erode the local production system and alienated many local poor farmers form their farming practices as a livelihood. Therefore, the rate of adoption of innovations by the third world farmers tends to fall behind because of the presence of so many factors out of their control (Lybbert & Sumner 2012). This implies that more proactive roles from the private and public sectors are required to facilitate adoption of innovations and eliminate the constraints of the diffusion of innovation as well.

2.4 Sensitizing to the Floating Bed Cultivation Specific Literature

In Bangladesh, the floating bed cultivation is practiced as an agricultural adaptation technique in the wetlands (*haor, baor*), dead canals and rivers, waterlogged and flood prone areas, and in the coastal areas which remain submerged under water for a long period, especially during monsoons. In Bangladesh, the floating bed cultivation practice is part of traditional agriculture. The people of different areas have adopted and modified the method of floating bed cultivation in different locations of the country according to their needs, experience, choice, demand-supply relationship of crops, availability of input materials for making the floating beds, and ecology of the area. The local name used to refer to the floating bed cultivation also varies by areas in Bangladesh. For instance, the floating bed cultivation is recognized as *Baira / Boor / Dhap / Gathua / Gatoni / Geto / Kandi / and Vasoman Chash* by areas although these names mean the same thing. This traditional cultivation practice is a traditional form of hydroponics, where the plant can be grown on the water in a bio-land or floating bed of water-hyacinth, algae and other plant residues (APEIS, 2004; Irfanullah *et al.* 2007; Haq, 2009). Haq (2009) refers this cultivation practice as *"Organo-hydroponics"* because this cultivation practice is similar to hydroponics

and does not require the use of soil. This system, in fact, uses semi-decomposed plant materials instead of nutrient solution which is the characteristic of "Organoponics".

Notably, the concept of growing plants without soil is traced back to the mythical Hanging Gardens of Babylon, *chinampas* of Mexico by the Azteces, the raised or drained fields of the pre-Columbian civilizations of the Americas etc. (Winterborne, 2005; Islam & Atkins, 2007). However, the commercial use of soil less cultivation i.e. hydroponics received attention in the US after 1945. Then, in 1950s, this practice expanded throughout the world including Italy, Spain, France, England, Germany, Sweden, the former Soviet Union and Israel (Winterborne, 2005).

The practice of soilless cultivation or hydroponics became popular in areas where cultivable lands are limited or cultivation in the normal lands is difficult. In Asia, this practice is adopted in Lake Inle in the South-eastern Burma, the Tonle Sap in Cambodia, Kashmir in India and some parts in Bangladesh but in their own traditional ways (Islam & Atkins, 2007; Haq *et al*., 2002). Besides, huge installations of modern hydroponics are found all over the world, such as hydroponic green houses in Arizona, USA and Abu Dubai in Middle East"

(Winterborne, 2005: 184). Haq *et al*. (2002) state that "Today, hydroponics is an established branch of agronomical science, it helps feed millions of people; these units may be found flourishing in the deserts of Israel, Lebanon and Kuwait, the Philippines, on the rooftops of Calcutta and in the parched villages of West Bengal" (Haq *et al*., 2002: 27).

Hydroponic as a scientific discipline is developing quickly through constant innovation and change although the basic principles of soilless cultivation remain the same (Winterborne, 2005: 185). Winterborne (2005) states that growers' can use hydroponics in all types of climates. Bradley suggests that the adaptation of basic components of the technology is simple but should be according to the local conditions and materials" (Bradley, 2005). Moreover, experts rated highly about the potential of hydroponics in developing countries.

There is also a social potential of hydroponics in developing countries such as Bangladesh because it does not utilize intensive irrigation and chemical fertilizers (Haq *et al*., 2002; Irfanullah, *et al*., 2007; Islam & Atkins, 2007). Hydroponics technology is also less expensive and locally manageable that, in turn, provides opportunities to farming in an economic way by utilizing of vast water-based landscape (Haq *et al*., 2002; Irfanullah, *et al*., 2007; Islam & Atkins,

2007). Hydroponics further ensures food security by increasing harvests (Dev, 2013) and ensuring of equitable distribution of water-based natural resources within the less-able communities (Haq, 2009).

Wetland Resource Development Society (WRDS), an NGO, has been working on wetland resource development in the Southwest region of Bangladesh for a long time. WRDS has published a book on wetland and waterlogged areas in the Southwest region of Bangladesh to conceive the environmental and socio-economic impact of waterlogging on the lives of the people of that area. This book also explores the potential of floating bed cultivation to increase food production and to support livelihoods to the poor communities of that area. This study collected information on the wetland and waterlogged areas of Southwest region of Bangladesh. It also collected information on the socio-economic status of soil-less farmers of that area. The study, in fact, unveils the history of detailed farming system of soil-less cultivation in different areas of Bangladesh along with the problems and prospects of this farming system.

According to the book published by WRDS, the floating bed cultivation is popular in areas affected by waterlogging problem because farmers cannot utilize their field for regular farming when the land remains under water for a long

period. The popular hydroponic areas of Bangladesh identified by the book are *Bisherkandi, Kashmir, Batiakhata, Monohorpur* and *Banaripara.* The farmers of these areas have acquired extensive experience they have taken floating bed cultivation system as their main source of income for a long time. However, farmers in some areas such as some parts of *Gopalgonj* and *Faridpur* districts have not taken the floating bed cultivation as a main farming system even though there is water logging in those areas. Similarly, in *Gopalgonj* district, the soil-less cultivation technique has been popularized as a supplementary cultivation system to meet the needs of vegetables and farmers often sell their surplus crops in markets (Haq et al. 2002). Haq et al. (2002) also reports that farmers of *Pirojpur* district have taken soil-less cultivation as their main occupation.

Farmers mainly grow different kinds of vegetables and saplings in the floating bed. The market and the marketing system of the vegetables and saplings are different in different areas. In some areas, for example in *Batiaghata* and *Swarupkati*, the marketing system is well established. However, few areas such as the *Gopalganj* area the marketing system is not well developed. Besides, the value of the growing products also vary by types, for instance, growing sapling is more profitable than vegetable production. Farmers sell their saplings and vegetables to

the nearby market. Then the vegetables is carried to the local market and is sold mostly in bigger cities like greater *Barisal*, part of the greater *Faridpur, Khulna* and even to *Dhaka*. Sometimes businessmen or middlemen collect saplings and vegetables from the field. But the situation turns bad when the transportation system turns bad due to heavy rains. In that situation, a large portion of the product gets perished which reduces the salability of the product, and forces farmers to sell their product at prices lower than the cost of production.

Importantly, WRDS identifies several constraints for the expansion, dissemination and improvement of 'Soil-Less Cultivation' practices in Bangladesh. These are lack of fund, scarcity of lands to settle floating beds, scarcity of quality seeds, lack of linkage with an agricultural institute, lack of institutional support, insect-pest infestation, lack of proper transport facilities, scarcity of raw materials, and market price. In addition, although the 'Soil-Less Cultivation' is labor intensive compared to other agricultural techniques, the production cost of this system is much higher as compared to the agricultural fields. The marginal farmers cannot afford this cultivation system because they do not have adequate money to make the initial investment and bear maintenance cost of the beds latter on. Besides, the landless farmers cannot solely depend on

this cultivation practice, as they do not have enough land where they can make the beds and later transform them into *kandis* (raised field). Sometimes, farmers do not get enough raw materials to prepare the bed. One of the common raw materials used for making the bed is water hyacinths which do not grow in saline water. In some areas, the growth and production of water hyacinth is reduced due to the intrusion of saline water. The availability of long paddy stub from *Aman* paddy (another popular raw material for making the bed) has also become scarce due to the introduction of high yielding variety paddies in some areas. But, there are few areas (*Najirpur* Thana) where people produce water hyacinths commercially and sell them in the market. Ready-made floating bed is also available in the market in some areas where floating bed cultivation is popular.

WRDS mentions that "Soil-less cultivation is a promising alternative food production system, which does not alter wetland ecosystem" (p. 107). The floating bed cultivation could be a good source of vegetable production, if wetlands or waterlogged areas can be utilized by providing the required facilities and supports to the local communities. WRDS argues that if the wetlands are fully utilized for practicing soil-less cultivation, it would eventually enrich the farmer's economy as well as the national economy of Bangladesh. To achieve the goal of

expansion of soilless cultivation, WRDS suggests the use of advocacy program and awareness campaign targeting the policy makers and stakeholders. WRDS argues that the government embankment/dams as *khas khal*, dead canal, could also be used for soil-less cultivation by involving poor and landless people enabling them the legitimate access. To popularize the soil-less cultivation system several programs such as credit support program for the poor, training for capacity building, dissemination through demonstration, private entrepreneur and NGO's business collaborations can be undertaken (Haq *et al*., 2002).

Research on Innovative and Strategic Policy Options (RIPSO) under the project Asia-Pacific Environmental Innovation Strategies (APEIS) carried out floating cultivation in Southwestern parts of Bangladesh as a mean of local resource management to cope with climate change. The objective of this floating cultivation project was to ensure sustainability in local natural resource management (submerged areas) and coping strategies with climate change. This research identified floating cultivation as a useful method considering the economic, environmental and social aspects. This research identified that waterlogged areas in Bangladesh can be used for floating cultivation as the area under floating cultivation is more fertile as compared to the conventional

cultivable land. APEIS (2004) argues that unlike in the conventional agricultural system, floating cultivation does not require additional fertilizers and manure. Besides, the floating bed generates biomass, which can be used as organic fertilizer in the field and, eventually, it conserves the environment. Besides, the floating bed can be used as a shelter for the poultry and cattle during the floods. Most importantly, the fishermen can also adopt this technique to cultivate crops and fish together at the same time (APEIS, 2004).

APEIS (2004), however, reports some drawbacks of floating cultivation technique. There are infestation by insects and rodents, deficiency of marketing facilities in the waterlogged area, and scarcity of the raw materials for bed preparation. Besides, there is a lack of capacity building program or organizational arrangement for promoting the practice among local people and at government level. This report states that floating cultivation technique can be practiced in the pond and other water bodies in other parts of Bangladesh and suggests DAE (Department of Agriculture Extension) to provide technical support to the farmers for its adoption and dissemination. The report further notes that the model can be used in other countries facing floods or waterlogging problems (APEIS, 2004).

Haq et al. (2004) of the Wetland Resource Development Society (WRDS) carried out a project of implementing the floating cultivation in waterlogged areas of the Southwest region of Bangladesh under the project of CARE RVCC (Reducing Vulnerability to Climate Change) which was funded by CIDA (Canadian International Development Agency). This project describes the construction procedure of floating bed, suitable crops for this practice, and benefits of this practice along with a cost-benefit analysis.

In this research Haq et al. (2004) note the potential of floating cultivation in Bangladesh. They argued that Bangladesh being an overpopulated country can ill afford to depend only on its ever-shrinking areas of arable land to feed the population. In this respect, floating cultivation could be an alternative to reduce the pressure on arable lands by turning waterlogged land into productive farming areas (Haq, *et al*., 2004). Furthermore, Haq, *et al*., (2004) mention floating cultivation as an economic and environmental friendly practice. Floating cultivation does not need any additional water, nutrients, or chemical fertilizers and their beds can be recycled as organic fertilizer in the main field. Besides, floating beds are mostly made of water hyacinth, a very invasive weed that doubles in a week or two. Floating cultivation is the way of using water hyacinth

in a beneficial way because this aquatic weed makes the water-body breeding ground for mosquitoes and reduces the carrying capacity of the water-body by breaking down the drainage system. It also has a positive impact on the open water fisheries (ibid.). As using water hyacinth allows for a productive use of the otherwise destructive plant species, it is argued that the productivity of the floating cultivation is higher in comparison to the traditional land based agriculture (Haq, *et al*., 2004).

Irfanullah *et al*. (2007) conducted a project for promoting *Baira* (floating cultivation) as a mean of alternative livelihood in the *Madhumati* Floodplain of Bangladesh under the Sustainable Environment Management Programme (SEMP) which was controlled by IUCN in association with Bangladesh Center for Advanced Studies (BCAS). This research focused on the extension action of the project and on the initiated approach for the extension of this technique. The research also described some constrains of floating cultivation and suggests some recommendations to overcome those constraints. Likewise, in a technical brief of training to local farmers for floating cultivation of *Gaibandha* districts in north-west part of Bangladesh, Anonymous (2006) describes the procedure of

floating cultivation along with suitable time for harvesting. The training also incorporates a case of a woman farmer who adopted this practice.

There is also an action research conducted by Irfanullah *et al*. (2007) for the introduction of floating gardening in a pilot-scale in the Northeast wetlands of Bangladesh. This project was under the SHOUHARDO Program funded by USAID and implemented by IUCN Bangladesh and CARE Bangladesh. This research mentions the importance of floating cultivation in ensuring food security and generating supplementary income for the marginalized community. The research discusses steps and methods of floating cultivation, input-output relationships, limitations of this practice and effect of this practice on that area. It also recommends some potential areas to explore for furthering this practice. This report concludes that floating cultivation practice helps in supplementing income generation which contributes to poverty alleviation and food security by increasing the land holding capacity of poor as well as landless people by allowing them to grow vegetables and crops with less input costs as it needs minimum infrastructure. However, the report contains a brief part on the comparison between the floating cultivation techniques of this area with the area of Southern Bangladesh.

On the other hand, Islam and Atkins (2007) apply the 'case study' method in analyzing the challenges in introducing floating gardening, the analogy to the hydroponics practice, and how these challenges can be overcome in the wetland areas of Bangladesh. The study was conducted in *Nesarabad*, the Northeastern part of *Pirojpur* district. It is one of the main *thanas* or districts where this indigenous type of cultivation is concentrated. This is a descriptive type of research and it has elaborated different phenomena equated with a new type of agro-technique in a particular region in Bangladesh. In this research, the researchers used a qualitative method by doing a participatory observation and intensive discussions with 30 farmers and interviewed key-informants in the local administration and representatives of the Ministry of Agriculture. The research also collected samples from the bed in order to investigate the nutrient status of the floating beds. The study notes that the floating cultivation has some positive social effects. The project involved both men and women and argues that gender balance increases people's perception on floating cultivation of that particular area. Besides, people who participated in the floating cultivation are found to be economically better off than people in other flood affected areas who are yet to apply this practice (Islam & Atkins, 2007).

2.4.1 Procedures of Floating Bed Cultivation in Bangladesh

Generally, farmers in Bangladesh practice the floating agriculture as an alternative method of cultivation during monsoons when most of the land becomes flooded. The key areas of floating cultivation in Bangladesh are *Gopalgonj, Pirojpur* and *Barisal* districts. In recent times, there are some projects on hydroponics run by different internal and external organizations in many other parts of the country. The size and shape of the floating beds also vary across regions. Farmers use various types of local material for building the floating layers. Actually, "the people living within the wetland ecosystem utilize locally available paddy stubs, water hyacinths and various aquatic plants for making the floating mat or organic bed on which the crops are grown" (Haq *et al*., 2002: 45).

In Bangladesh, the wetlands such as *haor, baor*, moribund canals, moribund rivers as well as the waterlogged areas are used for floating cultivation although most suitable places are those where floating bed raw materials are available. This is because cultivation becomes costly if it requires extra labour for collecting raw materials and carrying them to the desired spot. Haq (2009) states that "The non-flowing water bodies where aquatic weeds especially water

hyacinth grows profusely, are preferable as production site - no matter whatever may be the depth of water" (p.6).

Water hyacinth (*Eichhornia crassipes*) is the most commonly used raw material for making floating bed in Bangladesh. However, *topapana* (*Pista stratiotes*), *son ghash* (*Imperata cylindrica), noll ghash* (*Hamerthria protensa*), wood ash, and dissected coconut fibers are also used for making floating beds (Islam & Atkins, 2007). There are also some semi-decomposed aquatic weeds/plants that are used on top of the floating bed to grow vegetables and saplings. Haq et al. (2002) mentions several secondary materials such as *Khudi pana* (Duckweed), *Kata shawla* (*Najas graminea*), *Endurkandi lata* (*Salvinia spp*.), and *Dulali lata* (*Potamogeton alpinus*) as examples of semi-decomposed aquatic weeds. Normally, the above-mentioned aquatic weeds/plants are found in local wetlands. But in few areas, people grow water hyacinth commercially. Sometimes farmers purchase the aquatic plants from the nearby floating market in some parts of Bangladesh. Other raw materials, for example Bamboo and coconut husks, are collected from local sources. Bamboo and coconut husks are available in every village in Bangladesh. Farmers also purchase seeds, chemical fertilizer

and pesticides from local market. Some of these seeds are reserved by farmers for the next season (Haq *et al*., 2002, p. 45).

The collection of raw materials usually starts during the months of May and July. Farmers collect the water hyacinth from the nearby rivers, *khals* (canals) and other water bodies (APEIS, 2004). The collection of the water hyacinth usually starts 4-5 weeks before the platform preparation (Irfanullah *et al*., 2007). After the collection of the water hyacinth, farmers lay bamboos on dense water hyacinth to make a frame. More water hyacinth is needed to make the frame strong (see Plate 3.1). Thickness of frame depends on duration of waterlogging during that time. To accelerate the process, the previous year's decomposed bed/raft is also used. Then the beds are left for some days to decompose. After that they could be ready for cultivation. The length, width and height of the bed also vary by areas. The average length, width and height of the newly prepared platforms are length 4.6 m, width 1.4m and height 1.1 m as is mentioned by Irfanullah *et al*. (2007). "The height is decreased significantly to about 0.5m within 2–3 weeks when the platform is rotted and becomes ready to cultivate" (Irfanullah *et al*., 2007). Bamboos are used to strengthen the structure of the floating raft. Sometimes, bamboo poles are used to fix it on a position to avoid the

damage due to wave-action or drifting in some areas where water body is not stagnant. Sometimes taro plants are also planted along the edge to strengthen the structure of the floating bed as taro plants have a dense root system (Irfanullah *et al*., 2007).

In some areas, farmers use the floating bed in two phases. In the initial stage, the farmers plant vegetables and saplings on floating beds when the water level remains high. But, when the water level drops (in winter), the farmers convert the bed into *Kandi* (local name used for raised field). Farmers carry the floating bed and put on the raised land (Haq *et al*., 2002). In the monsoon (mainly during June-August), farmers cultivate ladies finger (okra), cucumber, snake gourds, ridged gourd, bitter gourd, wax gourd, amaranth, red amaranth, eggplant (brinjal), pumpkin, Indian spinach, taro, turmeric etc. on the floating bed. After the monsoon, farmers use the bed for cultivating spinach, aurum, spices, bottle gourd, yard long bean, bean, tomato, potato, cauliflower, cabbage, kohlrabi, turnip, radish, carrot, ginger, onion, chilli, garlic etc. (APEIS. 2004; Haq et al., 2004; Anonymous, 2006; Irfanullah et al., 2007; Islam & Atkins, 2007).

2.5 The Research Gap

This research hopes to the fill the lacunae that exists in the study of floating bed cultivation: They are as follows:

(a) The foregoing discussion reveals that empirical literature tends to discuss the problems of access to resources by poor people. However, to take the poor people out of vulnerability, different governmental and non-governmental organizations need to work together to create new income opportunities for them. Besides, it is less evident as to how vulnerable people respond to external supports. This research hopes to fill this gap by investigating the floating bed cultivation technique adopted in the Southwest part of Bangladesh that helped vulnerable people to get new income opportunities.

(b) In recent times, the world has been more volatile to hazards or disaster than it was before due to changes in climate. Poor people in third world countries are the main victims to this climate change as they do not have financial power and technology to combat them. To address this adversity, scholars suggest the use of more anticipatory and planned adaptation (FAO, 2008b). Several scholars also suggest that adaptation should be location specific (Srinivasan, 2004). However, it is yet to be made clear as to how a location specific adaptation technique serves

better than planned adaptation. This research explores the efforts of different governmental and non-governmental organization that consider location specific adaptation as a component of their planned adaptation projects.

(c) The discussion in Chapter 2 revealed that diffusion of innovation has meant primarily the technological innovation-diffusion. There is hardly any case where diffusion of an indigenous cultivation practice has been studied. The present study will fill this gap taking into account the indigenous cultivation practice in Southwestern Bangladesh.

(d) In addition, previous researches on floating bed cultivation mostly focused on the potential aspects of the cultivation practices. The research carried out by NGO personnel mainly focused on the immediate outcome of their projects than long term outcomes. To our knowledge, there are few studies undertaken so far that investigated the long term effect or economic consequences of floating bed cultivation in developing countries. Those papers also did not discuss the challenges in adopting the practice. Furthermore, empirical literature tends to overlook the floating bed cultivation as an innovation and researchers do not analyze its relative advantage, complexity and compatibility in operations. This research, however, considered the floating bed cultivation as an innovation in the

context of the study area and tries to explore its relative advantage, complexity and compatibility to unearth the challenges in adopting this practice.

(e) Finally, there are only two researches (Haq et al. 2004; Dev, 2013) carried out so far relating to floating bed cultivation in the Southwestern region of Bangladesh and the authors of these two of papers are also from NGOs who usually have a short-term goal of making detailed reports of their activities alone without examining longer term outcomes. Importantly, their papers mostly outline the floating bed procedure, its potential and a cost-benefit analysis of adopting this technique. A detailed discussion about the challenges in adopting floating bed cultivation in a new setting is absent in those papers. The present study also fills this gap.

2.6 Summary

This chapter discussed the relevant literature and theories related to hazards in agriculture, challenges of the poor to cope with adversities, the role of indigenous knowledge in coping with adaptation, the innovation diffusion process, the diffusion of agricultural technologies, and procedures of floating bed cultivation in Bangladesh. The discussion reveals that hazards can happen in any

uninhabited region, but they become dreadful and turn into disaster when people fail to adopt necessary measures to tackle them, and in consequence, they loss lives, assets and livelihoods. It also reveals that besides the climate change, human activity may also invite hazards and disaster. When people are exposed to hazards, they become vulnerable as adverse situations restrict their access to resources and opportunities. In general, the poor people of the less developed countries become more vulnerable to disaster due to lack of sufficient funds and technology to overcome the negative effects of hazards. In fact, disaster makes them more vulnerable. As a consequence, these vulnerable people become more risk prone to the subsequent hazards. Thus, hazards coping strategies and access to safety become necessity for the people in the extreme hazard areas to reconstruct their 'normal life' process. However, unlike developed countries, traditional resilience or local coping mechanisms are mostly used in the developing countries to tackle hazards. Besides, innovation, communication channels, time and the social system greatly matters in tackling hazards. Importantly, in earlier times, people are used to cope with the inconsistency in autonomous ways, but now anticipatory and planned adaptation has become an urgent concern. Scholars suggest that adaptation needs to be location specific as

vulnerabilities are mostly local. To address this location specific vulnerability, the practice of soilless cultivation or hydroponics has become popular (under the agricultural adaptation techniques) as an alternative livelihood option for waterlogged farmers in Bangladesh. Floating cultivation does not need any additional water, nutrients, or chemical fertilizers and their beds can be recycled as organic fertilizer in the main field. Thus, floating cultivation is viewed as one of the least cost and environmental friendly technique for the poor people in the water logged areas. However, empirical literature tends to overlook the floating bed cultivation as an innovation and previous researchers did not analyze its relative advantage, complexity and compatibility in operations. Besides, there are few studies that investigated diffusion of an indigenous cultivation practice. Thus, a new study on the challenges in adopting floating bed cultivation especially in the context of Bangladesh is indeed essential to adding to knowledge of the phenomenon.

Chapter 3: The Profile of the Research Area

3.1 Introduction

This chapter presents the agricultural, demographic, physiographic, and socio-economic information of the study area. In addition, this chapter describes the activities of Government of Bangladesh Agriculture Department and the other NGOs working in Chandra village. The purpose of this chapter is to provide a perspective about the study area. The data presented in this chapter is collected from various published materials, national census and survey publications as well as from the interviews with local residents. Before presenting the agricultural, demographic, physiographic, and socio-economic information, this chapter intends to describe the research process. This description aims to provide a better understanding about the reason behind selecting the research site. Besides, the description of the research process wishes to give an idea about the current situation of floating bed cultivation in the southwest region and the condition of the study area within this context.

This chapter is organized into six sections. The first section describes the research process of site selection. Following the description of the research process, a

detailed description of the location of the research site is provided. The next section explores the agricultural practices in the study area following a description of agriculture in Bangladesh's economy so that the village of Chandra can be located within the rural sociological aspect of Bangladesh. The third section describes the demographic features (population, age structure, religious structure, literacy rate) of the study area. The fourth section presents the physiographic information of the study area. This section covers the topography, soil condition, climate, temperature, water supply, and toilet facility of the study area. The fifth section describes the socio-economic conditions (housing condition and occupational structure) of the study area. The last section explores the activities of the Government of Bangladesh Agriculture Department and NGOs in the study area.

3.2 Site selection and Fieldwork process

Mahoney and Goertz (2006) stated "qualitative researchers usually start their research by selecting cases where the outcome of interest occurs (these cases are often called "positive" cases). This practice is not surprising when we recall that their research goal is the explanation of particular outcomes" (p.230). This research is

primarily grounded in in a village called *Chandra* (*Chandra* village is located in Trimohini Union of Keshabpur Upazila under Jessore District of southwest coastal Bangladesh). In this regards, Douglas (1976: xii) stated "most of the social researchers really want to learn about what can be studied through the direct involvement of a researcher in the field" (as cited in Neuman, 1991: 345).

The interests about the research sites have been generated from unpublished MSc dissertation written by this researcher. During the previous research study, the researcher studied an extension initiative of introducing an adaptation technique by an NGO in the southwest part of Bangladesh. The research area had waterlogging problem. The extension initiative was conducted by WRDS (Wetland Resource Development Society), and the project was 'adaptation to waterlogged situation through the promotion of floating gardens'. ActionAid funded that project from 2007 to 2008. The original project was implemented in four unions of *Manirampur* and *Abhaynagar* Upazila of *Jessore* district: *Nehalpur*, *Hariduskaty*, *Chlisa* and *Shundoli*. The NGO arranged exhibitions for the extension of the floating cultivation there, but the area had not started this indigenous practice at full speed yet. The field trip for the

master's thesis was conducted for one month. And it was conducted during the dry season after the exhibition. The researcher was able to interview a few participants who practiced the floating bed cultivation.

For the first field trip of this current study, the researcher went to Bangladesh on 10th February 2010 and stayed there for one and half months. During that period, he visited the southwest part of Bangladesh to explore the consequences of the project. The empirical research started with interviews of some known specialists on floating cultivation. The initial point of contact with a specialist took place in Dhaka, the capital of Bangladesh. The researcher also visited ActionAid NGO office in Dhaka who had done work on floating cultivation.

In the next phase of empirical investigation, the researcher went to Khulna to collect data from the WRDS (Wetland Resource Development Society) office. During the process he discussed about the progress and consequences of the projects in southwest part of Bangladesh with Mr. A. H. M. Rezaul Haq (Executive Director, Wetland Resource Development Society). The expert informed that the projects had finished but new projects were going to be implemented in the new areas of the

southwest part of Bangladesh. While discussing about the prospect and consequences of the projects with Mr. Rezaul Haq, the researcher realized that the non-government organizations' initiatives were more focused on the promotion or introduction of floating bed cultivation in the project areas rather than with the sustainability of the projects.

In order to experience the 'what's actually going on in four project locations', the researcher visited all four areas of the project 'Adaptation to waterlogged situation through the promotion of floating gardens' in the southwest part of Bangladesh including the earlier research area such as Nehalpur, Hariduskaty, Chlisa, and Shundoli. The intention of that trip was to know the follow up of the project – how many farmers were continuing the practice. The researcher found that the local people were not practicing floating cultivation after the NGO sponsored project ended. Furthermore, as the trip was made during the dry season, the researcher was unable to observe the situation during the waterlogging season. But from the field observation and interviews, it was evident that the rate of adoption of floating bed

was not positive. However, due to lack of familiarity with this type of agriculture, the farmers had not accepted it wholeheartedly.

During this time, the researcher visited a new area where a new project was to start soon and the information about this new project was given by Mr. Rezaul Haq. He also provided some useful secondary data and contact details of some key persons, which eased the access to the new study area. The area where the new project began was in *Chandra* village in Kesobpur Upazilla under Jessore district. However, the researcher came to know that a few years earlier another project had been conducted in the area. That initiative was run from 2003 to 2005 under the project name of "Reducing Vulnerability of Climate Change" with the support of CIDA and CARE. The funding organization was Canadian International Development Agency. That earlier initiative in this area (by a different NGO) was successful for one year in helping some farmers to do floating cultivation but the trend did not continue after the end of the project. After the project completion period, local farmers did not practice the newly promoted floating cultivation, except in few exceptions. The people of this area had adopted floating cultivation once again from 2010 with monetary and

technical assistance of another NGO. The new initiative was actually taken under the program '*Shiree*' (Stimulating Household Improvements Resulting in Economic Empowerment). This program was developed and funded by DFID (Department for International Development). The project of 'Adapting Natural Resource Management to Climate Change and Increasing Salinity,' was coordinated by the local NGO '*Shushilan*'. The main project 'Adapting Natural Resource Management to Climate Change and Increasing Salinity' was initiated to help 1,000 households in Satkhira, Jessore and Barguna Districts to assist the extreme poor out of poverty by 2012. At this phase, the research interviewed local people as well as NGO personnel about their expectations about this project.

During the earlier field trip, the researcher was able to identify a few sites related to floating cultivation, but direct observation of the floating cultivation was not possible because the trip was conducted during the dry season. The next field trip was planned to observe a project during its' implementation time. A subsequent trip to Bangladesh was done in August 2010 to directly observe the floating cultivation project in Kesobpur (*Chandra* village, Trimohoni union). Besides observing the bed

making and maintaining, the researcher also had informal group discussion with the working farmers, in depth interviews with other farmers and NGO personnel.

The next trip was planned to visit some areas where floating cultivation had been practiced for long time. All the areas where floating cultivation is indigenous or has been practiced for longer time are in very remote areas and mostly affected by waterlogging problem. The transportation system to those areas was very bad and became worse during the rainy season. For that reason, thinking about the difficulties to visit the areas during the cultivation time, the researcher planned to make the trip earlier and during the dry season. The next field trip was conducted from 9th February 2011 and the researcher was in Bangladesh until 31th July 2011. This phase of research included a visit to *Najirpur-Pirojpur* belt where floating cultivation is indigenous. The researcher visited the *Najirpur* Thana (Pirojpur) mainly the Mugarjhor village and Kandi village of Boithakata Union.

Additional field trips were also done in *Gopalgang* Zilla. In *Gopalgang* Zilla the researcerh visited - 1. Kotalipara (Bagan Uttar para, Amtoli purbo para etc) and 2. Gopalgang (Satpar Union: Bhennabari, Jalil bari , Kadom Bari etc.). The Gopalgang

Zilla is one of the areas where floating cultivation has been practiced for a long but not on a commercial scale. Even though this cultivation practice is not unfamiliar to the area, some NGOs had chosen the area for floating cultivation project.

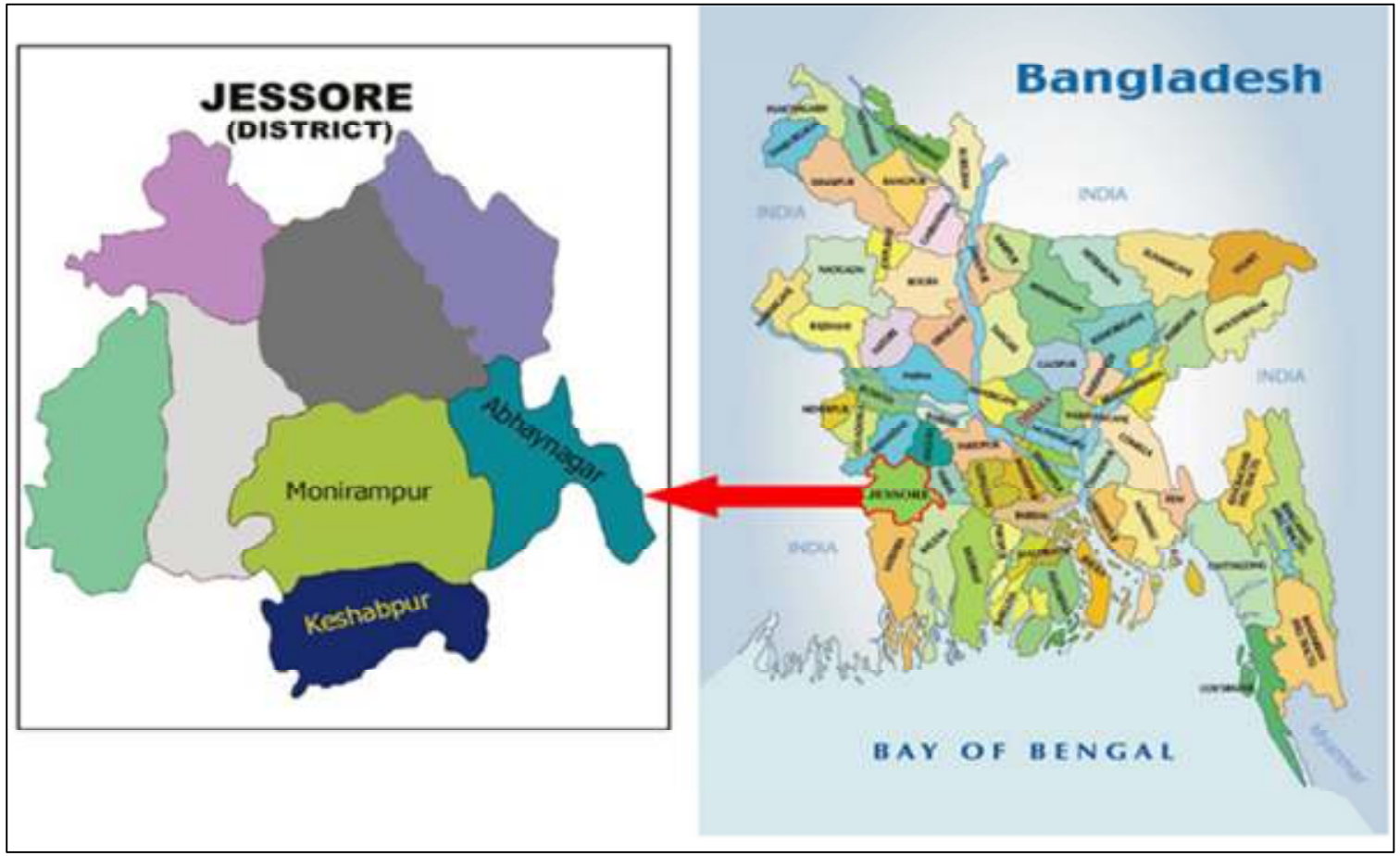
During this trip the researcher again went to the previously visited areas of southwest part of Bangladesh i.e. *Jessore* Zilla. In the Monirampur (Nehalpur), Abhaynagar (Sundoli, Hajirhat) of Jessore Zilla the researcher found that nobody was doing floating cultivation. Besides, the research also visited the *Singati* village of *Fokirhat* upazilla under *Bagerhat* district. In the case of Fokirhat Upazilla, the researcher came to know that a project on floating cultivation was conducted few years earlier but lately nobody was doing floating cultivation there. That initiative was taken under the Reducing Vulnerability to Climate Change (*RVCC*) Project. The *RVCC Project* was mainly managed by CARE Canada and implemented by CARE.

Finally, the researcher again visited the Kesobpur *upazilla,* (*Chandra* village, Trimohoni union) where an earlier initiative by an NGO was successful for one year in helping some farmers to do floating cultivation, but the trend did not continue after the end of the project. And, the people of this area adopted floating cultivation once

again from 2010 with monetary and technical assistance of another NGO, namely *Shushilan*. Then the researcher decided to explore this case (*Chandra* village) more in detail, considering the opportunity to observe a running project on floating bed cultivation in the south-west region where he will get the chance to observe the different phases of the project over time as well as interview respondents to know their perceptions during different phases. The researcher observed that the first year of this project was fruitful. But in the following years the researcher found less people working in the floating bed cultivation. The beds were less than in the starting year of the project.

The researcher traveled to the following sites (Monirampur, Keshobpur upazila of *Jessore* district) during his field trips in southwest region in order to identify the case, which is shown in the flowing image.

Figure 3.1 Location of Research Area in Bangladesh



Source: Newsnextbd, 2015 and SASNET, 2011

Based on the observation of all the sites from field trips, *Chandra* village was determined as the primary case.

3.3 Location of the Research Site

This study is located in the Southwest region of Bangladesh. The southwest region of Bangladesh covers Gopalgong, Barisal, Pirojpur, Jhalkhati, Bagherhat, Khulna and Jessore districts and some of the coastal areas as well (APEIS, 2004).

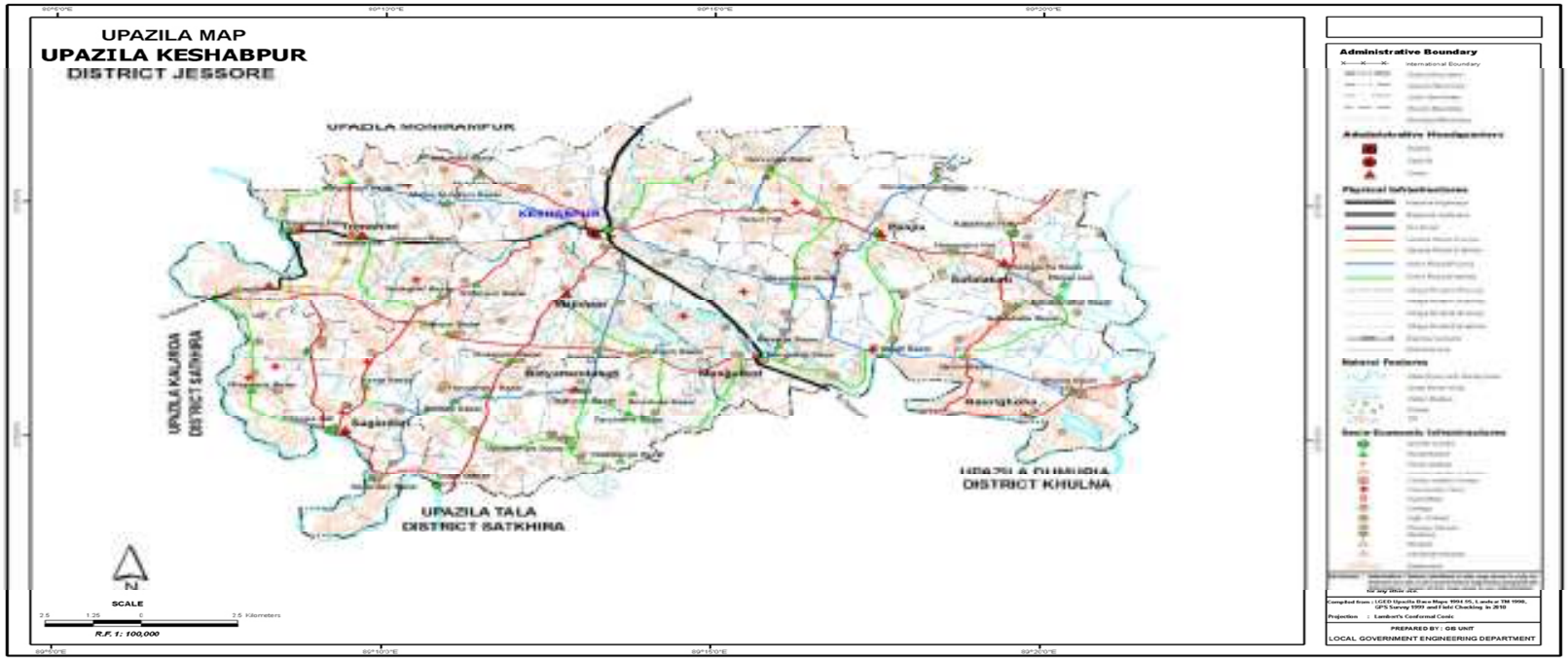
The study area of this research is in Jessore district. In the Jessore district there are eight (8) *upazilas* and those are- Abhaynagar, Bagherpara, Chaugachha, Jhikargachha, Keshabpur, Jessore Sadar, Manirampur and Sharsha. The current research solely focuses on a village named as *Chandra* (see Figure 3.1) under Trimohini union in Keshabpur upazila.

Figure 3.2 Map of Jessore District, Bangladesh

Source: LGED, 2015

Chandra is located between N 22°48′ to 22°57′ latitude and between E 89°07′ to 89°22′ longitude in the districts of Khulna and Jessore. The boundary of the study area is shown in Figure 3.2.

Figure 3.3 Map of Keshabpur Upazila, Jessore District



Source: LGED, 2015

3.4 Agricultural Practice of the Study Area

This section aims to explore the agriculture practices in the study area. Before describing the agricultural practice in the study area, this section highlights the overall agricultural practice in Bangladesh in order to explain both the broader as well as local perspectives of agricultural practices.

Bangladesh has an agricultural economy accounting for about 20 per cent of the GDP. About 60% of the people of Bangladesh depend on agriculture directly or indirectly for their livelihood (MoEF, 2008). This sector is providing employment to about 63 percent i.e. almost two-third of the 40 million strong labor force of the country (Baas & Ramasamy, 2008; Pender, 2008). The agriculture sector of Bangladesh is comprised of crops, livestock, fisheries, and forestry sub-sectors. But "the crop sub-sector, which accounts for about 73 percent of the agriculture and forestry sector GDP and about 14 percent of total GDP, still remains the single largest economic activity in the country" (Government of Bangladesh, 2005: 87). With a humid sub-tropical monsoon climate Bangladesh has three distinct crop seasons, *kharif* 1 (end of March to May), *kharif* 2 (May to September) and *rabi* season (mid-October to early March). Due to the local complexities of land type, soil type, fragmentation of land and

land tenure systems is an array of cropping patterns. However rice dominates the agriculture (Alauddin & Hossain, 2001). Rice occupies about 80 per cent of the cropped area and is grown in three seasons, two seasons (*aus* and *aman*) mainly under rain fed and flooded conditions in the *kharif* (wet) season, the other (*boro*) mainly with irrigation in the *rabi* (dry) season (Brammer, 1990: 13). According to estimates by the Bangladesh Government, "rice alone occupies three-fourths of the 14.3 million hectares of cropped area and contributes about two-thirds of the agriculture and forestry sector GDP" (Government of Bangladesh, 2005: 87). But due to population growth and increased urbanization, cultivated area is declining at a rate of 1 per cent per annum in Bangladesh (Government of Bangladesh, 2005: 95).

Ironically, crop production in Bangladesh is constrained by too much water during the wet season and too little water during the dry season (Rahman, et al., 2007: 42). As a consequence, crops like rice are rendered vulnerable to these mood swings of nature. The two main rice varieties in Bangladesh are facing extreme threat from climate change. High-yielding *aman* rice varieties are very easily destroyed by floods as they are unable to grow fast enough to keep up with the increasing flood water. On the other hand the dry season *boro* is more

vulnerable to moisture stress and arsenic. So, if the moisture stress and arsenic become more intense it may reduce the *boro* cultivation (Pender, 2008:33-34).

Due to waterlogging, a vast change has occurred in the agricultural sector of the southwest region of Bangladesh. Before 1990 most of the land of this southwest region was used for agricultural purpose. But after waterlogging became a widespread problem the average cultivable land decreased. Rice and other crops are susceptible to waterlogging and salinity. In the study area, almost all the households have been observed practicing mono cropping and the cropping intensity has decreased due to the prevailing waterlogging condition. This restricts accessibility to land and forces the farmers to mono cropping which is also reported by Datta (2005) during his study in *Beel Dakatia – Bhabadaha* region (*Jessore* zone of south-west part of Bangladesh). Before waterlogging assumed serious proportions, this area yielded three crops a year, rice, jute and sesame. Now the pattern has changed considerably.

The farmers are utilizing the *Kharif-1* season. They start sowing *Aus* and *Aman* either together or as a single crop in *Falgun/Chaitra* (end of February – March). *Aus* gives the harvest in *Arshin* (end of August and September) where the *Aman* is harvested in *Poush* (end of November and December). Then they could

sow the high yielding IRRI (International Rice Research Institute) strain. IRRI takes four months to complete the cycle. But now there is no chance to get three crops in a year. Recently, they are only doing IRRI by removing the extra water through pump if necessary. They start it in December. They call it Block IRRI as they block the cultivable land. The rest of the month they live by fishing or pulling van and any work that provides direct monetary return.

Table 3.1 Distribution of Cropping Pattern in the Study Area Before and After Waterlogging Situation (in a year)

Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Distribution of Cropping Pattern in the Study Area before Waterlogging											
Jute	*Aus*								Jute		
Sesame	*Aman*										Sesame
Distribution of Cropping Pattern in the Study Area after Waterlogging											
IRRI											*IRRI*

Source: Field Survey, 2013

The respondents report that the loss of natural fertility of soils in the agricultural field is the cause behind the lower production of crops in the study area. Thus agricultural practice like crop production is losing its importance in the

study area. As a consequence non-crop agricultural practices became important as a source of income in the study areas.

3.5 Demographic Features of the Study Area

3.5.1 Population of the Research Area

The total area of Chandra village is 570.27 acres. The village has a total number of 3,782 people with an average population density 6.63 persons per acre (BBS 2011). The total number of households is 924 in the year of 2011.

Table 3.2 Distribution of Population by Sex

Year	Total House holds	Population			
		Total	Male	Female	Ratio
2011	924	3,782	1,906	1,876	102
2001	733	3,498	1,796	1,702	105

Source: BBS, 2011 and BBS, 2001

3.5.2 Age Structure of the Research Area

Based on Population census 2011, the major age group of the population of Chandra is 22-29 and 04-09 years (27.7% and 12.8% respectively). The age distribution of the people of the study is shown in Table 3.2.

Table 3.3 Distribution of Population by age

Age Group	0-4	0-4	4-9	15-19	20-24	25-29	30-49	50-59	60-64	65+	Total
No. of Population	337	431	484	299	337	310	1048	238	95	204	3782
Percentage	8.9%	11.4%	12.8%	7.9%	8.9%	8.2%	27.7%	6.3%	2.5%	5.4%	100%

Sources: Bangladesh Population Census, 2011

3.5.3 Religious Structure of the Research Area

In the study area (*Chandra*) the majority are Muslims (93.60% of the total population of the union). There are a small number of Hindus (6.40%) who live in the village. Religious status of the people has been shown in Table 3.3

Table 3.4 Distribution by Religious People in Research Areas

Religious	Muslim	Hindu	Total
Number	3,540	242	3,782
Percentage	93.60%	6.40%	100.00%

Sources: Bangladesh Population Census, 2011

3.5.4 Literacy Rate

In the study area (*Chandra*) the total literate people is 59.2% of the total population of the village. In comparison to the other villages *Chandra* has a lower literacy rate. Of them 62.6% are males and 55.8% females. Table 3.4 shows the literacy rate of Chandra.

Table 3.5 Distribution of Literacy by Sex of Population in Research Area

Literate (Can write a letter)						Literacy Rate (%)		
Both		Male		Female		Both	Male	Female
Yes	No	Yes	No	Yes	No			
1,936	1,336	1,021	611	915	725	59.2	62.6	55.8

Sources: Bangladesh Population Census 2011

3.6 Physiography of Chandra Village

3.6.1 Topography of Research Area

The land of the study area is defined as medium high land. More or less uniform physiographic characteristics prevail in the union. The land is formed by the deposition of alluvial soil from regular flooding.

3.6.2 Soil Condition of Research Area

The type of soil of the study area is grey in color. Firm and calcarious type sediment prevail all over the area. Chandra mostly depends on the rivers *Rupsha* and *Bhariab*. These rivers increase the soil fertility of the study area.

3.6.3 Climate of Research Area

There is no climatological station in the study area. The nearest station is in Jessore Sadar (town). The study area is near the coastal region and under the southwest climate sub-zone of Bangladesh (Datta, 2005). The meteorological characteristics of this study area show hot summer and fairly heavy rainfall. March to May is mainly the summer with some sudden rainy days during occasional storms of '*Kalbaishkhi*'. However, the moist monsoon wind during April to October brings heavy rains. In particular, June to September is the rainy season with high humidity and heavy rainfall. And, the weather in October to

November is almost dry with some wet and stormy days followed by the dry winter period from December to February.

3.6.4 Temperature of Research Area

The temperature in the study area varies seasonally. The maximum temperature of the study area is 25° C to 40° C in summer season. During the hottest months in April and May, the temperature may exceed 40°C. The average winter temperature varies from a minimum of 10°C to a maximum of 19°C. The normal temperature of the study area is suitable for crop cultivation or residential development.

3.6.5 Water Supply of Research Area

Chandra is a remote village in Trimohini union and water is an important resource which is used for different purposes. There is no water supply system provided by the local government in Chandra. The main sources for drinking water in Chandra are electric pumps, and tube-wells. They also use pond and river water for different purposes.

Table 3.6 Sources of Drinking water

Year	Total House holds	Water Sources (%)		
		Electric Pumps	Tube-Wells	Others
2011	924	0	99.1	0.9
2001	733	0	94.9	5.1

Sources: Bangladesh Population Census, 2011 and Bangladesh Population Census, 2001)

Table 3.5 shows that in 2001 a total 94.9% households used tube-wells for drinking water and 5.1% households used other sources including ponds, river etc. In 2011 the scene is changed a little bit. Now almost every household 99.1% used tube-wells for drinking water. Although their livelihood changed positively but still 0.9% households used other sources for their drinking water.

3.6.6 Toilet Facility of Research Area

In the study area (Chandra) the condition of toilet facility is relatively moderate, more than 50% households had sanitary toilet facility. Among them 34.6% have sanitary toilet with water sealed and other 17.9% have sanitary toilet facility without water sealed. 41.8 % of total households do not have any sanitary toilet and 5.7 households have no toilet facilities. Toilet facilities of the people of Chandra have been shown in Table 3.6.

Table 3.7 Distribution of Toilet Facility

No. of Household	Toilet Facility (%)			
	Sanitary (water-sealed)	Sanitary (non water-sealed)	Non-sanitary	None
920	34.6	17.9	41.8	5.7

Sources: Bangladesh Population Census, 2011

3.7 Socio Economic Conditions of Research Site

3.7.1 Housing Conditions

In the study area (Chandra) there are four types of housing structure available: Pucka, Semi-Pucka, Kutcha, and Jhupri. Most of the households are Semi-Pucka and Kutcha. Pucka house is one which has walls and roof made by burnt bricks, stones, cement, concrete, timber, ekra etc. and semi-pucka is one which has walls made like pucka house but the roofs are made of wood and GI sheet. Kutcha house is made of timber and bamboo while Jhupri is made by other than materials mentioned above. According to Population Census 2011, there are 5.7 % Pucka houses, 43.6% semi-pucka, Kutcha is 47.5% and *Jupri* is 3.2%. Housing conditions of the study area areshown in Table 3.7

Table 3.8 Distribution of Housing in Research Area

Types	Pucka	Semi-Pucka	Kutcha	Jhupri	Total
Number	52	401	437	29	920
Percentage	5.7	43.6	47.5	3.2	100

Sources: Bangladesh Population Census, 2011

3.7.2 Occupational Structure

In the study area (Chandra) majority of the people are engaged in agriculture (80.06% of the total working people). Among them 74.23% are male and 5.83% are female. 19.94% of the people are engaged in service industry: among them 19.63% are males and 0.31% are females. In the industrial sectors the contribution is zero. None in industry. Table 3.8 shows the occupational structure of the people of the study area.

Table 3.9 Distribution of Occupational Structure

Category	Population aged 7+, not attending school and employed			Field of Activity					
				Agriculture		Industry		Service	
Sex	Both	Male	Female	Male	Female	Male	Female	Male	Female
Number	326	306	20	242	19	0	0	64	1
Percentage	100.00%	93.87%	6.13%	74.23%	5.83%	0.00%	0.00%	19.63%	0.31%

Sources: Bangladesh Population Census, 2011

3.8 Department of Agricultural Extension

Each union has one government agriculture office and a deputy assistant agriculture officer in-charge of that office. From the union based office, they extend their support to the village level. The agricultural department organizes exhibition plots in the field of progressive farmers in order to transfer advanced agricultural technology. The department also organizes farmers' field days and

farmer rallies based on the need of the local situation. In addition, the agriculture extension officers communicate with the local farmers to convey information about all types of agricultural technology. Besides, the officers also collect feedback from the farmers to inform the research institutions and the higher authorities for solutions. The agricultural department also provides practical training to the farmers about advanced agriculture technology. It supports the farmers to produce quality seeds, as well as assists in marketing farm products. Besides, the agriculture department provides compensate for the loss of agricultural materials due to floods, droughts and other natural disasters (Bangladesh National Portal, 2015).

3.9 Non-Governmental Organizations in the Study Area

The non-governmental organizations that are working in the Chandra village, mainly provide financial assistance to the local people. They are operating a variety of loan programs such as loan for education, health, and livelihood. The prominent NGOs working in the Chandra village are – *Asha*, Grameen Bank, CCDA (Center for Community Development Assistance), *Samadhan*, and *Shushilan*. The national or international NGOs mostly work with the local NGOs

to coordinate their project. Along with the micro-credit programs, the local NGOs worked on how to overcome livelihood difficulties during waterlogging period. Previous literature reports that the local NGO *Samadhan* worked with the CARE and WRDS to promote floating bed cultivation for improving the livelihood and food security of the village (Haq et al., 2004). *Samadhan* also worked for one of the government programs (Reducing Livelihood Risk Project). In that project, *Samadhan* trained local people on raising the ground level of homestead to prevent water intrusion into houses. They also provided support for tree plantation, fish cultivation, vegetable gardening, duck rearing etc. in the study area (Adri & Islam, 2012). Another NGO named *Shushilan* worked with the DFID (Department for International Development) supported project, particularly focusing on promoting initiatives to improve the economic empowerment of the households through adapting to climate change and increasing salinity. In relation to the economic empowerment, floating bed cultivation was one of the components of that project. In order to attain the project objective, *Shushilan* coordinated that project along with providing both technical and financial assistance to the poor farmers so that they can practice floating bed cultivation.

3.10 Summary

The existing profile of the Chandra village shows that agriculture is the main occupation of this area. However, the agricultural cropping patterns are changing due to the waterlogging problem. The governmental initiatives in the agriculture section are mainly focused on land based farming improvement. In parallel, different NGOs promote floating bed cultivation for the waterlogged affected marginal farmers. The next chapter describes the research approach, techniques and tools used for data collection of this study. It is followed by discussion on the floating bed cultivation of the study area in chapters 5 and 6.

Chapter 4: Methodology of Research

4.1 Introduction

The previous chapters discussed the background information and relevant literature related with diffusion of innovation, and challenges of access to resources for adoption of indigenous cultivation. This chapter illustrates the tool and techniques applied to undertake this research along with conceptualizing the research problem. This research is primarily framed with qualitative research design framework. This is an important consideration as designs for conducting both qualitative and quantitative studies on the topic vary considerably. Researchers might find some prescribed designs for conducting quantitative studies including survey research, experimental, and quasi-experimental studies (Schwandt, 2007: 265). In contrast, qualitative research requires a broader and less restrictive design, but that does not mean that researchers conduct qualitative studies without meticulous thinking (Maxwell, 2009: 215). Rather than pre-defining the issues likely to be important to landless poor households, qualitative research approaches allow respondents to identify those issues which are salient for them and to explain how these impact on their daily lives (Barbour,

2008:12). Although conventional measures of reliability are more closely associated with quantitative research than they are with qualitative research, thorough, careful, honest and accurate data generation and analysis in response to the research question can ensure and demonstrate reliability of qualitative research to others (Mason, 2002: 188). Based on an understanding of the above challenges, a qualitative research design has been adopted to address the research problem as well as to guide fieldwork as it provides a detailed understanding of the issues that can be established by talking directly with people, going to their homes or places of work, and allowing them to tell the stories (Creswell, 2007: 40).

This research was conducted through a case study approach in order to explore underlying challenges of floating bed cultivation as part of agricultural diffusion of innovation in waterlogged areas of southwest coastal Bangladesh. Simons (2009: 21) defines case study research as “an in-depth exploration from multiple perspectives of the complexity and uniqueness of a particular project, policy, institution, programme or system in a 'real life' context. It is research-based, inclusive of different methods and is evidence-led”. Many researchers have adopted case study approach in many ways to understand the degree to which certain phenomena are present in a given group (Flyberrg, 2006).

The reason for undertaking case study approach in contrast to other qualitative approaches such as narrative, ethnographic, and grounded theory is because it can provide a complex understanding of underlying challenges of diffusion innovation related to floating bed cultivation in waterlogged areas. It offers an in-depth exploration from multiple perspectives of the complexity and uniqueness of diffusion of innovation in relation to agricultural adoption programs with empirical investigation (what people receive from floating bed cultivation; how people perceive floating bed cultivation as part of diffusion of innovation) among poor farmers' (Simons 2009: 21). This study seeks to understand the challenges of delivering agricultural adoption programs as well as their diffusion among poor farmers in waterlogged areas. Considering the complexities in agricultural adoption programs implemented by government and non-government organizations and the underlying challenges of consequences of diffusion of an innovation in waterlogged areas, this research adopts case study research strategy because its primary purpose is to generate in-depth understanding of a specific topic or issue (Thomas, 2011). In this regard, Rogers (2003) also mentions that "extended observation over time, or in-depth case study, are usually used to study consequences" of diffusion of an innovation (p. 440).

Case study approach provides the opportunity to examine the ways in which poor farmers understand the floating bed cultivation and how it affects the overall diffusion of innovation process in waterlogged areas. By gathering rich and detailed data about floating bed cultivation with case study approach, it would be possible to explore the underlying challenges.

4.2 Research Paradigm: Social Constructivism

The elements of inquiry that are needed in the process of designing research (Creswell, 2003) are: "What knowledge claims are being made by the researcher", "what strategies of inquiry will inform the procedures" and "what methods or data collection and analysis will be used" (p. 5). About the 'knowledge claims', which might be called 'paradigms', Creswell (2003) means "researchers start a project with certain assumptions about how they will learn and what they will learn during their inquiry" (p. 6). For this dissertation, the researcher views 'knowledge' from the 'Relativist' perspective. He believes that "knowledge is a social reality, value-laden and it only comes to light through individual interpretation". The broad philosophical idea that has driven this research is 'social constructivism' as it constructs knowledge based on the

understanding of what is happening in the society giving emphasis to the culture and context of the society (Derry, 1999, McMahon, 1997 as cited in Kim, 2001). The researcher's assumption for this current research is that "individuals seek understanding of the world in which they live and work". He believes individuals (farmers) develop subjective meanings about the floating bed cultivation from their experiences. And, these meanings are varied and multiple, which will lead the researcher to look for the complexity of views (Creswell, 2003, p. 8). The goal of this research followed the view of Creswell (2003) about 'social constructivism' that is to "rely as much as possible on the participants' views of the situation being studied" and to "make the questions broad and general so that the participants can construct the meaning or a situation, a meaning typically forged in discussions or interactions with other persons" (Creswell, 2003: 8). The 'social constructivism' perspective also suggests "more open-ended questioning" and the researcher to "listen carefully to what people say or do in their life setting", because "often these subjective meanings are negotiated socially and historically" (Creswell, 2003: 8). And finally, this research intends to make sense of (or interpret) the meanings others have about floating bed cultivation, and tries to generate patterns and develop themes (Creswell, 2003: 9).

4.3 Research Approach

As mentioned in the introduction, the empirical inquiry of this research follows a 'Case Study' design as a research strategy to "investigate contemporary phenomenon in depth and within its real-life context", because "the boundaries between phenomenon and context are not clearly evident" for this current research (Yin, 2009: 18). According to Stake (1995), "the researcher explores in depth a program, an event, an activity, a process, or one or more individuals. The case(s) are bounded by time and activity, and researchers collect detailed information using a variety of data collection procedures over a sustained period of time" (Creswell, 2003: 15).

Regarding the selection between qualitative and quantitative data, Yin (2003) argues that case study can include both qualitative and quantitative evidence. About the choice between qualitative or quantitative approach, Yin (2009) stated that, "any contrast between quantitative and qualitative evidence does not distinguish the various research methods" (p. 19). This research chose to use qualitative evidence for writing this dissertation, as the research found it difficult to manage reliable information about the population of the research area as well as the actual number of people practicing floating bed cultivation.

Different researchers also suggested about qualitative methodology for doing researches in developing countries. In this regard Chand (2008) mentioned that, "a qualitative methodology may be the method of choice in developing countries because secondary data required for random sampling may not be available and the respondents may not be familiar with surveys or questionnaires" (Elder, 1973, Harari & Beaty, 1990 as cited in Chand, 2008: 3).

Considering the debate, whether researchers should start qualitative study from "theory and their own a-priori ideas, or do these categories and analytical concepts emerge from the data", this research adopts a hybrid approach including both the deductive and inductive approach to avoid the debate (Mills et al., 2009; Fereday, & Muir-Cochrane, 2008). In this regard, Mills et al., (2009) argue in their edited book "*Encyclopedia of case study research"* that "it is best to perceive data analysis as an enterprise that is never entirely inductive or deductive in nature but rather a combination of both. The need to organize in a systematic way the unstructured raw data or various kinds of data calls for a combination of structure (built by theoretical notions and frameworks constructed in a deductive way) with flexibility (exploring the data with an open mind, i.e., induction)" (p.

751). Thus, a hybrid approach incorporating deductive and inductive approaches seems suitable for the overall framing of research.

4.4 Conceptual Framework

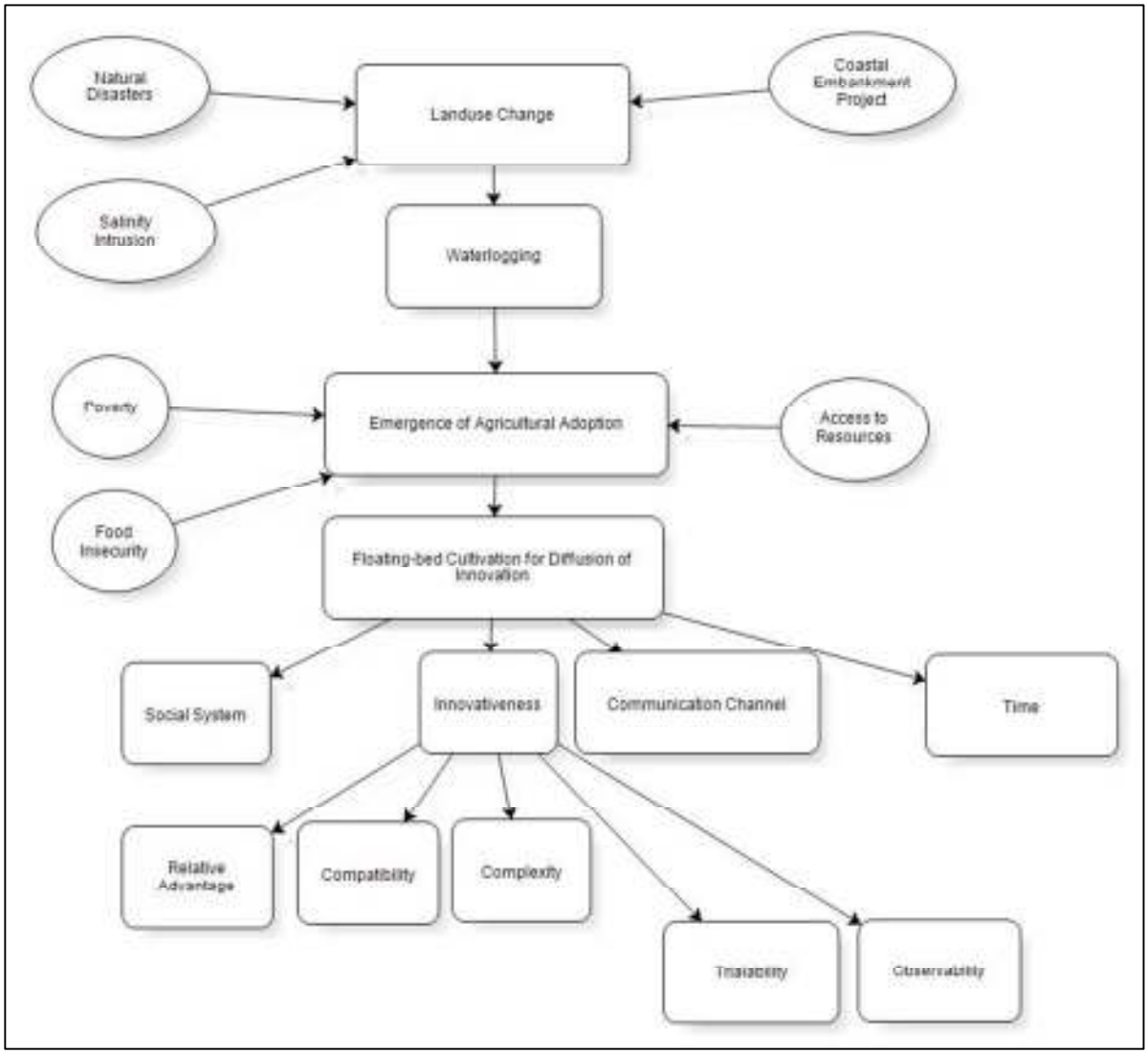
Hazards are able to create adverse situations, disrupt normal life of the local people, and if the intensity of the hazards is huge, then it turns into disaster, which has both short-term and long-term agricultural losses in terms of agricultural production and consumption. In a coastal area, saltwater intrusion tends to have adverse impact on agricultural practice, which can be further intensified by extreme natural events like flood or cyclone. In order to prevent saltwater intrusion as well as to maintain smooth flow of water for agriculture, a coastal embankment project (CEP) was initiated by the East Pakistan Water and Power Development Authority (EPWAPDA) in the 1960s. At the beginning, the coastal embankments showed positive results for increased agricultural production as well as prevent salinity intrusion in southwest coastal areas of Bangladesh. Gradually, as the riverbed rose from silt deposits, the embankments became a problem by creating waterlogging either temporarily to permanently.

Waterlogging and land use change disrupted the traditional agricultural practice. This adverse situation drew the attention of different governmental and non-governmental organizations. Different institutions tried to help the local people through different programs or project initiatives. Floating bed cultivation came to this area as part of coping or alternative livelihood practice through the initiatives of different NGOs.

Since the floating bed cultivation is a new cultivation practice (innovation) being introduced (diffused) by non-governmental organizations (client agent), the rate of adoption can be explored with the help of diffusion of innovation theory developed by Professor Everett M. Rogers. According to his theory, diffusion of innovation has four main elements such as innovation, communication channels, time, and the social system. He claimed that these four elements have influences on the rate of adoption. This research particularly focuses on the attributes of innovation of floating bed cultivation (an innovation) to explore the challenges of the adoption of the practice. The innovativeness of an innovation comprises of five attributes such as relative advantage, compatibility, complexity, trialability and observeability that influence the rate of adoption (from 49 to 87 percent) of an innovation (Rogers, 2003). This research assumes

that these five attributes clearly influence the adoption of floating bed cultivation among poor farmers in waterlogged areas in southwest coastal Bangladesh. Therefore, a comprehensive understanding of those five attributes of diffusion of innovativeness can illustrate the underlying challenges of adoption of floating bed cultivation practice in waterlogged areas in southwest coastal Bangladesh.

Figure 4.1 Conceptual Framework of the Research



Source: Author generated, 2014

4.5 Data collection Methods

As fieldwork continued in *Chandra* village, the researcher came to know many interesting dimensions of floating cultivation and the underlying challenges of diffusion of innovation for indigenous agricultural adoption in waterlogged areas. Throughout the fieldwork, the researcher tried to explore the respondents' feelings, perceptions, and understanding of floating cultivation in waterlogged situation. At the beginning, their stories did not seem meaningful as the experiences of different participants were very vast and diverse. Gradually, the researcher realized that their stories were diverse than the existing literature relating to floating cultivation. Surprisingly, the voices of participants about knowledge of floating cultivation in waterlogged situation seemed to be absent in the various reports of diffusion of floating bed cultivation. Therefore, an open-minded approach was adopted to collect data from research sites.

The data was primarily collected by undertaking interviews with five groups related with floating cultivation as well as diffusion of innovation for agricultural adoption in waterlogged areas. The five groups of people included poor farmers of ongoing projects, poor farmers from previous projects, poor farmers without experience of floating cultivation, agricultural landowners, and

experts and organizers of projects related to floating cultivation. Most of the interviews were between 30 minutes to more than an hour in length. All the interviews were conducted in Bengali and the interviews were digitally recorded with the consent of the respondents. Besides, the researcher took field notes, made observations as well as photos of the areas. In order to collect primary data from these five groups, firstly rapport was built by providing enough background information to research participants in order to get reliable and comprehensive information about the context and related issues of floating cultivation.

4.5.1 Rapport and trust building

The researcher intended to conduct interviews in order to produce more meaningful scenarios of the underlying challenges of floating cultivation in waterlogged areas in southwest coastal Bangladesh. The respondents were happy to talk about their experiences, but the researcher first had to develop rapport with them to gain their trust. The rural people of Bangladesh are very simple. While giving an interview to a stranger or outsider they fall into confusion in the beginning. In few cases, local people thought of the researcher as a journalist while in other cases he was identified as a representative of some donor organization or from government. The researcher had to convince the respondents

that he is a student doing research about their area. As a part of that explanation a brief description of the research project was given to each research participant both in written and verbal form well in advance so that they were able to share any confusion with the researcher. The researcher had to gain the trust of the local people otherwise they would not have shared their real situation. In addition, the researcher noticed in few cases that the respondents (mostly farmers who are working in the project) seemed to be uncomfortable while providing information during the interview in front of the NGO personnel. To avoid such kind of situation, the researcher conducted the interviews separately, even sometimes without informing the NGO personnel.

4.5.2 Role of the Investigator during Data Collection

During the field research and interviewing, the researcher first started with an informal conversation with the respondents and then introduced himself as a student. Then the researcher explained the purpose of the study. Usually, during the field trips, the researcher offered the respondents a cup of tea, or refreshments to make the conversation longer but before that respondents were asked about their time limitation and convenience. The in-depth interviews with the respondents were about their personal, occupational background, household

composition, and type and size of their farmland. Then the discussion would turn to the main topics of interest. During the interviews sometimes the researcher did not try to change the interview questions in any significant way. Sometimes the participants talked more about some topics than others but the researcher did not interrupt them as it allowed for deeper reflection by some respondents of issues that attracted them.

4.5.3 Interviews

Empirical data had been collected from the farmers, local administrators, extension personnel, specialists on indigenous farming and also from the organizations working for the extension of floating cultivation during field visits through both in-depth and group interviews.

Open-ended questions were used to gather stakeholders' opinions as well as a more detailed account of facts (Yin, 2003). In case study method 'open-ended nature' of questions allow the respondents to give the facts of a matter as well as their opinions about events (Yin, 2003). Yin's suggests that in 'open-ended nature' of questions "the researcher may even ask the respondent to propose his or her own insights about certain occurrences and may use such propositions as the basis

for further inquiry. The respondent also can suggest other persons for the researcher to interview, as well as other sources of evidence (Yin, 2003: 90).

The researcher had long conversations with respondents about the topics of their interest. This research followed the approach of Paul Polak (2008) for conducting long conversations that he used to know about the poverty situation of poor farmers. He stated that, "I learned quickly that the best way to satisfy my curiosity about poverty is to have long conversations with poor people in the places where they live and work and dream, and to listen to what they have to say" (p. 40). Another positive side of having long conversations is that sometimes the respondent also brings out a few interesting leads which has enriched the research as well as given new perspectives.

In addition to in-depth long conversation with a particular respondent, the research also conducted informal group discussions. The informal group discussion with farmers who were working in a project took place just after their work had finished in bed preparation or maintenance. The researcher was lucky to get a group of farmers together to have conversation about their experience of doing floating cultivation and their impressions about this technique. Furthermore, the researcher also had group discussions with farmers who were not practicing

floating cultivation as well as with local people. The research found this informal group discussion effective because during the discussions people could add information or ideas while others were giving interviews to complete or expand the statements. Besides, respondents could correct someone if he or she is going in a different direction or missing something while informing about the past from their memories. Group discussions allowed for a lot of information to be collected within a very short time.

Audio recording device was used during the interviews for improving the validity and reliability of data collection and analysis. All the information were recorded on Compact Memory card to ensure data safety and compact data storage. In every situation, the audio-recording device was placed visibly. Both note taking and audio recordings were used during interviews and group discussions to establish greater trustworthiness, and conformability in interpretation (Denzin & Lincoln 2005: 24). The audio-recording device (Sony IC Recorder ICD-SX 78) was always placed visibly during the interviews, in particular in front of the interviewee.

Aliases and pseudonyms were used during data transcription and data analysis to protect the identities of the landless poor household heads. Landless

poor household heads were coded with typical Bangladeshi names, such as Aklima Begum for female and Md. Abdul Rahim for male. No personal information of the landless poor household heads were identified in the published research documents. The experts' identities were published after collecting their informed verbal consent.

4.5.4 Sampling Technique for Data Collection

This research has used purposeful sampling strategy to select specific cases that best met the purpose of the study. Here, by sampling the researcher refers to the initial selection of the case and within case sampling in terms of informants (Mills et al., 2009: 837). For case study research, Michael Quinn Patton recommended that the selection of cases should be done purposefully. Furthermore, according to the *Encyclopedia of Case Study Research* - "in case study research, whether a single case is studied or multiple cases are studied, case selection will generally not use sampling procedures derived from quantitative analysis but will instead use a form of purposive sampling" (Mills et al., 2009: 761). Regarding the purposeful sampling strategy, Michael Quinn Patton mentioned about 16 forms of purposeful sampling that are mostly being used in case study research (Mills et al., 2009: 761). More specifically, among the

different forms of purposeful sampling strategies, this research has used the snowballing strategy to identify the informants. In the research areas where NGOs were working to promote floating bed cultivation, most farmers who were getting training were the extreme poor and landless. It was not easy to locate them, as floating cultivation is not the primary and only job they do. For that reason, the researcher had to use snowball method to identify the stakeholders related to floating bed cultivation.

Rogers (2003) mentions that, "the usual survey research methods are less appropriate for investigation of innovation consequences" (p. 440). Furthermore, it was difficult to find out secondary data for random sampling. The researcher was unable to access the government or non-governmental statistics about how many areas were practicing floating cultivation or how many farmers were engaged in this practice.

As mentioned earlier, the researcher used snowball-sampling procedure to find out the respondents. All together 27 research participants were selected, considering on an average of 5 participants from each classified group. The five groups of people included poor farmers of ongoing projects, poor farmers from previous projects, poor farmers without experience of floating cultivation,

agricultural landowners, and experts and organizers of projects related with floating cultivation. The researcher not only interviewed the higher level personnel or the officer in charge of a particular program, but also people from different sectors as well as outsiders to get more reliable information to avoid the hierarchy of credibility. The researcher looked for other opinions from people elsewhere of that organization or from outside. This research also searched for conflict and discontent in the program.

In the beginning, the research identified working NGOs through literature review. Then researcher collected the contact addresses from the articles or from the websites of those NGOs. Initially, the researcher decided to visit one of the prominent NGOs working with floating bed cultivation --- WRDS (Wetland Resource Development Society) office. There the researcher met Mr. A. H. M. Rezaul Haq who is a fellow of Ashoka Innovator for Public (USA) and Executive Director of Wetland Resource Development Society. As Mr. Haq has done research and projects on wetlands of Bangladesh, he helped the researcher in providing some useful secondary data and contact details of some key persons, which eased the access to the study areas as well as finding out the local organizer.

Based on the information given by Mr. Haq the researcher was able to meet two of the local organizers (opinion leaders) of *Nehalpur* and *Shundoli* unions. One of them was a high school master and another was a local chairman. The study was then able to find out other farmers who practiced floating bed cultivation. But the researcher did not rely only on the information given by the persons related to the floating bed cultivation. Local people were also asked to randomly identify farmers who had experienced floating bed cultivation. In general, most of the farmers were identified asking for information from the previous respondents or from asking local people randomly.

However, while reviewing the literature and project reports, interviewing the personnel related to the floating bed projects or working for the extension of this cultivation practice and even the farmers practicing this, the question of - why others are not adopting floating bed if it is really a very economic and environment friendly practice – was raised. The researcher then thought of asking other farmers (rival explanation) who were observing it but not adopting it. One of the respondents said, "*If it is really a very good practice, then why it is not sustainable*." Then the researcher started from a different premise. The researcher planned on interviewing a few farmers who were working on normal fields. These

farmers were not the owners of those lands they were working on. They were working as a day labor. The question of - what situations and processes led farmers or people to change their minds about this cultivation practice? And, why the others were not adopting this practice? The researcher thought of collecting rival explanations as they "increase the credibility of the research findings" (Mills et al., 2009: 833).

4.5.5 Reflective note taking for contextual information

Since case studies "take place in the natural setting of the case", the researcher gets the opportunity for direct observation (Yin, 2009, p. 109). While doing the field research, the researcher was able to observe the physical condition of the research area. Direct observation in the field, helped the researcher to realize how the situation of the areas or the local poor people would be during any extreme natural event (flood). The condition of the roads (made of mud) gave the researcher the idea about the underdevelopment of the areas. Since the researcher visited the research areas in two different seasons (dry and wet) the researcher got the opportunity to observe the difference. In addition, through direct observation over different years and different seasons in the field, the researcher was able to see the change in land use pattern of the waterlogged areas – how different

stakeholders were using the same land in different ways. Besides, the researcher also got the idea about the social status or economic condition of that household or the person by noticing the clothes and house structures while doing the interviews.

As the researcher was able to observe the floating bed cultivation during the project time, the hardship of this cultivation for a person (who does not have a boat) to go to the bed by swimming long distance in the river and to stay in the water for a while to collect the vegetable or for maintenance of the bed was recognized. Besides, by visiting the areas where floating cultivation is indigenous, the researcher was able to observe the geographical difference and structure of the rivers of those areas than the south-west part of Bangladesh where floating cultivation is being practiced on a project basis.

4.5.6 Documentation

This research tried to study all possible data sources like the farmers who were practicing to look for the causes of adoption. Additionally, field research publications and technical reports had been collected from the relevant organizations to identify successful, unsuccessful and recently initiated projects to understand the reasons behind successes and failures in each of the cases.

This research adopted the practice of Becker (1998) for documenting the published materials because according to him "the trick for dealing with the hierarchy of credibility is simple enough: doubt everything anyone in power tells you. Institutions always put their best foot forward in public. The people who run them, being responsible for their activities and reputations, always lie a little bit, smoothing over rough spots, hiding troubles, denying the existence of problems" (p. 129).

4.6 Challenges Faced during the Field Trips

Challenges are the unavoidable part of any field research. This research also faced challenges during the field trips. After going to Bangladesh and talking with the specialists, the researcher found difficulties in accessing study areas as planned before. Therefore, he had to adjust the plan due to time, accommodation, and financial constraints. The main challenge during the field trips was to access the research areas. All the areas - where farmers were practicing floating cultivation for a long time or the areas where farmers have started recently under projects – were located in very remote places. The transportation facilities were very poor and it was not possible to arrive at research sites by public transport.

The only vehicle convenient for transportation to those areas was a motorbike. But the researcher did not know how to drive a motorbike, so he needed to find someone who could help him to go to the research areas. That was also not easy as this kind of facilities to hire motorbike with a driver to go long distances is not available in Bangladesh. The researcher was lucky to get the assistance from one of his friends who took him to all the research areas using his own motorbike. However, the trips to the research areas during the rainy season (cultivation time) was very difficult as the roads to those areas were not made of concrete and they became muddy and slippery. It was risky and quite impossible to go to those areas during rainy seasons by motorbike. One day the researcher got stuck half way to the destination as the rain started suddenly. Then they had to return on foot.

Besides, there were no residential facilities in the research areas. The researcher needed to travel to research areas from his hometown (Khulna District). It was necessary to start the journey very early in the morning to reach the project areas, finishing the interviews and returning back before dusk. Security in such areas was also of concern. But during their trip to the floating cultivation areas, the researcher could not make it in one day as the distance to that area is very far

from the researcher's hometown. They had to find shelter (in a government rest house) half way to complete the tour.

4.7 Data Analysis

During the fieldwork, simultaneous data collection and data analysis techniques have been applied as it offers many important opportunities to researchers that can be taken only at the time of data collection (Ezzy 2002:61). In addition, leaving the collected data to the end of data collection process can lead to some significant problems during data analysis (Ezzy 2002:61). Therefore, as suggested by Miles and Huberman (1994:12), the data analysis was undertaken in parallel form with collection along with the three concurrent flows of activity such as data reduction, data display, and conclusion drawing/verification. A "Substantive case report" format has been adopted which exemplified the problem, a through description of the setting and the processes, and a discussion of important themes (Stake 1995; Lincoln and Guba 1985). As this research has adopted a case study approach which offers a detailed description of the case and its setting (Creswell 2007:163), the preliminary design of data analysis techniques, in particular narrative analysis technique has been incorporated while collecting

the data from research site. The specific reason for undertaking narrative analysis is because it offers the opportunity to analyze information without short and directed questions that cut off the interviewee (Ezzy 2002: 61). Another key issue for choosing narrative analysis is to identify contextual materials as well as to interpret the larger meaning of the story by using the categorical aggregation to establish themes or patterns from empirical data (Creswell 2007: 156). However, Yin (2009) has pointed out five analytical techniques such as pattern matching, explanation building, time-series analysis, logic models, and cross-case synthesis as related to case study research. The initial data analysis was undertaken through constant comparative method in order to draw the storyboard, and later to generate themes using the narrative stories of the participants (Creswell 2007: 156; Thomas 2011: 172).

During the data analysis, both literature and research questions have been used to explore the important themes from empirical data. As part of that the collected data during the fieldwork through audio recordings have been translated and transcribed in order to identify the major themes of each interview. A preliminary coding or leveling of the transcribed interviews has been performed to find out the connection between themes, and then to illustrate the themes as to

generate larger stories (Thomas 2011:172). In this research, a preliminary code symbolizes a word or short phrase to assign a summative, salient, attribute for a portion of language-based data (Saldana 2009: 3). In the concluding stage of the analysis, triangulation of the primary and secondary dataset has been done to see overlaps, divergence or other meaningful patterns to arrive at the final conclusion as well as to "increases the reliability of the data and the process of analyzing" (Yin, 1994 as cited in Varian, 2008: 78).

4.8 Summary

This chapter discussed the research methodology along with the researcher's philosophical stance. This research is primarily positioned within the constructivist paradigm, where the researcher undertakes 'knowledge' from the 'Relativist' perspective. The empirical inquiry follows a 'Case Study' design where data have been collected through a hybrid approach, mainly incorporating inductive and then deductive approach over a certain period of time. In order to generate the larger picture from the case, data have been collected from multiple sources such as grey materials, interviews, and reflective note taking. During the fieldwork, respondents were selected using snowball strategy, and in-depth long

conversations were done following an open-ended interview approach. Data collection and data analysis were performed simultaneously as it offered constant comparison to draw the storyboard from the narrative stories of the participants. Finally, after identifying the preliminary codes or levels from the transcribed interviews, major themes have been established to explore the connection between themes, and then to illustrate the themes with the theoretical aspects of diffusion of innovation, pointed out by Rogers (2003) to generate the larger story of the underlying challenges of floating cultivation as a part of innovative agricultural adoption in waterlogged areas in southwest coastal Bangladesh.

Chapter 5: Determinants of Adoption of Floating Bed Cultivation

5.1 Introduction

This chapter addresses the research question of the thesis as to 'Why and how is floating bed cultivation being adopted among poor farmers in waterlogged areas of southwest coastal Bangladesh?' As this research followed a qualitative approach, the presentation of the data in this chapter is primarily descriptive in nature. The findings are generated from the researcher's observation in the field, respondents' information and secondary data sources, which has been already discussed in the earlier chapters. As a detailed consideration of contextual factors is common in case studies (Stake, 1995; George & Bennett 2005, Creswell, 2007), this chapter firstly presents a comprehensive picture of the study area to provide a better understanding about the context of the study. In addition, it is important in qualitative research to observe phenomena in the real setting to understand the meaning (Trachtenberg 2006).

The first section of this chapter provides a detailed description of the vulnerability situation, changing land use pattern due to waterlogging in the study

area. Following the description of the vulnerability situation, the current land utilization pattern is described to show the dynamics of adoption of floating bed cultivation among poor farmers.

5.2 Vulnerability Created by Poor Infrastructure: The Reality of *Chandra* Village

Until recent years, agriculture was the predominant form of livelihood in *Chandra* village. During that time, the river flood was a normal phenomenon for the people of *Chandra* village. The villagers depended on the river for their agriculture, aquaculture, transport and other daily activities. Haq *et al*. (2004) had described in their study that "the villagers had land on the bank of the river and when the river flooded its banks, silt carried by the water was deposited on the adjoining rice-cultivation land, making it fertile and providing the farmers with good harvests. The village was also famous throughout Bangladesh for its mango, jackfruit and dates" (p. 17). However, the village now symbolizes the adversity of waterlogging problems among poor farmers in southwest coastal Bangladesh. Previous research claims that this area is extremely vulnerable to waterlogging for

several years, in particular after a severe flood in the year 2000 (Haq *et al*., 2004, Datta, 2005, Mollick & Jilan, 2006, Adri & Islam, 2010).

The fieldwork for the study revealed the vulnerable infrastructure of the *Chandra* village. Most of the roads are *kacha* in this area.

Image 5.4 Village Road (*Kacha*) during Dry Season

The above photo was taken at *Chandra* village of *Keshabpur thana* of *Jessore* district during the field visit in 2010. That field visit was conducted during the dry season (February – March) and the road was dry at that time. The road seen in the photo is the river embankment built to protect the upper land from floodwater

intrusion. However, this embankment has now become a road commonly used for local transport. Image 5.2 gives a clear view of this road as an embankment, which is made of mud. The photo shows the vulnerability of this road (embankment) during rainy season.

Image 5.5 Embankment (*Kacha* road) in *Chandra* Village

The local people reported that when the water rises it covers the roads, and damages the road by making holes. This is very risky and in most cases these roads remain unrepaired for many days. As waterlogging prevails for a long time

in this area, it affects the road networks. During the rainy season it becomes difficult or even impossible for the *rickshaw* or *van*[2] puller to take passengers through this road. This disrupts their livelihood. The following picture in Image 5.3 was taken during a wet season (July, 2012). The road changed into muddy potholes after a moderate rain. From this picture it can be assumed that the situation could be worse during heavy rain. The researcher could not reach the destination on that day. The road became slippery and was not possible to ride the motorbike on that road.

[2] A vehicle (tricycle) that is used in rural areas to carry passengers or materials.

Image 5.6 Village Road (*Kacha*) during Rainy Season

During the field research it was observed that not many modern structural buildings have been built which is the common scenario in most rural areas in Bangladesh. Moreover, the poor people do not have the ability to build any *pacca* (concretized) structure to live. Most of the houses are made of traditional rural construction materials like mud, straw and bamboo. Some semi-structured houses can be seen but all are vulnerable to extreme waterlogging. The local people informed me that during periods of heavy flood people have to change their place for residence. Either they take shelter on roads or in safer place like cyclone

centre or local school buildings. Generally, "in rural areas in Bangladesh, most of the mud-built houses are destroyed in water logged condition". That leads people to "take shelter on embankments" or sometimes people "take shelter on the roof top of the house" (Adri & Islam, 2012: 51).

Apart from this, the researcher was informed that no big agricultural market had developed in the rural areas as agricultural production was restricted due to waterlogging. The closest market for selling their harvest was about 30 - 45 minutes away by motor vehicle from the study area. But to regularly commute there was not possible. On the other hand, selling products in the local market does not give much profit to the poor and the vulnerable transport system has restricted the opportunity of getting higher return for their produce from a urban market or from a well-developed local market.

Besides, the sanitation system of this area has been affected as well. As the water level rises the latrines go under water. This also happens in the case of tube-wells. This creates a health hazard in this area. It can be also observed that this situation leads to the spread of water-borne diseases in the area. This study did not look in detail about the diseases, but it remains one of the major problem

affecting this area. Some NGOs are working on the sanitation and water scarcity problem in this area.

The presence of water hyacinth in *Chandra* village was noticeable. Water hyacinth is a very common aquatic weed in submerged or waterlogged areas that grows vigorously. Once the weeds start growing they multiply very quickly in a short time and within few days it becomes problematic for that area. An abundance of water hyacinth contributes to problems like decreasing water quality, increasing mosquito etc in the Chandra village. From the following picture (*Chandra* village) it can be easily understood the intensity of the water hyacinth in the waterlogged land.

Image 5.4: Waterlogged Land covered by Water Hyacinth

The waterlogging problem not only affected the physical infrastructure of Chandra village but also changed the land use pattern. On the other hand, this change in land utilization has affected the agriculture practice in Chandra village. The following section describes the changes in land use pattern in Chandra village.

5.3 Changes in Land Utilization: Scoping the Need for Floating Bed Cultivation

Due to the unstable condition of the water level in farming land, the farmers reported the need to change their land use pattern based on the availability of the water.

Image 5.5. The Embankment in *Chandra* Village to Protect Floodwater Intrusion

The above picture (Image 5.5) was taken in *Chandra* village of *Trimohini* union. The road shown in the photo is the embankment that was built to protect the upper lands of the area from floodwater intrusion. The right side of the embankment (in the photo) is the lower land. At the time the picture was taken (September 2012),

the lower land was flooded. This lower side (land) is the bank of the river which often gets flooded.

The upper lands (left side in the photo) of the embankment from the river side are less prone to flood or waterlogging. Those areas do not get flooded or waterlogged every year. In case of heavy rain those upper lands also get flooded as the drainage system is not very good. The area as well as the river cannot drain the excess water as it is already a moribund river. The following picture was taken during dry season (March, 2010) from Chandra village of *Trimohini* union. This rice field is situated in the upper land and was being used for rice cultivation at that time as the weather was normal that year.

Image 5.6 Upper land during the normal cultivation season in *Chandra*

In case of heavy rain and flood, the upper land also gets flooded with normal cropping delayed or disrupted. The following picture represents the situation of the upper lands during flood. When the picture was taken (September, 2012), that year the area experienced moderate flood or waterlogging problem. The local people informed the researcher that the situation becomes worse when there is a heavy rain or flood.

Image 5.7 Waterlogged Upper land in *Chandra* Village

The lower lands, which get flooded often and remain waterlogged for a longer period of time in a year, are mostly being used for fish farming during the time water remains on the land. There are two types of fish farming being practiced here, open water fish farming and the *gheer*. The poor people of the area are mostly doing the open water fish farming. The poor people catch fish from the unused waterlogged lands during the lag period when they do not have any income opportunities. The following picture was taken while the poor people were

fishing (March, 2010) in the waterlogged land. The river is also visible in the upper part of the photo and not covered by water hyacinth. The people are fishing in the waterlogged lands just beside the river flowing through the *Chandra* village.

Image 5.8 Fishing by Poor People on Waterlogged Land in *Chandra* Village

The *gheer* (a type of temporary man-made dam) farming is being done by constructing small dams to block the water for fish farming. The following picture represents how the waterlogged lower lands are being blocked to utilize for fish farming (*gheer*).

Image 5.9 *Gheer* Farm on Waterlogged Land in *Chandra* Village

The land owners of the lower lands give lease of their waterlogged lands to other persons who are interested in fish farming (*gheer*) with the condition that they (who took the lease) will use the land in waterlogged season for fish farming and after that they will drain the water from the field. When the *gheer* farmers drained out the water these lands are used for normal farming again during the dry season. This type of man-made dam (*gheer*) is expanding the waterlogging situation in the study area with the landowners and the *gheer* businessmen sharing the profit.

Despite the *Kabodak* river flowing through *Chandra* village, there are still a few areas in this south-west region where there are moribund rivers. The land use patterns also have changed in those areas in various ways. The following picture was taken from the *Hazrakathi* union near *Hajirhat* Bazar during April 2011. The river was totally dry during the summer preventing normal agriculture in this area.

Image 5.10: Moribund River near *Hajirhat* Bazar

Some people had tried to benefit from waterlogging by making small dams for *gheer* (a type of temporary man-made dam). That increased the problem to some extent.

This waterlogging condition has changed the income pattern of residents in this area as well. The limited scope in land based production system has pushed the people of this area to fish cultivation as an alternative means for livelihood. The framers who had more land both in high and low areas have been able to adapt to the waterlogging condition. Informants reported that initially they also suffered but after some people became interested in *gheer* farming, they were able to utilize their land again. The main sufferers are the marginal farmers who do not have lands in upper areas. Some of the respondents informed the researcher that they could not bear the initial loss at the beginning of waterlogging years and they had to sell their lands to others. The respondents also informed that some households sold some of their lands to send a member of their family abroad to earn money. Some of the respondents said they have engaged in pulling rickshaw or van while some turned to day labor. As this area does not have much scope for seasonal employment they go out of the area and sometimes to the nearby urban centers. A moderate number of people have migrated to neighboring India. Migration is a recent phenomenon in the study area. It started only a few years ago. Local people and previous research inform that "the siltation of *Kabodak* River in 2000 is responsible for the loss of rural livelihood and these people are

leaving the area" (Adri & Islam, 2012). However, the extreme poor could not even migrate or start a new business, as they do not have enough money to start with.

However, some other waterlogged areas of the southwest region have shown some progress against waterlogging with TRM (Tidal River Basin Management). This is a process where they have removed some dams to allow river silt to flow down the river. This area, however, has not benefitted from this TRM system (Haq, 2006; Field Survey). As to the question of how positive are the respondents about solving this waterlogging problem, the local people and NGO personnel do not see much hope of solving the waterlogging problem in a short time. However, few initiatives have been taken in Chandra village to help people to cope in adverse situation. The following section describes different GOs and NGOs initiatives in the *Chandra* Village.

5.4 Initiatives of Government and Non-government Organizations for the poor: A Way to Combat against Waterlogging Issue

While discussing government initiatives in reducing waterlogging or supporting the poor people, the respondents informed that there have been no big project by the government. The local people informed that sometimes the local authorities took initiatives to clear the river channel by removing the water hyacinth. Such initiatives were limited as the water hyacinth grow very fast and occupy the water body. For such projects the government employed local people. One respondent informed that he worked in a 90 days project for removing the water hyacinth from the water body during 2008. Furthermore, the government initiatives also have been taken to remove mud (soil) from the moribund river to deepen the channel. These types of initiatives also have other benefits like – the mud (soil) from the dead canal are being used to make embankments to protect the upper lands from flood water intrusion. Besides, those river channels can hold more rainwater for use in irrigation in the following season. For these types of program, authorities employ local marginal farmers during the lag agricultural period and they were paid 150 Taka per day. The following photo was taken from the *Hazrakathi* union near *Hajirhat* Bazar during April 2011. The local people

were working to excavate mud from the moribund river (*Mukteshwari*) to pile up on the embankment.

Image 5.11 Government Initiatives in *Hazrakathi* Union

Furthermore, previous researches report about the 'Reducing Livelihood Risk Project'. This project was under a government program that was limited to *Trimohini* (*Chandra* is one of the villages of *Trimohini* union), *Bidyanandakathi*, *Sagardar*i, *Pajia* and *Sufolakathi* union of *Keshabpur* Thana. This project with a large budget was locally operated by *Samadhan* NGO and was funded by CDMP,

EC, DFID, GoB, and UNDP. That program included the "increasing the ground level of homestead (so that water cannot enter into houses), tree plantation, increasing the highest of pond banks, fish cultivation, vegetable gardening, constructing *macha* and duck rearing." (Adri & Islam, 2012). Other government initiatives in *Keshabpu* Thana reported by Adri and Islam (2012) are – establishment of "refugee camps along the sides of main roads or embankments during extreme waterlogged condition", temporary construction of tube well and latrines for refugee families. (Adri & Islam, 2012: 54).

In addition to government initiatives, different non-governmental organizations also conducted various projects in the study area to help people to combat the waterlogging problem. NGOs conducted projects on disseminating coping techniques among local people. They trained people on "how to increase the height of a house and how to build durable houses" as well as teaching "people how to overcome livelihood difficulties during extreme water logging through establishment of ring based vegetable gardening or floating gardening" (Haq *et al.* 2004; Adri & Islam, 2012; Dev, 2013). The initiatives of promoting floating bed cultivation have been vital in the study area as it was introduced twice by two different NGOs. The following section describes in detail about the

floating bed cultivation situation in the study area, as it is the main interest of this research.

5.6 The Floating Bed Cultivation in *Chandra* Village

The floating bed cultivation projects are one of the prominent initiatives by NGOs to assist poor farmers in southwest region to cope with the waterlogging problem. Two initiatives of floating bed implementation were conducted in Chandra village. In the year 2003 Wetland Resource Development Society (WRDS) took the first initiative of floating cultivation implementation in Chandra village. The local NGO *Samadhan* worked with WRDS to improve the livelihoods and food security of the villagers by promoting floating cultivation as an alternative technique of coping mechanism. And the program was under the project of CARE- RVCC (Reducing Vulnerability to Climate Change), funded by CIDA (Canadian International Development Agency). About that project Haq et al. (2004) mentioned that, "after receiving training and technical support on soil-less agriculture, more than 150 villagers started to practice this type of non-conventional agriculture on their waterlogged areas adjacent to the river Kabodak" (p.18). However, during the conversation with Mr. Haq, he informed

the researcher that in 2003 they gave training to 60 farmers of *Chandra* village. But most of the local people did not continue the cultivation practice. On the other hand, the local NGO *Samadhan* is now mainly handling their micro credit program. Local people informed that poor people borrow money under the micro credit program from the NGOs to support their family during lag income period. When the researcher visited Chandra village during 2010, he came to know that only two farmers have been continuing the floating bed cultivation. These two farmers have little land which is waterlogged. They practice floating bed cultivation on their land during the waterlogged period. Moreover, the researcher came across one interesting thing about these two adopters that both of them have now become floating bed cultivation trainer. They work on hire for different NGOs to train new farmers on floating cultivation in different areas where NGOs conduct floating bed projects.

However, the poor people of *Chandra* village once again got the monetary and technical assistance from another project in the year 2010 to practice floating bed cultivation as an adaptation technique. The main project 'Adapting Natural Resource Management to Climate Change and Increasing Salinity' was an initiative to help 1,000 households in *Satkhira*, *Jessore* and

Barguna Districts to lift the local extreme poor out of poverty by 2012. By extreme poor (bottom 10%), they referred "the people living on an income of Tk. 22/person/day (2007 prices) or consuming under 1,805 kcal/person/day living in vulnerable household conditions, and as well as those individuals who are deprived of safety nets of the government and NGO IGA programmes". The new initiative was taken under the program '*Shiree*' (Stimulating Household Improvements Resulting in Economic Empowerment). This program was developed and funded by DFID (Department for International Development). The *Chandra* village falls under the project of 'Adapting Natural Resource Management to Climate Change and Increasing Salinity', which is coordinated by the local NGO *Shushilan*. And from the *Chandra* village 600 poor farmers got the help to adopt floating cultivation from 2010 with monetary and technical assistance. The project gave each farmer 10,000 Taka to make 5 floating beds and had selected landless farmer for giving the training. In the first year (2010) the project was successful in attracting people. The project employed both male and female farmers to make floating beds. But the project confronted difficulties in the second year which included managing land to place the beds and lack of adequate number of farmers. The field coordinator (Prosanto Sarkar) of the working NGO

Shushilan informed that in 2010 they were able to make 2,622 floating beds in total but in the following year they were struggling just to make 600 beds. The project ended in 2012. When the researcher visited *Chandra* village during September 2012 there were only four to five farmers continuing with floating cultivation after the project finished.

This situation (adopting during project time and then discontinuing) of floating bed cultivation has made the researcher more interested to explore further – why the farmers are adopting the cultivation practice during project time, what is their perception and why they are not continuing the practice? This seeks to explore more about the current situation of income opportunities of the poor people and their challenges to understand the actual need of the poor farmers for coping in adversities. The following section presents the finding about the vulnerability situation of the poor people in constructing income opportunities as well as their limited access to resources due to waterlogging condition.

5.7 Poor Farmers' Limited Access to Livelihood and Resources due to Waterlogging: Explain the Need of Adopting Floating Bed Cultivation

The local people and NGO personnel informed the researcher that the status of the marginal farmers of Chandra village is declining and they are becoming ultra poor day by day. The poverty situation of marginal people has brought NGOs to initiate projects in the area. The project 'Adapting Natural Resource Management to Climate Change and Increasing Salinity' (floating bed project) was planned and initiated to help the extreme poor of *Chandra* village. Besides, when the researcher visited the *Chandra* village he was informed that poverty is increasing for the families who do not have cultivable land. Local poor families came to talk to the researcher about their poverty, assuming him to be one of the representatives of some donor NGO. Two women showed their house to the researcher and said *we are the poorest of this village. We neither have cultivable land nor house. We are living besides the embankment*. Their intention of informing the researcher about their poverty condition was to get enlisted in the upcoming project because when the researcher informed them that he is a not from any NGO, he is just a student and came to collect data for his thesis, they seemed disappointed. But they were still cooperative in sharing information for the research. While the researcher asked them if he is taking their valuable time,

they replied that they do not have work and for that reason were looking for some opportunities.

It is now the reality of *Chandra* village that cultivable lands are getting waterlogged. This waterlogging condition is not allowing the farmers to utilize their land for full time in a year. It also does not allow landless farmers to work for those with large fields. There are also other issues that are making the local people more vulnerable and poor. During the discussions and interviews the local people informed the researcher that since the water covers a certain area, grazing land has also reduced leading to having less cattle and poultry in the area. Additionally, they informed that during the waterlogging period diseases spread and caused death of cattle and poultry in the area. This situation adversely affects the income of the local people. Fruit trees and other perennial trees are disappearing due to longer waterlogging area. Waterlogging also has restricted the homestead cultivation as it covers their yard as well. In extreme cases people have to live on the road when their house goes under water. Therefore, it can be said that this area suffers from lack of fruit, vegetable, poultry, and livestock that usually provided additional income sources for the rural poor. The following photo (Image 4.12.) was taken during August 2012 field trip. The researcher took

this photo of the upper land standing on the embankment. The following photo shows how situation during waterlogged time even in the upper lands. The photo was taken to capture the flooded home yard of a house.

Image 5.12 Waterlogged Home yard, *Chandra* Village in 2012

From the photo it is evident that the waterlogged households would not be able to do homestead cultivation. Even it would be difficult to raise poultry or cattle. Local people informed that if the water stayed for longer periods then the tree might also die. Duck rearing is considered by many respondents a method to cope with the waterlogging situation in southwest region since ducks can live in

both water and land. During the field trip in *Manirampur* village, the researcher had an opportunity to discuss at length with one who had started duck rearing. He informed the researcher that he had about 60 ducks that time. But there are always chances of disease among poultry due to prolonged waterlogged condition. The poor and vulnerable people sometimes do not want to take any initiatives where there is chance of risk.

Beside, like every disaster or hazard, this waterlogging problem also has some socio-economic impact on the daily life of local people. The local people informed the researcher that people are getting poorer, becoming jobless, their children's education is also hampered as well as they are facing food insecurity. Food security has been linked with climate change challenges (FAO, 2008c). A direct relationship comes in the form that waterlogging problem of this area has restricted their access to sufficient, safe and nutritious food to meet their dietary needs. People who are poor informed about their shortage of food during the waterlogging period.

One young farmer while talking about their crisis time (lag time) informed the researcher that sometimes they need to borrow money from their relatives. The man introduced himself as a farmer and worked on fields of others

as well as leases land from others and give half of the harvested crop to the owner of the land. He said – *it is not always possible to borrow money from relatives, as they are also not very rich. Some farmers borrow money from NGOs under micro credit program with high interest rate*. He also added – *if the lands remain underwater for long time and the extent of waterlogging situation increases poor people will be more vulnerable*. And his observation is right as the income opportunities of poor farmers will reduce if lands remain under water for longer time.

Though different people suffer differently following a flood or after getting their land waterlogged, the main victims of the waterlogging problem are those who do not have any cultivable land in the upland. While discussing with people of *Chandra* village, the researcher was informed that there are mainly three types of people who are somehow affected by the waterlogging problem such as totally land-less people, who live alongside the embankment; land owners of waterlogged land; land owners of waterlogged land but also having a little land on higher ground which can be used throughout the year.

However, it cannot be concluded that the flood-affected landowners are the only victims of the waterlogging problem. The most affected are the people

who work on the lands of others as agricultural labor. In another way it can be explained that there are poor people and rich people (poor farmers and rich farmers). Poorer people are mainly farmers. The poor people do not have lands. They mostly work in fields owned by others as agriculture day labor. But now due to waterlogging problem the total available cultivable land has reduced and for that reason less people are needed to cultivate fewer lands. For this reason the poor farmers who mostly work as agricultural laborers or leased-hold farmer have less work now. This situation has reduced the income opportunities of poor farmers.

One farmer who actually works on other's field as an agricultural day labour explained their situation to the researcher in detail using a metaphor. He narrated - *suppose one person has 40 BIGHA of land, he will need around 20 laborers for his land. But now he does not need that much people as half of his land went under water*. His describes how the income opportunities of the poor farmers have reduced due to the waterlogging problem in *Chandra* village. He also said that two to three months in a year, mostly between the finishing of jute cultivation and starting of rice field preparation they rarely get jobs on the field. During that time farmers are employed needed just to wash the harvested jute or

for taking care (weeding, cleaning etc.) of the crop field. During this time they need to depend on the money they saved during the normal farming seasons. The farmers informed that when they work during the rice cultivation period, they earn 300 – 400 *Taka* and they can earn 200 – 250 *Taka* during the jute cultivation period per day. But they do not need to spend the entire income and that's why they could save some, which they use during the lag time. But that is also not sufficient for maintaining a family for two to three months when they are totally jobless. They need to borrow money from others or from NGOs. If the water remains for prolonged time, they need to borrow more money and that loan becomes a burden for them. This is how the poor farmers are falling into the poverty or debt circle which will increase with the intensity of the waterlogging problem.

The waterlogged lands were totally unutilized for a certain period of time in a year. Later, those waterlogged lands were taken for the purpose of blocked fish farming (*gheer*) mostly by outsiders. The *gheer* businessmen took lease of the waterlogged lands from the owners for five years under the agreement that specifies that they (*gheer* businessmen) will not give anything in return to the owners of the land during the first two years. But from the third to fifth years they

will irrigate the remaining water from the land during dry season to make the land cultivable. Otherwise, they will give the same amount of money a farmer can earn from the rice cultivation. The waterlogged landowners informed the researcher that during the normal cultivation time, they could produce around 400 kg rice from 1 *Bigha* (14,400 sq. ft.) of land and they can earn about 10,000 *Taka* by selling 400 kg rice. Though the introduction of *gheer* farming has given some opportunities to the waterlogged landowners, it has reduced the income opportunities of the general farmers. Furthermore, the *gheer* farming has also affected those farmers who have little or no land but use leased land for cultivation. These marginal farmers do not have enough capital to take lease of a land for *gheer* farming as the initial investment is higher than normal farming. Other researches on waterlogged areas also found that - the poor people are not able to do *gheer* because it is a cost intensive and a skill based occupation. Additionally, fish farming is more vulnerable to disease infection as well as it is creating man-made waterlogging in the study area. Besides, all the people do not have the opportunity to do fishing (Datta, 2005; Mollick, 2006; Field survey).

G*heer* farming does not only reduce the agricultural income but has also reduced the free fish farming opportunities of poor people. The commercial fish

farmers (*gheer* owner) have blocked their lands making dykes around to do fish farming inside the dyke. As the waterlogged areas are now converting to *gheer*, the poor people cannot catch fish form the water body. Formerly anyone could do small-scale fishing.

Image 5.13 Waterlogged Space before the Making of *Gheer, Chandra* Village in 2012

The above picture was taken at *Chandra* village during the March 2010 field trip. At that time research observed that the poor people were doing fishing in the waterlogged lands that is just beside the river (*Kabodak*). The water level at

that time was suitable for the people to catch fish standing waist-deep in the water. But now these lands have been given for *gheer* farming and the owners of the *gheer* have created dyke and blocked the lands to do commercial fish farming. The following picture was taken from the same place in September 2012. During that trip the researcher observed the change of waterlogged lands into *gheer*. The local people informed the researcher that they are not allowed to do free fishing in the *gheer*.

Image 5.14 Waterlogged Space after the Making of *Gheer, Chandra* Village in 2012

Observing the changes in land use pattern, it can be seen that the scope of income opportunities of the poor (poor farmers) in *Chandra* village are reducing. One marginal farmer informed the researcher that work is still available in the areas but they need to do multiple jobs to maintain their family. He shared his experience – *now I work more than before to maintain my family and try to find different jobs to work for the whole year. Since the work in the agricultural field is reducing as well as the price of the products are increasing, it is getting difficult for me to maintain a family. I am working more than previously but earning less than I need*.

However, the phenomena of changing farming lands into *gheer* can also be found in other parts of Bangladesh where waterlogging is a problem. Haque, and Saifuzzaman (2002) stated in their research paper that due to the rise of the demand for, and price of, shrimp in the international markets in the 1970s, the fish *Bhery* were turned solely into shrimp *gher* (shrimp enclosure) which was a consequence of water logging. These changes gradually gave way to the rise of traditional *Bhery* (Large enclosures) for fish cultivation replacing crop in many areas of Bangladesh. Draining-in and holding brackish water in the agricultural land for raising shrimps makes the soil unsuitable for crop production for a long

time. They also found that the surplus agriculture labor force do not get other alternative employment opportunities in those areas (Haque, & Saifuzzaman, 2002).

The local people still do fishing in open water in the river or in places that have not been converted into *gheer*. But the problem arises in the years when there is very little rain, as an area that is moderately waterlogged cannot be used either for farming or fishing. Not all local people can afford buying boats to do fishing.

Regarding other income opportunities from rickshaw or van pulling have also become harder during the rainy season as the roads become muddy. One respondent reported why he was not doing rickshaw or van pulling either in local areas or going to cities. "*I just know how to do farming and not all people can drive rickshaw or van. Besides, leaving family here alone I do not want to go to cities"*. Furthermore, it is also not possible for all poor people to go abroad to earn money by selling their lands because some of them do not have adequate land to sell. In the study on climate-induced migration and violent conflict, Reuveny (2007) stated that, "people can adapt to environmental problems in three ways: stay in the place and do nothing, accepting the costs; stay in the place and mitigate

changes; or leave affected areas" (p. 657). But leaving the place is not always possible for poor people. The same type of statement can be found in Poncelet's (2009) work on Bangladesh about environmental change and forced migration scenarios. He states that "many poor families also cannot afford to move greater distance because of their economic inability and other uncertainties involved with long-distance migration" (p. 12). Most importantly, the ability of the poor to respond to and recover from disaster is limited because of their limited income and financial savings (Wisner et al., 2004). By losing or being forced to sell land and other assets people are moving towards poverty or fostering their existing poverty.

From the above discussion, it is evident that the waterlogging problem in Chandra village has restricted the land based agriculture practice. This situation has mainly reduced the income opportunities of the poor farmers. On the other hand, this adverse condition expresses the need of an alternative solution. The floating bed cultivation practice could have been a potential coping technique for this waterlogged area. However, the local farmers did not adopt it wholeheartedly. This seeks further explanation. This research plans to know further about the farmers' perception - why they do not continue the floating cultivation after the

projects ended; what are the challenges they faced while practicing the floating bed cultivation. The next chapter will present the findings about the farmers' perception about the floating bed cultivation as well as the challenges of adoption floating cultivation by the poor people of the *Chandra* village.

5.8 Summary

This chapter has sought to describe the dynamics of adoption of floating bed cultivation among poor farmers. In the case of *Chandra* village it is noticed that the waterlogging condition has affected the farming population. The poor landless farmers are the most affected. Waterlogging situation has changed the agricultural pattern as well as the land use pattern of the area. Due to the change in land use pattern, the poor farmers are losing their income opportunities. They have limited flexibility and little choice in case of income opportunities during adverse conditions. Even though the poor farmers are doing multiple jobs, they are still struggling to meet their family expenses. Besides, the newly adopted occupations are not stable and vary with the waterlogging condition. Most importantly, the waterlogging condition is reducing the access profile of the poor farmers, thus reducing their coping capacities as well as increasing their

vulnerability. To help farmers to combat with the waterlogging problem, different NGOs took initiatives to introduce floating bed cultivation in *Chandra* village. The poor farmers joined those projects, got training and practiced floating bed cultivation during the project running time. However, the research finds that the most of the farmers are not continuing this practice after the project finish. This situation seeks further exploration. This chapter has provided the context of adopting floating bed cultivation. The issues related to the challenges of adopting floating bed cultivation in the study area will be explored in the next chapter.

Chapter 6: Challenges of Adoption of Floating Bed Cultivation in Waterlogged Areas

6.1 Introduction

The previous chapter described the dynamics of adopting floating bed cultivation, providing a context for this chapter. This chapter is divided into three sections. The first section aims to present findings about the research question as to 'how do poor farmers perceive floating bed cultivation as an innovation in waterlogged areas of southwest coastal Bangladesh?' The second section explores the research question - 'what are the underlying challenges of adopting floating bed cultivation by poor farmers in waterlogged areas of southwest coastal Bangladesh?' The last section describes the research findings. The basis for discussion in this chapter is primarily drawn from collected data from interviews with poor farmers of ongoing projects, poor farmers from previous projects, poor farmers without experience of floating cultivation, agricultural landowners, and experts and organizers of projects related with floating cultivation.

6.2 Farmers' Perceptions about Floating Bed Cultivation

It was commented in the previous chapter that the poor farmers of the study area do not continue the floating bed cultivation after the project comes to an end. To explore the challenges of adopting the floating bed cultivation in the study area, the researcher considers it as an innovation since it is a new cultivation practice for the farmers in this area. The innovation is being introduced (diffusion) by NGOs. According to Rogers (2003), individuals can take decision of either adopting or rejecting an innovation at any stage of the innovation diffusion process (knowledge – persuasion – decision – implementation – confirmation). However, before taking the decision of either rejecting or adopting, the individuals are persuaded about the innovation (persuasion stage). In this decision making process, individuals mostly consider the relative advantage, compatibility, complexity aspects of an innovation. This research by using the innovation perspective mainly explores the relative advantage, compatibility, complexity attributes of the floating bed cultivation. Before illustrating the attributes of floating bed cultivation, it is important to briefly discuss the attributes of an innovation mentioned by Professor Everett M. Rogers.

According to Rogers (2003) five attributes (relative advantage, compatibility, complexity, trialability, and observability) of an innovation helps to describe the characteristics of an innovation as well as its rate of adoption. In general the relative advantages often represent the economic profitability of an innovation but there are other dimensions of relative advantage like status aspects, social-prestige factors, convenience, and satisfaction. Besides, Rogers (2003) mentions about sub-dimensions such as low initial cost, decrease in discomfort, saving in time and effort, and the immediacy of the reward, which also describe the rate of adoption of an innovation. He also mentions that an innovation having the least risk and uncertainty works positively for the adoption of that innovation. Likewise, in some cases the incentives or subsidies offered by change agencies works for the adoption of an innovation. Regarding the compatibility attributes, Rogers (2003) stated that the more an innovation is compatible with the sociocultural values and beliefs, previous or existing practice as well as the needs of the adopters, the rate of adoption will be less uncertain. He also mentions that sometimes a package approach works better for the adoption of an innovation as the innovation itself does not fulfill all the needs of the adopter. However, some innovations are more complex and difficult to use, and thereby influence the rate

of adoption. Regarding the complexity attribute, Rogers (2003) mentions that, "the complexity of an innovation, as perceived by members of a social system, is negatively related to its rate of adoption" (p. 266). Furthermore, if the adopters have a trail of an innovation and found it relatively advantageous and compatible, that also has positive influence on the rate of adoption. Finally, if the result or outcome of an innovation is visible to the potential adopter, that works positively for the rate of adoption of an innovation. In essence, the relative advantages, compatibility, trailability and the observability of an innovation, as perceived by members of a social system, is positively related to its rate of adoption, whereas the complexity of an innovation is negatively related to its rate of adoption (Rogers, 2003).

The following section presents the findings on the perceptions of the stakeholders about the attributes of floating bed cultivation. Since, the study took a qualitative approach, the presentation of the findings will be descriptive. The data represents the perceptions of different stakeholders (floating bed practitioners as well as non-practitioners, NGO personnel, experts, and land owners). The data will be presented under three main sections (three attributes).

6.2.1 Relative advantage dimension of Floating Bed Cultivation

The relative advantage of an innovation is mostly "measured on economic terms" and is being "perceived as better than the idea it supersedes" (Rogers, 2003: 15). However, Rogers (2003) mentions about other dimensions and sub-dimensions that influence the relative advantage aspect of an innovation depending on the characteristics of the adopter. Some of the dimensions pointed out by Rogers (2003) that relate to floating bed cultivation are economic profitability, status aspects, initial cost, comfort and satisfaction, time and effort, immediacy of the reward, risk and uncertainty, and the effect of incentives dimensions. The following section describes the economic profitability, status aspects, initial cost, comfort and satisfaction, time and effort, immediacy of the reward, risk and uncertainty, and effect of incentives dimensions of floating bed cultivation in the study area.

Economic efficiency

Before illustrating the economic efficiency attributes, it is important to understand the context of the introduction of the floating bed cultivation for the

poor farmers of this area. This is reflected in the explanation of Papon Biswas (a NGO personnel):

> *When we started the project, the situation was - few of the lands in this area could be used for Aman rice farming where the poor farmers used to get the opportunity to work. If the opportunity were limited in the area they also used to migrate to nearby villages where they could get work. But for rest of the months it was difficult for the farmers to get income. In that situation the project was initiated in this area*

From his explanation, it reflects that the program was initiated to help farmers to increase the income opportunities when there will be no or less work. He explained further:

> *The poor farmers can do floating bed cultivation for a maximum 4 –4.5 months in a year. For the rest of the year they work in the Aman rice field as agri-labor.*
> *From one bed if everything works out smoothly, maximum 2500 taka to minimum 1200 – 1600 Taka profit can be made in four months. Which is not sufficient but if someone can make five beds that would be sufficient.*

The researcher also asked the farmers during the project time about their perception of floating bed cultivation being economically beneficial. Mixed remarks were received. One famer explained (Md. Ismail) his view of the economic profitability of the floating bed cultivation:

> *I have been doing this practice since 2000, and I am getting benefits. If I would not have got benefits why I am doing this.*
> *Last year I prepared two beds of 11 hands long and I planted tomato. I got about 10 mon (400 Kg). Besides, my family also consumed; I also gave others that is not included. I received 10 Taka/kg.*
> *I planted okra last year on floating bed and the production was good. Now I am preparing the bed to make compost that can be used in normal field when the water will not be there. I will use this compost for my field to produce okra again in the normal land.*

While discussing about his income opportunities, it became evident that he also works as a floating bed cultivation trainer. He worked for NGOs to give training to new farmers. It showed that by adopting floating bed cultivation practice he got a new income opportunity.

Another farmer (Abdul Hossain) who had started practicing floating bed cultivation under the new project, stated his perception about the economic efficiency in the follow way:

> *I benefited. If some one can do it, it has huge benefits. Why they are doing if there is no benefit? Besides, if the compost can be used in upper lands, the benefit will be more. If not beneficial, will people do?*

Furthermore, most of the farmers reported positive impression about the food quality of the crop grown in the floating bed. They said, the vegetables grown on the floating bed are tastier than the normal field.

Different perspectives were presented by other farmers. They did not considering the floating bed cultivation as a better choice in terms of economic benefit while working for the project. They involved in it as they did not have many alternatives during adverse seasons. One respondent explained the problem in detail.

> *Now jute cultivation season is running. For washing the jute one person is getting 150 Taka. But we are getting 100 Taka for working in the project to prepare floating bed. Some people are earning more than 200 Taka in few cases. That is the problem.*

The researcher also asked the labourers, who did not join the project. They informed the researcher that they had job in the main field and they earn more from that job rather than working in the floating bed project. Md. Samil (an agri-labour) stated his perception in the following way:

> *When we work in the rice field during the rice cultivation period we can earn 300 – 400 Taka per day and during the jute cultivation period we get 200 – 250 Taka per day. The payment of a day labor varies between 150 – 250 Taka depending on the season. But the NGO is paying only 100 Taka for floating bed making. I can earn more working in other places now.*

So, if we consider the adopters as agricultural laborers, then other jobs are beneficial based on their availability? However, there could be another reason, why some farmers did not practice floating bed cultivation. One person who had a

waterlogged land but did not practice floating bed cultivation after observing the floating cultivation projects gave a different explanation. He (Karim Sekh) said:

> *Floating bed cultivation is not a better option for me; I would prefer fish farming as it is more profitable.*

From the remarks of the farmers who did not practice floating bed cultivation it shows that they had better income opportunities than practicing floating bed cultivation. This is contrary to the view of farmers who practiced floating bed cultivation. One female farmer (Monoyara Begum) expressed her situation in the following way:

> *I started it because of NGO initiative. We are poor people, if we get some benefit through them / if we can earn some money that will help us to maintain the family. If we had land, would we have come to do this tough job?*

In essence, from the perceptions of the famers about the economic efficiency of floating bed cultivation, it represents that floating bed cultivation is only beneficial when farmers do not have any income opportunities. But they are not considering this as the best option for their situation. Moreover, in the case of floating bed cultivation, economic benefit cannot be simply measured as it is referred as an alternative livelihood for coping in adversity. Besides, most of the

farmers who were given training are landless farmers and they do not have any sustainable job.

Furthermore, though some income opportunities were created during floating bed cultivation project but that was not the main intention of giving training to the farmers. The farmers were given training to continue the practice. To continue this practice, the poor farmers needed the initial investment, which was given by the NGO during the project time like, labour cost, seed, and bamboo. But when the project finished, the farmers were expected to manage themselves. The next part will describe the poor farmers perception about the initial cost for the floating bed cultivation.

Low Initial Cost and Immediacy of Reward

The researcher asked about perceptions on the 'initial cost and immediacy of reward' aspects regarding the floating bed cultivation because, in case of adoption of an innovation, the low initial cost and the immediacy of the reward dimensions works positively for the rate of adoption of that innovation (Rogers, 2003). About the initial investment for doing something in adverse waterlogged situation, the NGOs think that the local poor people can prepare the

floating bed by using the local resources, which was reflected from the Mr. Papon Kumar perception. He stated that –

> *Primary input cost is not that much. They just need to collect the water hyacinth to make the bed. And for making the bed they need three people and the labor cost of only 80 Taka at that time. So the preparation cost will be 300 Taka for labour and 100 Taka for bamboos, that's all.*

This remark of Mr. Papon Kumar represents that the NGO thinks the poor people will benefit from this cultivation practice through little investment. The farmers were given that support during the project time. Mr. Papan Kumar explained:

> *We are giving money only during the bed preparation but later they need to take care of the beds by themselves. Initially, we are also giving them the seeds.*

But the poor people viewed this differently. Some of them were not interested to invest money. Without any financial support the farmers were reluctant to continue the practice. One farmer (Ahmed Gazi) replied to the question - suppose you are not given any money, would you be able to do this practice:

> *Yeah, might be possible but not for all. I think only 1% will do.*

He explained further:

> *I cannot make the bed alone; I need help and for that reason I need to hire labour. At least two to three people are needed and the labor cost is 100 taka per person for one day. The bed can be made in one day but there are other works, which I can manage but it needs intense care. However, before starting the bed preparation we need to make compost as we need to compost in the bed. But the main thing is the money, not everyone (poor farmer) will be interested to invest, I guess.*

His prediction was not totally wrong as famers did not continue the floating bed cultivation practice. However, the initial cost alone cannot be advanced as the main challenge for adopting this practice. There are other challenges. The poor farmers did not want to invest on something that will not return profit immediately. The NGO field coordinator Mr. Prosanto Biswas explained his understanding in the following way:

> *Most poor farmers do not have savings. They live hand to mouth. In investing money (even if it is little), they cannot wait long time to get the return. For the floating bed cultivation, if they invest money for buying seeds, and other materials as well as for hiring supporting labour, they have to wait at least some time to get the return (production). They do not want to or they do not dare to invest money for this purpose.*

In the above statement of Mr. Prosanto Biswas, though it was not directly stated but it is reasonable to assume that - besides the poverty of poor farmers, risk and uncertainty are the other factors that work as a challenge against adopting floating bed cultivation. The next part will describe the risk and uncertainty dimension of the floating bed cultivation from the respondents view point.

Risk and Uncertainty

The risk and uncertainty dimension of an innovation is important as it influences the rate of adoption (Rogers, 2003). According to Rogers (2003), a less risky innovation will be adopted rapidly. There are some risk factors of practicing the floating bed cultivation that were mentioned by the farmers as well as the experts:

> *If the farmers cannot make the bed properly, the possibility of the bed breaking down due to strong wind and heavy flow of water is evident.*
>
> *Due to the heavy flow of water last year, few beds were washed way*
>
> *Main obstacle was drought. In the first year, beds were attacked by insects due to extreme dry weather.*
>
> *If the water hyacinth gets rotten, it will not work.*

The above statements show that the climatic condition of the study area is not stable. This unstable weather condition influences the waterlogging situation of the area. Since, the floating bed cultivation was introduced targeting the waterlogging problem, the fluctuation of the waterlogging condition is creating uncertainty for this practice. Subsequently, the poor people will avoid taking risk since they are already vulnerable. Any kind of loss will make them more vulnerable.

Turning now to social aspects, comfort and the satisfaction dimension of the floating bed cultivation, Rogers (2003) also stated that "social-prestige factors, convenience, and satisfaction are also often important components" for the rate of adoption of an innovation (p. 15).

Convenience, Satisfaction and Social-prestige dimensions

The farmers who tried floating bed cultivation found it a laborious job than working on the plain field. The researcher also observed the extreme hardship of the farmers during his visit to *Chandra* village. For floating bed preparation farmers need to wade in the water to collect water hyacinth. The researcher observed that the farmers were working while the sun was bright and

they had to remain in the water long to collect water hyacinth for preparing the bed. One of the farmers (female) informed –

> *We stared working from the morning and now it is past noon. Almost all day we are staying in and out of water. We get wet while in the water and dry the wet cloth by the sun's heat. It is very hard to work remaining in the water for long time. Besides, not all people can swim.*

Another respondent stated his hardship –

> *I worked earlier in the floating bed but now I do not want to work. It does not suit me. If I stay in the water I get cold. And if I get cold, I cannot work. Besides, this water also creates itching on the body. This work will only be done by very poor people.*

The researcher noticed that the person was referring to a particular section of people who belong to lower social status. But the main reason is that poor farmers do not have much option.

Regarding the 'social-prestige factors' the researcher came across one respondent in *Abhaynaga Upazila* who informed that he did not continue due to societal status problem. That respondent is a school teacher, who lives in *Moshihati* village under *Sundoli* union of the *Abhaynagar Upazila*. Though he is a school teacher, he adopted floating cultivation in 2008. During the first meeting

he shared his orientation and impression about the floating bed cultivation to the researcher. He said,

> *"I came to know about the floating cultivation from our Chairman and Rezaul haq (Director, WRDS) as I have a good relations with them. They requested me to start practicing this which could encourage other people to adopt this. After talking with them I realized that this practice could help the poor people of this union. Though I am not a farmer, I started practicing this because the poor people will not take the risk but if I can show them the success may be they could follow. After my starting one of my colleague also started this. It is not so tough to take care but it needs the willingness to start. And if proper care can be taken it does not need any fertilizer and pesticide. Before starting this we informed other people in the tea stall. Some of them came to see my bed. A few people have started this but the others people have not started yet as they fear to take risk. But if they can be encouraged I think floating cultivation will be a good option for them."*

But he did not continue practicing the floating bed cultivation. During the next meeting with the researcher in 2011 he informed that he is not continuing the practice. He said –

> *Being a school teacher if I do floating cultivation people talk behind me. When I did this cultivation some people said I am mad. Actually I do not need to do floating cultivation; I just did it for the sake of others. But people of this area are not interested about it. They think fish cultivation is more profitable and less laborious. …… Then my family members and relatives also insisted me not to do this practice. Then I stopped doing this.*

In this case the social-prestige factors worked against the adoption of floating bed cultivation.

Though farmers are very satisfied about the product of floating bed cultivation they were not doing it. One respondent shared – she produced cauliflower on her bed and got good production. After selling cauliflowers in the market, her products became popular and people came up to her house to buy more. When the researcher asked her why she is not continuing; she replied –

> *I do sometimes but not always. I am engaged with other jobs now. Besides, the NGOs are not coming and for the last two years our area did not have flood. However, I will do it again; it is easier for me to do it when my home yard gets flooded. I will be able to make the bed closer to my house as well as I can take care of the beds. The beds need constant monitoring.*

From the conversations the researcher realized that the product is not the factor but due to inconvenience and complexities people are not making it their first choice.

6.2.2 Complexities Dimension of Floating Bed Cultivation

By complexity Roger (2003) referred to "the degree to which an innovation is perceived as difficult to understand and use" (p. 16). Besides the extreme hardship, the procedure of floating bed cultivation is not very simple. Abdul Rahim (an early adopter) who is working for the latest project expressed his experiences about the complexity of the floating bed cultivation in the following way:

> *Not all people are getting equal outcomes even if their beds are placed side by side. Most commonly, people think that the beds can be prepared just by piling up the water hyacinth. It is not like that; the water hyacinth cannot be just piled up, have to place the lower part up then it will be locked. Otherwise, the bed will break apart. There is no fixed sized of the bed, farmers have to decide the size of the bed based on their suitability and convenience as they might need to move the bed in certain conditions.*

The field coordinator (Prosanto Biswas) of the NGO *Shushilan* in Chandra village also commented about the complexity of this practice. He stated –

> *It is not that simple as written in the book.*

The researcher became curious about what type of book he is referring and asked Mr. Prosanto about it. He informed the researcher that by book he referred to NGOs providing a guidebook as well as existing literature on floating bed cultivation.

However, the expert (Mr. Rezaul Haq) expressed his perception about the complexity of the floating bed cultivation in a different way. He asserted that -

> *If someone does not understand the science of this practice and just blindly copy others it will not work out.*

He went on to elaborate –

> *The floating cultivation requires constant observation. Even though the beds stay on the water, famers still need to water the top of the bed as the sun's heat dries up the vegetables very quickly. They also need to monitor frequently whether the roots of plants touch the water body. Even if the roots touch the water body, the plants can be dying.*

He further explained:

> *The technical aspects about the floating bed cultivation is not so easy. Many people attempted but could not succeed. There are better options to make the beds like using Salvinia, NaHS, coconut leaves etc. but the people here are not using them because the NGOs are not informing them about this. Besides, the poor farmers will not be able to afford them or will not be able to use them properly. The poor farmers only use water hyacinth, which are locally available. However, this also becomes hard for the famers to collect water hyacinth and prepare the bed as some of them cannot master the easier way of doing it. Sometimes they just pile up water hyacinths that displaced the layer. If the farmers cannot make the bed properly, the possibility breaking down of the bed is evident due to strong winds, heavy flow of water etc.*

Furthermore, the farmers need to watch the water flow as well as high tides as the beds may be broken up and pushed far away. Besides, the complexity in use or understanding of the cultivation practice as well as its hardship, the poor people also faced other complexities like lack of resources and raw materials for the continuation of this cultivation practice. One important practice is that the beds should be removed from the main field after the waterlogged period. Otherwise it will create problems for the cultivation of other crops. This becomes a challenge for marginal farmers as they have little or no land to keep the beds for making compost from them. However, the land owners think that the floating bed cultivation is not compatible with their current cultivation practice (rice farming and fish farming). The next part describes the compatibility dimension of the floating bed cultivation.

6.2.3 Compatibility Dimension of Floating Bed Cultivation

In the case of floating cultivation, the project did not get adequate flooded space to make enough floating beds in the following years, because the land owners did not allow the poor farmers to use their lands. The landowners think that the floating bed is not compatible with their current farming system. The following picture was taken in *Chandra* village during the field trip in August

2010. During that time the farmers were allowed to use the space given for *gheer* farming to make floating beds.

Image 6.1 Floating Cultivation in *Chandra* Village during August 2010

In 2010 the project was able to negotiate with landowners to allow the poor farmers to make floating beds and keep them in the open space (waterlogged lands). But in the following year the landowners did not allow the farmers to keep their floating beds on their lands. During the visit to Chandra village in July 2011, the researcher found that the *gheer* owners blocked the same space by constructing a dyke, which was being used to keep floating beds in 2010. The researcher found (refer to Image 6.2) only few beds beside the *gheer*. However,

the researcher came to know that the person who made those beds also owned the land where the beds were kept.

Image 6.2 Floating Cultivation in *Chandra* Village during July 2011

The local people informed the researcher that in 2011 the owner of the land did not allow floating beds on his land. The NGOs personnel (Prosanto Biswas) informed the researcher that *they were still negotiating with the owners of the waterlogged lands to allow the poor farmers to keep their beds.* The projects targeted the extreme poor of the *Chandra* village who are landless agricultural farmers. Since the beneficiaries were landless farmers, the NGO's had to manage the land for them to keep the beds. However, this location was chosen after

observing the unused waterlogged lands and when the project was planned the lands were not given for *gheer* farming. The problem arose as the lands were given for *gheer* farming. In the first year of floating bed cultivation the land owners as well as the *gheer* owner allowed the poor farmers to keep their beds on their lands. But after the floating cultivation the landowners suspected that the floating bed cultivation had some negative impact on the *gheer* as well as on rice (IRRI) farming. One of the landowners (Shirajul Islam) informed the researcher that-

> *The floating beds were harmful for the fish. There was the doubt that water hyacinth could create disease for the fish as the production of the fish was not sufficient. Besides, the farmers did not remove their beds from the lands, which created huge problem during the ploughing for the next rice cultivation. The floating bed farmers supposed to remove the beds from the land before the beds mixed with main land. The beds (water hyacinth) become harder mixing with the soil and it was really hard to plough the land. Finally, this affected the rice production. This is called ironing of rice. Those water hyacinth carried iron and for that reason the rice plants become red.*

From the above remarks of Mr. Shirajul Islam (landowner) it reveals that the floating bed cultivation practice was not compatible with the existing practices.

And for that reason, the landowners did not want to take the risk to allow poor farmers to use their waterlogged land.

Since, the landowners and the *gheer* farmers did not allow the local poor to use their waterlogged land, the poor people were not able to make floating bed easily. But still there were options for them to make the beds in the river or other areas where the land is waterlogged but unused. However, the poor farmers did not do it. One farmer (female) explained the reason why it is difficult to pursue floating cultivation in the river or in some places far from their home. She explained that the floating bed cultivation requires frequent maintenance and observation. She explained further:

> *If we place our beds in a distant place, we cannot observe the condition of the bed. If there is a strong flow of water, the bed might break or might be washed away somewhere else. The same problem would happen if we keep the bed in the river. We would not be able to observe our bed. Besides, going there is also very difficult. We do not have boats to go to the river. Even if we had, it does need energy to go up to that distance. If I go there, I need more energy and for that I have to eat more.*

The observation of the field and discussion with the informants conclusively point out that the incompatibility of the floating bed cultivation with the existing farming practice remains a challenge for the adoption of the floating bed cultivation for the poor farmers.

6.3 Challenges in Adopting Floating Bed Cultivation

The interviews on the perception about the relative advantage, complexity and compatibility revealed that there are few major challenges (risk and uncertainty, hardship, complexities, incompatibility with the existing farming system) remain as the barrier for the adoption of floating bed cultivation in the study area. However, the following section describes further challenges that this research identified from the empirical evidences. These include climatic variability, emphasis on incentives rather than the agricultural practice, incompatibility with the geographical settings, limited NGOs efforts, landlessness and limited access to resources. These challenges are further explored below.

Climatic variability

The floating bed cultivation practice was introduced by the NGOs in the study area to create income opportunity targeting the waterlogging problem. However, the climatic variability of the area remains as the challenge for the successful continuation of this cultivation practice. If the precipitation is high in one year then the area will be heavily affected. From the interviews it reveals that the fluctuation of the waterlogging condition in contrast is creating the uncertainty

for this practice. The poor people actually struggle when the area get severely waterlogged. However, during that time making floating bed is bit difficult due to intense of the water level. On the other hand, after making the bed it cannot be just left on the water because of high water flow. From the interviews on the relative advantage perspective of floating bed cultivation, it reveals that the farmers are considering about adopting this practice when there is a lack of income opportunities. Because, during the normal waterlogged time, they can manage some job and if the job is available, they can earn more than preparing floating bed cultivation. The observations on the field and discussion with the informants conclusively point out the challenges of practicing the floating bed cultivation due to climate variability.

Incompatibility with the geographical settings

According to Fliegel (1993) and Saltiel et al. (1994) "geographical settings affect adoption by influencing the applicability of the innovation to the ecological infrastructures of the potential adopter and by exerting spatial effects of geographical proximity. The impact of the ecological aspects such as climate, weather, or soil conditions on adaptation generally applied to agricultural

innovation because some of the innovations can be adopted only when they are suitable to the ecological conditions" (as cited in Wejnert, 2002: 311).

The common challenges reported by the local people are – hardship and skin diseases. One farmer described the situation:

> *Everyone's body is not the same. I got Itching, skin disease. I got affected severely and my body got weak.*

Besides, the field coordinator described the situation in the following way:

> *They do not want to work in winter season as the water is very cold at that time and during the summer they do not want to work because working in the water causes severe skin diseases. The body becomes swollen. New people got fever and cold after doing it. If the water gets into the eyes it got affected and this is because of the moribund water.*

Developing skin related diseases are the major problems of farmers working on floating bed cultivation. The farmers felt that the floating beds pollute the water and the pollutants cause itching. Due to the itching and skin disease problems many farmers are not interested in floating cultivation in the south-western region. The water related diseases was not evident in areas whose floating bed cultivation was indigenous. The *Mugarjhor* village and *Kandi* village of *Boithakata* Union under *Najirpur* Thana (*Pirojpur)* did not experience such

problems. It was evident from the response of farmers in those regions that skin diseases did not occur when there was water-flow. The water body of Najirpur Thana is not totally stagnant. There were high tides and low tides. Due to the tide-flows, the water body was cleared of stagnant pollutants. But in the south-western region the rivers are blocked and not affected by tides. If there are no tidal-flows the water body cannot be purified of pollutants, which degrade the water quality. When floating bed cultivation is practiced in those blocked waterlogged lands, it degrades the water causing skin related diseases. This adverse condition conclusively point out the restraints on the sustainability of this practice in the study area. Besides, the geographical settings of the study area remain as a challenge for the availability of the raw material of the floating bed cultivation.

One of the benefits of floating bed cultivation mentioned by different researchers is that this practice can use local raw materials for preparing the beds. It is said that floating cultivation is a pro-poor practice that needs low cost input like aquatic weeds and bamboo, which are locally available. The main raw materials used to make the floating bed is water hyacinth (*Eichhornia crassipes*) but paddy stub, topapana (*Pista stratiotes*), son ghash (*Imperata cylindrica*), noll

ghash (*Hamerthria protensa*), wood ash, and dissected coconut fibers are also used (Islam & Atkins, 2007; Irfanullah *et al*., 2007; Haq *et al.*, 2002). However, due to waterlogging condition, the farmers are not able to grow *Aus, Aman,* and other indigenous long straw variety rice. In the waterlogged lands farmers are cultivating IRRI paddy that has very short stub. For that reason, not much input of the floating cultivation can be expected from the paddy field. But an abundant amount of water hyacinth is present in the water body that was used as raw material to make the floating bed in the study area. However, Mr. Rezaul Haq explained the problem in a different way:

> *If the water hyacinth gets rotten, it will not work. On the other hand, very young water hyacinths also cannot be used. For that reason mature water hyacinths need to be used. However, the mature water hyacinth is not always available. So, the farmers can start preparing the bed only when the mature water hyacinth are available.*

From his comment, it reveals that even if the water hyacinths are available, farmers cannot just use it for the bed preparation.

Besides, the researcher also found that in a few areas of south-western region water hyacinth got destroyed due to saline water intrusion. Water hyacinth cannot survive in saline water.

Image 6.3: Withering Water Hyacinth due to Saline Water Intrusion in *Nehalpur* Village

The *Nehalpur* people informed that the water hyacinth is not always available as the seawater enters into the area during flooding. The observation of the field and discussion with the informants conclusively point out that the incompatibility of the floating bed cultivation with the existing farming practice remains a challenge for the adoption of the floating bed cultivation for the poor farmers.

Emphasis on incentives rather than the agricultural practice

As we know that "if individuals adopt an innovation partly in order to obtain an incentive, there is relatively less motivation to continue using the innovation." (p. 238). In this regard Rogers (2003) states that, "although incentives increase the quantity of adopters of an innovation, the quality of such adoption decisions may be relatively low, leading to limitations in the intended consequences of adoption. In the case of adopting floating bed cultivation by the poor farmers during project time, incentives worked as a vital factor. This was also reflected from the comments of Project coordinator (Mr. Papon Kumar). He states:

> *The attraction to the incentives is a common thing. You will notice in the other places also that the poor people have the tendency to get incentives.*

One of the respondent's perception about the adoption of the floating bed cultivation also represents the attraction for incentives against adoption of this practice. The researcher asked her (Monowara Begum) why she did the floating bed cultivation – whether of her own interest or just followed the NGO. She explained her stand –

> *Yes, I started it because of NGO initiative. We are poor people. If we get some benefit through them, we can earn some money that will help us to maintain the family. If we had land, would we have come to do this tough job? This is a very tough job. Staying in the water is very tough. Besides it causes itching. My body became red due to bad water and water hyacinth.*

Another farmer commented on the benefits from this practice. She (Amena Bibi) described –

> *We are poor people. Through this initiative we are getting some benefit. I got two goats. Others got sewing machines or boats.*

Mr. Rezaul haq explained the situation in more detail. He explained:

> *The hardcore people themselves have some limitations. They are not entrepreneurs. It is very difficult to use them in the productive sector. They have some psychological problems as well. As vagabonds, rampant characteristics are common within them. They have the tendency of mendicancy and are attracted for relief or support. Besides, lack of capacity to make maximum profit – less maintenance, may be they also do others work.*

From the discussion with the poor farmers, it is evident that the poor people could not consider the long-term benefits of practicing floating bed due to their poverty, as it requires some initial investment, has some risk and return comes after some time. Poor people live on hand to mouth, and for that reason

they need quick returns for their work. In the case of floating bed cultivation, it is noticed that poor people considered the incentives that they received from the project to join the training rather than the sustainability of cultivation practice.

Limited NGOs efforts

Apart from this there are other challenges like the extent of change agent efforts. In this regards, Rogers (2003) states that, when the effort by the change agent decreased or stopped the adoption or practice of an innovation also decreased or stopped. Besides, Stone (1952) also found similar evidence (Rogers, 2003). Furthermore, Rogers stated that, "diffusion campaigns often fail because change agents are more innovation-minded than they are client- oriented" (p. 319) and "the less privileged clients often lack the necessary resources to adopt the innovations that the change agent is promoting" (Rogers, 2003: 383).

However, Mr. Rezaul Haq also mentioned similar observation. He stated -

> *The problem arises when the donor fixed the selection criteria for beneficiaries. They asked us to select ultra poor (per day income of less than 22 Taka). For that reason we could not include farmers who were interested or had the potential to carry out the cultivation.*

The actual extension effort needed for the promotion of the floating bed cultivation is very limited in this project. Because the criteria for selecting beneficiaries were determined by the donor and the donor asked us to select the hardcore poor. The main project aimed at targeting the improvement of the hardcore poor people. But for the betterment of this area the waterlogging issue is needed to be addressed. For the extension of floating bed cultivation the central theme should be waterlogging problem whereas the central theme of this project is hardcore poor.

This floating bed cultivation will not spread rapidly because it is not a community-based project where other farmers who are interested should have been incorporated. For example, Mr. Rahim is interested but he cannot be a beneficiary of the project. This time he is working as a trainer. But if we can incorporate people like him there are more possibilities of adopting the floating bed practice in the area.

For the spread of this practice in this area on a large scale, entrepreneurs are needed like the Chairman of the Nehalpur who took the initiative in his area and involved the people to practice this cultivation. That project was successful but due to the effect of Aila (tropical cyclone), saline water entered into that area in the following year when he took that initiative. Due to the saline water intrusion water hyacinth died. That caused the discontinuation of the practice.

Besides, he also mentioned about the lack of market facilities for the products of the floating bed cultivation. He explained in the following way:

Some NGOs took initiatives without understanding the bottleneck of this practice like developing a marketing channel for the produced crops on the bed. We tried to find out a market to create an opportunity for the farmers where they would be able to sell

> *their produce. We also contacted and did a survey in nearby markets but we failed to develop the channel. However, the channel could have been developed by the farmers of this area. They are not expert enough to produce the quality seeds that could satisfy the need of the buyer or the market. Besides, the cost of transport will be high since the market collects seeds from the nearby villages. Furthermore, they are also not aware about the positive side (better taste) of the products from floating bed.*

In essence, the floating bed cultivation is not a technology that developed through scientific research in the lab considering the context of the southwest region. Rather, it is a local cultivation practice that is indigenous to a specific area. From the literature review we know that an indigenous technique developed through years of experience and by solving problems in trial and error basic (Naimir, 1990; McClure, 1989). Despite that, floating bed cultivation is a unique case, where we see that a local innovation is being diffused to different areas to solve the problem of that particular area. However, the research findings articulate that the diffusion of an indigenous cultivation practice cannot solve the problem in a new area. In the areas where floating bed cultivation is indigenous, a well established market has developed based on floating bed practice. The products from the floating bed have a good market value in that area. However, this research finds that the NGOs could not develop a marketing channel for the

products from the floating bed cultivation in the study area. On the hand, it is also not possible for the poor people to locate a good market for their products in a short time. This remains as a major challenge for poor farmers in adopting floating bed cultivation, which also reflected Mr. Papon Kumar perception that the floating bed cultivation is more appropriate as a coping mechanism. From his perspective:

> *They will adopt it even without the incentives if their area remain waterlogged and they do not have any alternative.*
>
> *Floating bed is more feasible as an adaptation technique rather an alternative livelihood practice. People do it when they do not have any thing to do. However, it also depends on the individual.*
>
> *Why they are not taking it as an alternative livelihood because the products do not have a market here. On the other hand, the product has less than the main land product. If the production were the same then why would they go for floating bed cultivation?*
>
> *If they could have sold the bed as an organic fertilizer, everybody would have practiced the floating bed rather than doing other things.*

Landlessness and limited access to resources

For the reconstruction of livelihood after any disaster the poor people need access to common property resources. In this regard Wisner et al. (2004)

stated that, "access to common property resources (CPRs) is also of great importance to household livelihood and vulnerability" (p. 92). The common property resources, according to them, "include trees, pasture, ground or surface water, wildlife, marine resources, famine foods and arable land, depending on the region and its history" (Wisner, et al., 2004: 92). But the limited access to the common resources by the poor farmers remains as a challenge of the adoption of this practice. The NGOs selected the poor farmers for giving training, but these poor farmers do not have land. To place the floating beds, they need some space. From the discussion in the previous section (Compatibility Dimension of Floating Bed Cultivation) we came to know that the landowners are not allowing the poor farmers to use their space as they think floating bed is not compatible with the existing farming system. This was also reflected by Mr. Rezaul Haq:

> *We are facing problems. We are not getting places to place the beds. This time we probably can give them two beds per person.*
> *The land-owning local people have seized a huge area in the Chandra village and that news also came on the newspaper. All the spaces are occupied, some of them claiming that certain portion are their lands and they have the documentary proof. Some of them already prepared papers supporting their claims. Due to continuous drought for the last three years, the river almost dried up and then the local people blocked the river to make gheer or do farming (rice, jute etc.). Until they blocked the land there were no problems with the floating bed cultivation but just after they*

> *blocked the lands, the problem arose and that is hampering the floating cultivation.*

The project coordinator Mr. Papon Kumar explained the problem in more detail.

He explained:

> *Actually the socio-political issues arise when something turns into a bigger shape. He explained using a metaphor - When someone opens an industry in an area, no one bothers that much. But when the same industry starts growing and making huge profit then other people will notice that.*
> *Why the landowners are allowing their lands to practice the floating bed because they are not able to use it or they are not using it now. On the other hand, the floating bed practice is still very new in this area or initiated under small scale. But this time scale of the project is quite big. During the first year of the current project, there was no problem. But in the second year we faced some problems getting access to the lands. Now they are talking about taking lease of their waterlogged lands to practice floating bed cultivation. Besides, some have already given their land for gheer farming.*

On the other hand, since the waterlogged lands has transformed into *gheer*, water hyacinth have been removed from the waterlogged lands due to their negative effects (incompatibility), which has created the scarcity of water hyacinth in *Chandra* village. Besides, local people informed that sometimes water hyacinth is also being removed under government initiatives to protect the water-body from becoming breeding ground for mosquitoes as well as to protect

the carrying capacity of the water-body. The reasons behind removing water hyacinth from the water body are that the water hyacinth is a very invasive weed that doubles in a week or two, and this aquatic weed makes the water-body breeding ground for mosquitoes and reduces the carrying capacity of the water-body by breaking down the drainage system. Besides, it also has a negative impact on the open water fisheries (Haq, *et al*., 2004).

When the researcher visited Chandra village in 2010 (August), the waterlogged lands were totally covered by water hyacinth (refer to Image 6.4).

Image 6.4 Waterlogged Lands in *Chandra* Village Covered by Water Hyacinth in 2010

In 2010 the researcher noticed that farmers made the floating bed collecting water hyacinth from nearby areas. But when the water body was blocked for making the *gheer*, the landowners removed the water hyacinth. During 2011 (July) and 2012 (September) visits the researcher found the water body almost clean as the area was being used for *gheer* farming.

Image 6.5: Waterlogged Lands in *Chandra* Village without Water Hyacinth in 2011

Though the removal of water hyacinth from the water body had reduced some problems of the area but it had become difficult for the poor farmers to collect water hyacinth if they want to make beds for floating cultivation. The floating bed

practitioners informed the researcher that even though water hyacinth can be found nearby but making beds there and bringing them to a suitable place to keep would be very difficult and troublesome.

From the above discussion it is reasonable to assume that landlessness and limited access to resources remain as a challenge for the poor farmers to practice floating bed cultivation.

6.4 Contributions of the Study

The research fills some important gaps (pointed out in Chapter 2) in the field of floating bed cultivation for social change and climate change adaptation. They are as follows:

(a) Extant literature argued that poor people fall into a poverty trap due to their limited access to resources needed to tackle the adversities. They tend to remain in the poverty trap unless external supports are given to them (Wisner et al. 2004; The World Bank, 2009). However, this research reveals that, the poor people cannot properly utilize the external assistance due to their limited access to resources and poverty. The floating bed cultivation initiatives that were taken in *Chandra* village confirmed that landless poor people could continue the floating bed cultivation despite having limited access to resources (land, raw materials,

and market facilities of their product). However, they prefer working on projects that provide them income within a shorter duration to maintain their livelihoods. This thesis argues that this is one of the primary reasons as to why poor people do not consider long-term benefits of practicing floating bed cultivation. In other words, poor people consider short-term incentives that they can receive from the project rather than the sustainability of cultivation practices. Besides, this research finds that the main problem of poor people in the Southwest region is waterlogging and their limited access to resources, not the lack of knowledge in using technologies.

(b) Scholars in previous studies tend to favor the location specific adaptation technique over the planned adaption technique without making it clear as to how a location specific adaptation technique serves better than planned adaptation. On this point, this research finds that even though NGOs consider the floating bed projects as location specific in the context of Southwest region, it is not always the case as there are instances where the water hyacinth is not always available within convenient distance, a crucial location specific resource for making the floating beds less costly and convenient. Furthermore, the study finds that by using water hyacinth, people generate problems for successive crops if water

hyacinth are not removed from the field. Furthermore, farmers used their floating beds as compost for the main field in areas where floating bed cultivation was indigenous. However, in the case of Chandra village, the study found that the used floating bed created problems when used in the normal field. Notably, the study area is close to the coastal belt, and as such, salinity is a common problem in that area. As the local people noted, the use of water hyacinth absorbs heavy metal when used in the fields as compost. This finding also supports the earlier studies of Muramoto & Oki (1983) who claimed that water hyacinth absorb heavy metal. In addition, this study finds that NGOs overlooked the fact that water of the cultivation area was stagnant creating serious health hazards as soon as hyacinth used for making beds start to rot. As local people note, this is one of the key reasons why local people face skin diseases during the period of floating bed cultivation. This thesis argues that NGOs need to look for a solution to this problem before implementing the project, and they should not be driven by receiving immediate results ignoring the long-run health hazards of the local people.

(c) Previous studies on the diffusion of innovation were mainly meant for technological innovation-diffusion. There was hardly any case where diffusion of

an indigenous cultivation practice was studied. Given this point, this research finds that the floating bed cultivation is not a technology that developed through a scientific research in the lab. Rather, it is a local cultivation practice that is indigenous to a specific area. In fact, people of the South region acquired such a technique through years of hands-on experience and solving problems on a trial and error basis (Islam & Atkins, 2007; Irfanullah et al., 2007). This study further finds that there is a spillover of indigenous knowledge of floating bed cultivation as such knowledge is used by people of other areas to solve problems of those areas. Thus, this research provides a unique case of local innovation-diffusion for policy making institutions. However, the research notes that merely encouraging the diffusion of an indigenous cultivation practice is not sufficient to solve problems related to cultivation practice in a new area. In the areas where floating bed cultivation is indigenous, a well established market has developed based on floating bed practice. The products from the floating beds also have a good market price in that area. On the other hand, this research finds that in the study area, NGOs just introduced the cultivation technique but did not help to develop marketing products from the floating bed cultivation. Importantly, it is not

possible for the poor people to locate a good market for their products in a short time.

(d) Previous research mostly mentioned about the potentiality of the floating bed cultivation. However, this research finds some different perspectives (from the respondents) of the floating bed cultivation which include relative advantage, complexity, and compatibility in adopting floating bed cultivation technology. Besides, there are certain factors such as risk factors, complexities, incompatibility, climate variability, and limited access to resources are found to play important roles in adopting floating bed cultivation practice. Furthermore, this research finds that landlessness and limited access to resources remain as a challenge for the poor farmers to practice the floating bed cultivation. Although NGOs provide training to the poor farmers, they do not have land and as such the training does not produce effective results in most of the cases. This thesis argues that NGOs should consider the availability of places for making the floating beds before conducting any training. The research suggests that the potentiality of floating bed cultivation cannot be achieved unless other conditions such as places for making the floating beds are note ensured.

(e) The thesis pointed out earlier that the diffusion of an innovation is not the ultimate solution to a particular problem. The consequences as well as its sustainability are indeed matter much to make the innovation effective. However, very limited research have explored the consequences of innovation thus far (Rogers, 2003). In this thesis, this issue has been dealt through a case study. The thesis studied the consequences of introducing an innovation (floating bed cultivation) into different areas that face similar type of adversity (waterlogging). The research found that people in the projects areas (CIDA and CARE funded "Reducing Vulnerability of Climate Change" project and ActionAid funded 'adaptation to waterlogged situation through the promotion of floating gardens') do not practice the floating bed cultivation technique once the projects finished or withdrew for some reason. Importantly, without taking initiatives to tackle this undesirable consequence, new projects have been implemented in other areas of the Southwest region, for example, in the Chandra village. This study explored the challenges in adopting the floating bed cultivation technique among poor farmers in the Southwestern part of Bangladesh which was not studied earlier. Thus, it is expected that findings of this research will help policy making institutions and NGOs to make the floating bed cultivation technique effective. Moreover, it

would also help potential scholars to investigate challenges of diffusion of innovation in areas affected by adverse climatic situation.

6.5 Summary

This chapter started with the aim to explore the underlying challenges behind the discontinuation of floating bed cultivation after a project finished in the study area. The discussion has revealed a number of challenges such as risk and uncertainty, hardship, complexities, incompatibility with the existing farming system in the study area. However, the research also identified other challenges. These include climatic variability, emphasis on incentives rather than the agricultural practice, incompatibility with the context, limited NGOs efforts, landlessness and limited access to resources. In essence, the limited income opportunities of the poor farmers of the south-western region are becoming more limited due to the adverse waterlogging condition. Though they are adopting alternative livelihoods, the sustainability of those livelihoods is questionable. In the case of floating bed cultivation, though the farmers are adopting the practice, different challenges are hindering the sustainability of the practice.

Chapter 7: Conclusion and Recommendations

7.1 Introduction

This chapter discusses the main findings along with the objectives, highlighting the synopsis of the background of thesis. This chapter also offers the recommendations based on the research findings which are generated from chapters 5 and 6. In discussing the research findings their limitations are also listed.

While reviewing the literature, it has been noted that the local farmers from the southern part of Bangladesh have invented an indigenous cultivation practice (i.e. floating bed cultivation practice) to produce seedlings and vegetable on their waterlogged land. However, in the last decade, this floating bed cultivation has become a popular policy recommendation for coping with adverse ecological condition in waterlogged farm land. This has been documented well in the literature (Irfanullah, 2013). Both local and international developmental organizations have started incorporating this cultivation practice into their developmental and adaptation projects for other areas in Bangladesh.

While developing an in depth understanding regarding the spread of floating-bed cultivation, the findings from previous research illustrate that the practice

has been introduced in the southwest part of Bangladesh as part of development initiatives for the poor people. Large sections of the region suffers from stagnant water bodies resulting from disruption of river flow due to coastal damming against tidal surges (Haq, et al., 2004; Dev, 2013). The construction of embankments under the Coastal Embankment Project (CEP) initiated in the 1960s, has gradually created waterlogging, which has become worse with frequent floods. Consequently, marginal poor farmers have become landless and jobless during the waterlogged period.

This research has explored the consequences of the introducing the floating bed cultivation in southwest region of Bangladesh and to understand the dynamics of adoption of the floating bed cultivation among poor farmers. This research focused on the floating bed cultivation in the southwest region as it an innovation for the farmers of this area, though it is not particularly suited to the region. Rather, it is an indigenous cultivation practice from southern part of Bangladesh. To achieve the research objectives, the research used a case study approach to study an area from south-western Bangladesh. The research site has waterlogging problem as illustrated in Chapter 5; even a moderate rainfall makes the agricultural lands inundated under water. As a result, in any year of severe flooding waterlogging becomes a year round phenomenon. And, the severity of the waterlogging has increased with the passage of time. Conditions improve

only in years when rainfall is low. The summary of the findings are presented in the next section.

7.2 The Findings of the Research

This section summarizes the findings in relation to the objectives of the research. While addressing the first research objective (*the dynamics of adoption of the floating bed cultivation among poor farmers given their limited access to resources in waterlogged southwest coastal Bangladesh*), the research found that in the study area the people are losing their crop land. They even cannot use their home-stead area for vegetable cultivation. As water covers the area for longer period of time grazing land is being reduced leading to decreased cattle and poultry in this area. Moreover, during the waterlogging period, diseases spread causing death of the cattle and poultry. Fruit trees and other perennial trees are also disappearing. This situation is adversely affecting the income of the local people and making them more vulnerable.

The findings from Chapter 5 shows that the waterlogging situation has changed the land use pattern of the study area. Due to waterlogging, a huge change has occurred in the agricultural sector and the cropping intensity has decreased. The households have been observed practicing mono cropping. Thus crop production is losing its importance.

To sustain lives under such condition, non-crop agricultural practices become important as a source of earning for the people. The waterlogging condition has changed the income pattern of this area. People are becoming interested in fish farming. But the poor farmers cannot take the risk of practicing commercial fish farming as fish too are vulnerable to disease infection.

While a small number of households are trying to recover their loss by adopting alternative options like *gheer* farming, the situation of marginal famers remains vulnerable. Due to changes in agricultural and land use patterns, poor farmers are losing their income opportunities. The changing landscape of the area due to waterlogging is reducing the access of poor farmers to resources, making the situation difficult for the poor farmers to reconstruct their livelihood. Waterlogging is forcing farmers to change their occupations. Some of them have engaged in pulling rickshaw or van or have turned into day labor. As this area does not have much scope for employment, they need to go out of the area and sometimes to the nearby urban centers. Migration, however, is not possible for every affected household. The poor majority cannot afford to migrate. The newly adopted occupations are not stable and vary with the season, resulting in decreases wages and increased vulnerability. This study explained in detail – how limited income opportunities and access to resources are making the poor farmers

vulnerable and pushing them to extreme poverty. Consequently, the poor farmers are becoming interested to practice floating bed cultivation, especially when supported by non-government organizations in order to enhance their income opportunities and access to resources.

The research found that local NGOs are working in collaboration with international aid organizations and farming experts are playing an active role in the diffusion of floating cultivation practice, which has been especially beneficial for poor and unemployed women. All the floating cultivation practitioners were ultra-poor (according to NGOs evaluation) and all of them are beneficiaries of the local NGOs. During the project time, the research did not find any case of individual initiative of doing floating cultivation. During the project time all the practitioners were given cash money as daily labor costs for working in their own bed by the NGO. Besides, the NGO also distributed seeds, so no initial investment by the farmers were made while they received wages on a daily basis. It was an attractive offer for the marginal farmers and the poor.

In order to address the second research objective (*the perception of the different stakeholders about the relative advantage, compatibility, complexity, triability, and observability of floating bed cultivation*), the research explored the different perceptions of farmers towards floating bed cultivation. The farmers who did not join the project advanced the view that floating bed cultivation is not a better option for them in terms of economic efficiency. They also perceived that floating bed cultivation is only for those who do not have any income opportunity. The research found that some poor farmers were reluctant to practice floating bed cultivation because working for floating bed project gave less amount of wage in compare with wage of traditional agricultural labor in the crop fields. Moreover, floating bed cultivation is a labor intensive work that requires both physical work as well as technical knowledge. The research found that when project (floating bed cultivation) time coincided with the peak season for jute cultivation, farmers were less interested about floating bed cultivation, considering the hardship and low payments for a day's work. Besides, the landowners think that floating bed cultivation is only for the extreme poor, and it is a project for NGOs. The farmers who practiced floating bed cultivation think that floating bed cultivation is beneficial for them if they are given initial input costs support by NGOs. However, the poor people received benefits not only by adopting floating bed cultivation but added incentives for

adopting the practice. Besides, most of the farmers reported positive impression about food quality (taste) of the crop grown on floating beds. On the other hand, practitioners reported that this cultivation practice was harder compared to cultivation on flat farm lands. The making of floating beds, taking care of them, staying in the water for a long time is very hard work. Staying for long periods in water causes skin diseases. One of the solutions to this problem could be using a boat but the practitioners are too poor to buy a boat.

In essence, from the perception of the famers about the relative advantage of floating bed cultivation, this research found that floating bed cultivation is only beneficial when farmers do not have any other income opportunities. Besides, they do not consider this as the best option for their situation unless they get support from NGOs.

On the other hand, about the complexity dimension of floating bed cultivation this research has found that there are some technical aspects of the floating bed cultivation, which is not so easy. To get the best output from a floating bed, one needs to understand the science of it. For making the bed properly, the farmers need to understand the technique, otherwise bed preparation becomes harder for them. Besides, the beds can break down due to strong winds or heavy flow of water, if they are not

prepared properly. Furthermore, the plants can die due to sun's heat or for their roots not touching the water body. All these require constant observation.

While exploring the compatibility dimension of the floating bed cultivation, this research has found that floating bed is not compatible with the current cultivation practice (rice farming and fish farming). The local land owners reported that floating beds create problems for the cultivation of other crops, if the beds are not removed from the main field after the waterlogged period. The local land-owning farmers blamed floating bed cultivation for the negative impacts on the *gheer* (aquaculture) as well as on rice (IRRI) farming. There is the suspicion that water hyacinth create diseases among the fish. On the other hand, local people criticized floating bed cultivation for ironing of rice.

On balance, in the context of south-western Bangladesh, the floating bed cultivation is an innovation for the farmers of this area as it is not indigenous to this area and different nongovernmental organizations worked as the change agent (as linkers). This diffusion of innovation was a centralized diffusion process. However, the diffusion of floating bed cultivation in the south-western region happened in the context of developing a coping mechanism. Unlike other innovations, the attributes of floating bed cultivation cannot describe its rate of adoption in this area. At first the decision process

was not totally made by the farmers themselves. Besides, most of them worked as beneficiaries of an NGO. Likewise, most of the farmers who were given training are landless farmers and they do not have any sustainable job. Moreover, in the case of floating bed cultivation, relative advantage cannot be simply measured as it is referred as an alternative livelihood for coping in adversity. NGOs gave poor farmers the chance to participate in an experiment (trialability) and the result of the innovation was also visible to the other local people, even though most of the farmers did not continue the practice, which further reflected the failure of the final objective of the research.

The findings in relation to the third research objective - *underlying challenges of floating bed cultivation* – was reported in Chapter 6. While discussing the underlying challenges of floating bed cultivation, the research found numerous challenges in adoption floating bed cultivation. The challenges ranged from risk and uncertainty, hardship, complexities, incompatibility with the existing farming system to limited access to resources. This research has reported that the underlying challenges of adopting floating bed cultivation is not only related with geophysical phenomena such as climate variability but also with social dimensions of access to resources by the poor farmers. This research has also explained that emphasis on incentives rather than the

agricultural practice, incompatibility with the context, limited NGOs efforts are also acting as crucial impediments for adopting floating bed cultivation.

While discussing the challenges of floating bed cultivation in relation to climatic variability, this research has shown that the fluctuation of the waterlogging condition is creating uncertainty for this practice. If the precipitation is high, the area will be heavily affected and during that time making floating beds is difficult as well as risky. And for that reason, the poor farmers are precarious about floating bed cultivation.

Considering the incompatibility with the context in practicing floating bed cultivation, this research has illustrated that floating beds pollute the water, which causes itching and skin diseases. The water body of the southwest region is stagnant as the rivers are blocked. Rotting water hyacinth as well as chemicals in stagnant waters has resulted in contamination of the water. Since, there is no tidal-flows in this area, the water body cannot be purified of the degraded water. Staying for long periods in such water causes skin diseases and due to these problems many farmers are not interested in floating bed cultivation.

This research has found that the offering of incentives in adopting floating bed cultivation remained as challenges for the sustainability of this practice. The findings of this thesis have illustrated that the poor people considered the incentives that they

received from the project to join the training rather than the sustainability of the cultivation practice. The research has found that the poor people could not consider the long-term benefit of practicing floating bed cultivation due to their poverty. As floating bed cultivation practice requires some initial investment and wait for a period of time to receive returns, landless farmers are averse to take it up.

Limited NGO effort remains as a major challenge for poor farmers in adopting floating bed cultivation. As NGOs introduced the cultivation technique without ensuring other facilities like marketing of the products and farmers' access to common lands, the innovation is not continued. Since, there is no proper marketing channel for the products of floating bed cultivation in the study area, the farmers are reluctant to accept floating bed cultivation wholeheartedly.

Finally, landlessness and limited access to resources remain a challenge for the poor farmers to practice floating bed cultivation. The poor people need some space. As they do not have land, initially they used open spaces or others' land but the land owners did not allow them to place the floating bed on their lands in the following season blaming its incompatibility with the existing crops. There was the doubt that water hyacinth could cause ironing of rice as well as create diseases for fish farming (*gheer*). On the other hand, *gheer* farming is occupying the waterlogged spaces, which is

restraining poor farmers' access to waterlogged lands as well as availability of raw materials (water hyacinth).

In essence, the research findings indicate the presence of NGOs as the key element for the success of floating bed cultivation in the study area. The sustainability of this practice is correlated with NGO involvement and supervision of projects. The poor farmers did not continue the practice by themselves after the project ended. There were only a very few cases of individual initiatives of floating cultivation. Thus the NGOs seem to be a vital presence and it also seems that floating cultivation in Bangladesh is not a grassroots level adaptation strategy welcomed universally in southwest part of Bangladesh. It becomes viable only in cases where monetary and training assistance are present. Most importantly, it is costly for the poor farmers (day-laborers) to start practicing floating cultivation as it requires initial investments (i.e. employing daily-labor, buying seeds etc.) and returns are delayed. Most of them were unable to invest money for any duration. Besides, there are risk factors like breaking of bed, or being washed away due to high tides or floods. Since, poor people always remain at poverty's edge, they try to avoid risk. However, by doing paid jobs like fishermen, day-laborers, rickshaw or van pullers, poor people can earn wages on a daily basis. These jobs are risk free. Moreover, lack and access to resources has made their adoption

harder. But the training giving to the poor farmers will help them in extreme adverse situation, as they are already familiar with the cultivation practice and know how to do it.

The study's findings conclusively support the view that the adverse situation created by waterlogging problem has reduced the income opportunities of the poor farmers as well as their access to resources. This situation has made them more vulnerable. Due to limited income opportunities, poor farmers need to go through different occupational transition. And here the diffusion of floating bed projects also worked as a transition phase. But none of these worked as a sustainable solution for the poor farmers. On balance, the NGOs as well as the poor people received aid or assistance for overcoming poverty but different challenges hinder the process of sustainability.

7.3 Limitations of this Study

Although this case has revealed some primary findings, it is important to mention that this study is not without flaws. A number of limitations need to be mentioned about this current study. The main limitations are as follows:

First, the research design and methodology chosen for this study has some limitation. The chosen research design and methodology itself come with certain limitation, over which the researcher had limited control. This study followed a qualitative case study approach. Similar to other research methodologies, case study also has both strengths and limitations. It is difficult to make generalization from a case study research, thus the findings of the study cannot be used for broad generalization about the challenges in adopting floating bed cultivation outside of the area studied. Besides, the limited sample size chosen for this study remain as a challenge to meet rigor and trustworthiness of the research findings.

Second, the interviews with the respondents were conducted in Bangla, then translated into English by the research. This may have caused researchers' bias in data interpretation. Moreover, the researcher could not check the accuracy of the research findings with the respondents due to long distance, time and lack of contact.

Lastly, there are certain limitations which are unavoidable like finance, time, availability and access to important information. These factors also worked as constraints for this study. The researcher traveled to many projects (floating bed related projects) in southwest region of Bangladesh as the intention was to make a multiple case study. However, due to limited availability of time and access to informants, this research adopted a single case study, particularly based on one village in southwest part of Bangladesh where some projects on floating bed cultivation were run by the initiatives of non-government organizations. Identification of the poor farmers was difficult because they did not have any fixed job.

7.4 Recommendations

The findings of the research provide several recommendations. During the interviews and discussions with the respondents, the researcher enquired about their opinions how certain problems can be solved or how the situation can be improved. The following conclusions are offered based on analysis and findings of the current study.

The research findings suggest that more government initiatives in the study area are needed to reduce the waterlogging condition. The main problem of the southwest region is the waterlogging. Without taking initiatives to reduce the waterlogging, the

problem of the poor people of the southwest region of Bangladesh cannot be solved. Adaptation techniques like floating bed cultivation can just serve a short-term purpose. Moreover, sustainability of these type of short time projects remain questionable in case of ensuring long term income opportunities for the poor farmers. Better planning and long-term initiatives from both government and non-government organization is needed to ensure long-term employment for the poor farmers. Most importantly, initiatives like river dredging, tidal river management, removal of illegal construction inside the river to prevent the obstruction to drainage, prevention of unplanned *gher* (aquaculture) farming is more important. If the problem of waterlogging can be solved, land based production will increase. This will create more income opportunities for the poor farmers.

In order to guide the initiatives of future development, collaboration and cooperation among government, non-governmental organizations, and local people should be emphasized. This research found that different initiatives by different organization sometimes conflict with each other. For example, if government runs water hyacinth removal project from the waterlogged land, any floating bed cultivation project during that time will be affected as water hyacinth is the main raw material for floating bed making. It will be more beneficial if the government and the NGOs work together to properly utilize the water hyacinth.

As the study area is waterlogged and the presence of water hyacinth is also abundant new problems like decreasing water quality and increasing mosquitoes have arisen. According to local water hyacinth increased so much at times that it encouraged the local government to employ people for removing it from the water body. Thus, the local people could easily collect water hyacinth from the nearby *beels*, if they wish to make floating beds. Besides, all the lands of the area are not being used for the full length of a cropping year due to waterlogging; thus the floating cultivation can be done using this unwanted water and disturbing weeds to make the fallow lands productive. Some poor people are still interested but they have limitations. If assistances can be given to them, they might continue the practice. For example, the solutions to skin disease problem could be solved by using a boat but the practitioners are too poor to buy boats. For that reason, providing a boat to the poor famers might encourage them to practice the floating bed cultivation.

Besides, the identification of the vulnerable group and knowing their real need will be more effective for disaster management rather than implementing some centralized projects in the area. Research findings suggest that one single adaptation technique (floating bed cultivation) cannot serve the purpose of all poor people of the area. Research findings suggest that different people of the study area have different

perspectives as well as priorities. Local people in the waterlogged areas also have some ideas about how they will benefit or what will be convenient for them. During the interviews, some respondents have expressed interest in using the *khas* (Government lowland) area for fish farming. With some financial incentives they are willing to make the area productive. So, with the government initiatives in collaboration with the local people of these areas (*khas* land) can come under productive practices. In the same vein, Marschiavelli (2008) in his study of a case in Indonesia, has also argued that, "risk perception and coping mechanisms can be used to improve mitigation and preparedness for natural disasters. Acquiring the knowledge of why and how certain groups are more vulnerable than others involves effective community participation. The result of risk assessment as well as coping mechanisms learnt from local people can improve the risk perception level and can be used as an input in planning for local government and all stakeholders to cope with the flood." (P. 2).

The marginal landless farmers do not get any assistance from agriculture related departments. In the study area, the research has found no extension contact of the poor farmers with the DAE extension officers, BADC officials, and agriculture related NGOs. In Bangladesh, dissemination of agricultural technologies to farmers for the overall development of the country is the responsibility of the Department of Agricultural

Extension (DAE) (Kashem, 2006). Besides this organization, other government research organization, international research organizations, international or local NGOs are also working in transferring new ideas, technology, and strategies. But the communication gap between researchers, extension workers and farmers has been under serious scrutiny over the past decades in Bangladesh (Mele *et al.*, 2005). These organizations only deal with farmers with lands (according to local people). However, the number of marginal farming households (Agriculture labour) in rural Bangladesh is comparatively higher than other occupation in terms of main source of income. According to government statistics, the main source of income for 228 households (a total of 730 households) in the *Chandra* village is agriculture related job (BBS, 2001). So, for the improvement of the livelihoods of the poor, marginal and landless farmers, proper extension programs are required to ensure their access to the information or to the innovations. Most importantly, the extension communication should be both ways.

It has been discussed earlier that the phenomena of changing farming lands into *gheer* is creating man-made waterlogging as well as gradually reducing traditional farming. Draining-in and holding water in the agricultural land for commercial fish farming makes the soil unsuitable for crop production in the long run (Haque, & Saifuzzaman, 2002). Though the introduction of *gheer* farming has given some

opportunities to the waterlogged landowners, it has reduced the income opportunities of the general farmers. This surplus agriculture labor force does not get other alternative employment opportunities. On the other hand, this situation can lead to possible food shortage, food price rising in future that will make the life of the poor people harder. The government agricultural department should step up, and take some initiatives to keep the agriculture production stable in waterlogged area. They can introduce alternative cultivation practice like floating bed and can utilize the surplus agriculture labor force.

However, the research findings suggest that future researchers as well as potential practitioners of floating bed cultivation not to blindly rely on floating bed related publications but rather observe the field and take decision based on the local conditions. According to Becker (1998), "institutions always put their best foot forward in public. The people who run them, being responsible for their activities and reputations, always lie a little bit, smoothing over rough spots, hiding troubles, denying the existence of problems. What they say may be true, but social organization gives them reasons to lie. A well-socialized participant in society may believe them, but a well-socialized social scientist will suspect the worst and look for it" (p. 129). Specially, scientific research should be done about the issue of water pollution (causes of skin disease) and

ironing problem of the compost made from floating bed. We know that water hyacinth absorbs heavy metal. Since the beds are commonly made of water hyacinth, this research suggests laboratory testing for the nutrient quantity of the floating bed products. It is necessary to check if the products from the floating beds also carrying heavy metal or not.

Furthermore, in the case of floating bed cultivation project implementation, the research findings suggest that besides understanding the area where the floating cultivation project will be implemented, an understanding of the area where it is indigenous is also necessary. The area where it is indigenous has its unique geographical and ecological characteristics like high and low tides phenomena etc. In those areas a very well organized market system has also been developed focused on the floating bed cultivation. The farmers of those areas mainly produce seedlings and there is a high demand for those seedlings. Even the farmers can directly get orders for seedlings from the businessmen. The market related to floating bed cultivation of those areas are so developed that the prepared floating bed can also be bought from the market. There are few villages of those areas where people just prepare floating beds to sell in the market. In the new areas where floating bed cultivation can be implemented, this research suggests that a good market system be developed for the products from the floating bed.

By developing a good marketing system for the floating bed farmers, the projects can be more successful.

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