POPULATION GROWTH AND ACCESS TO NATURAL RESOURCES IN *HAOR* AREAS: A SPATIO-TEMPORAL APPROACH

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Submitted by

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DECLARATION

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I hereby certify that the thesis entitled "Population Growth and Access to Natural Resources in *Haor* Areas: A Spatio-Temporal Approach" is the original research work carried out by Shah Israt Azmery. The research is accomplished under my supervision for the Degree of Master of Philosophy in Geography and Environment. She has fulfilled all requirements according to the rules of the University of Dhaka regarding submission of the thesis.

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ABSTRACT

The present research interprets the decadal population change in *haor* areas and assesses the impacts on natural resources in the study area. In the study, using on both quantitative and qualitative methods mainly primary data were collected from two selected upazilas (Tahirpur and Dharmapasha) of Sunamganj District. A total of 150 households were selected in nine villages for questionnaire survey. Four Focus Group Discussions were conducted with the villagers such as farmers, fishermen, day labors and local people of the study area. Moreover, eight Key Informant Interviews associated with the government, journalist, leaseholder and other organizations for collecting in-depth information were also carried out. Collected data were analyzed with SPSS. Secondary data were also collected from the relevant intuitions. Study results show that the study *haor* areas significantly contribute in the national economy being sources of a large number of fish species, flora, fauna and fertile cropland. Thus, the people of *haor* area immensely rely on these natural resources. People living in the study area are fully dependent on *haor* resources to sustain their lives. But over time, due to increasing population pressure, *haor* resources are over-exploited and being degraded. Results from both qualitative and quantitative analysis demonstrated that the population of the study area has increased manifold in the last few decades. Most of the local people involved in various *haor* related activities. Agriculture is the main source for their livelihoods through a significant part of them are involved in fishing during monsoon period. Thus poverty, illiteracy, lack of awareness, illegal fishing, hunting water birds, over harvesting, dewatering for fishing, over fishing, using chemicals and pesticides for agriculture, water logging, deforestation and shrinking of water birds are the major issues for degradation of natural resources. The land cover, vegetation and waterbody of the study area have also decreased due to over-exploitation. Therefore, proper implementation of existing policies and strategies as well as community participation in *haor* conservation is essential for the sustainable management of wetland resources. Thus, government and stockholders have important role in the sustainable management of natural resources in study areas.

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CHAPTER I

INTRODUCTION

1.1 Background

Wetlands are the most significant productive ecosystem and rich in biodiversity, which depend on them to survive. In addition, a high number of fishes, amphibians, reptiles, birds, mammals and invertebrate species are reinforced by the wetlands (Khan et al. 1994). In Bangladesh, these are very important components of the environment, ecology, resources and biodiversity. They are also integral part of the local ecosystem based cultures (Daily Star, 2010). Bangladesh is located in the delta part, which is one of the world's major river systems and land of vast water and wetlands. More than two thirds of the country's landform may classified as wetland and it has great role for the country's every sectors. (IUCN, 2012). Geographically, the main characteristic of Bangladesh is that the country has great quantity of water and wetlands (Alam and Chowdhury, 2003). By the grace of nature, these wetlands are the major parts of Bangladesh and provides a large of species and other components.

According to Mitch and Gosselink (1986), wetlands are the transitional lands between terrene and aquatic ecosystems where the water table is nearer on the surface or else land covered by shallow water. That means wetlands provide different and unique phenomena, and have a great importance to support the ecology of a country. These wetlands include world heritage sites, which have significant values to ecological, biological, hydrological sets such as thermal features and underground rivers (Blasco and Aizpura, 1997). These wetland mechanisms are enriched with sedimentation composition as clay soil, organic matters and silt deposition, which occurs during the monsoon (Bhuiyan, 2013).

Wetlands create a link between land and water in our country. Most of the people of Bangladesh are seriously dependent on wetlands for their livelihoods (Byomkesh et. al, 2008). Therefore, these are very essential for biodiversity, agricultural diversity, fisheries and for other purposes. In the monsoon, these inundated at shallow to deep levels. According to Alam and Chowdhury (2003), wetlands defined as "low-lying ecosystem

where the ground water table is always at or near the surface including areas of marsh, fen, bog, floodplain and shallow coastal areas." Moreover, International Union for Conservation of Nature (IUCN 2012) mentioned that, wetlands ecosystems have a great importance for their critical economic, ecological role that they play in sustaining life and livelihoods in the country.

The term "wetland" means a very low-lying ecosystem. It includes marshes, *jheels, beels,* bogs, floodplains and shallow coastal areas. It is divided into Estuarine and Freshwater zones, which are again subdivided according to their soil types and plant life (Bhuiyan, 2013). Globally, wetlands are defined as all areas, which are permanently or intermittently inundated with a depth of water of maximum six meters. These included inland water such as peat areas, wet grasslands, shallow lakes, marshes and swamps, streams and river. Moreover, wetlands includes coastal areas and these are mudflats, sea grass areas, mangroves, coral reefs and human-made wetlands such as rice paddies, saltpans and aquaculture ponds (Dam, 2019).

The Ramsar Convention, adopted and used in Bangladesh (1971), defined wetlands as "Areas of marsh, fen, peat land, or water, whether natural or artificial, permanent or temporary, with water that is static or flouring, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters." Thus, these wetlands are the formation of contrasting habitats like the fluvial, estuarine, coastal and marine habitats. Generally, 39 categories of wetlands are globally recognized and 30 are natural and the nine are human- made. These categories are mainly based on their biological, physiological and ecological characteristics (Dugan, 1990; Bhuiyan, 2013).

The Ramsar Convention is an international treaty and signed in Ramsar, Iran in 1971. Ramsar is the first modern global treaty for conservation as well as works for the wise use of wetlands and wetland resources (Ramsar Convention, 1971). By the estimates of global wetland area range are about 5.3 to 12.8 million km^2 and about half of the global wetland area has been lost. However, Ramsar Convention (1971) helped 144 nations to protect the most significant remaining wetlands (Zedler and Kercher, 2005). The convention also recognized that more than two-thirds of Bangladesh's area classified as wetlands. Water, agricultural functions, fish and natural vegetation and soil structure influence the

characteristics of Bangladesh's wetlands, which are different from the surrounding uplands (Byomkesh et. al, 2008). Wetlands form a unique mixture of habitats with extremely rich biodiversity of flora and fauna. Wetlands also support the livelihood of local people and many people are engaged in such diverse activities. Fishing, agriculture, thatching material and collecting of fuel wood are the activities of wetlands area (Daily Star, 2010). There is a close relationship between wetlands and the local people and the people depend on wetland resources for their livelihoods. Wetlands of Bangladesh has a great role to support the economic, ecological and commercial sector. They are rich in biodiversity as well as to floral and faunal composition. A large variety of fish species and migratory birds are the important assets of wetlands. Wetland areas are the consisted of rivers, streams, freshwater lakes and marshes including *haors, baors, beels,* water storage reservoirs, fishponds in Bangladesh (Rahman et. al, 2001).

Haors are back swamp or bowl shaped floodplain depression, which is seasonally inundated. According to IUCN *haors* are covered an area of approximately 24,500 km^2 (2004). Generally, *haors* found in the northeastern part of Bangladesh such as Mymensingh and in greater Sylhet and the total *haors* known as *haor* basin. The region formed by the out of the Meghna basin. It is a wetland ecosystem, which is characterized by the presence of large, bowl shaped floodplain depressions (Care Bangladesh, 2016). It is also exceptional wetland with hydro-ecological environment and rich in biodiversity. According to IUCN (2004), during the monsoon, *haors* remain under water for several months. *Haor* basin mainly consists of seven districts in the northeastern part of Bangladesh. Sunamgonj, Habigonj, Moulvibazar, Kishoregonj, Brahmanbaria and Netrokona are covering areas of 20,022 square km. The abundance of natural resources made the areas richer than any other parts of the country and provide food, fuel wood, aquatic resources and retain the ecological balance for the local people and for the land. The people of *haor* areas mainly rely on *boro* crops and fishing. Some other people also dependent on livestock and small business (Farid, 2018). CNA, Bangladesh (2017), estimated that, 5.25 million MT of rice produced in the *haor* areas, which contributed about 18% of the total rice production of Bangladesh. These areas have an estimated fish habitat area of around 967,000 ha as well as about 269,005 ha of forest resources, minerals and energy resources towards support the country.

There are many *haors* in the northeastern part of the country. Among them Tanguar *haor* is one of the largest wetland systems in the northeastern part of Bangladesh, which recognized as Ramsar sites in 2000 (Sobhan et al, 2012). It plays an important part in the country's economy due to its natural richness and diversified ecosystem (Haughton, 1994). The *haor* consists of 46 to 50 *beels* of various sizes (large and small) and total river areas within the *haor* is about 359, 39 ha (BFD, 2012; Sobhan et al, 2012). Tanguar *haor* mainly lies in Tahirpur and Dharmapasha upazila of Sunamgonj district. This *haor* has diversified biodiversity. It is rich in fish habitats. It also provides a large number of migratory waterfowls. However, it is seriously endangered for human interventions (IUCN, 2012).

Haor region remains a part of Bangladesh where natural hazards, seasonal food insecurity, typical socio-economic patterns and political exploitation create extreme condition for long time. Moreover, this region is highly vulnerable due to climate change. Unique physical sites and hydrology are the magnitude reasons for the climate change and affect people and natural resources (Care Bangladesh, 2016). Flash floods are the major natural disaster that the *haor* basin faces in every year. That is why flash flood is a serious issue, which disrupted livelihood and others (every 2-3 years) in *haor* areas (Farid, 2018). Local dwellers are at very high risk for flooding and threatened to crop production. Wetlands destroyed gradually by human made or spatial activities. However, the conservation and management system is not sufficient for ecological restoration (Paula et al, 2014). The wetlands of Bangladesh play a crucial role to maintain the ecological balance of ecosystems. Besides, the wetlands habitats of the country is under threat due to the rapid population growth, intensive agriculture, over fishing, siltation problem, environmental pollutions, ill-planned infrastructures, lack of institutional coordination, lack of public awareness and for other reasons. For that purposes, biodiversity is reducing; many species of flora and fauna are threatened as well (Talukder et al, 2008).

The wetland-based ecosystem is also decreasing and the living standards of local people such as livelihoods, socio-economic conditions and cultural values are affected. Islam (2010) observed that smart use of wetlands and research on wetlands may solve the ecosystem problems in the floodplain areas of Bangladesh.

In order to balance human needs and wetlands conservations, Bangladesh government took initiatives for community based wetlands management approach (Byomkesh, 2008). However, this is not abundant to prevent the degradation of wetlands. Government initiatives are not sufficient. There is no specific legislations for the management and monitoring system of wetlands in our country, though very few laws adopted for wetlands. However, International organizations and NGOs are playing a vigorous role for the consumption of wetlands (Bhuiyan, 2013). Therefore, Bangladesh needs comprehensive strategies in every divisions as political, economic, social and technological approaches to control the wetland degradation (Byomkesh et al, 2008). That is why appropriate policies, strategies and management for sustainable use and conservation of wetlands in Bangladesh are very important. In order to protect the wetland resources, significant knowledge and awareness of people are the integral part of wetland management processes.

1.2 Statement of the Research Problem

Wetlands ecosystems are rich in biodiversity and have a great role to provide tremendous natural resources in Bangladesh. The geographical condition, biodiversity and livelihood patterns of *haor* areas are distinct from other parts of Bangladesh. Wetlands are important northeastern part of Bangladesh and have rich biodiversity, geographical characteristics and other important components. The people directly or indirectly depend on *haor* related activities. Therefore, any changes of natural resources and biodiversity of the *haor* area directly relates and affects the livelihood patterns of *haor* area. These areas also include Tanguaor *haor,* recognized as second Ramsar Site of Bangladesh. Tanguar *haor* is famous as a single source of fishes, which fulfill the demand of protein, source of greenery, covered with green swamp forest, and remain as the sanctuary for various local and migratory birds. However, rapid population growth is a common and most serious issue in Bangladesh, which is extremely, influenced the northeastern part as well as the *haor* areas. (Haque and Basak, 2017). On the other hand, Tanguar *haor f*aces many threats and challenges such as soil erosion, forest degradation, habitat degradation, water imbalance, unbalanced human interference and illegal poaching (Sobhan et al. 2012). Moreover the people of *haor* areas involved with various fishery related activities like catching fish, producing fish, fish drying, transporting fish, knitting net for fishing, trading fish and fish related products to

maintain their regular needs. Though *haor* areas are resourceful, the activities of *haor* people destruct the biodiversity and ecology of the region. Subsequently, it affects the inhabitant like animal, birds and different fish species.

Rapid population growth is the common feature of our country. For that reason high population growth, extremely influence this part of the country. High population growth rate is the most common issue in our country. In order to accomplish these basic needs, like food, shelter *haor* people cut forest trees and they destruct the forest and land. At present many species of fish extinct from *haor* areas. Besides there is no proper initiatives for using *haor* resources and people extract natural resources in *haor* region. Current leasing system is one of the major threats to the management of the area and it encourages maximum exploitation. For that purposes, the people who engaged to the *haor* activities by inherent are displaced from their ancestor's profession. During last few decades, extensive agricultural activity has been expanded in those areas. Extreme use of agrochemicals, insecticides, fertilizers made the environment of the areas worst, which directly or indirectly disturb the wildlife specially the waterfowls and the fish habitats. The people of these areas, involved with various types of activities. From the previous record, a very few people started agricultural activities in the areas and thus they disrupt the areas, reserve forest, swamp forest, state forest and planted forest in *haor* areas. The unemployment rate is noticeable in the area. Many people already have been migrated from the *haor* areas due to lack of employment opportunities. For that reason, poor people are being poorer day after day, resourceful areas gradually turned into resource less through overexploitation. Therefore, population pressure creates many complications in the *haor* areas and mostly the local people rely on *haor* resources. All these issues are responsible for the environmental degradation of the areas to require the demands of the local people.

1.3 Research Questions

i) What are the spatio-temporal changes on *haor* resources due to population growth?

ii) How is the access to *haor* resources influenced through overexploitation?

1.4 Objectives of the Study

The broad objective of the study is to analyze the population growth and access to natural resources in *haor* areas in a spatio-temporal approach. However the specific objectives are-

i) To analyze the decadal population change in *haor* areas.

ii) To assess the impacts of rapid population growth on natural resources in the study area.

1.5 Justification of the Study

Wetland includes *haor, baor, beels* and a wetland ecosystem in the northeastern part of Bangladesh is known as *haor*. Physically it is a bowl or saucer shaped shallow depression and also known as a back swamp. These areas are the most important part of Bangladesh and day-by-day *haor* areas are influenced by both humanitarian activities and natural calamities. High population growth is one of the most influencing factors, which impacts on the natural resources of these *haor* areas. Therefore, the biodiversity and natural resources are constantly degraded. However, there are many research works on wetlands as well as population growth and changes of natural resources in *hao*r areas. Nevertheless, there are few studies on population growth and the impacts on *haor* resources by humanitarian activities in spatio-temporal approach. Thus, these issues inspired me to work to analyze the decadal population change and access to natural resources in *haor* areas in the basis of spatio-temporal approach. Hence, the study is very important to find out the decadal changes of population growth and the decadal changes of natural resources of *haor* areas, which are influenced by overexploitation.

1.6 Organization of the Chapter

This study is divided into seven chapters. Chapter I presents the background of the study that discussed about the wetlands, mainly freshwater wetlands in the northeastern part of the country. These wetlands are known as *haor* Basin of Bangladesh. Also presents the overall scenario of *haor* basin and summarized through background. The study tries to find out the problems, which is discussed throughout the problem statement. Research questions and study objectives have been presented in the first chapter to examine the actual

condition of the *haor* basin and how the people access on natural resources and affect as well. This chapter also included justification of the study and the organization of the chapter.

Chapter II tries to present the comprehensive discussion by the relevant documents and literatures as journals, newspapers, articles, reports and others. This chapter titled as literature review and described the status of natural resources and population growth. . This chapter demonstrated the previous studies and researches, which are particularly related and supportive to the present study. Therefore, it includes the definition, classifications, physical scenario of wetlands. Besides the natural resources, biodiversity, ecosystem, importance of *haor* resources, the people and socio-economic conditions of the local community, the impacts of population growth on wetland resources are included here. Finally, this chapter discussed about the degradation of the wetlands, policies and acts, management and the community participation in the sustainable management system. All these arranged and contained within a general consequence.

Chapter III presented the whole process of the study and titled as research design. This chapter totally discussed about the complete procedure of research methodology. It presents the location of the study area, section of the study area, respondent's selection, data collection, Key Informant Interviews and group discussion (FGD). Data analysis, data interpreting and map-making procedures are also encompassed here.

Chapter IV is the part, which presents the decadal population change and growth rate of the study area. The socio-demographic profile, incomes, livelihoods pattern, migration, landownership, health and dependency on *haor* resources comprised. This chapter titled as population change and the respondents. It also configured by the results from field survey and secondary information about the study area. It tries to recognize the problems and research objectives and thus it presents the past and present conditions of the respondents in the study area. Chapter V demonstrates the state of natural resources. Therefore, it attempts to examine the *haor* as decadal changes of vegetation, land cover, waterbodies, and biodiversity and like to discuss about the natural hazards, which damages the crop production in the study area. This chapter embraces the causes and indications of *haor* degradation and the impacts of population growth on natural resources in the study area.

Also tries to focus the governmental and non-governmental initiatives to protect *haor resources.*

Chapter VI presents degradation and *haor* conservation in the study area. This chapter configures the results from the group discussions and key interviews through the locals and officials. Mainly based on the interviews that they are very relevant and engaged to *haor* areas. The present study tries to fulfill the study objectives. Thereby this chapter thoroughly discussed about degradation, activities, environmental issues, conditions, and conservation of the *haor* resources in the study area. In addition, presents the possible steps to protect *haor* resources for the sustainable management.

Chapter 7 is the final chapter and it comprises the major findings, summarized the present study and provide concluding remarks, which is mainly based on the research findings. Finally, the chapter ends with several recommendations, which are able to adopt in the future development project or policy framework for the sustainable management of the *haor* resources.

1.7 Chapter Summary

According to Master Plan (2012) of Haor Areas, there are 373 *haors* or wetlands in the northeast part of Bangladesh. This study tried to find out the rapid population growth change and examined the impact on natural resources of *haor* areas. The areas are rich in natural resources as well as to contribute in country's economic development. Thus, these areas are very important part of our country. Now days, to fulfill the demand of high population growth, directly or indirectly local community dependent on *haor* or wetland's resources. In that case, *haor* people constantly affect many species of fish, migratory birds, vegetation, and lands. Population pressure is highly interrupted the natural feature of *haor* areas. Moreover, lack of proper transport and *haor* management systems are hedges for the development of the *haor* areas. Thus, the study area needs proper management that is necessary for the natural resources.

CHAPTER II

LITERATURE REVIEW

2.1 Wetland

Bangladesh has enormous wetland area, which included rivers and streams, freshwater lakes and marshes, haors, *baors, beels*, fishponds, artificial lakes, flooded cultivated lands and estuarine systems with wide mangrove swamps (Rahman et al.1996; Chakraborty, 2009). Wetlands are very important that are the part of human heritage and played a significant role to develop human culture and society. It also contains very rich components of biodiversity and has local, regional and national importance. Moreover, wetland provides waterfowl, a significant number of endangered species and a large number of species, which are commercially very important for a country (Islam, 2010).

The total area of wetlands in Bangladesh estimated as 70000 to 80,000 km^2 and it is about 50% of the total land of the country (Akonda, 1989; Khan et al. 1994). In Bangladesh, wetlands reduced severely due to human intervention. People are involved in different activities to dominate wetlands for fulfilling their essential needs. Due to flood control, drainage system and irrigation development, approximately 2.1 million ha wetlands are lost in the Ganges-Brahmaputra-Meghna flood plain (Rahman et al.1994; Kabir and Amin, 2007). For that, reason wetlands are facing serious problems by the humanitarian impacts and environmental changes (Sarkar, 1993; Nair, 2004; Ahmed et al. 2008).

2.1.1 Definition of wetlands

Generally, there is no any adequate definition of wetlands to classify, because it depends on the objectives and the background of the manipulators (Gopal, 1992; Kabir and Amin, 2007). According to Ramsar convention Bureau (1971), "Wetlands are the areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary with water that is static or flowing, fresh, brackish or salt including areas of marine water, the depth of which at low tide does not exceed 6 meters." Wetlands are the areas where water is the primary factor to control the surrounding environment, plants, animals and others. In addition, they occur where the water table is at or near the land surface. Otherwise, wetland occurs where the land is covered by water. In addition that wetlands are also defined as

"wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water"(Cowardin et al. 1979). In 1990 Dugan defined the term of wetland as groups of a wide range of inland, coastal and marine, shares a number of common structures.

2.1.2 Classification of Wetlands

Wetland includes the major ecosystems in the world, which is comprised forest, grassland, agricultural lands and aquatic habitats. Globally more than six percent (8.6 million km^2) of the land is associated with wetlands, which plays a great role in locally or regionally (Mitsch and Gosseslink, 1993). IUCN identified thirty-nine categories of biological and physical characteristics. From that, thirty are natural and nine are human made (Dugan, 1990). There are also three broad classifications of wetlands, which are covered these thirty-nine categories. These three broad classifications are – (a) salt water (b) fresh water (c) human made wetlands. Fresh water wetland includes *haor, baor, beel, jheel*, which contains four landscape units such as floodplains, freshwater marshes, lakes and swamp forest. Furthermore, Ramsar recognized that there are also 42 wetlands types in three categories. These are mainly (a) marine and coastal wetlands (b) inland wetlands (c) human made wetlands (Ramsar Convention Secretariat, 2010). It also can divide in to six major divisions such as (a) The Ganges-Brahmaputra-Meghna floodplain basins, (b) The *haor* basin of northeast region (c) Lower Punarbhava floodplain (d) Gopalgonj-Khulna beels (e) Chalan-Beel (f) Surma-Kushiara floodplain (Alam and Chowdhury, 2003). Swamp, bogs, marshes, fens are the general classification of wetland.

2.1.3 Importance of Wetlands

Wetlands are extremely precious for the environment, ecology and biodiversity also. These are the integral part of the local ecosystem, which closely related with local culture. Moreover supports the livelihoods of millions of people mainly based on diverse activities such as fishing and agriculture (Byomkesh et al. 2008). Furthermore, provides important ecological functions, socio-economic services and yields and have commercial value. On the other hand, these are very significant and other benefits such as recreational value, flood control value, water, pasture value and others have significant value (Colavito, 2002). Wetlands are the world's most productive environment and supporting the high

concentration of birds, mammals and for other species. It is also important storehouses of plant genetic material. Thus, these are important and sometimes essential for the health, welfare and safety of local people who live in or near wetlands.

Sharma (2010) mentioned that, most of the people of Bangladesh depends on wetlands, which covered more than half of the country's geographical area. Moreover wetlands are the shelter place for some inhabitants, most of them are engaged in agriculture and fishing in the *haor* area. During the monsoon, these are very important fishing ground for a country as well as significant area for *boro* crop production. Especially the poor and landless people derive various resources from wetlands for their regular use.

2.2 Wetlands in Bangladesh

Geographically Bangladesh is bordered by India in the east; west and north, except in a slight portion in the east by Myanmar and the country allocated 288 mountainous borders in the southeast part. The country extends 1004 km north to south and 700 km east to west. The south portion is highly irregular deltaic coastline of about 210 km long where many rivers and streams are flowing into the Bay of Bengal (Islam, 2010). Bangladesh lies in the largest delta part in the world. The Ganges, Brahmaputra and Meghna (GBM) river system form the Bengal Basin. It comprised only seven percent of the total GBM catchment area (Coleman, 1969). Furthermore, ninety percent of the wetlands of Bangladesh are dependent on the flow from three major rivers (Figure 2.1). Now these are threatened by the change of water in India to the Gages-Padma Rivers (Gopal, 1995).

The wetlands of Bangladesh have enormous economic, ecological and commercial importance. They are rich in biodiversity, which consists of floral and faunal composition. In Bangladesh, the total wetland area is estimated at seven to eight million hectors and it is about fifty percent of the country's land surface (Rahman et al. 1996). These wetlands are embraced a wide variety of dynamic ecosystem. In addition, included mangrove forest, natural lakes, human made reservoirs, *beels*, rivers, *haors*, extensive floodplains, which are seasonally inundated (Akter, 2011). Wetlands are the great linkage between land and water that made the environment richer than other parts of the country. There are five types of wetland in Bangladesh and such as saltwater wetlands, freshwater wetlands, palustrine wetlands, lacustrine wetlands and human made wetland (Nishat, 1993; Khan et al.1994;

Gopal, 1999). Most of the people in Bangladesh are critically depended on wetlands (Byomkesh et al. 2008). Huge variety of freshwater fish species exist in wetlands of Bangladesh and the physical characteristics of fresh water wetlands (Figure 2.1) provides natural resources, which are immensely important components of the environment

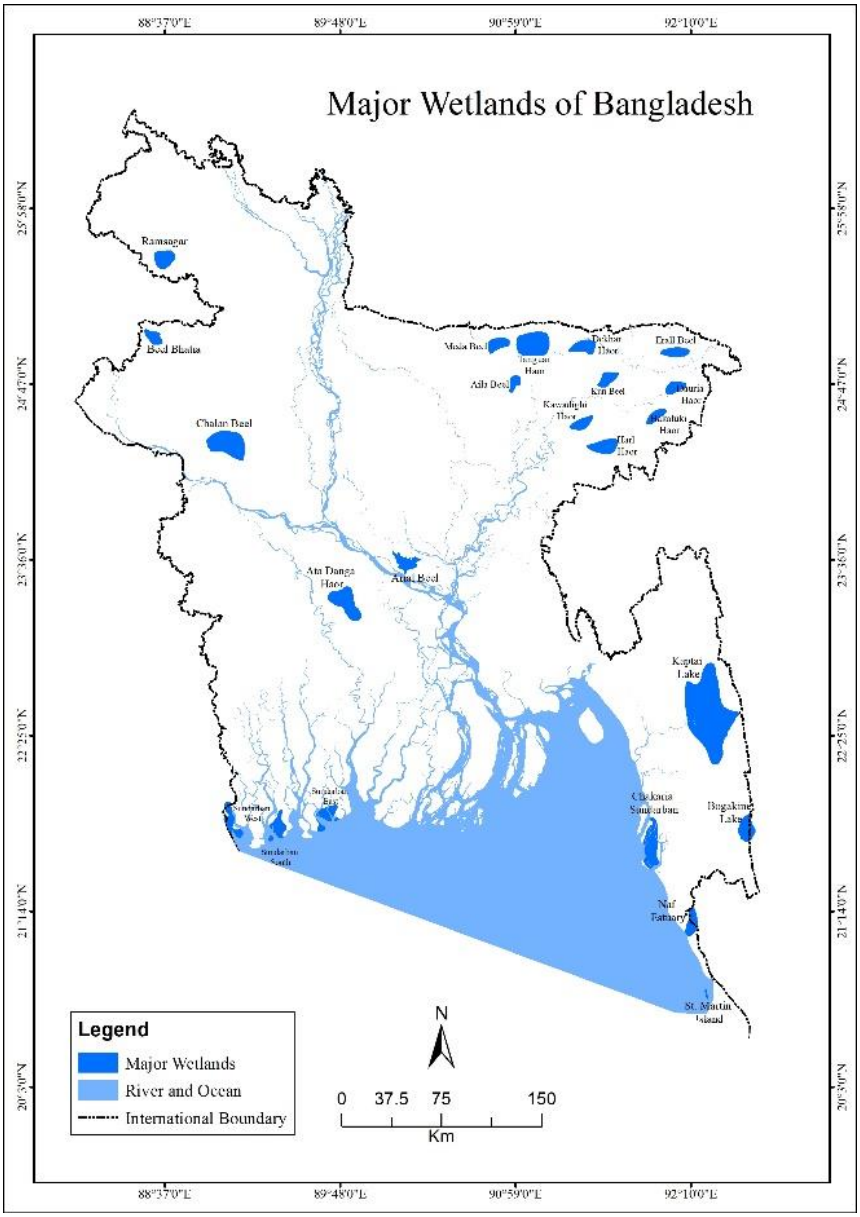

Figure 2.1: Major wetlands in Bangladesh.

2.2.1 *Haor* Basin in Bangladesh

According to IUCN Bangladesh (2004), "*Haors* are back swamp or bowl shaped depressions between the natural levees of a river which are subjected to seasonal flooding every year." They mostly found in the eastern part of greater Sylhet and Mymensingh

district. The total regions known as *haor* Basin in Bangladesh. It covers an area of approximately 24,500 square kilometers. Every year they remain under water for several months as seven to eight (7-8) months. According to IUCN (2004), the difference between a *haor* and floodplain is that the retaining of water, which is 7-8 months for *haor* and 4 to 5 months for a floodplain.

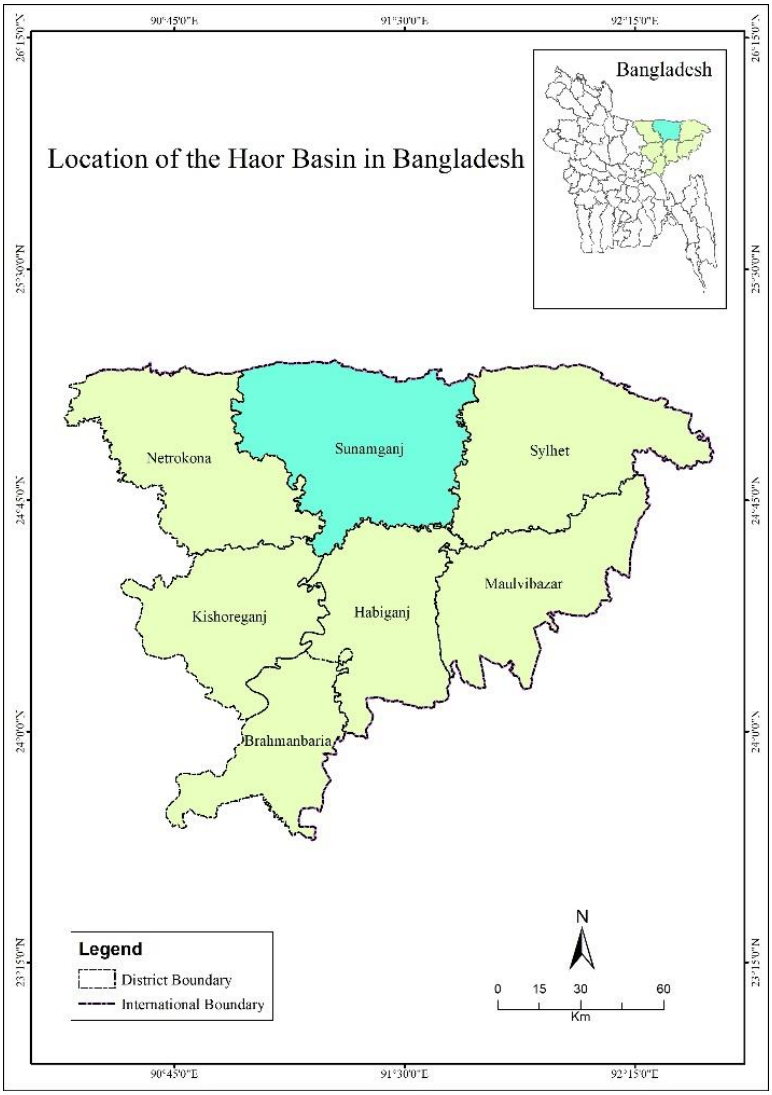

Figure 2.2: *Haor* Basin in Bangladesh

The *haor* basin has unique hydro-ecological characteristics that is completely exceptional to other sight in Bangladesh. The northeastern part of Bangladesh is covered approximately 1.99 million hectors of area and almost 19.37 million people are accommodating in that

region. There are about 373 *haors* in our country and these are located in the districts of Sunamganj, Sylhet, Habiganj, Maulvibazar, Netrokona, Kishorganj and Brahmanbaria (Figure 2.2). These wetlands are covered an area is about 859,000 hectors, which is around 43%of the total area of the *haor* districts. It is a mixture of wetland habitats and includes rivers, streams, canals, *beels* and large number of areas, which is seasonally flooded cultivated plains (Master Plan of *Haor* Area, 2012).

2.2.2 Ramsar Site of Bangladesh

The convention on wetlands is the only international legal treaty and mainly it focused on wetlands. This legal treaty on wetlands signed in 1971 in the Iranian city of Ramsar and known as Ramsar Convention. It came into force in 1975 and 170 countries joined in this convention as contracting parties (Global Wetland Outlook, 2018). The purposes of the Ramsar convention is to promote the wetland conservation as well as the wise use of wetlands. It also provides a platform to deliver a lot of global wetland related targets.

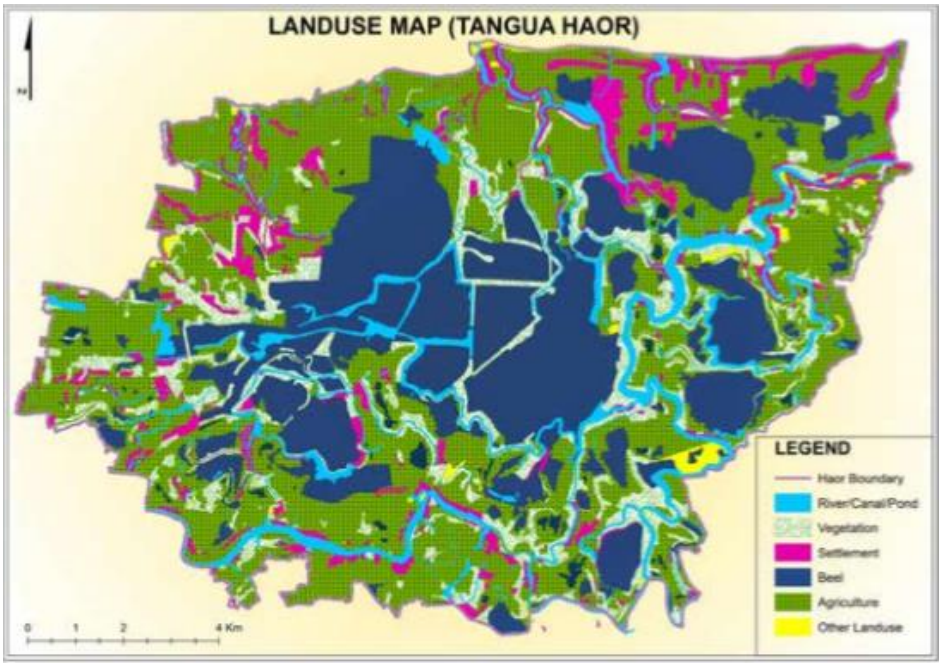

Figure: 2.3 Land use Map of Tanguar *Haor*
(*Source: IUCN 2015)*

Bangladesh demonstrated its concern for the management and conservation of wetland by the National Environment Policy to carried out a workshop on wetland. Finally, in May 1992, it became a signatory of Ramsar convention (Khan et al. 1994). The government of

Bangladesh recognized the ecological importance of the area as Tanguar *haor* and declared the *haor* is an "Ecological Critical Area" in 1999 (Daily Star, 2017). In 2000, the Ministry of Environment and Forest (MOEF) declared that "Tanguar *haor"* is the second Ramsar Site in Bangladesh. It is one of the largest *haor* in the country and has a diversified ecosystem and biodiversity (Figure 2.3). Tanguar *haor* is located in the northeastern part of the country, Tahipur and Dharmapasha upazilas of Sunamganj district. The *haor* is covered with 46 villages including incredible biodiversity and natural resources (Figure 2.4).

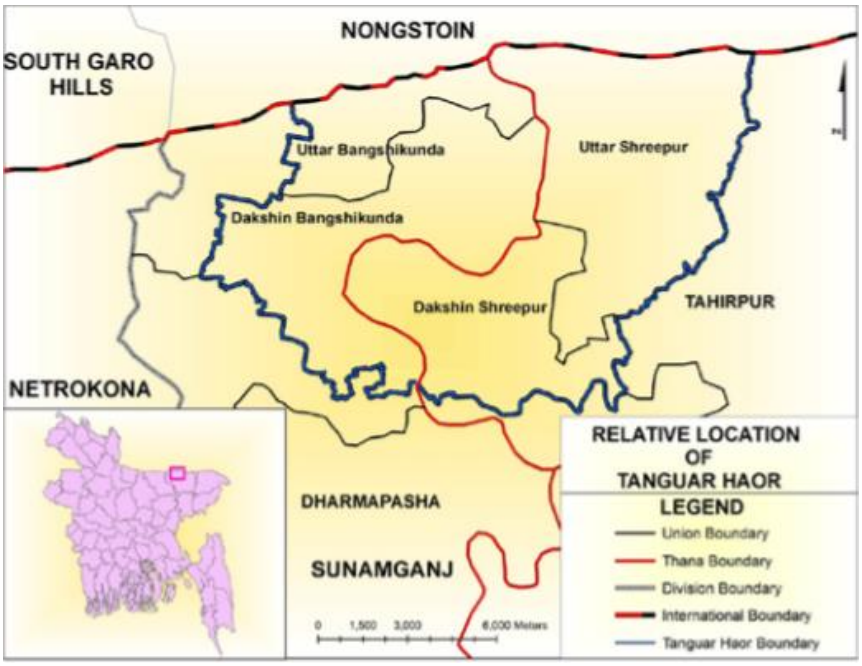

Figure: 2.4 Map of Relative Location of Tanguar *Haor*
Source: IUCN, 2015

Due to human interruption, *haor* resources are immeasurably degraded and the species are seriously endangered. Thus, IUCN Bangladesh is working for the conservation of Tanguar *haor* on behalf of the Ministry of Environment and Forest. Local people are also included in the conservation as community based participation for wetland management system (IUCN, 2015).

Bangladesh government took several projects and initiatives in order to implement the wise-use policy of wetland conservation. The participation of local communities is widely accepted for the local natural resource management (GOB, 2002; Agarwal, 2001). Thus in

the Tanguar *haor*, the villagers participated in the conservation system to protect *haor* resources. Moreover, these natural resources are more important for the sustainable development.

2.3 Physical Scenario of *Haor* Areas

The physical composition and hydrology of *haor* region created unlimited opportunities and has distinct hydrological characteristics. The annual rainfall is ranged from 2200 mm along with the western boundary to 5800 mm in the northeast corner. It is as high as 12000 mm in the headwaters of some catchments, which extends to the part of India. The *haor* region receives water from the catchment slopes of the Shillong plateau, which across the boundaries in India to the north and the Tripura Hills in India to the southeast part (Master Plan of *Haor* Area, 2012). According to CNA Bangladesh (2017), heavy rainfall and runoff from the upstream hills in India lead flash floods. It occurs in the cropland of *haor* areas and in the low-lying areas of northeast part of the country. Flooding started in March and gradually affected six districts (Habiganj, Kishoreganj, Moulvibazar, Netrokona, Sunamganj and Sylhet). Rising water overflowed and inundated the areas of cropland and damaged a significant number of houses as well. It influences the lives of local community. Moreover, the area as agricultural land remains under water for several months. The primary crop (Boro) also damaged by flooding in every year. Generally, flash floods occur in April and early May. On the other hand, monsoonal flood mainly starts in June to August.

2.4 Natural Hazards in *Haor* Areas

Flash flood is the major hazard in *haor* areas that hampered the primary production as *boro* crop and threatened to the lives and livelihoods of the local community. Thus, flash flood is the most unwanted issue for the people and causes huge damages in the whole *haor* region. Improper drainage system, deforestation, excessive rainfall in the upstream hilly region, landslides are the reasons for flash floods. The people are more vulnerable than any other part of the country due to flash floods and they have no work to sustain their lives and families properly (CNA, Bangladesh). Every year it occurs in April and early May and causing huge damage in the surrounding areas. People lose their crop production and facing

many challenges. Moreover huge amount of silt deposited in *haor* by rivers and causes siltation problem. Every year siltation problem creates many complications and acutely influences the *haor* functions. Moreover, floods, soil erosion and storms are regular natural hazards in the *haor* areas.

2.5 Natural Resources of *Haor* Areas

Wetlands are the most productive ecosystem. Huge varieties of plants, species and animals are depended on wetlands to survive. Wetlands support a high concentration of fishes, birds, reptiles and a large number of mammals, invertebrate species and amphibians (Khan et al. 1994). It plays a crucial role to maintain the ecological balance of ecosystem. However, the wetland habitats of Bangladesh are under threatened due to over population, overfishing, intensive agriculture, siltation, pollution, ill-planned infrastructures, lack of institutional co-ordination and lack of awareness (Byomkesh et al. 2008).Wetlands are encompassed different habitats and included ponds, marshes, swamps, which are very ecologically important areas of a country. However, these places attach land and water as well as pouring themselves. Vegetation, plants, fishes, aquatic plants, reeds, algae helps to make the wetlands highly productive environment. The composition of flora is relatively uniformed and these are the influential part of the wetland ecology.

2.5.1 Fisheries

Generally, *haor* basin is a low-lying bowl shaped basin, which is covered approximately 6,000 sq. in Sylhet division. It has huge fishery resources. Thus, it is important fish production area of the country as well as commercial and ecological value (Salauddin and Islam, 2011). The *haor* area comprised a wide variety of finfish including 143 indigenous and 12 exotic species along with various species of fresh water prawns. Fish species broadly grouped into two categories such as large and small fish. Wetlands are the ground for breeding, nursing, feeding and for the freshwater migratory fish species that make environment resourceful. (Master Plan of *Haor* Area, 2012). The following Figure 2.5 shows the fish species in Tanguar *haor* and this *haor* provides a large variety of fish species.

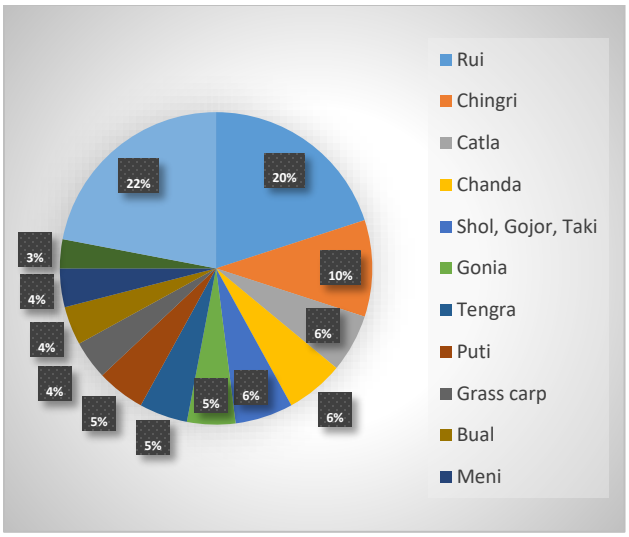

Figure 2.5: Fish Species in Tanguar *Haor* (Catch Basis)
Source: IUCN 2015

In Bangladesh the fish production of *haors* have commercial and economic importance. Every year all over the country, a large number of fish production provide the main source of protein for the country's people (Byomkesh et al. 2008). Therefore, fishery resources of *haor* areas are the most important for the country's economy. A large number of fish species such as Rui, Chingri, Catla, Shol,Gojor, Tengra, Bual, puti, Kalbaush and other species of fish are available in Tanguar *haor* (Figure 2.6).

2.5.2 Forest

Naturally, *haor* areas are full of hill forest, social forest, fresh water swamp forest, reed lands, bush, bamboo, grove homestead vegetation and others. Forest resources are also important part of the *haor* region. Local people are mostly depend on the forest resources for their domestic needs. They collect non-timber trees for domestic fuel wood. Furthermore, local villagers collect grass and reeds from forest. About hundred years ago, before the establishment of leasing system, local people collected fuel wood, grass, reeds for their domestic purposes. Nevertheless, in the recent past years, local villagers were restricted to exploit *haor* resources. The leaseholders maintained *haor* resources for their own purposes as to construct entrenchment in the *beels* to attract fish habitats. Local villagers blamed them to deteriorate the forest resources by collecting trees from the forest (Kabir and Amin, 2007).According to Alam and Choudhury (2003), typical wetland trees

are Hijal, Tamal, Barun, Chalta, Dehua, Dumur, Madar, and Gab. A large number of wetland plats are collected as fodder for the cattle. Fuel wood from the swamp forest and people collect grass and reeds for the construction of settlements with in the reed beds (IUCN, 2012).

2.5.3 Wetland Waterfowls

Wetlands are exclusive that have potential for attractive tourism. In winter, *haors* and *beels* receive thousands of migratory birds. This winter season is the right time to visit migratory birds especially in the Tanguar and Hakaluki *haor* (Master Plan of Haor Area, 2012). Tanguar *haor* is the largest wetland of Bangladesh and provides a wonderful habitat. Every year in the winter season, a large number of waterfowls exist in the area and the floral diversity is suitable for migratory birds. As a result in winter season, 100 types of migratory birds come to this *haor* to make their temporary habitat and this areas are suitable for their breeding (IUCN, 2012). The Figure 2.7 shows the availability of birds in the Tanguar *haor* but this are threatened due to over hunting. After the declaration as Ramsar site, government banned hunting and trapping all kinds of waterfowls in the *haor* area. During the leasing system hunting was very common issue and most of the local people involved in hunting birds. They sale waterfowls in the market as commercial basis (BCAS, 1997).

2.5.4 Mineral Resources

Wetlands are valuable for unique and dynamic ecosystems, which have productive and ecological value (Salauddin and Islam, 2011). These are also very rich in mineral resources. Various types of energy and mineral resources are available in the *haor* areas. The mineral resources are as natural gas, crude oil, limestone, white clay, coal peat, glass, grave, and sand as construction materials (Master Plan of *Haor* Area, 2012).

2.6 Biodiversity and Ecosystem

The most significant wetlands in Bangladesh are Hakaluki *haor*, Tanguar *haor*, Matian *haor*, Boro *haor*, Dekar *haor*, Sonamohol *haor* and others. These *haors* are rich in wildlife community including 257 species of birds, 40 species of reptiles, 29 species of mammals and 9 species of amphibians (Master Plan of *Haor* Area, 2012). Wetlands are the rich components of biodiversity as well as they have local, regional and national significance.

Also provides large number habitats for a variety of inhabitants and waterfowls (Khan et al. 1994). It has great economic value to provide various services. Naturally, *haors* are very flourishing to contribute in every field as human health and wellbeing. However, many wildlife species had disappeared over the past few decades. Some are threatened and affected both national and global level (IUCN, 2012).

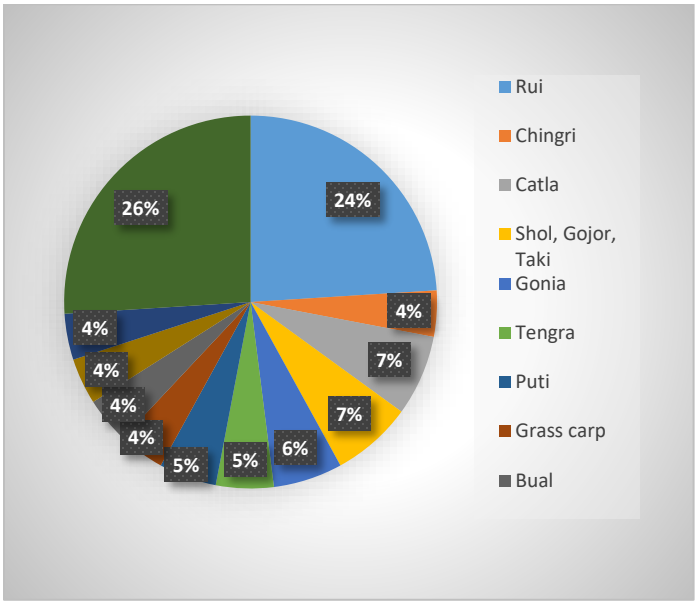

Figure 2.6: Fish Species in Tanguar Haor (Stock assessment basis)
(Source: IUCN 2015)

2.7 Ecosystem Services

According to Ramsar Convention (1971), wetlands provide tremendous benefits in every sector, which is very important for a country's development especially in economic development. It plays a vital role and have some economic benefits. Thus, the benefits of wetland resources that obtain from natural ecosystem is known as ecosystem service (Dam, 2019). Wetlands play a great part to deliver ecosystem services than other ecosystems (Costanza et al. 2014; Russi et al. 2013). Wetlands of Bangladesh provide major scopes for livelihoods, which provides cultivating food, crops, vegetables, fishery resource and fodder for cattle. Rice cultivation is a major livelihood activity in the *haor* basin (Table 2.1). It around the wetlands of Ganges- Brahmaputra floodplain (Daily Star, 2010).In addition that it plays a key role in the different types of natural hazard regulation and provide micro climate regulation (Grant, 2012).

Table 2.1: Ecosystem Services of Wetland

SL.	Ecosystem Services
01	Water supply (quantity and quality)
02	Fisheries (over two thirds of the fish harvest is linked to the health of coastal and inland areas)
03	Agriculture (through the maintenance of water tables and nutrient retention in floodplains)
04	Agriculture (maintenance of water tables and nutrient retention in floodplains)
05	Timber production (Fuelwood)
06	Energy Resources (peat and plant matter)
07	Wildlife resources
08	Transport (In monsoon period)
09	Recreation and tourism opportunities.

Source: Ramsar Convention, 1971

Wetlands have multiple values that generated the income of local people to support their economic activities. Besides these, it is supportive for the cultural concentration and spiritual fulfilments (Kumar et al. 2017). Wetlands are the place that play a vital role in the country's lifecycle and these are highly productive and diverse ecosystem (Daily Star, 2010). However, in the recent history of the development of landscape, wetland ecosystems are the most affected phenomena of the country.

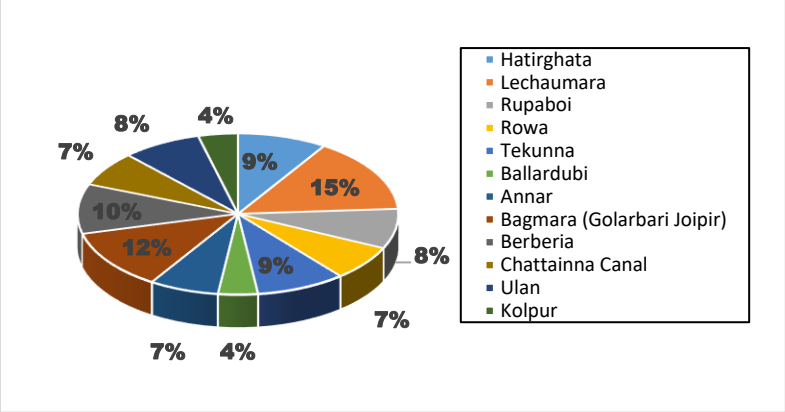

Figure 2.7: Percentage of Bird Species Occurrence in Tanguar *Haor*
Source: ICUN 2015

2.8 The People of *Haor* Areas

Bangladesh comprised complicated system in both ecological and sociological dynamics due to the geographical factors and population density. The population of Bangladesh depends on wetlands that covered more than half of the country's geographical area. Wetlands are the place for accommodation about 25,000 inhabitants and most of the people are involved in fishing and farming. The population density of the *haor* region is relatively lower to the rest of the country (Sharma, 2010). Master Plan of *Haor* Area (2012) noted that the total population of the seven-*haor* districts is about 19.37 million, which projected from Bangladesh Bureau of Statistics (BBS) census in 2011. The total population density in the *haor* district is lower than another part of the country as well as lower than the national population density.

2.8.1 Occupational Status

Mainly farming and fishing are the principal occupations of the people of *haor* area. Otherwise hunting and trapping waterfowls, collecting fuel wood, grass, and reeds are the activities of survival for livelihoods of the people (IUCN, 2012). During the winter season, in November villagers start agricultural activities in their lands until the area gets overwhelmed in the month of June. The area remains under water for six months. In that, time farmers have no works to do and become unemployed. During this period, some of the day labors migrate to other area. Mainly they involved in coal transplantation activities as daily basis worker in the northern part of *haor* area.

2.8.2 Economic Activities

Generally, agriculture (crop cultivation) is the main economic activity in the *haor* region. Farmers cultivate boro crops (rice) in December while the *haor* drained up. Usually the harvesting time starts in the mid-April to mid-May (Master plan of *haor* area, 2012). Sharma noted that agriculture is the major economic sector of income. The agriculture mainly based on mono cropping system but flash floods wash away the boro crops. Therefore, people lose their crop production, which forces them to the extreme poverty cycle (2010).

Typically, the *haor* area has only one crop for cultivation. The job opportunities in the agriculture sector is limited to the local people. Comparatively other parts of the country, the scope of economic activities are inadequate over the area.

2.8.3 Landownership Status

Haor areas are different from other region in Bangladesh due to geographical location. Thus, the history of the land ownership rights are very critical and the local poor people deprived from the *haor* land from the very early age. During the Zamindar system, Zamindars (Landlords) are controlled the *haor* area. The Zamindar system ended by the enforcement of the State Acquisition and Tenancy Act 1950 (kabir and Amin, 2007). The government took the power to control *haor* land, which known as "Khas Land". The land management and record system were very informal until 1960. The local people adopted the Likhon system in that *haor* area. According to Masterplan of *Haor* Area (2012), there are mainly three types of tenure groups in the *haor* area and these are owner, tenant and owner-cum-tenant. Landowners cultivate *haor* land by themselves or cultivated by hired labor. Owner-cum-tenant cultivate their own land along with the others land. The tenants only cultivate others land or work as a day labor.

2.8.4 Social Condition

Fishing is one of the most important occupation in *haor* areas. Due to traditional leasing system, the elite people control the *haor* and jalmahals. Thus, fishing is highly restricted and the poor local people deprived to access the natural resources in *haor* areas (Care Bangladesh, 2016). Mostly local elites control the entire formal and informal sectors or institutions of the entire *haor* areas. Leaseholders regulate the local people and they do not get any permission to access *haor* resources. Most of the locals are living in the area, which is very close to *haor*. Seasonal unemployment is the serious problem in *haor* areas due to single crop (boro crop). Moreover, transport is one of the major issues in *haor* region. In the period of monsoon, boat is the only one way to transport the local people. As a result poor transport system is the barrier for the development of *haor* areas.

2.8.5 Health and Diseases

In the *haor* areas, the most common diseases are asthma, peptic ulcer, anemia, acute respiratory infection, worm infection, hypertension, diarrhea, malnutrition, skin diseases, dysentery, malaria, pneumonia and fever (influenza). Women and children are more vulnerable in the area. According to Master Plan of *Haor* Area (2012), the mortality rate of infant and child is very high and women faces critical situation in the period of childbirth.

2.9 Population Growth and Wetland

Rapid population growth is the important factor to decline per capita agricultural land, forest, and water resources. High population growth rates increase population pressure and for that proposes a great number of people live in below poverty line. Since population pressure is an unfortunate event as well to responsible for land degradation and soil erosion. As a result, it influences the economy that based on productive resources (Ray and Ray, 2011).Bangladesh is one of the most densely populated countries in the world and three times higher than the neighboring country. Excess Population impacts on environment and causes degradation in many ways. Correspondingly, put pressure on arable lands, forest and biodiversity (Chowdhury and Hossain, 2018).

Globally population growth is a great pressure for arable land, water, energy and biological resources to provide foods and other services (Pimentel et al. 1997). It also supports essential natural resources and services and the people of Bangladesh extremely rely on wetlands for fishery and agriculture (GOB, 2001; Byomkesh et. al. 2008). It provides different types of resources for the welfare of human being. Population pressure, demand of wetland resources in the market and other functions are continuously affected the wetland products.

2.9.1 Population Growth and Natural Resources

Sustainable development is the challenge for uprising population and environmental degradation. Thus, heavy pressure on land, land degradation, forest, habitat destruction and loss of biodiversity are the serious environmental crisis (Ray and Ray, 2011). Moreover, global warming, air pollution, climate change, water pollution and others are the

consequence of uprising population growth. In the past Thomas Malthus argued that population growth could be hampered the living standards for a long period. It could reduce per headland and pushed the downward pressure to the land (Chowdhury and Hossain, 2018). For that reason, several complications such as poverty, hunger, malnutrition and other will increase to ensure the demand. According to Fischer and Heilig (1997), the world population is growing by about 80 million people per year. It is very slightly less than in the early 1990s, while the growth was more than 85 million per year. The density of Bangladesh population is really much higher than any other mega country in the world (Chowdhury and Hossain, 2018). Therefore, high population growth severely affects the environment through using natural resources and production. In Bangladesh, agriculture is the driving force and most of the people of this country rely on it. In agricultural sector for growing more production, people put pressure on wetlands, which resulted in the destruction of fishery resources. Also reduced the wetland property. In the fishing sector, one million people of the Gross Domestic Product (GDP) contributed in our country. On the other hand, traditionally the fishery resources are restricted. The leaseholders in the wetland area also maintain the fisheries. Thus, the poor and landless people denied to access on the wetland resources and deprived from their benefits. Therefore, lack of opportunities for employment and earning sources in the villages and the ecological stresses always forced to migrate another places as urban areas. (Ahmed, 1993; Parveen and Islam, 2001; Ray and Ray, 2011).

Generally, poverty is the consequence of population growth and depleting the environment for their regular needs to survival. Unfortunately, to ensure the growing demand of food, the rising population is forcing on the lands, forest and grazing land used for several activities as extraction of reeds, harvesting of aquatic vegetation and fishing and for other activities also. Other economic benefits that locals derived agricultural and wild food production, timber as fuel wood, livestock grazing, fodder for cattle and aquatic plant harvesting. Nevertheless, the limited opportunities and unequal distribution of resources caused push and pull factor for the people, where they live in below poverty line.

The rural people are mostly depending on wetland resources for their livelihood requirements. However, inequality may create unsuitability because poor people extremely

depend on natural resources more than rich or urban people of a country as well. Thus, they depleted natural resources very fast, as they have no option to use other types of resources. Finally, they degraded the environment and the major issues are as per forest and land degradation, resource depletion, loss of biodiversity, public health, loss of resilience and others (Ray and Ray, 2011).

2.10 Degradation of Wetland

Wetland biodiversity is reducing due to population growth, lack of institutional coordination and awareness, intensive agriculture, siltation, pollution etc. As a result, many species of flora and fauna are threatened and ecosystem is deteriorating in the wetland region. The living condition of the local people are failing such as socio-economic sectors and cultural values are affected in the wetland area (Byomkesh et al.2008).

Generally, the local poor communities live in the nearer to the wetlands to generate their livelihoods. Thus, their dependency on wetland resources caused wetland degradation. As a result, globally a wide range of human activities are responsible to change the wetland functions and responsible for the wetland degradation (O'Connell, 2003). According to Haider (2015), the wetlands of Bangladesh are degraded rapidly due to the pressure of population growth. Usually local people utilize the wetlands as fishing, farming, collecting fuel wood, irrigation and for others also.

Geographically Bangladesh is one of the most vulnerable countries in the world due to climate change. It is a major threat to the survival of the species and integral part of wetland ecosystem. It may affects the hydrology of individual ecosystem of t wetlands (Hulme, 2005 ;Erwin, 2009). Moreover, the degradation of floodplain is closely related to the rapid decline in fresh water biodiversity habitat alteration, flood control, habitat invasion and pollutions are the basic reason behind the wetland degradation (Tookner and Stanford, 2002).

2.11 Policies and Legislation for Wetland Management

Bangladesh developed a significant constitution of policies and legislation, which contributed to achieve the sustainable use of natural resources of haor areas. These initiatives are helpful for the sustainable use of wetland resources. For conserving wetland

and natural resources, Bangladesh adopted several acts and legislations for wetland management and conservation from the very early age. These conservation strategies and plans directly or indirectly focused on wetland. These wetland related acts and legislations are given by the following table:

Table 2.2: Laws, Polices and Legislation for *Hour* Resources Management and Conservation

Year	**Sectoral Laws, Policies and Legislations**	**Requirement of the Laws**
1927	The Forest Act (Amended in 1989)	Prohibits hunting and fishing in the reserved forests.
1950	East Bengal Protection and Conservation of Fish Act (amended in 1982)	Protection and conservation of fisheries in the inland water of the country.
1950	The East Bengal State Acquisition and Tenancy Act	Transferred the ownership of jalmahals (fishing grounds/beels) from the zaminders to the government.
1974	Bangladesh Wildlife (Preservation) Act (Amended in 1972)	Strictly prohibits of hunting, killing and capturing of animals as protected. Provides for declaring an area as wildlife sanctuary where hunting, shooting and other activities affecting wildlife are prohibited.
1977	The *Haor* Development Board Ordinance	It requires the Board to prepare projects and schemes to develop the *haors* and other depressed low laying areas. Very short duration of the Board mainly executed a few projects related to flood control, land reclamation and extension of agriculture and fisheries.
1982	Protection and conservation of fish (Amendment) Ordinance	Prohibits unsustainable fishing techniques, and calls for conservation of fish resources.
1985	New fisheries Management Policy (1985-87)	Return of jalmahal fisheries to fisher folk, instead of leasing to external parties.
1991	Land Management Manual	Guidelines for leaseholders and sustainable exploration of fishe resources.
1992	National Environment Policy	Promotion of sustainable development, protection of biodiversity, wetlands and migratory birds.

1992	National Conservation Strategy	Recommendations to achieve sustainable development in all sectors. NCSIP-1 is implementation mechanism.
1992	Ramsar Convention (ratified by Bangladesh)	Sustainable use of wetland resources, if appropriate, with community-based management.
1994	National Forestry Policy	Emphasizes on habitat and biodiversity conservation, reforestation, community participation.
1995	National Environmental Management Action Plan	Halt degradation; promote sustainable use, conservation of biodiversity.
1997	Environment Conservation Act (1995) and Environment Conservation Rules (1997)	Focus on EIA and protection of Ecologically Critical Areas.
1997	Tanguar *Haor* Management Plan	Sustainable management (wise-use) of the *haor* dealing with community based *haor* management.
1998	National Water Policy	Sustainable use of water resources, produce National Water Management Plan
1999	Sustainable Environment Management Programme	Participatory Ecosystem Management is one of five main components.
1999	Notification of Ecologically Critical Areas	Enactment of the ECA clause in the Environmental Conservation Act (1995) and Rules (1997)
2000	National Water Resources Management Plan	Regional hydrological and water planning issues
2000	Tanguar *Haor* Management Plan (revised)	Emphasis on implementation of wise-use principle prescribed in Ramsar guidelines and community based *haor* management.
2004	National Biodiversity Strategy and Action plan	A framework for conservation, sustainable use and sharing the benefits of biodiversity with social and economic development of the country.
2009	Bangladesh Climate Change Strategy and Action Plan (BCCSAP)	Emphasis on food security, social protection and health, comprehensive disaster management, infrastructure, research and knowledge management, mitigation and low carbon development, capacity building and institutional strengthening.
2012	Wildlife (Presentation and Security) Acts	Focus on conservation and protection of biodiversity, forests and wildlife.

2015	Tanguar *Haor* Management Plan Framework and Guidelines	This book documents the results and insights of a compilation, review and collation exercise towards developing and formulating a planning framework including resource management guidelines for Tanguar *Haor*.

Source: Huq, 1993; GOB, 2002 Giesen and Rashid, 1997; Kabir and Amin, 2007; IUCN Bangladesh, 2015

International agencies play fundamental role for implementing laws and they provide funds and co-operation for the proper management of the wetland resources. However, the funds are not sufficient for the implementation of wise-use concept and community based management system needs the actual support from the local people of *haor* areas. Consequently, International collaboration is very important to maintain *haor* and needs to train the local people for building a sustainable environment of *hao*r areas.

2.12 Leasing System

Traditionally the leasing system was controlled by the landlords and *jamindar* in the past. After that, the local influential and political leaders joined in the leasing system (kabir and Amin, 2007). The leasing system is generated by three categories. Firstly, leaseholders get fisheries from the ministry through development scheme for six years. The development schemes include several terms and conditions for maintaining and protecting the *haor* resources. These are planting, sanctuary, fish habitat restoration of natural resources. Second category is that they get fisheries from the DC office for three years, which fisheries are higher than 20 acres and bellow 20 acres are distributed by Upazila office for leasing. Thus, officially lease agreements assigned for three years to the DC office. Otherwise, Ministry of Land also contributes in the fisheries agreements for leasing with some legislations.

2.13 Wetland Management Approach

In Bangladesh, from the very beginning wetlands are disrupting by humanitarian activities. In 1990, the country seriously recognized the importance of resource management and from then management and conservation of wetland got significant importance for the sustainable management of wetland; the country needs adequate interdisciplinary policy rules (Chakraborty, 2009; Islam, 2010). According to Williams (2002), community

participation in the conservation and management of wetland resource is very important and required, that globally understood.

2.13.1 Wetland Conservation and Management

Conservation and wise use of wetlands are obligatory for human livelihoods. Wetlands provide a wide range of ecosystem services and need sustainable development for the conservation of wetland resources (Global wetland outlook, 2018). Under the IUCN programs of wetland, a workshop on "Conservation and Sustainable Management of Freshwater wetland of Bangladesh", which held in 1992 to conserve the freshwater wetlands in the country (Nishat et al. 1993). Wetland provides water for irrigation and domestic use and act like winter habitat for the variety of species and migratory waterfowls. A healthy wetland ecosystem always act as a safeguard for floods and helps to reduce the vulnerability of local communities from droughts. Undoubtedly, the wetlands of Bangladesh degraded due to humanitarian actions. For that purposes, wetland conservation and research started in the early 1990, which based on both regional and global perspective. IUCN took first global initiatives to conserve wetlands with special importance on wildlife and finally in 1971 adopted wetland conservation. IUCN promoted a wetland conservation program jointly with the worldwide fund for nature in the time of 1985 to 1987.

After endorsed of 1980's World conservation strategy, Bangladesh started working on the National conservation strategy for the natural resource conservation. The government of Bangladesh is committed for the conservation of natural resources by the relevant laws, polices and strategies. It is a project, which provides guidelines for the future use and conservation of natural resources. Thus, the government adopted this project to ensure the conservation of resources for the natural resource utilizations and economic development of this country (IUCN, 2015).

2.13.2 Community Based Management System

Wetland ecosystems are threatened for various reasons as human intervention and other environmental issues. Thus to protect the environment of wetlands and natural resources, the participation of local communities is one of the most important practices to stop the

destruction of biodiversity and ecosystem. That is why any management plan or strategy on wetlands is not possible without active participation of local people (Dugan, 1990).

"Community Participation" is the term that defined as the involvement of the local people in the management system of any natural resources management. The participation of local people usually recognized as an institutional imperative in the management of local natural resources (Agarwal, 2001). Bangladesh government suggested a community based management of *haor* resources in order to reduce the degradation and to develop sustainable the use of natural resources (Khan et al. 2005). Therefore, the public participation in wetland management and decision-making are the significant element for the success of sustainable development of wetland resources (Global wetland outlook, 2018).

In Bangladesh community based *haor* management projects were implemented by IUCN-Bangladesh for the first time with the collaboration of Ministry of Environment and Forest (MOEF) and also UNDP since 1998 (IUCN, 2004; Waliuzzaman et al. 2003).

2.14 Chapter Summary

In this study, literature was conducted to find out the overall scenario and the impacts of population growth on natural resources of *haor* areas. The literature consulted are as journals, article, environmental guidelines, books, newspapers, websites and other sources. Among these literatures, wetland ecosystems are rich in biodiversity and *haor* areas are the most important northeastern part of Bangladesh. However, at present population growth and extensive uses are the crucial factors to deteriorate the environment and natural resource. Although government, NGOs and international organizations are, working together but these are not sufficient to manage and maintain the *haor* areas properly. Rapid population growth is one of the main reason and from the literatures; the study assumed that in last few decades there is no specific information to recognize the degradation of *haor* resources due to overexploitation. Thus, the study tried to analyze the population growth and impacts on natural resource of *haor* areas due to human intervention in a spatiotemporal approach.

CHAPTER III

RESEARCH DESIGN

3.1 Introduction

The *haor* basin of Bangladesh is rich in natural resources. Geographically these areas are unique for biological diversity. The resources of these areas play an important role to meet the demand of fish protein all over the country. Thousands of local people are depending on the natural resources. Nevertheless, in few decades, people immensely interrupted and influenced the wetland ecosystems. Thus, the resources reduced day after day and degraded the wetland ecosystem. This study tried to figure out the rapid growth of population and access to natural resources in *haor* areas. The chapter comprised with research design including selecting areas and household, sample size, intervening respondents, developing questionnaire, techniques of data collection and analysis.

3.2 Research Methods

The present study mainly based on both quantitative and qualitative method. Quantitative method is one of the most important method for measuring, ranking, categorizing, identifying outlines, interpreting and generalizing the study objectives. In this study, quantitative method is conducted by household survey. On the other hand, in qualitative method, mainly interviews and group discussions are the main components to analyze the study. Qualitative method accommodated through Focus group discussion (FGD) and key informant interviews (KII) to achieve the actual knowledge about the study objectives. In this study, Figure 3.3 presents the complete procedure of research methodology.

3.3 Selection of the Study Area

Geographically the study area is located in Sunamganj district, which situated in the northeast part of Bangladesh. Therefore, the study accompanied on two selected upazilas (Tahirpur and Dharmapasha) of Sunamgonj district.The study aimed to address the impacts of population growth on natural resources of *haor* areas. The selection of the study area also influenced by the location, which areas are the storage of dynamic ecosystem and biodiversity. Tahirpur and Dharmapasha are highly eligible to find out all the criteria.

Moreover, this study area includes Tangoar *haor*, which is located in the Dharmapasha and Tahirpur and it is the largest *haor* of Bangladesh. It declared as a Ramsar site in 2000. On the other hand, there are many *haors* are belonged to these two upazila. Most of the local people of these areas directly or indirectly depend on agriculture. Naturally, these areas are plenty of fish as well as to breeding ground for fish species. *Haor* areas are the sanctuary for a large variety of wildlife and waterfowls. The vegetation of *haors* also contributes in the ecosystem of the surrounding environment. Due to intervention of population, destructed the natural resources constantly. Thus, extraction of natural resources of *haor* areas are the major issues of these two selected areas. Moreover, siltation and other environmental degradation also hampered the wetland ecosystem (Figure 3.1).

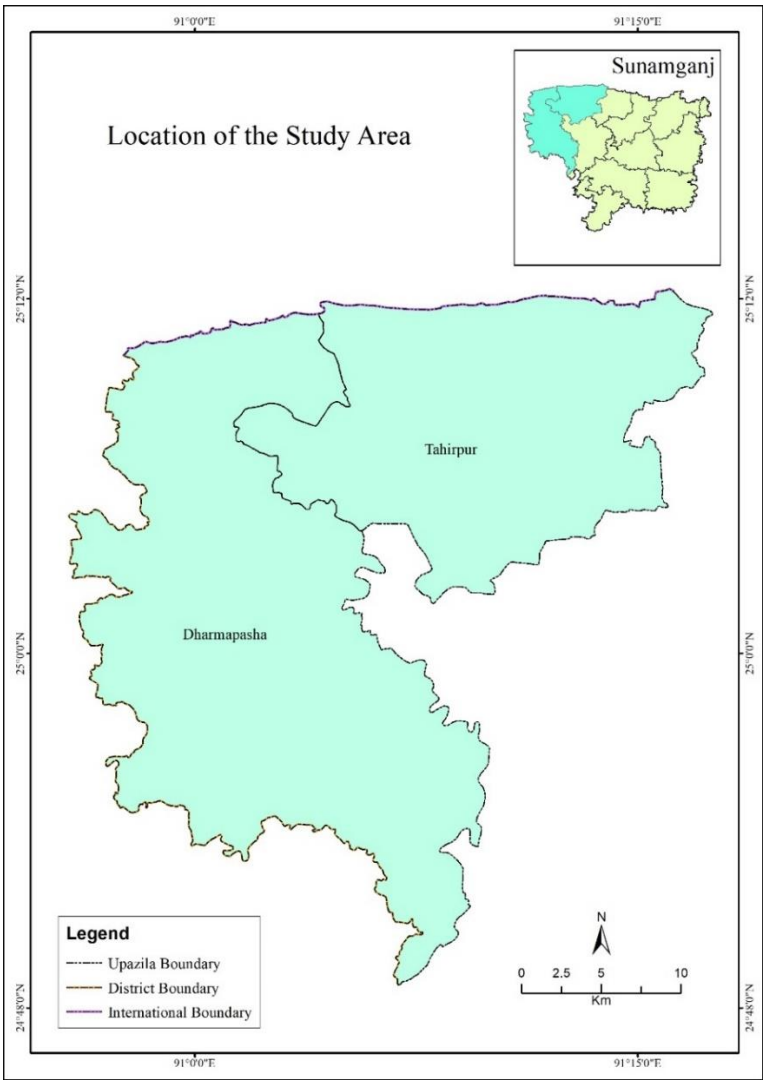

Figure 3.1: Location of the Study Area

3.4 Geographical Characteristics of the Study Area

Sunamganj district was one of the former sub-division of Sylhet district, which become a sub division in 1877. Finally, it was upgraded into a district or zila in 1984. The district is bounded in the north by Khasia and Jaintia hills of Meghaloya State of India. In the east, it is bounded by Sylhet district and in the south by Habiganj and Kishoreganj districts. In the west section, the district is surrounded by Netrokona district. The total area of Sunamganj is 3747.18 sq. km and 71.28 sq. km areas are under forest of the total area of the district (BBS, 2011). In addition that 268,531 ha are under *haor* areas. Surma, Dhamalia, Kushiyra and Jadukata are the main rivers of this zila. It consists of 11 upazilas, 87 unions, and 4 pouroshovas. The upazilas are Bishawmbarpur, Derai, Dharmapasha, Tahirpur, Chhatak, Dowarabazar, Jamalgonj, Jagannathpur, Sulla, Sunamgonj Sadar and Dokshin Sunamgonj. From these 11 upazilas of Sunamganj, the present study selected two upazilas as Tahirpur and Dharmapasha.

Tahirpur and Dharmapasha are the two-selected upazila of Sunamgonj district in Sylhet division. The study area is located at 25.0715^0N, 91.3992^0E. Tahirpur is bounded by the Indian state of Meghaloya to the north, Dharmapasha and Jamalgonj upazilas on the south, Bishwambarpur on the east and Dharmapasha upazila on the west. Dharmapasha is located on the bank of the Kongsha River, which is very close to the *haor* areas of Sunamgonj district.

3.5 Selection of the Study Area

The study selected two upazilas as Tahirpur and Dharmapasha. Nine villages are selected to accomplish this present study. Marala, Matian, Tahirpur, Jamlabad, Bhabanipur, Anandanagar are selected from Tahirpur upazila and two villages such as Rangsipara and *Haor*para are selected from Dharmapasha. These nine villages are adjacent towards *haor* and the people of these area are extremely depended on *haor* resources (Figure 3.2).

3.6 Selection of the Respondents

In this study, respondents were selected from *haor* areas of Tahirpur and Dharmapasha upazila; where the villages are closely located to *haors* and people are more dependent on *haor* resources. From the study area, nine villages are selected purposively for conducting

household survey, which closely related to *haors*. Individual household survey was randomly selected from the nine villages by using a formula, which was given by Miah in 1993. Thus, 150 respondents are selected to conduct the present study. Most of the respondents are selected where the people dependence on *haor* resources for supporting their livelihoods. The following Tables (3.1 and 3.2) present the sample collection procedures and methods.

Table 3.1: Sampling Procedures and Methods

Step	Sampling Techniques	Description	Outcome
1	Sampling	Sampling was assumed that the villages, which were closely located to *haors* and mostly dependent on *haors* resources	Tanguar haor, Matian *haor*, Shanir *haor* and other *haors* of selected areas.
2	Sampling	Nine villages have been selected from Tahirpur and Dharmapasha to conduct household survey	Nine villages
3	Random sampling	Households selection from the study area	individual households

Table 3.2: Selected Villages and Sample Households

No.	Name of Unions	Name of Villages	Total number of Households	Sample Households (n)
01	Dakshin Sreepur (Tahirpur)	Ramsinghpur	126	40
02	Dakshin Sreepur (Tahirpur)	Marata	119	30
03	Uttar Sreepur (Tahirpur)	Matiain	99	20
04	Uttar Sreepur (Tahirpur)	Tahirpur	99	10
05	Dakshin Baradal (Tahirpur)	Jamlabad	81	10
06	Dakshin Sreepur (Tahirpur)	Bhabanipur	75	10
07	Dakshin Sreepur (Tahirpur)	Anandanagar	70	10
08	Uttar Bangshikunda (Dharmapasha)	Rangsi Para	70	10
09	Madhynagar (Dharmapasha)	*Haor* Para	36	10
			775	150

Source: Bangladesh Bureau of Statistics, 2011.

To collect primary data, questionnaire have been systematically developed to find out the required information. The respondents were given written list of questions, which he or she responded to deliver appropriate explanation.

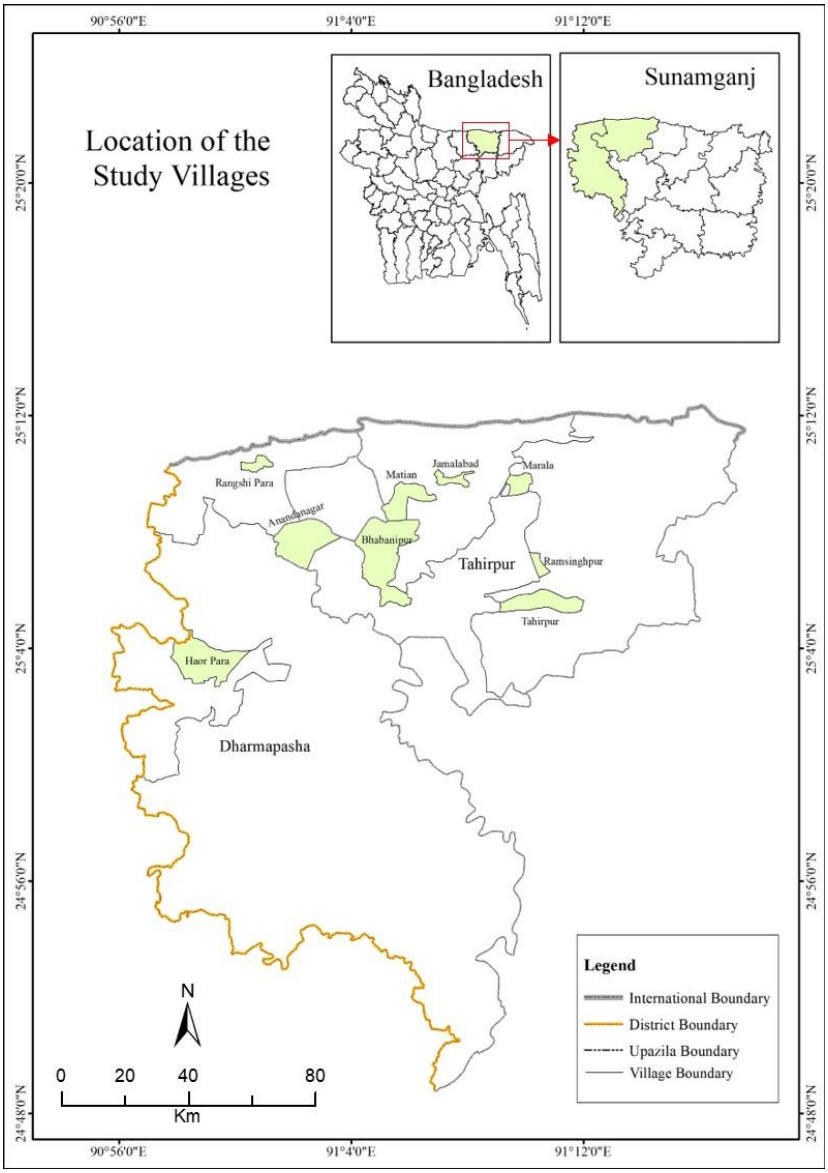

Figure 3.2: Location of the Study Villages

3.7 Techniques of Data Collection

The study mainly based on mix method (qualitative and quantitative) to collect information about the population growth and impact of natural resources in *haor* areas. For that

purpose, data collection on relevant information was conducted by household survey. Survey questionnaire, which contain both open ended and close-ended questions on various issues, which were relevant to the study. During the survey period, tried to observe the specific issues and taken notes, pictures as data. Key information obtained from interviews, focus group discussion household survey and secondary data were used for obtaining the study properly. This study based on both primary and secondary data. Household survey, key information interviews and focus group discussion (FGD) obtained here properly. Other secondary materials collected from relevant sources.

3.7.1 Primary Data Collection

Primary data were collected from mainly field survey and from personal interviews. Observation, experiments and others comprised also. The sources of primary data collection of this study included the following as:

i) Household Survey

ii) Focus Group Discussion

iii) Key Informant Interviews

3.7.1.1 Household Survey

In this research, household survey is one of the primary sources of data to collect quantitative information. Survey questionnaire was designed according to study objectives. Both close ended and open-ended question were included here. These questions were reflected by demographic profile of respondents, social, economic and environmental conditions, management and conservation of *haor* resources were added in the sample questionnaire to proceed the present study. Both close-ended and open-ended questions were embraced to accomplish the individual household survey.

3.7.1.2 Focus Group Discussion

Focus group discussion of the present study is arranged with four groups of the villagers in the study area. Generally, the discussion is grouped into four categories of people. Fishermen, farmers, day labors and local people were involved in the group discussion.

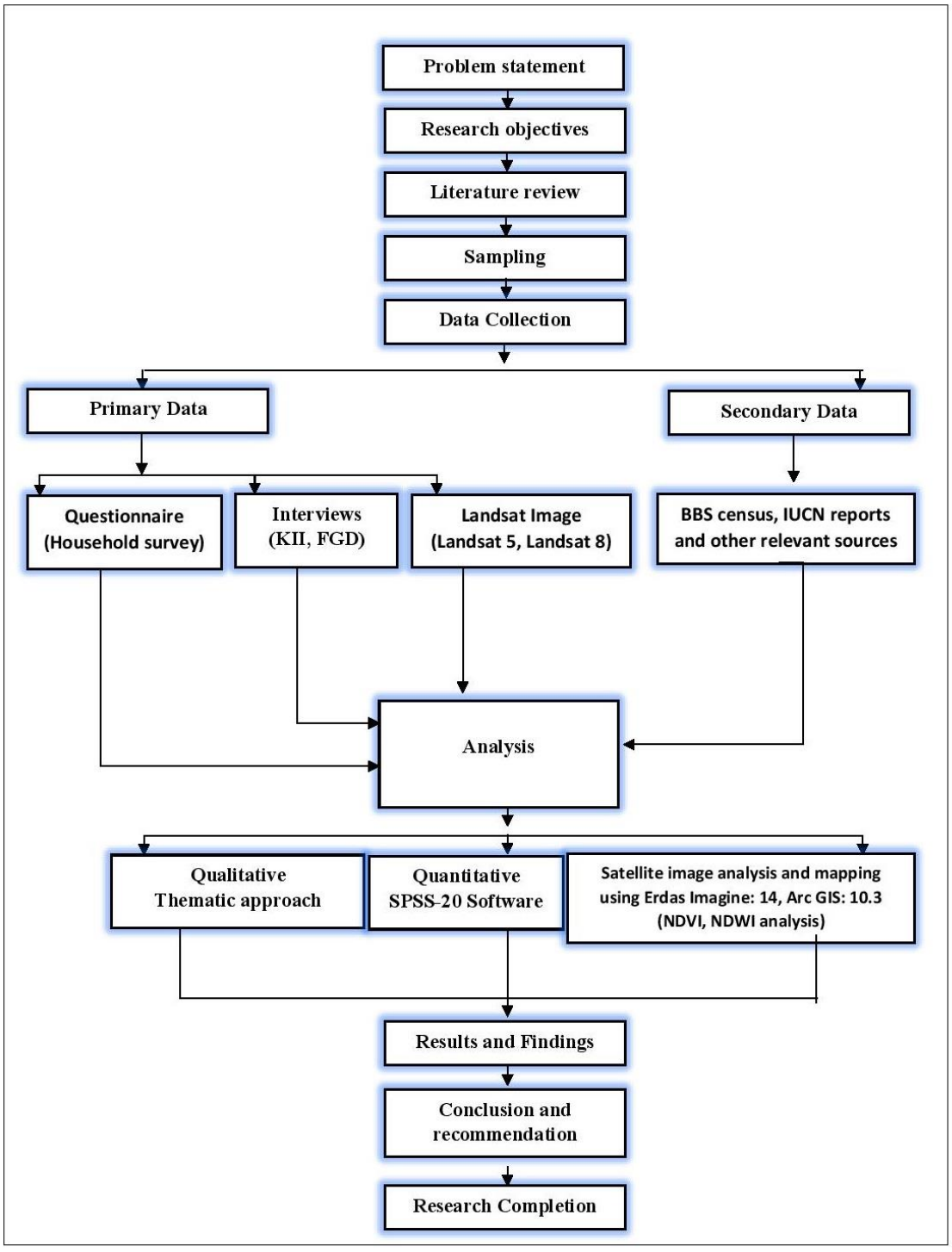

Figure 3.3: Flowchart of Research Design

The participants delivered different type of answers and opinion from these groups. By this discussion, the study tried to know about the present conditions and environmental issues as well as the initiatives of *haor* conservation. The participants also joined in the discussion section to recommend some important initiatives for the conservation and management of *haor* resources.

3.7.1.3 Key Informant Interview

In this present study, eight KII are associated for achieving and understanding the overall scenario as well as to investigate the information about the status of natural resources in the area. The study conducted with eight KII to know the current issues, present initiatives for the management of *haor* resources and possible steps, which are necessary for the *haor* conservation. Eight interviews with District Commissioner of Sunamganj district, Upazila Nirbahi Officer, Fishery Officer of Tahirpur Upazila, leaseholder, journalist, NGO, Water Development Board, CNRS organization are comprised to gain knowledge, which are very supportive for the study. Among these interviews, three key interviews were completed by telephonic conversation with Water Development Board, BARCIK (NGO) and Center for Natural Resource Studies (CNRS). Because they were not available to communicate for direct interview.

3.7.2 Secondary Data Collection

Secondary data were contained here to improve the quality of discussion of the study to supplement the primary data. Secondary data of different census years were collected from Bangladesh Bureau of Statistics (BBS). In addition, maps and statistical data of *haor* resources were also gathered from Bangladesh Bureau of Statistics. In addition, secondary materials were collected from relevant institution International Union for Conservation of Nature (IUCN). Alongside, journals, books and other printed documents were consulted.

3.8 Techniques of Data Analysis and Map making

Data analysis is the process of inspecting, cleaning, transforming and modeling data to discover useful information for decision-making. That means it is a systematic process of applying statistical to organize, represent, describe, evaluate and interpret data for research findings. In this study while the total primary data were collected then checked the entire

questionnaire to search any gap of information. After that, Statistical Package for the Social Science (SPSS) used, which is a computer based statistical data analysis software and used to analyzing and interpret data properly. GIS software (Arc GIS) has been used for map making and Computer software MS word and MS excel were used for the graphical illustration of data. On the other hand, Statistical techniques applied in the process of data analysis.

3.9 Validity and Reliability

Validity and reliability is a crucial part for any research work. That is why the study followed some instructions to assess the validity and reliability of measurement. At first, the questionnaire of this study consisted of selected question and conducted the interviews by the questionnaire. The study tried to examine and analyze the correct data and for that reason, a pilot test was needed to identify the gap of the questionnaire.

3.10 Ethical Consideration

Ethical consideration is an unavoidable part of any research. Therefore, researchers should be careful about the ethical issues for conducting any research work. In every stage, the study team must maintain the ethical standards and levels. Also, need to ensure the privacy of the respondents. However, the respondents were supported to share their opinions and answers cordially.

3.11 Report Writing

After collecting all types of data and information, I tried to manage and started data analysis. In this study, I used several techniques for collecting and analyzing data accurately. Finally, I started to write the main thesis paper, which comprised into six chapters.

3.12 Chapter Summary

In this chapter, study plan was discussed, which included the study area, study design, population sampling technique, method of data collection and plan to conduct survey or study area. Data processing and analyzing were also discussed. According to the objectives

of the research, primary and secondary data were collected from different areas. Qualitative and quantitative methods were also used for collecting and analyzing data.

CHAPTER IV

POPULATION CHANGE AND THE RESPONDENTS

4.1 Introduction

In this chapter, the present study acknowledged that the area has a long-term experience for human habitation through the relevant literatures, sources and field observation also. Mostly the people rely on *haor* resources for various purposes. Their livelihood conditions are extremely *haor* oriented. Thus, this study, tried to identify the authentic decadal population change and growth rate, settlement, land use pattern and discussed the socio-economic conditions and issues, which impact on the natural resources in the study area.

4.2 Decadal Population Change in the Study Area

The study tried to find out the past and present population of the study area. According to population census of 2001 and 2011, total population of Tahirpur upazila is two, 15,200 (BBS, 2011) while the population was one, 55,188 in 2001. Likewise, the total population of Dharmapasha upazila is 2, 33,202 (2011) while the population was 1, 82,969 in 2001.

Table 4.1: Population of the Study Area

Villages	Population	
	2001(Year)	2011(Year)
Bhabanipur	250	273
Rangsipur	148	318
Anandanagar	334	377
Jamlabad	371	454
Haor Para	164	472
Matian	428	545
Tahirpur	103	571
Ramsingpur	523	620
Marala	471	625

Source: BBS 2001, 2011

4.2.1 Population of the Study Area

The present study has been shown that, population of the study area is rapidly increased. The Table 4.1 indicated the decadal changes of population growth in the study area .By the population census of 2001 and 2011(BBS), in 2001, village Marala had 471 people and in 2011, the population was about 625. Moreover, Tahirpur village, which is adjacent to the Tanguar *haor*, have been rapidly increased .In 2011 the population was about 571 while

the number of people was 103 in 2001. By the field observation, the villages are very congested. Moreover, fully surrounded by large water body. In past village Haor Para had 164 and in 2011 the population was about 472 while Rangsipur was 148 (2001) and 318 (2011).On the other hand, the decadal change of population growth in Matian was about 428(2001) and 545(2011). However, rest of villages as Bhabanipur, Anandanagar and Jamlabad shown that the population of the study area had increased also.

4.2.2 Annual Growth Rate

The present study tried to examine the annual population growth in the study area. Thereby the following Table 4.2 shows that, in 1991 to 2001 the annual compound growth rate is 3.49% at Tahirpur upazila while the annual growth rate is 3.27 % in 2001 to 2011. In addition, the annual growth rate of Dharmapasha upazila is 1.09% in 1991-2001 and the recent growth rate is 1.98 % (2001-2011).

Table 4.2: Annual Growth Rate

Study Area	Year	Annual Growth Rate
Tahirpur	1991-2001	3.49%
	2001-2011	3.27%
Dharmapasha	1991-2001	1.09%
	2001-2011	1.98%

Source: BBS 2011

4.2.3 Decadal Population Growth Rate

According to Population and Housing Census 2011, the decadal population growth rate of Tahirpur upazila (Table 4.2) is 38.7% (38.67) and it increased. The annual compound growth rate is 3.27%. The decadal growth rates over the last half-century shows that the growth rate slightly decreased than before (1991-2001), while the growth rate was 40.9 %. In the previous record, the growth rate highly increased in the study area and population growth rate of Tahirpur is 30% in 1951-1961.

Decadal growth rate for Dharmapasha upazila is 22% (21.99) and the annual compound growth rate is 1.98%. The Table 4.3 shows that the decadal population growth is increased and the growth rate in 1991 to 2001 was 11.5%, which is lower than present growth rate. Unfortunately, in 1961 to 1974, the growth rate acutely increased in the study area. After that, this growth rate decreased in the decade of 1974 to 1981 but again rapidly, it increased.

Table 4.3: Decadal Population Growth Rate in the Study Area

Year (Census)	Tahirpur	Dharmapasha
1951-1961	30.0%	18.3%
1961-1974	72.4%	29.3%
1974-1981	10.5%	20.3%
1981-1991	21.8%	12.1%
1991-2001	40.9%	11.5%
2001-2011	38.7%	22.0%

Source: Population and Housing Census, BBS 2011

4.3 Socio-Demographic Profile

The present study reveals that the age of the respondents classified into three categories. Thus, the study shows that 20-40 years of age is 24.67%, 41-60 years age of is 57.33% and rest of the respondents are 61-80 years (18%). Majority of the respondents were male (98%) and the head of the household, while rest of the respondents were female (2%) or wives of the household head. All of the respondents are married. Table 4.4 shows that most of the respondents passed primary level education (72.67%), while about 11% had passed SSC. Few respondents are illiterate (10%) and rest of the respondents studied class eight only.

Table 4.4: Socio Demographic Profile of the Respondents

Socio demographic status	Range	Percent (%)
Age	20-40	24.67
	41-60	57.33
	61-80	18.00
	Total	100
Sex	Male	98.00
	Female	2.00
	Total	100
Education	Illiterate	10.00
	Primary Education	72.67
	Class-8	6.00
	SSC	11.33
	Total	100
Status of Interviewees	Household heads	98.00
	Wives of household heads	2.00
	Total	100
Marital Status	Unmarried	0.00
	Married	100
	Total	100

4.3.1 Household Size

The average household size (general) for the study area is 4-5 members. Most of the respondents (70.67 %) had 4-5 family members and 17 % of the respondents have less than 4 members. 10.67% respondents have 6-7 members and rest of the respondents mentioned that there are more than 7 members of their family (Figure 4.1)

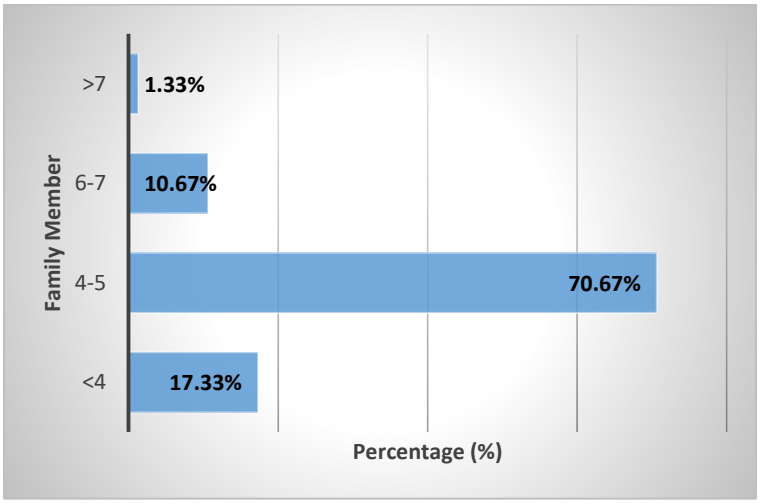

Figure 4.1: Household Size

Source: Field Survey 2019

4.4 Characteristics of Settlement

Settlement condition of the study area is not suitable for the respondents. Table 4.5 shows that most of the respondents (85.33%) have house, which made with tin and wood (kancha) while 29.33% in the past. Otherwise, 94.67% respondents have only 1-5 decimal area for their settlement at present but only 4.33% respondents had this same area in past. Moreover, 88.67% respondents have 31-60 decimal area for their settlement (total land of the house). At present 52%, respondents have nonagricultural land (1-100 decimal) in the study area. In the past 57.33%, respondents had nonagricultural land. Thus, Table shows that the condition of nonagricultural land is decreasing than past. However, the study reveals that 72.67% respondents have 301-600 decimal agricultural land in the study area and it increased than before.

4.5 Economic Activities of the Respondents

The people of *haor* areas are engaged in *haor* related activities. Thus, the present study reveals that 76% respondents are involved in agricultural activities and it means they are mostly depended on agricultural activities. Some respondents (5%) are engaged in small business, fishing, services, and work as day labor and others also. The following Figure (4.2) shows that 3% of the respondents have no job while three percent also engaged in other activities. In the study area, only 4 percent of the respondents are involved in fishing.

Table 4.5: Characteristics of Settlement

Status of settlement	Range	Present Condition Percent (%)	Past Condition Percent (%)
Types of House or Home	Semi Pacca	6.67	6.67
	Kancha (Tin and wood)	85.33	29.33
	Kancha (Tin and Bamboo)	6.67	3.33
	Kancha (Grass and Bamboo	1.33	7.33
	Shanty	0.00	53.33
	Total	100	100
Area of the house (Decimal)	1-5	94.67	4.33
	6-10	4.67	4.00
	11-15	0.67	91.33
	Total	100	100
Area of total land of the house	1-30	8.67	12.67
	31-60	88.67	87.00
	61-100	2.67	0.67
	Total	100	100
Other Non-agricultural land without household (Decimal)	1-100	52.00	57.33
	101-200	35.33	32.00
	201-200	4.67	4.00
	301-400	4	3.33
	401-500	4	3.33
	Total	100	100
Other agricultural land without household (Decimal)	1-300	22.67	29.33
	301-600	72.67	64.00
	601-1000	4.00	7.00
	Total	100	100

Source: Field Survey 2019

4.5.1 Duration of Occupation

The study reveals that most of the respondents (38%) had been continuing their running occupation for 24-36 years (Figure 4.3), besides thirty six percent respondents are continuing their current activities for 12-24 years and followed by less than 12 years (19.30%), 36-48 years (4.67%), more than 48 years (2%).

4.6 Status of Income of the Respondents

Local people dominated by the management authorities, both government and internal agencies. There are no rights to use *haor* resources. The present situation extremely influenced the income of local people. It is not sufficient to maintain their families properly.

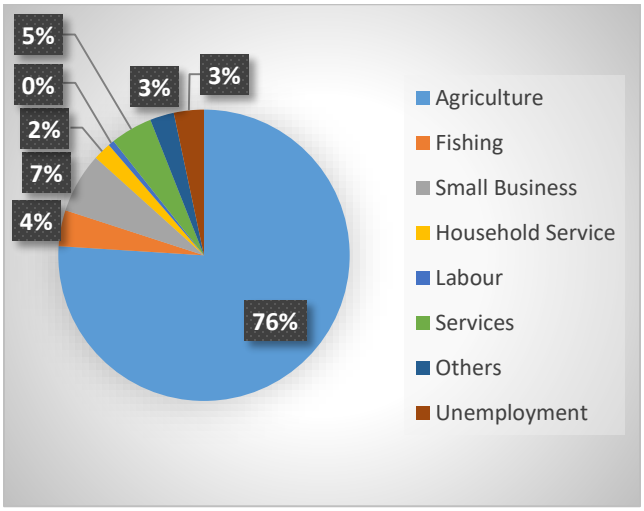

Figure 4.2: Economic Activities of the Respondents

Source: Field survey, 2019

4.6.1 Monthly Income Status

Figure 4.4 demonstrated that most of the respondents' monthly income (41.33%) was not more than Tk.10, 000. Only 33.33 percent respondents' monthly income is about Tk.10, 000-20,000; while about twenty-two percent respondents' monthly income is about Tk.30, 000-40,000. On the contrary, almost 3.33 percent respondents had more than Tk.40, 000.

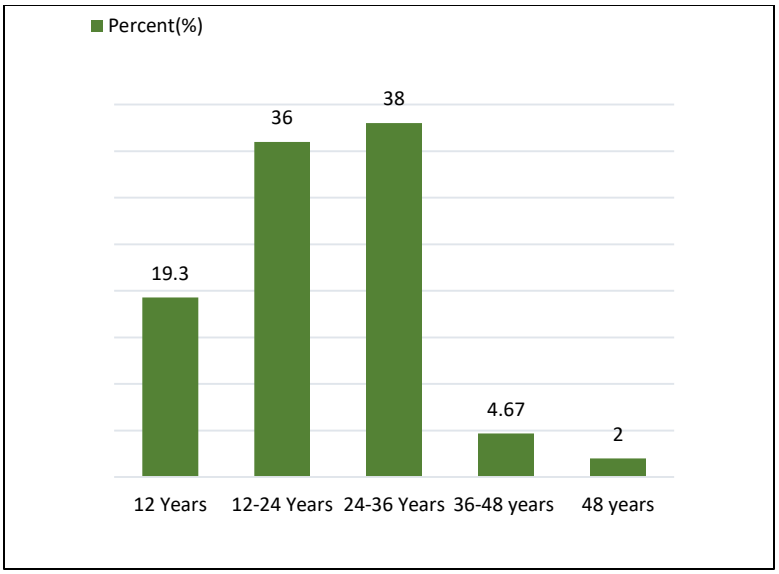

Figure 4.3: Duration of Current Occupation

Source: Field survey, 2019

4.6.2 Monthly Expenditure

The respondents of the study area have no satisfactory income and thus they could not provide more as they need. Thus, the study shows that most of the respondents' monthly expenditure (45.33%) was about Tk.4000 taka or below Tk.4000; while about 32.67 percent respondents' monthly expenditure was Tk.4000-8000. Approximately sixteen percent respondents' monthly expenditure was Tk.8000-12,000 and rest of them had the expenses of a month was more than Tk.12, 000 (Figure 4.5).

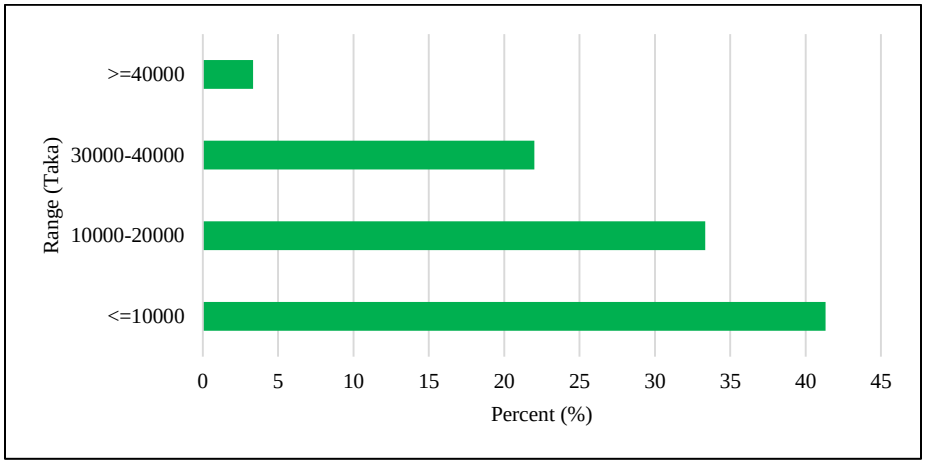

Figure 4.4: Monthly Income Status

Source: Field Survey 2019

4.6.3 Status of Savings

They could not save money for their families and the expenditure status of the respondents was very low to improve their living standards. As a result, people lend money to ensure their expenditure from NGOs and other organizations. Figure 4.6 indicated that majority of the respondents (76%) did not have any savings from their monthly income. Among the respondents, about 12.67 percent respondents had savings Tk.300-30,000. Only six percent respondents had savings with the amount of Tk. 30,000-50,000 and rest of the respondents (5.33%) had savings more than Tk.50, 000.

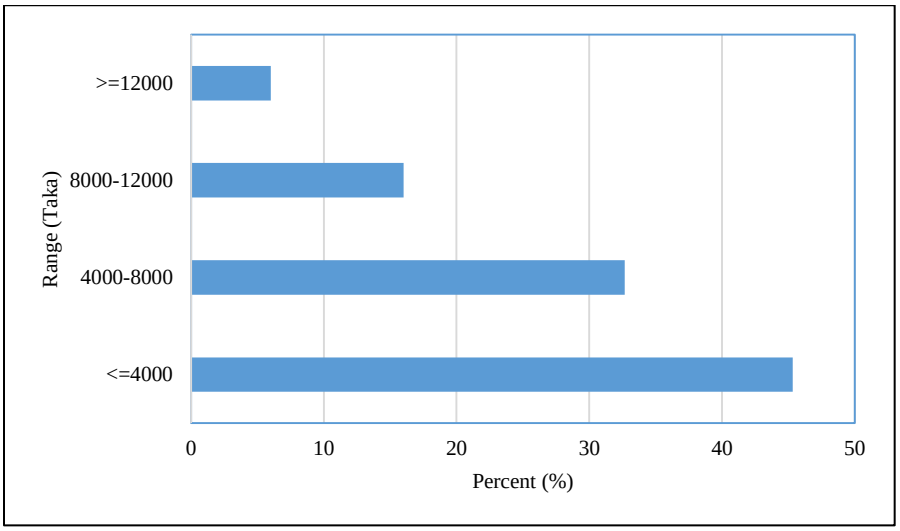

Figure 4.5: Monthly Expenditure

4.6.4 Status of Loan

Every year flash floods damage their crops and others. For these reasons, they become vulnerable as well as they do not get any permission to access on the *haor* resources. Thus, the following Figure 4.7 shows that they take loan from Banks, NGOs and other organizations. However, not all respondents are fascinated to take loan because they are unable to pay interest. The study reveals that 57.7% respondents did not take loan and around 25.3% respondents (Tk. 25,000-50,000) took loans from various sources.

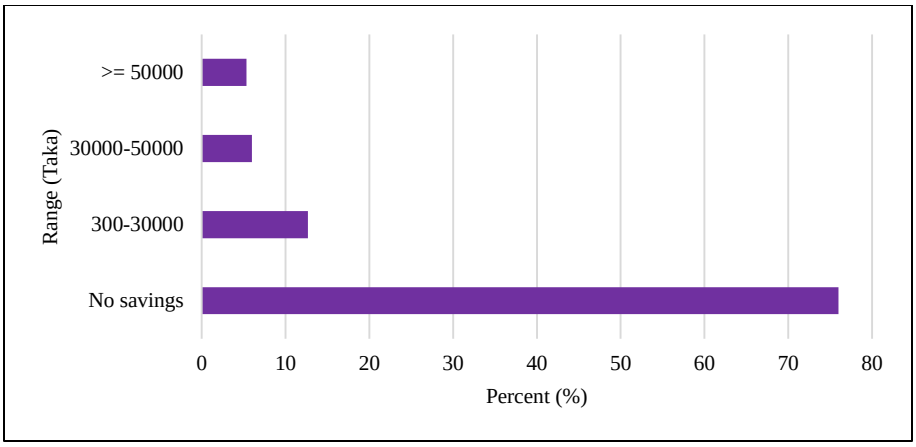

Figure 4.6: Status of Savings of the Household

Source: Field Survey 2019

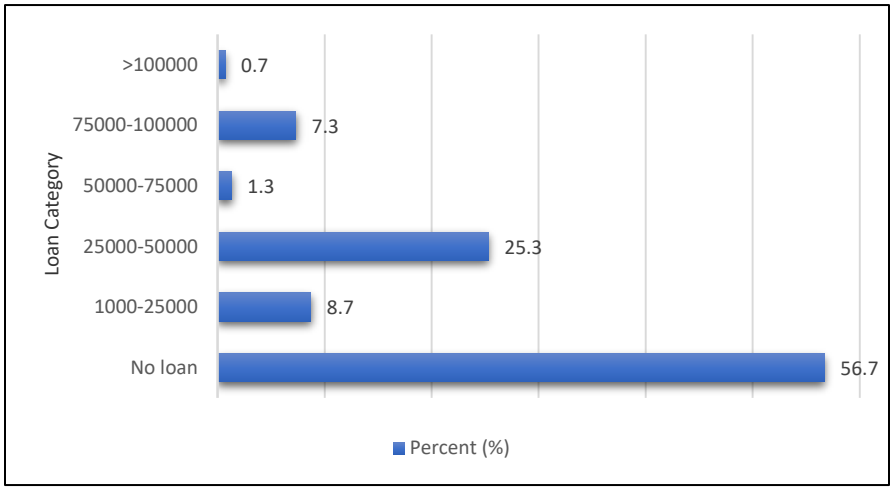

Figure 4.7: Status of Loan

Source: Field Survey 2019

4.7 Land Ownership

Usually the local farmers cultivate upper ground of the beels. Locally it known as kanda. There are many kandas in the wetland and support the major plant communities in dry season. These kandas are used as agricultural activities as well as to use as grazing land for the cattle. The study reveals that 76% respondents have no agricultural in plain area and there is no change between past and present. On the other contrary, 42.67% respondents have no agricultural land in *haor* and 44.67% respondents had no land in the previous year (Table 4.6).

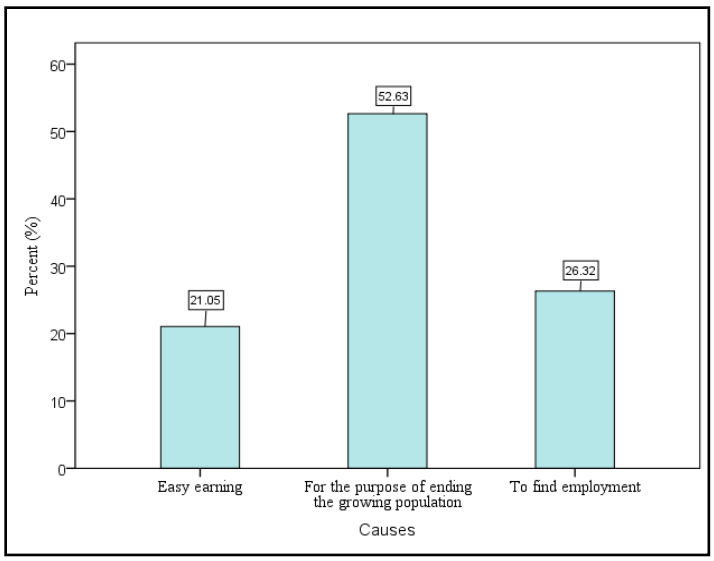

Figure 4.8: Resettlement of the Study Area
Source: Field Survey 2019

Table 4.6: Land Ownership of the Respondents

Land ownership	Range	Present Condition	Past Condition
		Percent (%)	Percent (%)
Having agricultural land in plain area	Having no land	76.00	76.00
	1-25 Decimal	4.00	5.33
	25-50 Decimal	7.33	6.00
	50-75 Decimal	8.67	8.67
	75-100 Decimal	0.67	0.00
	>100 Decimal	3.33	4.00
	Total	100.00	100.00
Having agricultural land in Hoar	Having no land	42.67	44.67
	1-50 Decimal	18.00	17.33
	100-150 Decimal	9.33	8.67
	150-200 Decimal	4.00	6.00
	50-100 Decimal	14.67	13.33
	>200 Decimal	11.33	10.00
	Total	100.00	100.00

Source: Field Survey 2019

4.8 Seasonal Occupation

The villagers directly or indirectly reliance on wetland resources .Farming, fishing, grazing, collecting fuel wood from swamp forest are the common economic activities of the study area. Water resources also used as transport and agricultural activities. The dependency obstructed the occupational condition of the local community. For the dependency on *haor* resources, people are mostly engaged in agricultural activities (Table: 4.7). Farmers involved in farming to cultivate their land in dry season. In the winter season (November month) they started cultivation .While the area inundated in June, they cannot do anything. During this season, they have no works or jobs to do. Agricultural day labors get unemployed in this period. Thus, the following table shows that 94% of the respondents are involving in dry season while only 6% respondents involved in farming before. Besides these, during monsoon 62% respondents involved in fishing activities in the past time but at now only 2% are involving in fishing.

Table 4.7: Seasonal Occupation of the Respondents

Seasonal occupation	Range	Present Condition	Past Condition
		Percent (%)	Percent (%)
Occupation in dry season	Agriculture	94.0	6.0
	Non-agriculture	0.0	10.0
	Fishing	2.0	62.0
	Job	0.7	1.3
	Business	0.7	9.3
	Unemployment	2.7	11.3
	Total	100.0	100.0
Occupation in monsoon	Agriculture	94.0	6.0
	Non-agriculture	0.0	10.0
	Fishing	2.0	62.0
	Job	0.7	2.0
	Business	0.7	8.7
	Unemployment	2.7	11.3
	Total	100.0	100.0

Source: Field Survey 2019

4.9 Resettlement

About half of the respondents (52.63) mentioned that, people migrated due to growing population. The standards of living is not sufficient and thus they migrated to other places for searching new job (Figure: 4.8). 26.32 % respondents noticed that people migrated the area for employment. Moreover, rest of the respondents (21.05 %) remarked for easy earing.

4.10 Reasons to Change Present Occupation

Most of the respondents (33.33%) claimed that decreasing of agricultural land is one the reason to switch their present occupation. Besides this, some respondents (30.56%) also claimed that decreasing income is another cause that forced to search another occupation. Rest of the respondents also provided their opinion that decreasing of fish production and other barriers are causing to leave their current occupation and to switch other occupation for their livelihood (Figure 4.9).

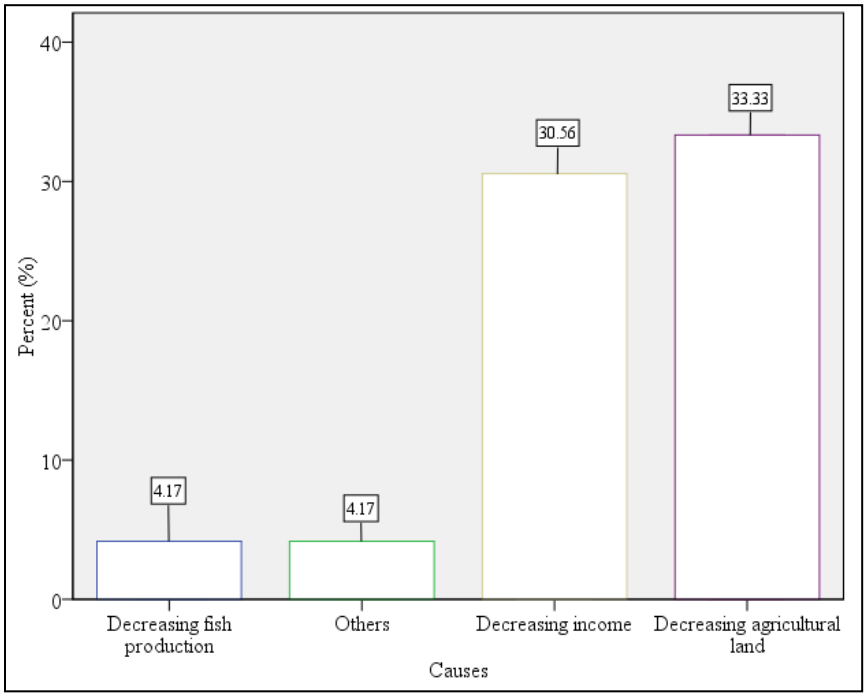

Figure 4.9: Reasons to Change the Present Occupation

Source: Field Survey 2019

4.11 Causes of Diseases

The following Figure 4.10 shows that the causes of diseases in both the present and past. It shows that most of the respondents agreed that airborne (about 41%) caused disease and followed watery (30.7%) and others (13.3%). Those causes remained responsible both in the present and in the past.

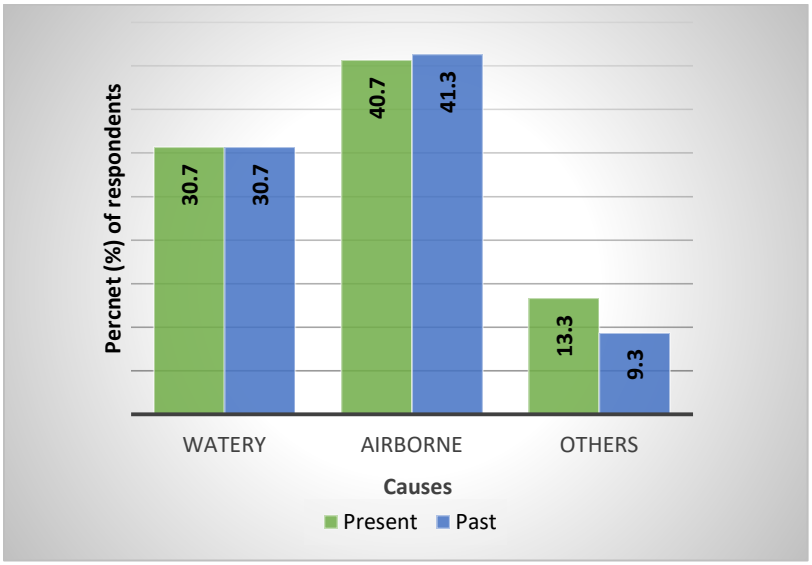

Figure 4.10: Causes of Diseases

4.11.1 Types of Diseases

The following Figure 4.11 shows that the comparative scenario of different types of diseases that caused sufferings of the respondents in both the present and past. In the past, most of the respondents suffered from cough (24%) and followed by fever (20%), diarrhea (12%), pneumonia (10%), malaria (3%), bellyache (3%), breathing problem (2%). At present, the types of disease have changed a little bit with the passage of time. Majority of the respondents claimed that people used to suffer from fever (22%) at present-day and followed by cough (20%), diarrhea (12%), pneumonia (10%), malaria (3%), bellyache (3%), and breathing problem (2%).

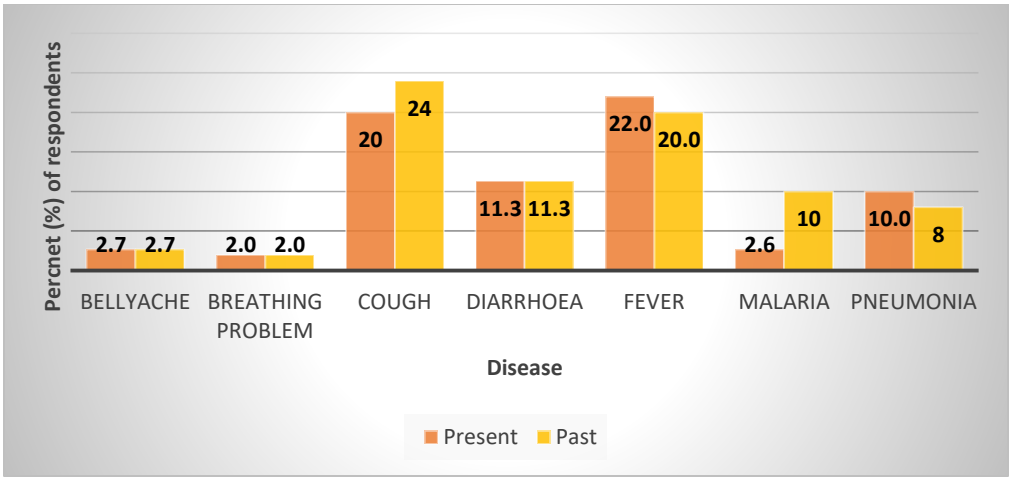

Figure 4.11 Types of Diseases

Source: Field Survey 2019

4.12 Livelihood Condition of the Respondents

The livelihood condition of the respondents also influenced by the nature, they could not get proper facilities to sustain their lives and families. The study revealed that majority of the respondents' source of drinking water was tube-well (Table 4.8). Most of the respondents claimed that they have unhealthy sanitation (95.33%). However, 64% respondents have poultry breeding that is very common in the study area. Moreover, they are underprivileged in every stages and the Table shows that the condition of livelihood pattern is not enough to lead a better life. Hence, 80% of the respondents have domestic animal and they did not get electricity facilities. Therefore, most of the respondents (83.33%) have no electricity in their house.

4.13 Changes in Price of Production

Boro crop and fisheries are the major source of livelihood for the local community in the study area. However, a remarkable number of the respondents (92.7%) intimated that the price of rice production is decreasing which is very unfortunate to the villagers (Figure: 4.12). On the other contrary, 94% respondents specified that the price of fishery resources is constantly decreasing in the entire *haor* region. The market price is not sufficient for the local community .They deprived to get fair price for rice and fish production for many reasons.

Table 4.8: Livelihood Condition of the Respondents

Livelihood condition	Range	Percent (%)
Sources of drinking water	Tube-well	98.00
	Pond	2.00
	Total	100.00
Using water after purification	Not at all	85.00
	Others	15.00
	Total	100.00
Condition of sanitation	Healthy	4.67
	Unhealthy	95.33
	Total	100.00
Having domestic animals	Yes	80.00
	No	20.00
	Total	100.00
Continuity of school going children	Yes	78.00
	No	22.00
	Total	100.00
Having electricity in home	Yes	16.67
	No	83.33
	Total	100.00
Poultry breeding	Yes	64.00
	No	36.00
	Total	100.00

Source: Field Survey 2019

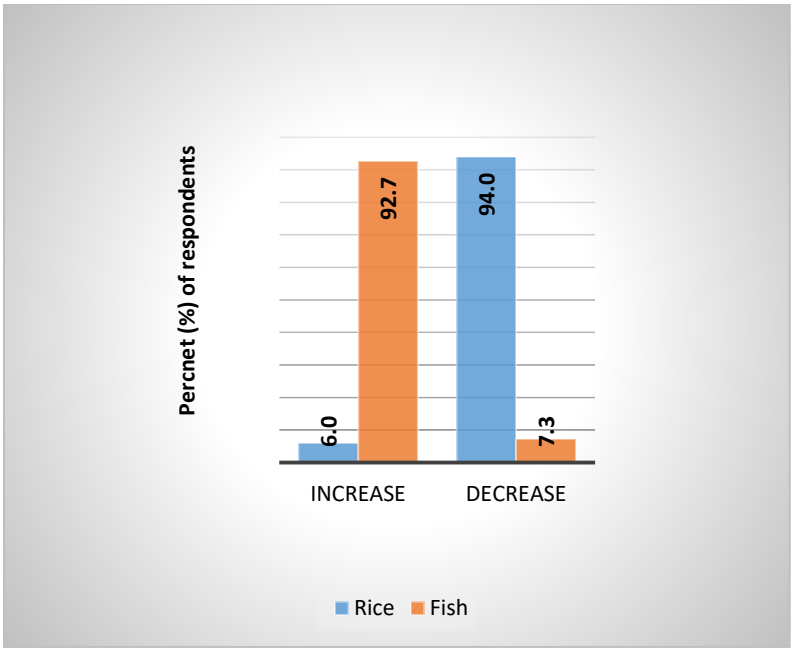

Figure 4.12: Changes in Prices of Production from *Haor*

Source: Field Survey 2019

4.14 *Haor* Management Authority

In the past, local property owners and jamindar leased the *haor* fishery resources. The local anglers employed to exploit the fishery resources. Nevertheless, later, the local political and influential elite people leased *haor* due to develop the fishery resources. Figure 4.13 shows that 84.7% respondents opined that leaseholders maintain *haors* in the past. Still there is a same situation and the fishermen dominated by the leaseholders for a long period of time. In the figure 4.12, 89.3% of the respondents opined that leaseholders or local elite people are controlling *haors*. Yet there are no rights for the general fisherman to access on the *haor*. The local influencers have denied local people day after day. On the other hand, 10.7% of the respondents remarked that the administrators or local government agencies are controlling *haors* (past and present days). Moreover, rest of them thought that in the past local farmers controlled *haor* resources.

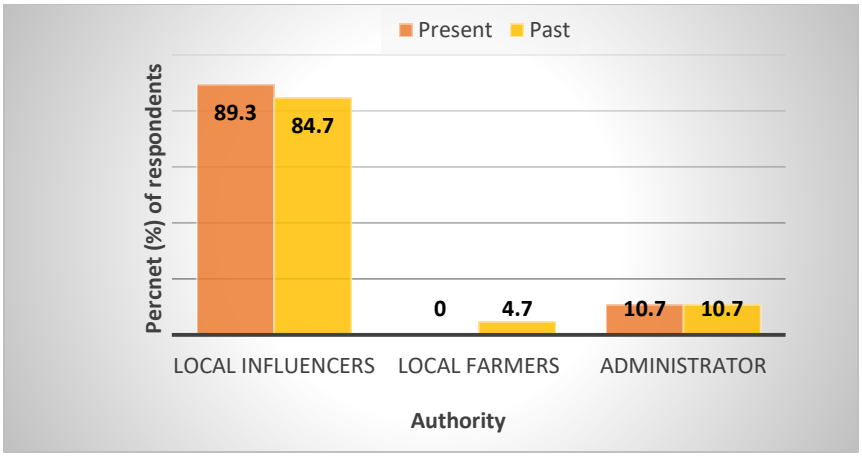

Figure 4.13: *Haor* Management Authority

Source: Field Survey 2019

4.15 Chapter summary

Most of the local people live in the adjacent of *haor* area. That is why agriculture and fishing are the main source of economic activities. The study shows that population change is the pressure, which influence over the natural resources for the inhabitants of the area. The study demonstrated the present and past conditions of the social and economic activities of the locals to bring out the changes and impacts of the *haor* resources.

CHAPTER V

STATE OF NATURAL RESOURCES

5.1 Introduction

Haors are the place of natural resources that supports the entire environment. From the field survey, results and secondary sources *haors* have unique biodiversity and ecosystem. This chapter comprised with the decadal change of land cover, waterbodies, vegetation, biodiversity and other natural resources of the area. This chapter presented the indications, causes and impacts of natural resources due to over population. Also demonstrated the natural hazard and other obstacles of the study area. The activities of government and other organizations obtained here to understand as well as to clarify the condition of the natural resources conservation and management in the study area.

5.2 Changes Land Cover in the Study Area

Haor is flooded by water seasonally which helps to control water flow and directly improve the quality of entire ecosystems. It plays a vital role for biodiversity, wildlife and for human being. Table 5.1 shows that the total land cover of the stud area (2009 and 2019). In the study area the total vegetation (Figure: 5.1, 5.2) is 39.40% and the water body is 18.29% and the rest of is about 42.31% (2019). However, in 2009, the total vegetation was 54.86%, water body was 25.40%, and others were 19.75%. Thus, the study shows that, there is a massive change in land cover of *haor* areas and day after day, it is decreasing. To meet the rising people's demands, they are fully dependent on *haor* lands and resources. The study demonstrate that the villagers are extremely dependent on the *haor* resources. Local community mainly dependent on various resources such as fisheries, forest, plants and other products, waterfowls, grass, reeds and other flora and fauna.

Table 5.1: Land Cover of the Study Area (sq. km)

Year	2009	2019
Vegetation (sq. km)	449.917	323.16
Waterbody (sq. km)	208.292	150.022
Others (sq. km)	161.98	347.007
Total Area (sq. km)	820.189	820.189

Source: glovis.usgs.gov/app

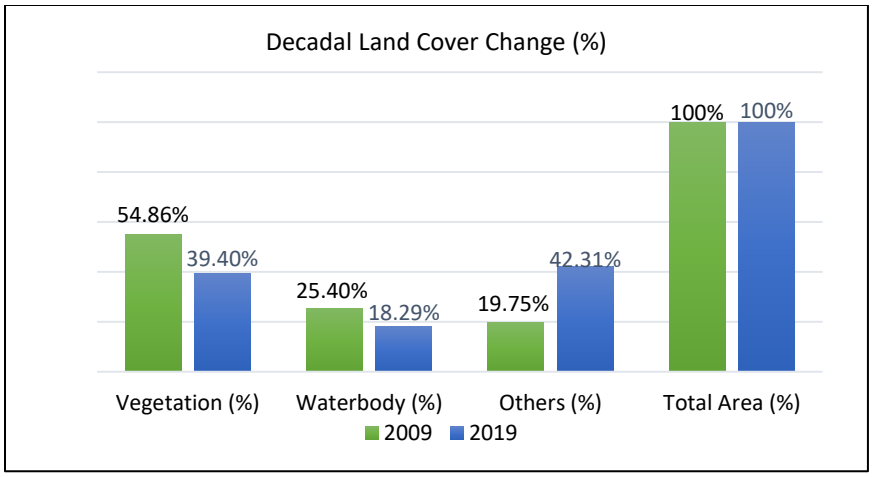

Figure 5.1: Decadal Land Cover Change

Source: glovis.usgs.gov/app

5.2.1 Changes of Waterbody

The large water body of *haor* areas is the invaluable natural resource to the local community. The local farmers directly dependent on this *haor* water for agricultural activities in the dry season. Agricultural crops (mainly Boro rice) produced in *haor* land in the dry period (November to March). Therefore, *haors* have great role on the livelihood of the local community. Local people are mostly depending on farming activities. During the dry season, they start cultivation while the water recedes from the *haor* to the rivers.

Table 5.2: Water Body of the Study Area

Year	Area (Sq. km)	%
2009	208.292	25.40%
2019	150.022	18.29%

Source: glovis.usgs.gov/app

Boro rice is the main crop in *haor* land. Local people are extremely rely on the crops in the drier month as because they do not have any other works in the rainy season. During this rainy season, they depend on stored food, crops, fisheries, waterfowl hunting, forest resources, grass, reeds and many others. To support families and lives, the local try to produce more crops from the *haor* lands but it is not possible to get more from the fertile lands of *haors*. The table 5.2 identified that in 2019 the total water body is 18.29%, which

was in the past 25.40% (2009). The study also indicated that in the northeastern part of Tahirpur upazila, the decreasing of water level is highly noticeable (Figure: 5.2, 5.4).

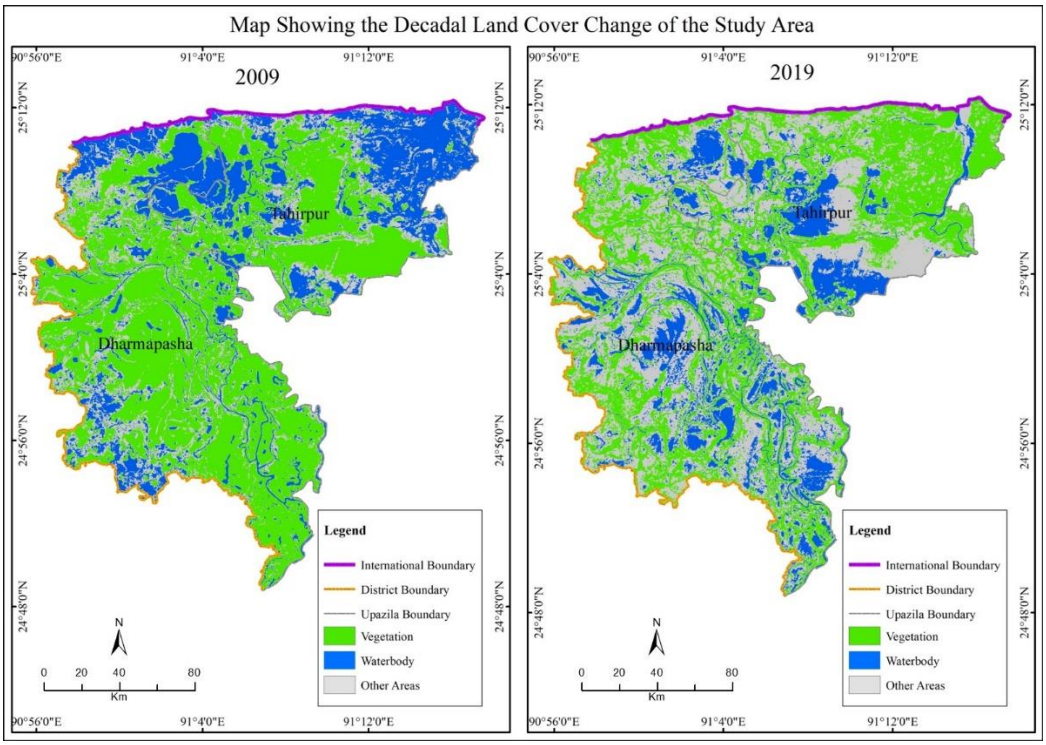

Figure 5.2: Satellite Image of Decadal Land Cover Change of the Study Area

Source: glovis.usgs.gov/app

5.2.2 Changes of Vegetation

Wetland vegetation is very important part to the local people or villages for their domestic needs. Local people used to collect forest trees for domestic fuel woods. By the following Figures 5.3 and 5.5, the study notified that, in 2009 the vegetation of total area is about 54.86%. Most of the local people depend on *haor* as a source of animal fodder, fuel wood and collect grass and reeds, thatching materials for their regular purposes.

At present the total area of vegetation 449.917 (Table: 5.1) sq. km have been reduced due to over using. In 2019, degradation of vegetation is very high and the reduced area of vegetation is 39.40%. The study shows that forest area has drastically exploited by human activities. Furthermore, the leaseholders degraded the forest resources by frequently collecting tree branches and sometimes collect whole trees to fulfill their commercial activities.

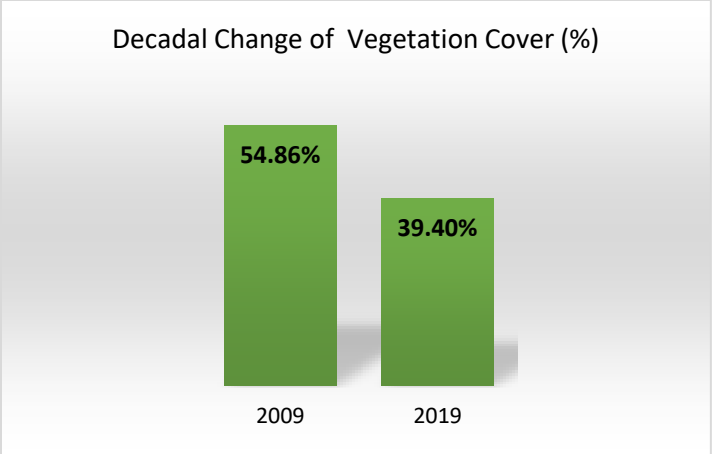

Figure 5.3: Decadal Change of Vegetation

Source: glovis.usgs.gov/app

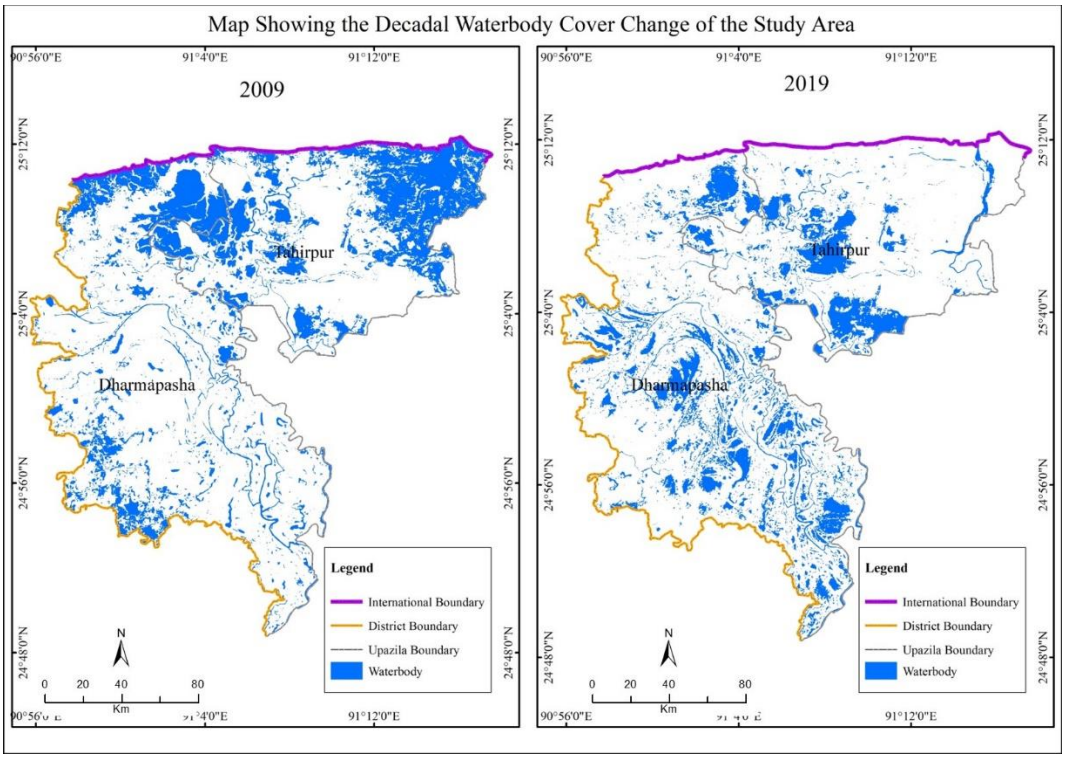

Figure 5.4: Satellite Image of Decadal Water Body Change of the Study Area

Source: glovis.usgs.gov/app

At present the study shows that vegetation cover is highly degraded in the entire study area but in the northeastern part of Tahirpur it is in the flourishing level where the volume of wetlands have decreased. Swamp forest is one of the most important resources of *haor* areas, which plays an important role in the wetland ecology. Therefore, the total area of

vegetation is highly decreased than before. The study notified that, in the southwestern part of the study area, vegetation cover has been lost. For that reason the water body is focused very clearly by the satellite image (Figure: 5.5).

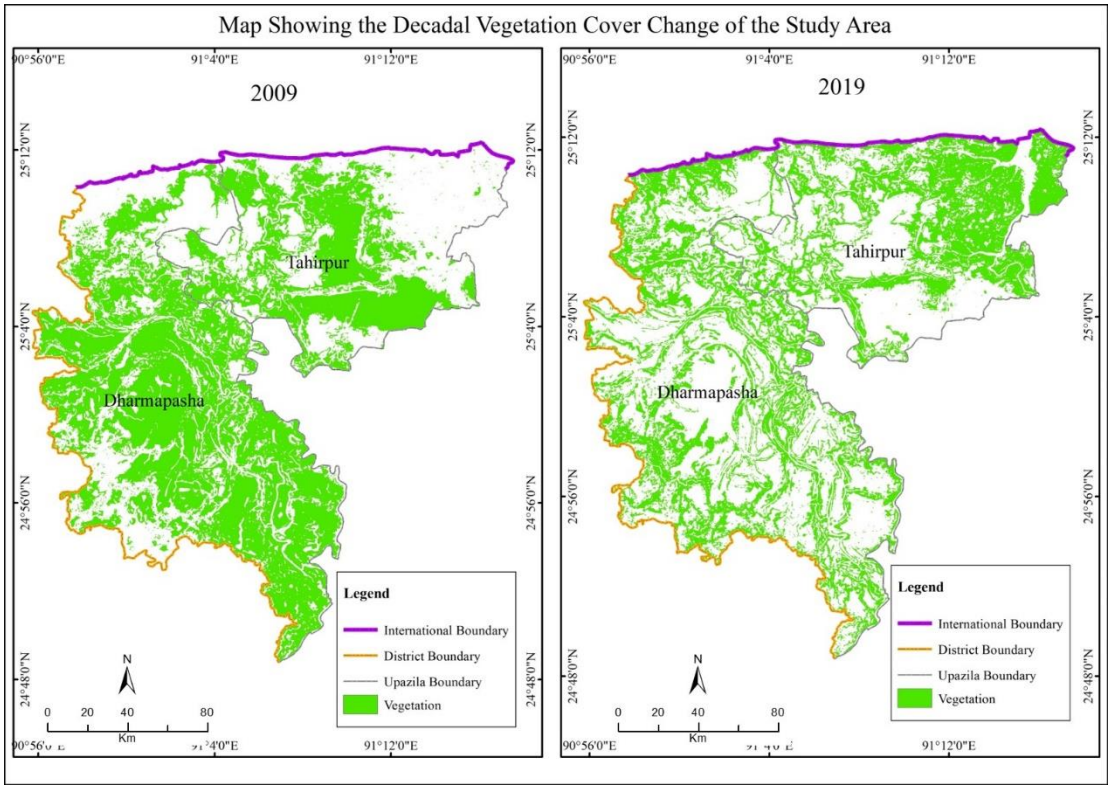

Figure 5.5: Satellite Image of Decadal Vegetation of the study area

Source: glovis.usgs.gov/app

5.3 Biodiversity in the Study Area

There are many *haors* in the study area such as Tanguar *haor*, Sanir *haor,* Matian *haor* and others. Among them Tanguar *haor* is the largest wetland in the country. It has exclusive dynamic biodiversity and ecology. However, it is seriously endangered for various issues. Local people interrupted the *haor* resources. Thereby it recognized as one of Ecological Critical Areas of the country in 1999. In addition, it declared as Ramsar site in 2000.

Bangladesh Bird Club conducted a survey on waterfowls in January while birds are available in Tanguar *haor* (IUCN, 2012). The survey the census noted that from 2001 to 2005, the population of birds is available and the range is higher than previous years.

Unfortunately, the range of birds availability is decreasing from 2006, birds' population is highly decreasing.

Fishery resources are decreasing at an alarming rate. The trend of ecology and biodiversity have been lost for human intervention. The following Table 5.3 shows the commercial fish harvesting in different years (2009-2014).

Table 5.3: Fish Harvesting in the Tanguar *Haor*

Year	No. of Beels	Harvested Fish (kg)	Fish Price (Taka)	No. of Days of Fishing
2014	8	13,920	25,50,714	26
2013	8	8,316	7,24,010	52
2012	12	55,580	59,86,976	75
2011	5	6,195	6,59,325	16
2010	10	18,738	39,31,813	54
2009	7	20,218	22,86,057	26

Source: IUCN report on biodiversity of Tanguar Haor, 2015

5.4 Indications of *Haor* Resource Degradation

The present study reveals that fishery, forest, waterfowls are the main product or resource of the area. The area was full of enormous resources in the past. However, at present, the local community abuses hoar resources. The study found many indications, which are deteriorated *haor* resource for long years.48 percentage of the respondents (Figure: 5.6) noticed that less availability of fish resources than past is the most significant indicator to degrade wetland. Otherwise, 33.33% respondents opined for declining number of water birds .13.3 % respondents mentioned as reducing of forest resources also indicated the degradation. Rest of the respondents opined that extracting of flora and fauna are the indications to destroy *haor* resources. The Figure 5.6 has shown many indications, where the people of the study area degraded *haor* resources day by day.

5.5 Reasons of *Haor* resource Degradation

The study reveals that most of the local people acquainted and have some ideas about the ideas about the degradation of *haor* resources. Generally, local people are very close

towards *haors* and usually rely on natural resources for their personal needs. However, people who exploit the *haor* resources also realized that the plenty of national resources are decreasing continuously.

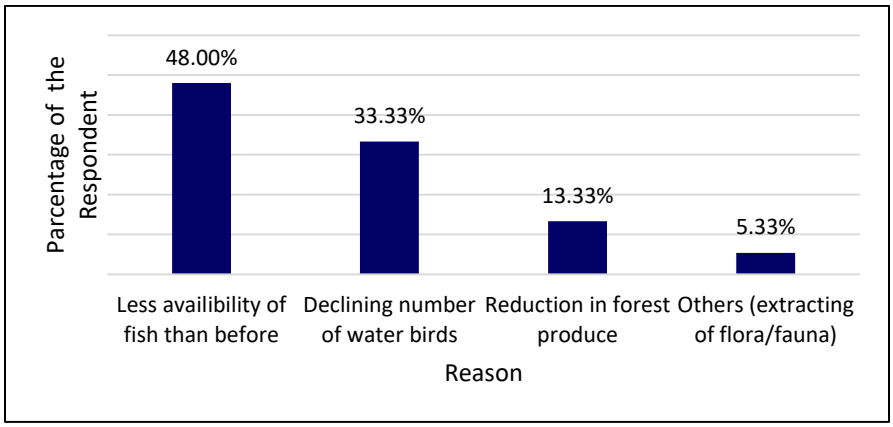

Figure 5.6: Indications of *Haor* Resource Degradation

Source: Field survey 2019

At present in the area, people are more able to understand the overall situation through many sources. Moreover, local people can easily identify any changes that may occur in the area. It was difficult to understand the destruction of the *haor* resources such as fisheries, waterfowls, forests and others. However, the local people recognized the changes of *haor* ecosystem and biodiversity. Their livelihood activities are *haor* oriented. Thus, people identified various issues, which are responsible for the deterioration of the *haor* resources.

5.5.1 Forest

The causes of forest degradation identified through interviews, which have shown, by the Figure 5.7. However the causes of forest resource degradation which are mentioned by the respondents such as illegal cutting, collection of fuel wood, construction material and other activities. Most of the respondents (51.33%) mentioned that resources have been degraded by cutting trees. Moreover, 26% respondents mentioned that collection of fuel wood is the cause of degradation. Moreover, rest of the respondents (20.67%) remarked that locals are involved to collect trees and forest resources as construction materials.

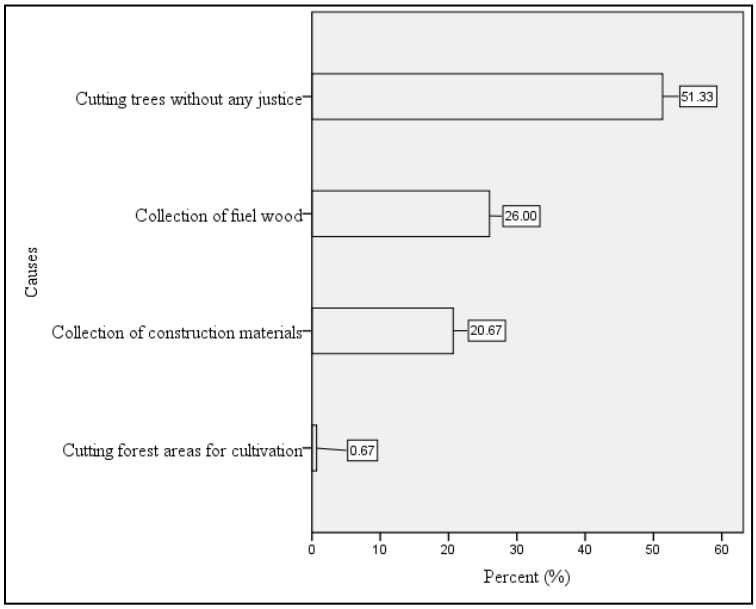

Figure 5.7: Causes of Decreasing Forest Resource

Source: Field survey 2019

5.5.2 Fish Resources

Major causes of fishery resources identified through field survey that has shown by the following Figure 5.8. Seventy-eight percent respondents mentioned that both local people and leaseholders have occurred overfishing. Illegal fishing is one of the significant issues for fishery resources. Some of (15.33%) respondents recognized that cultivation system

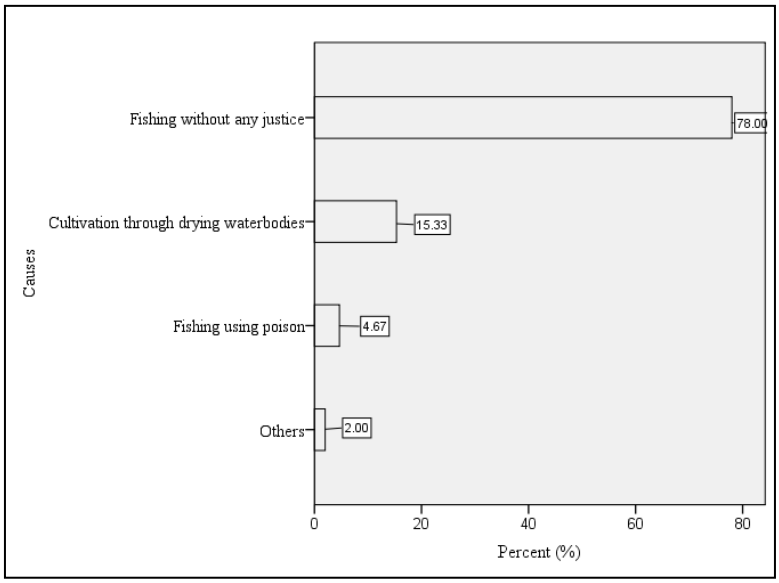

Figure 5.8: Causes of Decreasing of Fish Resources

Source: Field Survey 2019

through drying the waterbodies is the another reason. Moreover, rest of them (4.67%) observed that people are involved to collect fish by using poison.

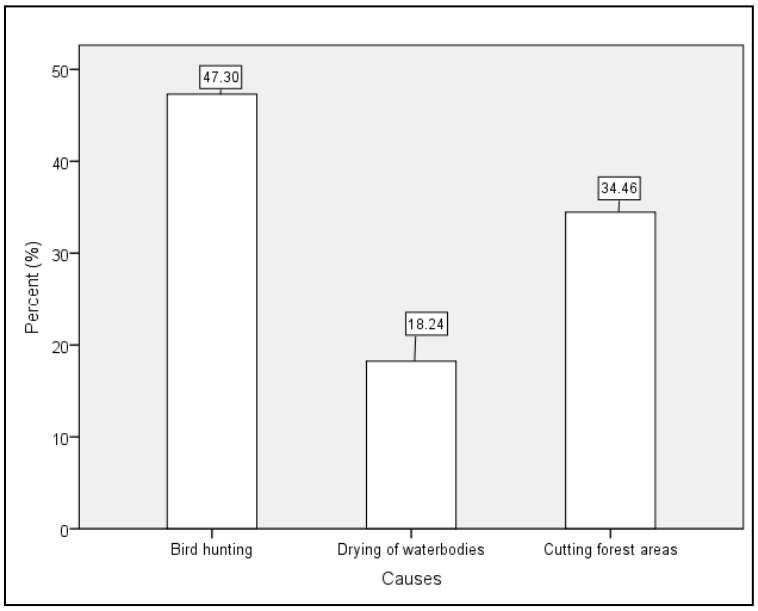

Figure 5.9: Causes of Decreasing Migratory Birds

Source: Field survey 2019

5.5.3 Migratory Waterfowls

According to the field survey, 47.30% of the respondents mentioned that illegal hunting is the major issue for decreasing waterfowls. 34.46% respondents remarked that deforestation or cutting swamp forest resources is the reason for declining water birds in the area .And rest of the respondents mentioned that people try to dry the wetland for their needs (Figure 5.9).

5.6 Impacts of River Embankment

River embankments are the most significant reasons for degradation of wetland resources. 78.86% respondents claimed that it has been created waterlogging in the *haor* area. 10.57% respondents also mentioned that suddenly flood is occurred through barrage. On the other hand, 8.94 percent of the respondents opined that it damages agricultural production. Rest of the respondents mentioned that inundated their houses and roads which is also hampered their lives (Figure 5.10).

5.7 Natural Hazards

Natural hazards are the common environmental issues of the study area. Both usual and flash floods, storms, drought, riverbank erosion are occurred in every year. However, flash flood occurs in April and early May and the area inundated very fast which is hampered the livelihood activities. In the following table: 5. 11.95% of the respondents remarked that flash flood is the cause to destroy the *haor* region. Flash flood is one of the most unusual floods and causes huge loss of agricultural crops. Boro is the only one crop in the *haor* area but flash flood impacts on crop production.

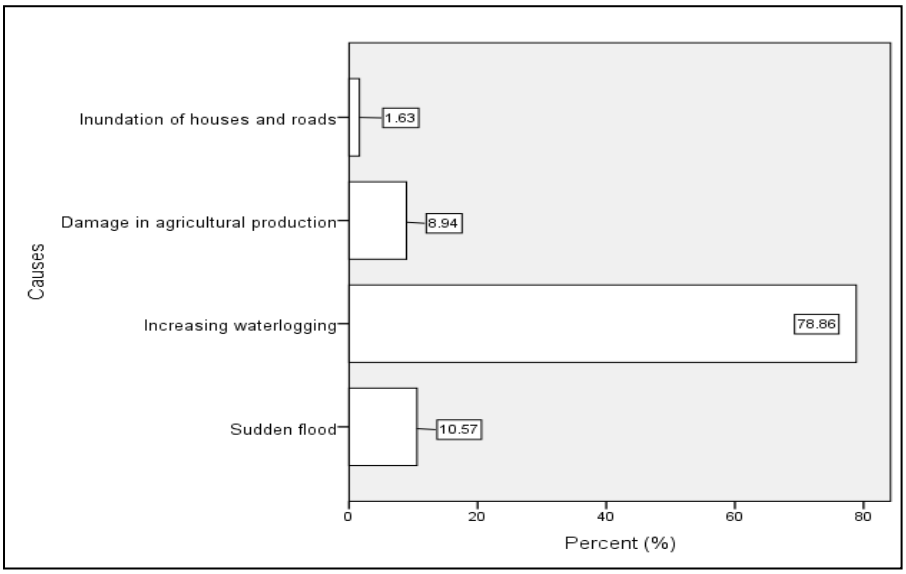

Figure 5.10: Impacts of River Embankments

Source: Field survey 2019

Local people suffers from flash floods and every year people loss their crops. Table 5.4 is showing that natural hazards damage crops that are very important to survive. In this table we have shown that 80% respondents have lost <=50000 Taka (damage in taka) while in the past the percentage was 79.33.

It is the regular feature of the entire *haor* area. Moreover, storms, drought, and hail are the obstacles to damage crop production. Thousands of tons of boro crops are lost due to these hazards. Natural hazards affect their lives and suffer from financial crisis. The Table 5.4 represents the status of damage of the crop production (past and present year) which is caused by different natural hazards.

Table 5.4: Damages and Natural Hazards

Natural hazard	Range of damage (Damage in Taka)	Present Condition	Past Condition
		Percent (%)	Percent (%)
Flood	No Damage	7.33	7.33
	<=50000	80.00	79.33
	50000-100000	11.33	10.67
	>=100000	1.33	2.67
	Total	100.00	100.00
River erosion	No Damage	88.00	89.33
	<=15000	6.67	7.33
	15000-30000	3.33	2.67
	>=30000	2.00	0.67
	Total	100.00	100.00
Hail-storm	No Damage	82.67	85.33
	<=15000	8.00	8.67
	15000-30000	8.00	6.00
	>=30000	1.33	0.00
	Total	100.00	100.00
Drought	No Damage	94.0	94.0
	<=15000	2.0	2.0
	5000-10000	3.3	3.3
	>=10000	.7	.7
	Total	100.0	100.0

Source: Field survey 2019

5.8 Impacts of Population Growth on *Haor* Resources

Population growth is the most important issue on *haor* area .Because, hoar has a unique biodiversity and ecology. Mostly people are dependent on *haor* resources. However, lack of proper knowledge, education and transport, locals have no other option to work in other sectors. As a result, local people involve in fishing, hunting (waterfowls), farming and work as day labor. At present *haor*, resources are degraded to fulfill the demand of rising population.

5.8.1 Forest Resources

Mainly fisheries, swamp forest, waterfowls, waterbodies, flora and fauna are important resources of wetland. From the field survey, 53.33% (Figure 5.11) of the respondents mentioned that they collected fuel wood from the *haor*, where the people cannot use kerosene or other fuel. In addition, locals have domestic animals and collected wetland plants as fodder. 26.67% of the respondents are involved to collect fodder for their cattle and grazing in the open area of *haors*. Aquatic plants, grass, reeds and sedges are the source of fodder. Besides these, 16.67% respondents opined that people are cutting forest plants for their domestic needs. Moreover, they claimed to the leaseholders for cutting trees. Rest of the respondents mentioned that local people impacts on forest resources for various reasons.

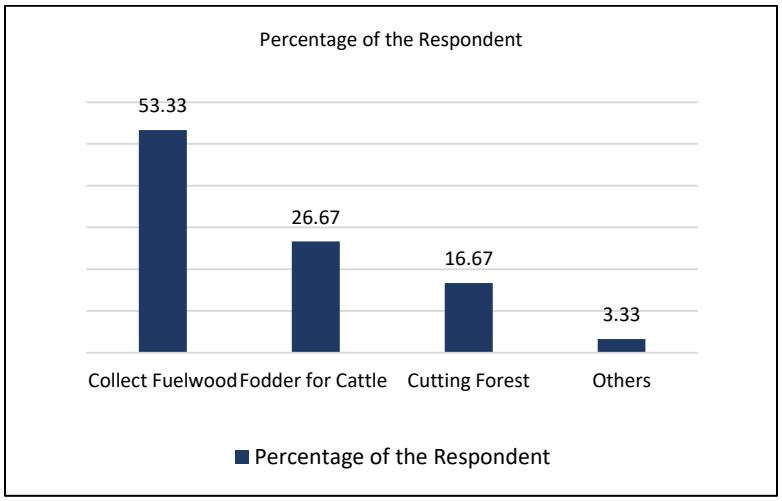

Figure 5.11: Impacts on Forest Resources

5.8.2 Agriculture

Farming is the major source and people extremely reliance on boro crop production. They try to produce more crops from the *haor* land. Therefor they tried to provide more food to support their families. Sixty percent of the respondents (Figure 5.12) mentioned that people exploited land by over harvesting. Otherwise, 38 % of the respondents claimed that increasing demand of locals is also impacts on *haor* resources while two percent remarked for other reasons.

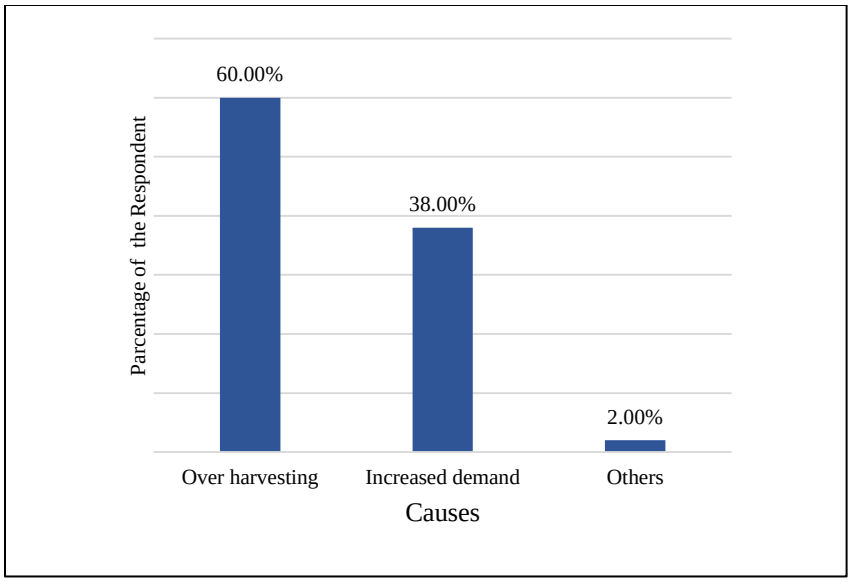

Figure 5.12: Impacts on Agriculture

5.8.3 Fish Resources

Tanguar *haor* is the mother sanctuary of fisheries, which is included in the study area. *Haors* are enrich in fisheries from other regions of the country. But overfishing and illegal fishing are the regular issues to impact on fishery resources. Figure 5.13 shows that half of mentioned illegal fishing is the main reason. Besides, 28 % of the respondents (Figure 5.13) mentioned that overfishing is the reason behind to impact on the fishery resources.

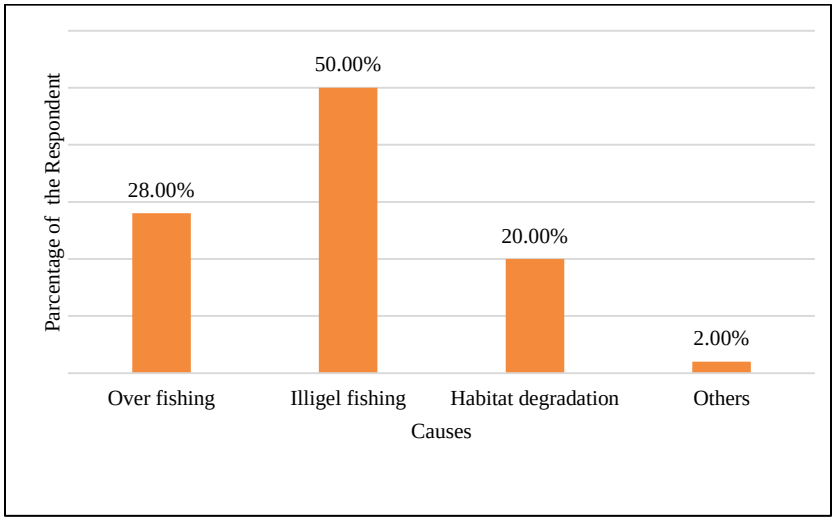

Figure 5.13: Impacts on Fish Resources

Source: Field Survey 2019

5.8.4 Wetland

Wetland provides wonderful habitats. Every year a large number of migratory birds exist in the *haor*. These birds come to the *haor* in winter season. However, local people illegally hunted the migratory and local birds.

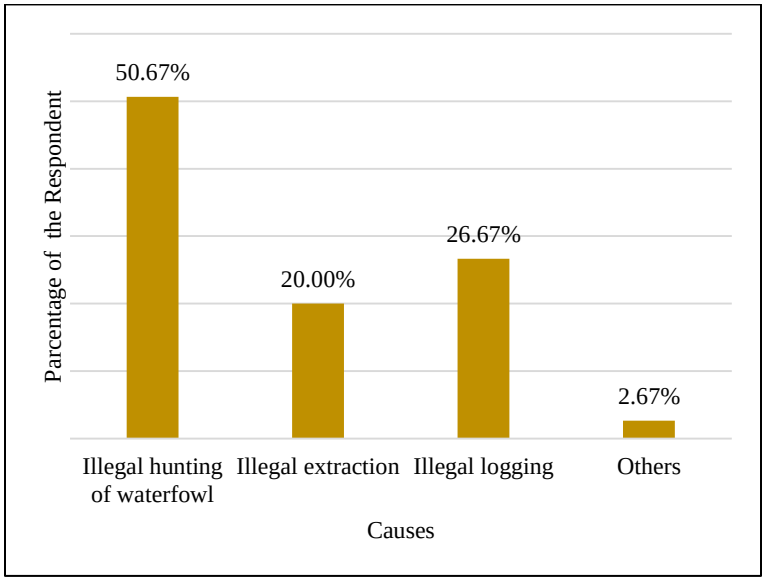

Figure 5.14: Impacts on Wetland

Source: Field survey 2019

From the field survey, half of the respondents (50.67%) opined that wetland is destructed by waterfowl hunting.26.67% (Figure 5.14) respondents mentioned that illegal logging of the waterbodies also impacts on the *haor* resources while 20 % claimed for illegal extraction. Moreover, 2.67 % mentioned that other causes also impact on the *haor* resources to fulfill the increasing demand of population.

5.9 Migration of the study area

The study reveals that the population growth is the major factor to cause various problems in the area. Maximum portion of the respondents (45.71%) opined that people migrated the present area for earning more money than before. 28.57% percent respondents mentioned that they want to relocate another place for decreasing of production as well as the rising population. On the other hand, 24.29% of the respondents remarked that they have no option to participate in *haor* production. Local community thought that migration is the way to mitigate their problems and they get enough facilities (Figure: 5.15).

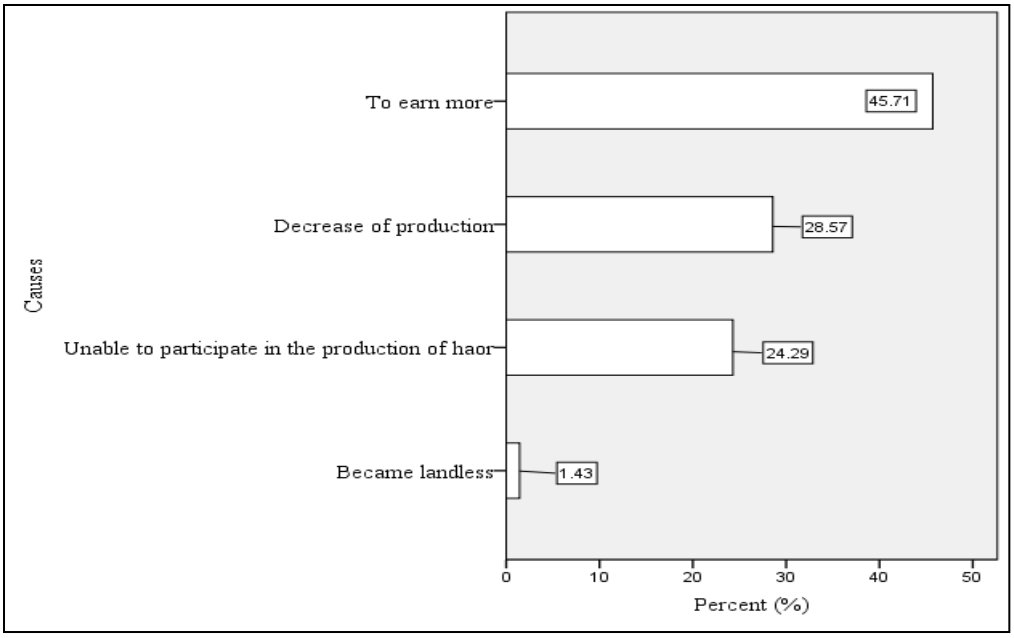

Figure 5.15: Causes of Migration

Source: Field survey 2019

5.10 Mitigation of Arising Problem

The present study reveals that population growth is the major factor to cause various problems in the *haor* area. Maximum portion of the respondents (37.33%) wanted to migrate for earning more money than before (Figure 5.16). 29.33 % percent respondents mentioned that they want to build house in the agricultural land for accommodating the rising population.

The Figure 5.17 shows that the way of providing food for the growing population. Thirty eight percent of the respondents selected the way of using artificial techniques in the cultivation system. Moreover, 32 percent respondents mentioned that changing of occupation is the right option to mitigate problems. Moreover, 26% remarked that increasing of agricultural production could also support to solve problems.

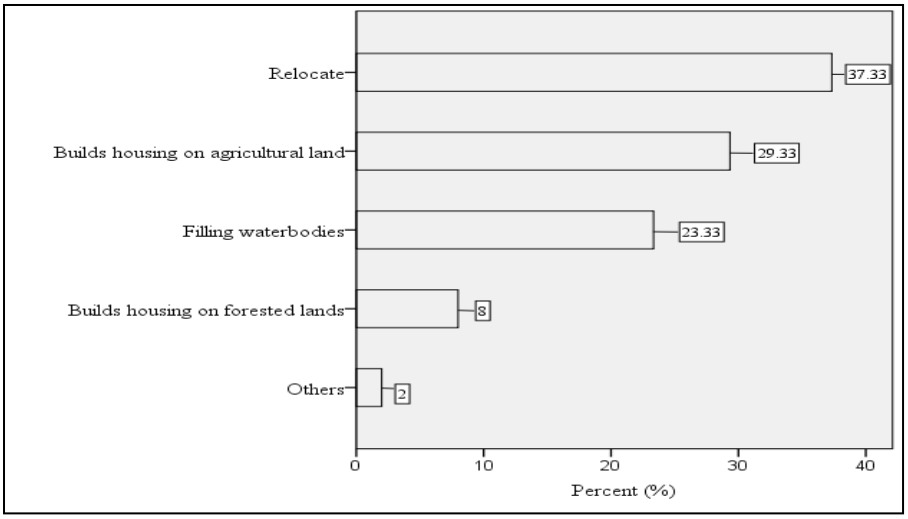

Figure 5.16: Ways to Accommodate Increased Population

Source: Field survey 2019

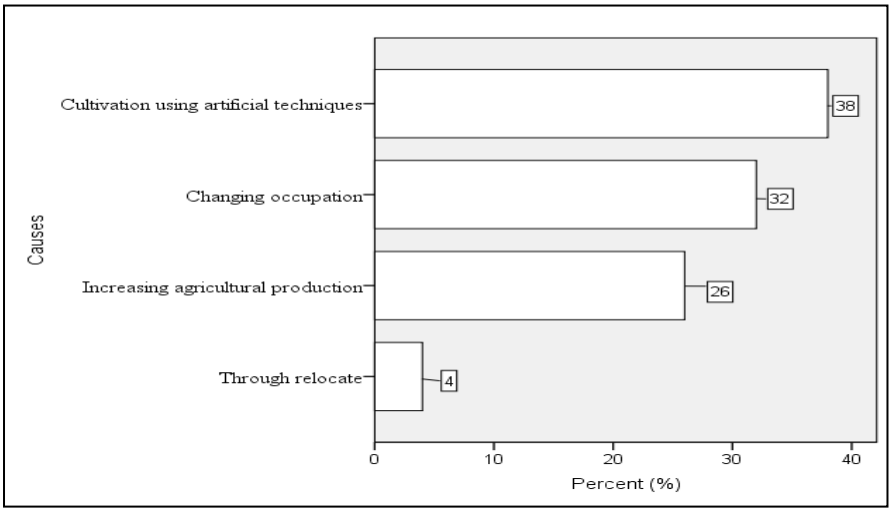

Figure 5.17: Ways to Provide Food for the Growing Population

Source: Field survey 2019

5.11 Initiatives to Protect *Haor* Resources

Government, NGOs and International agencies have taken several initiatives for protecting *haor* region. The present Figure 5.18 shows that most of the respondents (78.67%) opined that government built barrage and 13.33% respondent also mentioned that government also took initiatives to banned poison. And rest of them remarked that government is working to stop cutting forest .NGOs have some role to protect *haors* but these are insufficient .From the field survey 27% of the respondents mentioned that they have been taken

initiatives to maintain barrage as a volunteer. Mainly government is the authority to build barrage in the area. Six percent of the respondents picked the option that NGOs are also working to stop cutting forest plants.

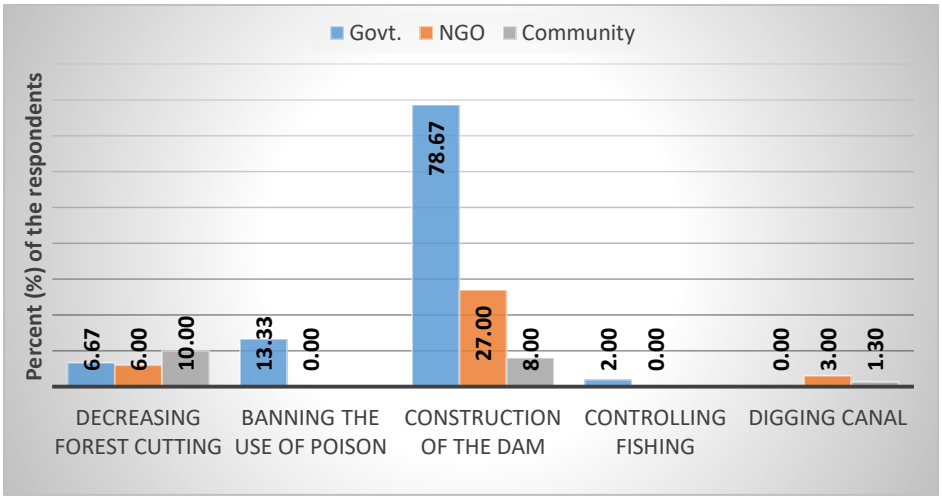

Figure 5.18: Initiatives Taken to Protect *Haor*

Source: Field survey 2019

5.12 Initiatives for Sustainable Management of *Haor* Resources

From the field survey, both leaseholders and local people suggested many initiatives, which are more sustainable for *haor* resources .The study reveals that respondents were not satisfied to the present taken initiatives. The respondents (Figure 5.19) mentioned that government should take more sustainable initiatives to protect natural resources. Moreover, local community have some rights to take initiatives for resource management. They want to participate in resource management system. Thereby the respondents suggested digging canal for the sustainable resources management. Community based management system is very important to maintain the entire *haor* resources of the area. In addition, NGOs have responsibilities to protect and maintain the resources.

In this study, respondents also mentioned the involvement of international agencies and NGOs .They should take initiatives to ensure sustainable resource management. Sixty-six percent respondents expressed their opinions to the organizations for digging canal. Moreover, twenty-six percent respondents emphasized for river barrage, which is very important for protecting *haor* from flash flood. The respondents also emphasized for local

people's participation on management activities. The figure also shows that 41.3% respondents intimated that community have also responsibilities to dig canal for the sustainable resource management.

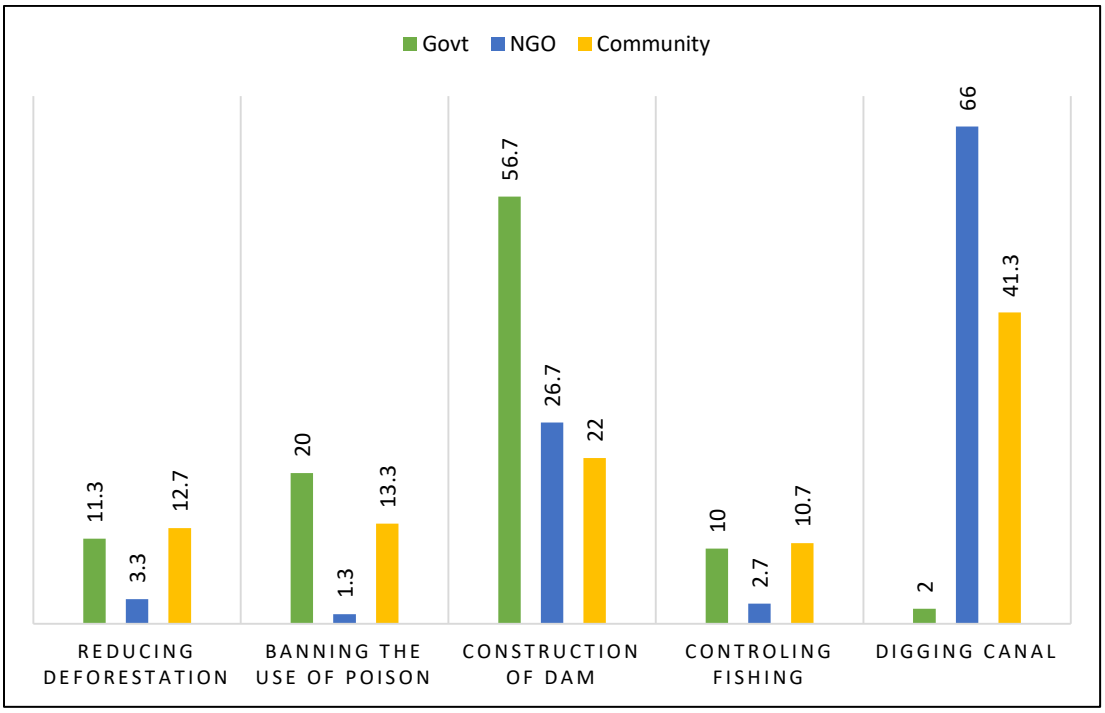

Figure 5.19: Other Initiatives for Sustainable Management of *Haor*

Source: Field survey 2019

The Figure 5.19 shown that 10 % of the respondents opined to participate NGOs in sustainable management activities. Respondents suggested some favorable strategies, which shows in the figure 5.19. The respondents also expressed their opinions for saving the natural resources and they need sustainable management for wetland resources. 56.7% of the respondents emphasized for building barrage to protect *haor* resources properly. Moreover, 20% respondents opined that government should take more initiatives to banned poison.11.3percentage of the respondents mentioned that government should take effective steps to protect swamp forest by stopping deforestation.

5.13 Chapter Summary

Every year in the study area, local people fight to the natural disaster. Lack of proper knowledge, improper management and transport systems are the barriers for the development of the natural resources in the area. Thus, population growth and extreme humanitarian activities acutely impact on the natural resources of the *haor* for a long period of time.

CHAPTER VI

DEGRADATION AND HAOR CONSERVATION

6.1 Introduction

In this chapter, the present study demonstrated the existing function, utility and structural system of the entire *haor* area through field observation, key informant interviews and focus group discussion. The study aims to understand the present scenario and reliance on crops or natural resources and current issues of the study area with the suggestions of the participants. These chapters also revealed the socio-economic conditions, management practice of *haor* area, role of NGOs and international agencies and other related circumstances. This study also provide possible steps or recommendations of the officials to highlight the major issues of the area.

6.2. *Haor* Oriented Activities of Local People

From the group discussions of the selected areas, this study revealed that the overall scenario as socio-economic and environmental conditions are not satisfactory. Poverty is one of the most unwanted issues in the surrounding *haor* areas, which leads to excessive exploitation of the natural resources (Figure 6.1). The people of the area fully depended on *haor* resource such as fish, fuel wood, grass, reeds, fodder for cattle and others (Figure 6.3). They start cultivation in the Mid October and harvest crops in the Mid-April of the year. Some of the local people work as day labor in various activities. At present the locals are completely depended on agricultural activities and *boro* crop is the main crop to provide their livelihoods and a very few number of people involve with other activities, which are not related to *haor* resources.

Figure6.1: The People of *Haor* Areas

The natural resources are the main source of income for the villagers. These *haor* supports them in various sectors. They use *haor* resources for maintaining their livelihoods. Most of the people works in the agricultural land. Otherwise, fishing is the sources of income during monsoon but this are not satisfactory because they are not allowed for fishing in *haor*. However, the participants use *haor* resources as their regular needs. They collect fuelwood, grass and reeds for animal fodder from *haor*. Besides these, resources are using as hunting, irrigation and transportation in the rainy season (Figure 6.2).

6.2.1 Current Issues in the study Area

Through group discussion first group of the local community, mainly the farmers opined that large varieties of fish species are the main resource of *haor*. Now fish species are not sufficient. Illegal fishing is the common fact that local people are depriving from access to *haor* resources. They also mentioned that people collect fuel wood from forest and forest plants are crucial part and has important role for fish breeding. They believed both forest plants and fish species are complementary to each other. As a result, the inhabitants disrupt the ecological balance of the *haor*, while they extract the natural resources for their common activities. Therefore, the fish species and biodiversity are declining and the range is higher than past few years. On the other hand, lack of proper transport, current leasing system, deforestation and management systems are the major problems of the area.

Traditionally the leaseholders controlled the *haor* resources. Thus, the second group of local people expressed their opinion as the influential leaseholders excluded the local villagers to access on the natural resource of *haor* areas. In order to require their livelihoods most of the people are involving with illegal hunting and fishing by the absence of local security or guard in the *haor*. From the group discussion, local fishermen are also opined that they are not satisfied to the leasing system. Leaseholders continuously excluded them from the utilization of natural resource. The leaseholders banned the local villagers as outsiders and the relationship between locals and leaseholders are not favorable. On the other hand, local communities are satisfied to the service of the government as river embankments in the prevailing *haor* from few years. River embankments are supportive to control the excessive water flow during the monsoon and the damage of crops are minimized than before. Otherwise government did not take any proper initiatives in the

agricultural sector. During the rainy season, the day labors of the study area become unemployed and involve in fishing for several days.

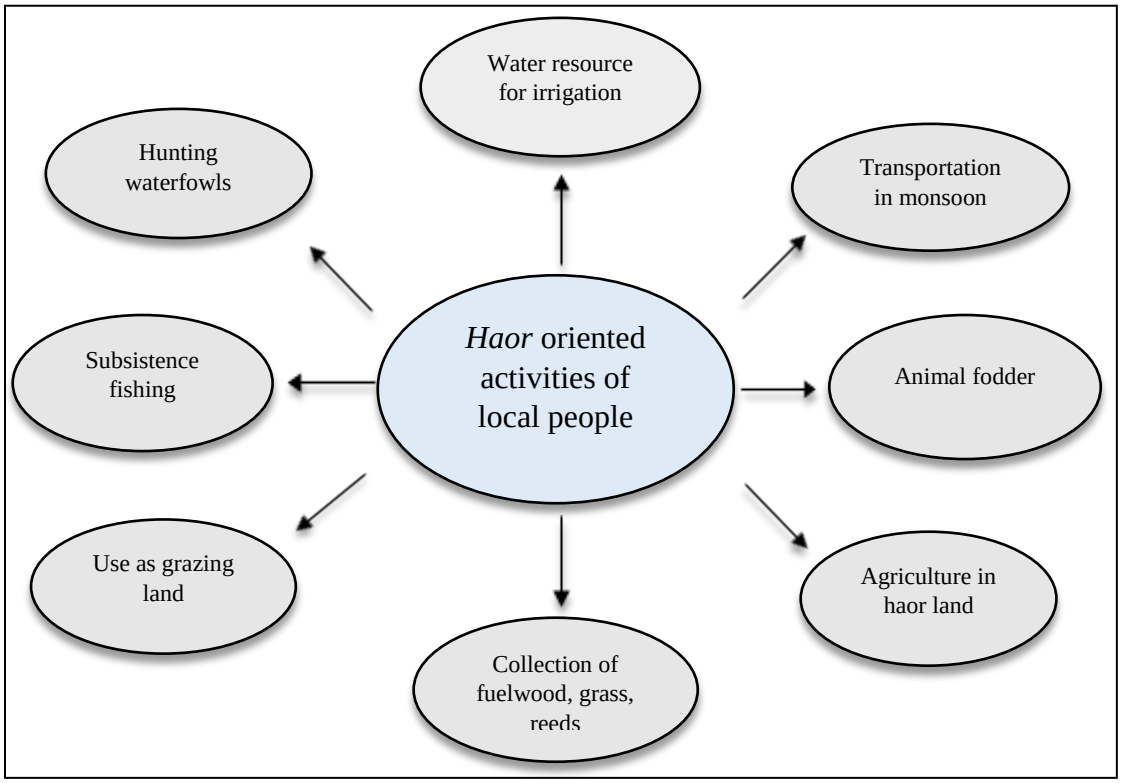

Figure 6.2: Reliance on *Haor* Resources in Different Purposes

6.2.2 Integration of Local People in *Haor* conservation

The participants of the selected areas are concerned about the present condition that hampered the socio-economic and environmental function in the *haor* area. The local community faced various problems such as lack of proper management of *haor* basin, transport system, illegal fishing and waterfowl hunting, leasing system, deforestation, poor irrigation system, river embankments and others. These are the major issues of this area and for that purposes the participants suggested to the government, NGOs and other agencies to mitigate all these common issues through providing facilities as transportation, suitable irrigation system, proper rights to access on the *haor* and contribute in the management activities to protect the natural resources of the area. The participants wants to join in the conservation process for the sustainable management of *haor* resources.

Subsistence Fishing in *Haor*

Harvesting in the Winter Season

Dependence on *Haor* for the Fodder

Collecting Fuelwood

Figure 6.3: Dependence on Various *Haor* Resources

Table 6.1: Indications of FGD Session in the Study Area

FGD	ISSUES	Effective ways: Recommendations
1. Farmers	• Deforestation • Lack of transformation • Hunting • Fishing • Natural hazards	• Improvement of transport system • Digging canal for suitable irrigation in the *haor* area • Development of the management system in the study area
2. Local People	• Illegal hunting • Illegal fishing • Deprived to access on *haor* resources by leaseholders	• Wants to participate in the conservation of *haor* resources • Need proper government initiatives
3. Fishermen	• Dissatisfactory to the leaseholders activities	• Desires to access on *haor* for maintaining their economic activities
4. Day Labors	• Unemployment during rainy season	• Scope for alternative occupation • Relief

Source: Field survey, 2019.

6.3 Wetland Degradation

Natural calamities as siltation, flash floods and humanitarian activities are the major causes to degrade wetland resources. Siltation is one of the key issues of wetland degradation and the activities of local people, which deeply related to the natural resources, hamper the natural balance of the area. People are frequently interrupted the wetland environment. Thus extreme fishing, hunting and using chemicals and pesticides in the agricultural activities are the major reason for the wetland degradation. Since the past, a large number of migratory birds are reducing in the study area. During the winter, illegal hunting, shrinking of bird's habitat, noise and other reasons are responsible for decreasing of

waterfowls (Figure 6.5). Otherwise, local farmers are fully rely on the *haor* land in the dry period of years and they use chemicals and other pesticides for weeding in their crop cultivation. As a result, these chemicals are threaten for the wetland. In addition, *haor* lands are facing many complications and dewatering for fishing is one them (Figure 6.4). The process of fishing disturbed the *haor* land and *jalmahals*, which provides different biodiversity and ecosystem in the *haor* area. Furthermore, fishing technics are not suitable and thus illegal fishing during the breeding period, which is seriously impacted on fish species, habitats and disturbed the physical and natural conditions in the entire *haor* and *jalmahals* (Figure 6.6).

Figure 6.4: Dewatering *Haor* Land for Fishing

6.3.1 Expansion of Agricultural Activities

In agricultural sector, people use chemical fertilizer and pesticides to produce more crops to fulfill their basic demands. However, these chemicals are extremely hazardous for the fish habitats, flora, fauna and drastically impact on the ecological balance. Most of the farmers using chemicals and pesticides for weeding, which are highly harmful for environment. In the Haor region, *boro* rice is the only one crop and the villagers fully depended on this crop. Infect the boro rice production of the area can provide sufficient rice all over country (for three months) if harvested at right time. BR-28 and BR-29 are the

types of boro rice, which is cultivated in the *haor* areas. Unfortunately, flash flood and other natural calamities are the obstacle for the agricultural sector and every year damaged the crop production. Still government is trying to protect *haor* crops by using modern harvester and related equipment.

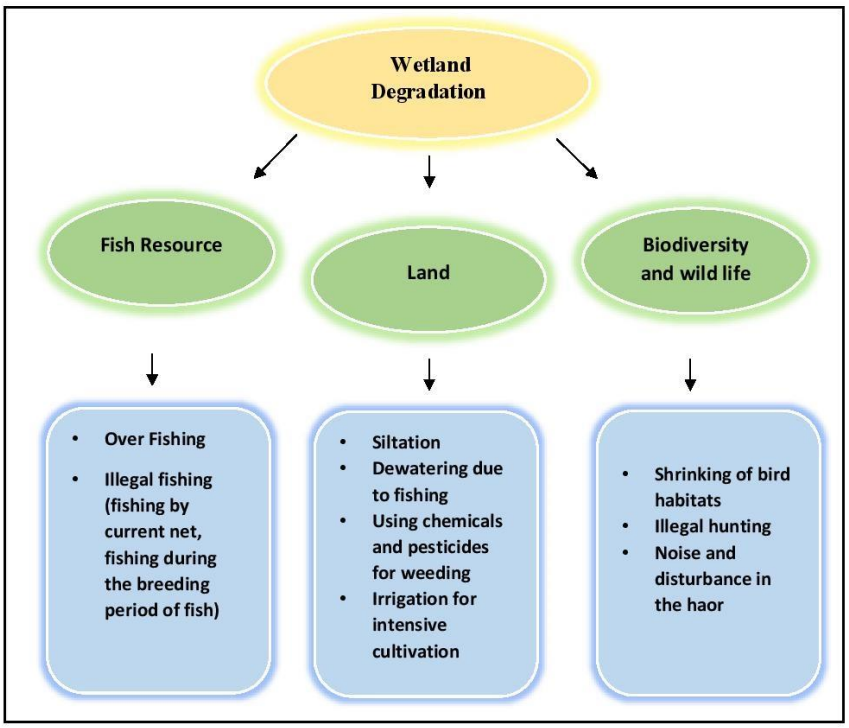

Figure 6.5: Causes of Wetland Degradation

6.3.2 Exclusion of Local People from Fisheries

The local people are officially excluded from the utilization of natural resources of the *haor* ecosystems. Fishermen are deprived in the *jalmahals* due to the intermediary intervention. The allocations that are distributed through the local influential elites and politicians for the local societies are controlling by the intermediary. The intermediating system collapse the fishing activities in the entire *haor* areas. So poor fisherman dose not access to the *haor* for collecting fish and for other services. During the wet season, poor people are fully dependent on fishing. Otherwise, they have no option to do other works. Sometimes they try to use modern current net for extreme fishing, which is not accessible and liable for the disruption of fish species and wetland habitats. Insects and chemical pesticides are also impact the water resource highly in the area. Thus in the study area, fish species like Nanid

and Mohashol are depleting for the human interference. Nowadays high breed fishes are available in the local market. Thai pangas and other high breed fishes are available but most of the fish species are extinct. However, poor people deprived to entree for fishing and thus involved in various illegal activities.

Figure 6.6: Illegal Fishing (Collecting juvenile fishes)

6.3.3 Conflicts

From the very beginning, the relationship between leaseholders and the local villagers are not satisfactory due to the rights and controls over the whole natural resources of *haor* area. The main conflicts arise for depriving the local villagers from fishery, hunting and trapping waterfowls, collecting woods and grasses and for many reasons. Leaseholders banned the local people to extract *haor* resources especially; they excluded from *haor* fisheries, which is very unfortunate. Besides these, agriculture is the main source for the local villagers and only one way to survive. The agricultural activities as crop production is determined on *haor* water, which is required for crop irrigation. Thus, the local farmers try to preserve the water for irrigation. However, the leaseholders wanted to drain the *haor* water for fish farming. This unfortunate event causes conflicts and clashes between the leaseholders and the local farmers.

6.3.4 Disruption of Fish Production

At present leaseholders are not interested to lease fisheries in future due to several reason. In order to maintain the *haor,* they paid tax for fisheries, which is higher than they earn from fish production. Leaseholder opined that irregular river embankment systems also disrupted fish production in the study area. For that reason, they are facing many crisis during fish farming. It influenced on fish breeding and disrupted fish habitats as well as siltation problem causes many barriers for fish species. On the other hand, lack of awareness of Water Development Board also responsible for creating physical barriers in the *jalmahals*. Thus, many fish species are declined for a long period. River dredging system also disrupted the fish production and for that reason, leaseholders do not want to involve in leasing system.

6.4 Management Practice

During the past, the policies and legislation related management system fragmented in several sectors. Several ministries and departments influence the administration and management system in various resources such as fish, land, water, biodiversity, wildlife, etc. Bangladesh Water Development Board, Ministry of Land, Ministry of Environment and Forest, Department of Fisheries are the management authorities for monitoring and controlling the *haor* functions. There are many NGOs, international organizations took initiatives for the conservation and management of *haor* resources, and working for the community based sustainable management for the *haor* resources as well.

6.4.1 Administrative System

Haor area is mainly controlled by two local government agencies. The Ministry of Land and District Commissioner's office maintained lease agreements and other administrative activities and related issues. The local government office at Tahirpur Upazila maintained and controlled the daily matters as leasing systems and other activities including the entire *haor* related activities. The administration also celebrated fishery week in every July month in the *haor* area for the conservation of fish resources. Local poor fishermen get cards for fishing in the *haor*. However, there is no proper initiatives for protecting forest. The forests are overwhelmed during the monsoon (8-10 months). People collect forest

wood from the forest but these woods are important food for fish species, mainly the Hijal plants.

6.4.2 Laws and Legislation

Bangladesh government took laws and legislation for the development of the wetland management. Nevertheless, some of these laws, plans and policies are not specific to the needs and problems of wetland management and conservation. Thus, the Wildlife Act prohibits all hunting that included waterfowls, but in the real situation is that hunting is available at a very high level (Kabir and Amin, 2007). The study reveals that NGOs, Anser, Ramsar and local government are working for the wetland management. Most of the time the poor fishermen are engaged in fishing at night illegally. The laws and regulation of fish conservation enforced in the area but sometimes, due to humanity no legal action is taken against the poor people .Mobile court always concern about bird hunting. Infect the administration did not take any initiatives to develop the forest resource yet. On the other hand, during the past, leaseholders never maintained any rules and acts but at present, they maintained the rules and laws properly. Fisheries Act 2009 is categorically responsive for wetland ecosystem and friendly for the fishers. Now a day this act needs proper monitoring for the sustainable management of natural resources in the *haor* region. Through this act, locals or general community or societies get chance to access on the *haor* resources. However, there are several reasons, which deprived the people to access on the *jahlmahals* or *haors.*

Table 6.2: Key Informant Interviews in the Study Area

KII	ISSUES (socio-economic and environmental)	Initiatives	Recommendations/ Possible steps
Coordinator, BARCIK (NGO)	• Deforestation • Endangered fish species • Damage crops • Decreasing waterfowls, flora, fauna • Extinct fish species	• Development projects for the conservation and management of wetland resources (community-based	Ensure community participation in management and conservation of wetland resource.

		participation) and sustainable management.	
Leaseholder	• Irregular river embankment system • Siltation • Lack of awareness of Water Development Board • Illegal fishing • Dredging river and rising high water level	• Conservation and management of *haor* resources (forest, fish, flora and fauna)	• Plantation • Build canal for the irrigation
Chief Engineer (design), Bangladesh Water Development Board	• Conflict between leaseholders and local people • Damage crops	• Maintain natural balance in dry season to protect Biodiversity, ecology, fishing resources. • Embalmment for protecting *haor* resources and agricultural activities especially for Boro crop production.	• Need proper technology and modern equipment for agriculture.
Journalist, Tahirpur upazila	• Using chemical and pesticides • Using net • extinct fish species	• The initiatives are not sufficient	• Stop using pesticides and insects
Upazila Nirbahi Officer(UNO)	• High siltation • River dredging and embankments • Water pollution • Illegal fishing • Hunting migratory birds	• Enforcement of acts for illegal fishing and hunting in the study area	• Stop siltation
Fish Officer of Tahirpur Upazila	• disruption fish species • Conflict and murder (past)	• Take initiatives to stop illegal fishing • Fisherman get cards for fishing.	• separate institute for conservation fish species • Research institute

			• Alternative occupation for the local people • Build relationship between leaseholders and local people • Initiatives for reduce irrigation problem
			• Skilled manpower • Increase the standard of livelihoods
District Commissioner (DC) of Sunamganj District	• Deforestation • Water logging • Siltation • One crop cultivation system	*Haor* oriented development activities	• Food supports for the poor people • Changing occupation • Residential school for the children
Project coordinator, Center For Natural Resource Studies (CNRS)	• Endangered biodiversity and wildlife • impacts on natural resources such as fish, flora and fauna	• Community based sustainable management • conservation and management of *haor* resource along with government	• Environmental Impact Assessment is required for development projects and works • Implementation of fishers friendly policies and laws

Source: Field survey, 2019.

6.4.3 Conservation of Water Resources

There are 363 *haors* in Bangladesh. *Haors* are submerged in the monsoon for several months (7 to 8 months).Considering the importance of socio-economic condition in the *haor* area, the Bangladesh Water Development Board has constructed sixty six major submerged embankments in *haors* from 1962-2005, which is only one third of the total *haors*. The main purpose of constructing the submerged embankments is to keep the environment of *haor* intact. Therefore, that farmer can take their crops home properly. Haor survey report is prepared through Mathematical Modeling. The design criteria of this report

was, “1 in 10 years pre-monsoon flood up to 15 May of each year, to fill and train out of Haors.” Based on this report, the top level of the embankment has been determined. Every year the submerged embankments regularly damaged by water waves during floods and repaired.

There are many low lands in the *haor*. Most of these low lands at the bottom of the *haor* are government’s *khas* lands. In order to protect various aquatic plants and animals including fish resources during dry season, the issue of retaining some of the water at the bottom of the *haor* is seriously considered during the project planning. In addition, it is required to keep some water remaining for the natural balance. Thus, the height of the embankments are determined in such a way that the *haor* water overflows the embankments immediately after harvesting the boro crops (Figure 6.7). Considering all these purposes, submerged embankments had constructed that the water could not enter the *haor* region before 15 May. There are several considerations in determining the water level on 15 May such as to protect *haor* ecology, biodiversity and fishery resources.

Figure 6.7: Submerged Embankment in *Haor* Area

Every year massive floodwater in Meghalaya, Assam, India and Sunamganj, Sylhet areas of Bangladesh overflowed the *haor* dams after 15 May. These vast *haor* save floodwater and keep the large areas flood-free such as Sunamganj, Kisherganj, and Netrokona. Thus, the Water Development Board tried to make the area suitable for fish farming and poultry

rearing inside the *haor*. Also works for making the *haor* water free and appropriate for Boro cultivation by maximum December. At present most of the farmers, cultivate BR-29 (Boro crop) with a cultivation period of about 155 to 160 days. Therefore, the harvesting in the *haor* area is usually completed by May 15.

6.4.4 Activities of NGOs and Other Organizations

In the *haor* region, international agencies and nongovernmental organizations are working along with government for the resource conservation and management. IUCN and other NGOs like BCAS, BARCIK, Water Aid, Caritas, Plan International and other organizations worked for a long time in the area. IUCN works as a development partner of the Ministry of Environment and Forest (MOEF) and CNRS is the implementation partner of the IUCN and worked for natural resource conservation. They tried to preserve *haor* by the local community in a sustainable process but could not achieve due to lack of holistic plans. Some NGOs engaged local people to conserve *haor* resources, which are not sufficient for the conservation of *haor* resources. Otherwise several projects are working as Haor biodiversity conservation, community based *haor* management, increase fish verity, plantation of local adaptive plant varieties, income generating training and others. Besides many organizations are working for the socio-economic development of the locals. ASA, BRAC, Grameen Bank, TMSS and others are also working to support the poor people of the area. The organizations help them by providing micro credits to improve their livelihoods.

6.4.5 Community Based Sustainable Management System

Community based sustainable management project is mainly established for the conservation and sustainable use of natural resources of Tanguar *Haor,* which is declared as 2nd Ramsar Site. This project focused on ecosystem values as well as to work for improving the livelihoods of the local communities. The Ministry of Environment and Forest (MOEF) started this project in collaboration with IUCN in 2006. This project is mainly works in three parts. These are as community mobilization, natural resource conservation and research, which based on biodiversity and water resources. This project worked successfully but there are many limitations to accomplish the targets of natural resource conservation. Nevertheless, IUCN established the concept of conservation of

natural resources in the marginal level and sent this massage "*Haor* resource conservation" in the Tanguar *haor*.

Figure 6.8: Community based sustainable management

Mainly the local people are engaged in this management system to protect the natural resources and ecosystem in the *haor* region. Some local people tried to cultivate local crops and planted various local plants such as Hijal, Koroch and Azawary grass for the conservation of *haor* environment (Figure 6.8). Some of the local people are also participated in the community-based management and conserving waterfowls in their house as bird sanctuary.

6.4.6 Possible Initiatives for *Haor* Conservation

Appropriate policies, planning and strategies are extremely needed for the conservation and management of *haor* resources. In the study area, experts observed that need proper initiatives to provide more food for supporting the poor local people as well as to change their typical occupation for their better life. Additionally develop the relationship between leaseholders and local villagers Through stopping conflict and violence over the resources of the area. In addition, alternative occupation can change the present condition by providing more facilities. Furthermore, need separate institute for the conserving fish species and similarly need research institute including skilled workforce for the progress in fishery resources. In agricultural sector, most of the locals use chemical and pesticides, which causes hazardous issues, extreme irrigation and siltation are the disruption factors

of the environmental deterioration. Thus to reduce the entire environmental degradation, environmental Impact Assessment, plantation, digging canal, modern harvesters and equipment are essential way for agricultural development in the *haor* region. In order to ensure management and conservation of wetland resource, community based participation is mandatory, which includes the local people for the conservation of wetland resources in a voluntary approach.

6.5 Chapter Summary

The chapter revealed that the overall conditions as socio-economic and environmental conditions in the study area are not supportive for the local people. Through the interviews the study also showed humanitarian activities are constantly disrupted the entire *haor* resources in the area. Consequently, lack of proper knowledge, awareness, conflicts, poor transport and improper management systems are the barrier for the local community. Every year the people of the study area fight to the natural hazards and population change impacts on the resources to ensure the demand of growing population as well.

CHAPTER VII

CONCLIUSIONS AND RECOMENDATIONS

7.1 Introduction

The former chapters of this study were mainly based on field observations, key interviews, group discussion, secondary data and primary data, which are collected by questionnaire survey in the selected sampled villages (nine villages). This final chapter presented the major findings of the study with some concluding remarks that are reflected here to fulfill the required objectives. This chapter also included several recommendations, which can be recognized for future development.

7.2 Major Findings of the Study

The chapter aims to triangulate both qualitative and quantitative data with existing literature. In this research, qualitative study applied to support the quantitative data and to explore the relevancy of current literature regarding *haor* area's issues. The represented data in the study illustrated the decadal population change and the impacts on natural resources in the *haor* areas. The present study also revealed the local people's regular livelihood considering the past and present status, which are connected towards the *haor* resources. Thus, the major findings of this study are indicating the facts that hamper the natural resources of *haor* areas. The study also emphasized the issues that happened because of insufficient management system. As a result, the study identified the major findings and these are:

High Population Growth

Bangladesh is a populated country. The population growth of this study area is increasing day by day and the decadal population growth rate is higher than previous growth rate. The population of Bangladesh depends on wetlands, which is covered more than half of the country's geographical area. Approximately 25,000 dwellers lived in wetland area and most of the people are involved in fishing and farming. (Sharma, 2010). In *haor* areas, over population create many problems those are food insecurity, malnutrition, agriculture, health, economy etc. Population growth and environment are interlinked because where

there are many people living in *haor* area, are creating environmental disruption. So environmental disruption creating many crisis for the people of the study area. Considering the worst impacts of environment people are facing many challenges regarding health, economy, agriculture, social, environmental and others. Therefore, high population growth is the significant reason behind the impact of *haor* resources. In fact, the needs of rising population are creating many problems and effects on the wetland resources very badly. Thus, the study identified the major findings and these are:

Socio-economic Condition

The socio-economic condition of the *haor* area is unstable due to many reasons. They face problems of unemployment and regular earning. As a result, the lives and livelihoods of the people of *haor* area are fragile. They suffer from various problems as malnutrition, food insecurity, and nutritious diets. However, some micro credits are provided to them but those are insufficient in terms of their necessity and demands. Infect people of *haor* areas have been living with the vicious cycle of poverty, hunger, unemployment, health risk and environmental problems. Considering the problems of other areas of Bangladesh, people of *haor* areas face more problems. Forty-one percent of the respondents mentioned that the monthly income level is less than 10,000 and 76% respondents have no savings for the future. Also 56.7% have no loan while rest of the respondents get loan to maintain their families. Seventy six percent of the respondents told that they have no agricultural land in the plain area and 43% have no lands in *haor*. Thus, the present study examined that the occupation changed than before. They wanted to change the present occupation for decreasing agricultural land and fish production, low income and for other reasons. On the other hand, most of the respondents claimed that people migrated the area for over population as well as to generate their income level.

Strong economy is the wheels of national development of any country. The background of the socio-economic condition of *haor* areas keeping them behind the mainstream development. Lack of required lands, most of the respondents of the study area have very small places to live. Thus, they are facing the challenges of settlement arrangement. They are depriving from their rights, which could not expected for survivals.

Reliance on *Haor* Resources

Naturally, the resources are highly important to the local community. Local people extremely rely on the natural resources of *haor* as fisheries, agricultural crops, fuel woods, grass and reeds for animal fodder and other flora and fauna. *Haors* are rich in natural resources and mostly the local poor people depended on them for maintaining their regular needs. Especially the poor and landless people derive various resources from wetlands for their regular use. According to Abdullah (2010), in Bangladesh 50 million people depend on wetlands due to various purposes. Most of the respondents are farmers (74%) and directly dependent on the lands of *haor* for farming. For the agricultural activities, farmers are extremely depended on *haor* water. The study revealed that 76 % respondents are involving in agricultural activities. Consequently water resource also used for the irrigation in dry season. Geographically *haor* areas are full of natural resources. The seasonal variation helps to make the environment and biodiversity exceptional from the other parts of the country. Thus the *haor* region characterized by two major season as dry and wet. During the dry season, local villagers mainly engaged with agricultural activities and in the wet season when the area become drenched in water, the locals involved with fishing. Moreover, leaseholders leased the *haor* for fisheries during the rainy season and they totally excluded the locals from fishery activities. As a result, economic activities of the poor people mainly based on natural resources. The dependency on *haor*-oriented activities make the lives of poor people embarrassing. Usually the leasing system, which is continuously excluded them to fish resources and denied to access on *haor* resources. In winter or dry season 94 %, respondents are involved in agricultural activities and only 2% are engaged in fishing. However, in the past 62% are involved in fishing and only 6 percent are involved in farming. Eleven percent of the respondents had no job to do. That is why the economic activities of the local community fully disrupted and they have no rights to *haor* resource extractions as their own properties. Unfortunately, this worst situation forces them, especially the extreme poor people of the community to often attempt to illegal activities for providing their basic needs and family's expenditures

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Socio-economic Problem

Socio-economic conditions are the major issues in *haor* areas. Poverty, illiteracy, unemployment, conflicts, criminal activities, malnutrition are the issues that interrupted overall development of the area. Because rising population creates many complications and disturbed the social and economic activities. Therefore, various problems are arising in the study area for over population. Moreover, migration is increasing in that study area. People are moving in different places of the country to survive. In addition, that the price of fish and rice production decreased and the locals' are underprivileged to get fair price due to many reasons. On the other hand the people of the *haor* area suffers various problems due to flash floods and loss their crop productions. Every year floods and other natural calamities (natural hazards) damaged the agricultural crops of the entire haor area. As a result, these issues make those people more vulnerable. Finally, they are depriving from their basic demands of food, cloths, housing, education and health.

Environmental Issues

Rising population always put excessive pressure on agricultural land for crop production in the wetland area. Due to this fact cropland, fish production and other resources are greatly reduced (Ahmed, 1993)**.** In the study area, *haors* are deteriorating for the exploitation of resources. The study reveals that over population is responsible for the entire degradation of the area. Local people are fully reliant on *haor* resources to ensure the livelihoods especially the poor of the study area. Consequently, the people are involved in fishing, farming and other activities. In last few years, the environmental degradation of the area has increased at a very high rate. The most significant indicators of environmental issues are less availability of fish resources, declining number of water birds, reduction in forest resources and others, which are interrupted *haor* resources. Thus, 48% respondents marked the reason as less availability of fish resources.33.33percentage also recognized the indicator that declining water birds is the way to hamper the environment of the study area.

Haor resources such as waterbody, land cover and vegetation are decreasing day after day due to humanitarian activities. Thus the present study revealed that the total vegetation is about 39.40%, water body is18.29 percentage in 2019 while the amount of vegetation

54.86% and 25.40% in 2009. Compared to the previous record the rate of the physical condition of the wetland of the study area is decreasing for a long time. Environmental degradation is one of the main reason for making the people of the *haor* area most disadvantaged. Because many people particularly the poorest are responsible for overfishing and other illegal activities. The leaseholders are also part of the problems of making the *hao*r areas unlivable for the biodiversity and ecosystems. On the other hand, the respondents blamed the submerged embankments for waterlogging in the area. It damaged the agricultural production, causes sudden flood and inundated the houses and roads of the areas. Therefore, at present the rate of the degradation is higher than before. However, *haors* in the study area lost the natural phenomenon including diversified biodiversity and ecology.

Population Growth and Natural resources

Bangladesh is densely populated country and the population is much higher than other neighboring countries. Agricultural land, forest, biodiversity degraded due to population pressure (Chowdhury and Hossain, 2018). Hence, fisheries, swamp forest, waterfowls, waterbodies, flora and fauna are the important resources of wetlands. In last few decades, these natural resources disrupted through human exploitation. All of the respondents claimed as population growth is the main issue that affects natural resources. It impacts on agriculture, fishery resources, forest resources, flora and fauna of *haors*. Large varieties of fish species are the main resource but now fish species are not abundant due to various causes. Respondents claimed for overfishing, illegal hunting habitat degradation are the main causes to impact on fishery resources constantly. Farming or agriculture is the main source in the *haor* area. Thereby 60 percent of the respondents expressed their opinion that most of the people exploited land by over harvesting. In addition, that 50.67 percent respondents mentioned for illegal hunting of water birds is one of the issue that interrupted wetlands. Half of the respondents marked illegal fishing as the cause that impact fish resources seriously. Moreover, 53.33 percent respondents opined that fuelwood collection also hampered the forest resources. Besides these illegal extracting and waterlogging are the issues to deteriorate the wetlands day by day. On the other contrary, expansion of agricultural activities are immeasurably demolished the *haor* function. To ensure the

demands of the increasing population local people awfully irrigated agricultural lands and dewatering the *haors* for extensive fishing. In consequence, *haors* of the study area become drier due to over harvesting and the increased demand of the local community directly or indirectly affect the natural resources. Furthermore, for maintaining their livelihoods, the people of *haor* areas, collect fuel woods, grass and reeds for fodder, cutting trees from the forest and others. Therefore, deforestation is the consequence of environmental degradation. However, wetland resources are very important parts of the nature but the extra pressure of growing people is degrading these. Thus practicing of illegal activities in the *haor* where the people are engaged, are constantly ruined the *haor* function.

Conservation Practice of Study *Haor*

The local influential elite people control wetlands. Still the influencers are maintaining the entire *haor* as fisheries. Local people also denied from the utilization of natural resources due to traditional leasing system. The leaseholders banned the local general people from *haor* resources. There is no changes in the management authority and the local people treated like before. Bangladesh government and International agencies play fundamental role for implementing laws and they provide funds and co-operation for the proper management of the wetland resources. However, the funds are not sufficient for the implementation of wise-use concept and community based management needs the actual support from the local people of the area. Most of the respondents opined that government works only in constricting submerged embankments in the study area to protect *haor* resources. Other activities are accessible in the area to stop over fishing, hunting, maintaining and others initiatives are available in the management practice of the natural resources. The government and NGOs took initiatives for the development of *haor* resources but these are not beneficial to the locals. In order to maintain *haors* and natural resources resources the total respondents suggested several initiatives for the sustainable management. Local people have some rights and they believe that government and related organizations should take proper steps to protect the natural resources of *haor* areas. Thus, most of the respondents (56.7%) suggested to build suitable embankments as well as to banned poisoning and stop deforestation through implementing laws and strategies. Otherwise, they also (66% respondents) proposed for digging canal to the NGOs and

international agencies. Finally, half of the respondents emphasized for local people's participation as community based management activities and 41.3% respondents interested to join for digging canal for the sustainable resource management.

Thus, the respondents suggested to take some initiatives for protecting the natural resources in the area and mentioned the ways of providing food and accommodation for the growing population.

7.3 Conclusions

Wetlands are the important phenomenon of environment. It includes various forms such as tidal zone, marshes, bogs or swamps and other different types. Therefore, these are the blessing of nature where they provide several ecosystem services and habitats for wildlife. It helps to reduce erosion and recharge aquifers. Thus, wetland is the physical component of nature that has great importance to create an ideal balance in the surrounding environment.

Generally Swamp, marsh, bog, fen are the main types of wetland. It also includes *haor, baor, beels* and the wetland ecosystems are known as *haor* basin in the northeastern part of Bangladesh. Haor areas are the most important part of the country. The Physical structure of *haors* are bowl shaped with shallow depression, which receive surface runoff from rivers and canals in the monsoon. During this monsoon period, the whole area become fully submerge. Tanguar *haor*, Hail *haor*, Hakaluki *haor*, Shanir *haor* and others and contribute in ecological and economic sector in Bangladesh. Moreover, Tnaguar *haor* is the largest *haor* in the country and has enormous economic value in all over the country through providing various benefits such as a large number of fish species, wetland habitats. Thus, the haor is recognized as an Ecologically Critical Area in 1999. Moreover, declared as Ramsar Site in 2000.

Naturally, *haors* provide various resources and supportive for agricultural activities, timber production, water supply, transport, recreation and tourism services and so on. However, in recent decades, globally wetlands are the most threatened ecosystem due to ongoing drainage, pollutions, overexploitation of their resources. Unfortunately high population growth is the effective reason behind the impact of *haor* resources. Local people are

involving in many activities, which are tremendously related to the *haor* and *haor* resources. Local people are more vulnerable than other areas in Bangladesh to join other activities for their survivals.

Considering the enormous benefits of wetland resources, the northeastern part in Bangladesh plays vital role for the economic development. Nevertheless, there are huge barriers such as extensive agriculture, siltation, and extraction of natural resource, unequal distribution of *haor* resources and ill planned management systems are the issues to degrade the natural resource continuously.

Traditionally *haors* and *jalmahals* are controlling by the influential elite people and they lease the fisheries from government, mainly government is the owner of *khas* land. In wet season, *haors* converted into fisheries, also controlled by the leaseholders. Moreover, in the winter, local farmers cultivate Boro crop, which is the only one crop in the area. Generally, leaseholders deprive the local people to enter and extract resources. Thereby some local poor people access on the natural resources because they have no works to contribute in the wet season. Most of the local people are suffering from various difficulties. They faces many crisis and have no option to do and finally involve with some illegal activities in the *haor* areas. Moreover, rising population is continuously forcing to access on that natural resources. Thus, the resources influenced that have wildlife habitats. As a result, poverty illiteracy, population growth, natural hazards are the forcing factor to reliance on these resources. For that, purposes most of the people of the areas engaged in *haor* oriented activities and illegally extract the resources. Overfishing, hunting water birds, expansion of agriculture, deforestation are the major causes to impact on the resources of those *haor* areas. Due to high dependency on *haor* resources, some people wanted to change their present occupation and wanted to migrate another place for their betterment. They completely deprived to extract resources. Most of the locals also harassed by the leaseholders.

In recent few decades, the *haor* functions are deteriorating continuously. Biodiversity and wildlife also threatened by over exploitation of natural resources. The natural phenomenon of wetlands such as land cover, water bodies, vegetation are also reducing, which create imbalanced situation to disrupt the physical and ecological functions of the entire *haor*.

The existing management system of *haor* resources are not enough to reduce the rate of degradation properly.

The government of Bangladesh and other organizations are working together for the sustainable management of natural resources. They took several initiatives and implemented policies and legislations for the development of wetland resources. Community based participation also worked for understanding the local people about the *haor* resources and involved the people to protect the resources of that area. Generally community based activities are worked in the villages, which are related to the Tanguar *haor*. It needs not only in the Tanguar but also in the whole *haor* areas. Thus, these are very important parts of our country, which contribute to deliver various resources as well as to improve the economic condition. That is why for the conservation of wetland resources as well as to protect the *haor* areas, need proper knowledge, polices and management practices.

7.4 Recommendations

Considering the major issues that influenced the *haor* resources by overexploitation. Following steps should be taken to mitigate the current issues in the study area.

Population is one of the major issues and influencing factor of wetland degradation. The rising population creates many problems in the wetland areas and create pressure and influence on wetland resources. Therefore, we must control the ever-growing population in Bangladesh as well *haor* areas. In order to ensure the sustainable management of the wetland resources, the local community need alternative occupation for their livelihoods. Traditionally the local people depended on *haor* resources and engaged in various *haor* oriented activities. Every year flash floods and other natural calamities obstruct their crop production. Thereby to improve their lives, alternatives occupation is the way to afford more facilities for the *haor* people. In addition, in that period of disaster, they need proper relief and assistance for sustaining the lives of local people. Relief is the key approach to mitigate the reliance on wetland resources in the study area. Therefore, it may supports the people to minimize the arising problems that they are suffering for a long time.

To develop the local people's skill, education is very important to the area, which provides and ensure many facilities for the future. It also helps to improve the quality of socio-economic condition and make the people eligible for different economic activities. Thus education can be improved their livelihoods and dependency rate will be decreased in the *haor* areas and can be diverted the people to work into another sectors.

The locals are suffering from severe issues for a long time being and they are the fighters of the nature in the wetland area. Likewise, they have rights to get some financial backup from various sources as banks, NGOs and other foundations.

Plantation is the way to reduce deforestation in the wetland region. Therefore it may provide a positive impact on the natural resources and supportive to create a balance for the wetland ecology and biodiversity. Correspondingly, awareness and counseling are the processes to understand knowledge about the resources conservation for the future generation in the community level. Thus, these are not only compulsory in the Tanguar *haor* related places but also in the entire areas, that has many *haors* and *beeels* (Matian, Shanir *haor* and others).

Law enforcement is necessary for stopping illegal activities in the area. Effective rules and legislations may ensure *haor* resources management. Thus, disciplinary acts are required for the encroachment of natural resources in the surrounding area. Proper initiatives are must need for stopping illegal activities as well as to prevent the resources for the sustainable management. Government and other organizations must take appropriate strategies to preserve the resources. Henceforth actual monitoring is compulsory in the local administrative sector for ensuing sustainable management of the wetland resources. That is why all kind of illegal hunting and fishing should banned for saving the ecological function of *haor* areas.

Holistic approaches are mandatory for monitoring and preserving the *haors* and *jalmahals* including natural resources. Therefore, Environmental Impact Assessment (EIA) in any development projects or works like river embankment, infrastructures in the whole *haor* region is very significant for protecting the biodiversity and ecology. Thus, relevant policies and acts, which are friendly and appropriate, may take a vast place for the conservation of wetland resources. In order to protect the wetland area from the

devastation, proper implementation of policies and acts is the accurate approach. Therefore, government and the related organizations must conscious to apply the sustainable management of wetland resources. Therefore, need experts, skilled work force, research and training institute in the areas.

Haor areas have enormous value in economic sector and it has a great potentiality in the tourism sector. Thus, all kind of threatened may tackled by preserving natural resources and biodiversity of the wetland environment. Therefore in-depth study, research and analysis are essential in the *haor* area. Adequate knowledge and proper initiatives of all stakeholders can make sure to protect the natural resources of that area. Therefore, to achieve the Sustainable Development Goals (SDGs), government and stakeholders have important role in the sustainable management of natural resources in the study area. These are needed as early as possible for *haor* conservation.

7.5 Further Research

The Present study will open the opportunity for the further research regarding the implementation of policies and strategies and wise-use for the conservation of natural resources in *haor* areas.

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APPENDIX

Household Survey Questionnaire

Form number

Population Growth and Access to Natural Resources in *Haor* Areas: A Spatio-Temporal Approach

This field based informational study is part of the educational activities of the "MPhil Research" program under the Department of Geography and Environment, Dhaka University and Tahirpur and Dharmapasha Upazila of Sunamganj district have been selected as the place of this research. The collected information from field survey will be used only in the educational and research activities of the students. The Department of Geography and Environment will be especially grateful to the esteemed respondents for their valuable time and information in this regard.

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Household Information

Survey Area: Village: ……Union: …….. Upazila: ……..

Name of the respondent: ……. Roll no: ……. Date of signing ……

Age of Signature giver: …… years Relation with household chief: ……. How many years have you been living here?

1. Household Type: A) Single household B) Combined household C) Extended household D) Others ……

2. Information related to household members:

Name of household members	Relation with household head	Age	Gender	Educational Qualification	Marital Status	Occupation	Where do work and monthly income
01	02	03	04	05	06	07	08

*05 (not applicable under six years)

A) Illiterate
B) Primary education
C) JSC pass
D) SSC pass
E) Graduate
F) others……

*06

A) Unmarried
B) Married
C) Widow
D) Divorced
E) Seperated

*07 A) Not Applicable
B) Household work
C) Student
D) Jobless
E) Agriculture
F) Small buesiness
G) Job (write specifically)
H) Fisherman
I) Craftsman
J) Others ……

*08 A) Research Area
B) Research Upazila
C) Research District
D) Others District (write specifically)

3. Homestead information

Serial number	Information type	Amount /Number/Type (Present Condition)	Amount /Number/Type (Past Condition)
01	House type		
02	Number of main house		
03	The size of the house		
04	The amount of land in the		
05	Lands Other than homestead (Non-agriculture)		
06	Lands Other than homestead (Agriculture)		

07	Amount of land for fish farming		

*01: A) Pucca
B) Semi- Pucca
C) Kuccha (Tin Wood)
D) Kuccha (Tin Bamboo)
E) Hut
F) Others……

*06 A) With large paved roads
B) On the side of the local road
C) By the side of river
D) There are other aquatic plants around the house
E) Homestead is a flood free area
F) Others……

4. Income sources of household (related to homestead)

Serial number	Main income source	The amount of income for last 30 days
01	Permanent income of the family (Shop/Van/Rent allowance/Others)	
02	Income from job/business	
03	Income from sale of paddy	
04	Income from selling wheat	
05	Income from sale of vegetables	
06	Income from selling fish	
07	Income from sale of poultry	
08	Income from cows / goats / sheep	
09	Income from donations / assistance	
10	Income from pension / allowance	
11	Other sources of income	

05. Scope of household expenditure:

Serial number	Expenditure sectors	Amount of expenditure
01	Cost for rice / pulses / ginger / garlic / onion (7 days)	
02	Cost of soybean / mustard oil / spices(7days)	
03	Cost of vegetables (7 days)	

04	Cost for fish / meat (7 days)	
05	Cost for clothes / shoes / sandals (30 days)	
06	Treatment/medicine/test/doctor fee cost (30 days)	
07	Education material of children/school fee/others cost (30 days)	
08	Expenses for donations / assistance / gift items (1 year)	
09	Expenses for bank / association installments (30 days)	
10	Others (30 days)	

6. Do your family members have savings? If yes, then what are the sources of savings?

Serial number	Sources	Savings amount
01	Bank	
02	NGO	
03	Club	
04	Insurance	
05	Others	

7. Have your family taken any loan within a year? If yes, then what are the sources?

Serial number	Sources of loan	Amount of loan	Paid amount	Unpaid amount
01	Bank			
02	NGO			
03	Club			
04	banker			
05	Relatives/friends			
06	Others			

8. How many years have you been engaged this profession? .....year

9. How many years your family /you engaged this profession? .....year

10. Do you have any agricultural land? If yes, then (description of agricultural land)

Serial number	Types of information	Present Condition	Past Condition	Comments
01	Plain land			
02	Haor			
03	Lease			

11. What are the natural resources in this area?

Serial number	Natural Resources	Present Condition	Past Condition	Comments
01	Forestry			
02	Fisheries			
03	Migratory Birds/Animals			
04	Sand			
05	Stone			
06	Others			

12. Seasonal occupation:

Serial number	Type of information	Dry season	Rainy season	Comments
01	Present			
02	Past			

*A) Agriculture B) Fish E) Business

C) Non-agricultural work D) Job F) Others (……)

13. Impacts due to production change.

Serial number	Type of information	Impacts	Comments
01	Change of profession		
02	Transfer		
03	Poverty		
04	Landless		

*A) Decrease *B) Increase

14. Detail of natural Hazard:

Serial number	Type of information	Current loss	The amount of previous damage	Comments
01	Flood			
02	River erosion			
03	Hail			
04	Drought			
05	Others			

15. Impact of increasing population

Serial number	Type of information	*Impact	*How/Cause
01	Forest		
02	Fisheries		
03	Agricultural land		
04	Wetland		

*A) Decrease *B) Increase

16. Has anyone newly settled in this area?

A) Yes B) No

If yes, then what is the reason?

A) Easy earning

B) For the purpose of housing the additional population

C) For employment

D) Because of high production

17. Has there been a recent outbreak of any disease?

Serial number	Type of information	Past	Present	Comments
01	Disease			

02	Symptoms of diseases			

*A) Water borne B) Airborne C) Insect-borne D) Others

18. Changes in *haor* management and its impact.

Serial number	Type of information	Controller	Impact
01	Past		
02	Present		

*A) Local influential B) Local farmer C) Administration D) Others

19. Has there been any change in the prices of crops produced from Haor? If yes, provide the following information.

Serial number	Type of information	Decrease	Increase	Comments
01				
02				
03				

20. What do you think about the cause of the disaster in the haor area?

A) River filling

B) Construction of embankment.

C) Flash flood

D) River erosion

E) others (…….)

21. Have you wished to change your occupation?

A) Yes B) no
If ye, why you wished to change your occupation?
A) Decrease of income
B) Decrease of agricultural land
C) Decrease of fish production
D) Others (……...)

22. Way to accommodate the increasing population

. A) Construction of housing on agricultural land

B) Building houses in the forest

C) Filling wetlands

D) Relocate

E) Others (……)

23. Do you think that the forest areas are decreasing?

A) Yes B) No
If yes, then what are the causes of decreasing forest areas?
A) Collecting fuel wood
B) Collecting housing materials
C) Indiscriminate deforestation
D) Cutting down trees for cultivation
E) Others (…….)

24. Do you think the production of fish is decreasing?

A) Yes B) No
If is it yes so what are the causes decreasing fish production?
A) Fish hunting by using poison
B) Cultivation by drying water
C) Indiscriminate fishing
D) Others (…….)

25. Do you think that the number of migratory bird is decreasing?

A) Yes B) No
If yes, what are the causes of decreasing of migratory bird?
A) Hunting birds
B) Drying up of wetlands
C) Deforestation
D) Others (……...)

26. Has anyone recently relocated from this area?

A) Yes B) no
If yes, why?
A) Due to declining production
B) Could not take part in the production of *haor*
C) The purpose of earning extra money
D) Being landless
E) Others (……...)

27. Do you thinkembankments are causing problems?

A) Yes B) no
If yes, what do you think about the problems causing due to artificial barrages?
A) Sudden flood
B) Increase of water retention
C) Damages of agricultural production
D) Drowning of houses or roads
E) Others (……..)

28. Way to provide food for increasing population

A) By increasing agricultural production
B) By changing occupation
C) By cultivating through artificial means
D) By relocating
E) Others (……)

29. Initiatives taken to protect the *haor*

Serial number	Type of information	Initiative	Comments
01	Government		
02	Non-government		
03	Community		

* A) Reduce deforestation
B) Prohibiting the application of poisons
C) Construction of Embankment
D) Controlling fishing
E) Digging canal

30. What other steps can be taken to protect the *haor*?

Serial number	Type of information	Initiative	Comments
01	Government		
02	Non-government		
03	Community		

* A) Reduce deforestation
B) Prohibiting the application of poisons
C) Construction of Embankment
D) Controlling fishing
E) Digging canal

31. Provide information on the following topics.

A) Drinking water source: 1. Tube well 2. Pond 3. Others…….

B) How do you purify water: 1. By boiling 2. By filtering 3. None of them 4. Others…

C) Condition of toilet: 1) Hygienic 2) Unhygienic 3) Toilets less (there is no specific place of toilet)

D) Do you have mobile phone? 1) Yes 2) No

E) Do your family members have NID? 1) Yes 2) No

F) Do you have domestic animals? 1) Yes 2) No

if yes, Number of cow……Number of buffalo……... Number of goat……

G) Number of farming equipment (Tractor/ Plow/ Shallow tube wells):
……

H) Are there any children with autism in your house? 1) Yes 2) No

I) Have any school going children continue to their school? 1) Yes 2) No 3) Not applicable

J) Does your house have electricity? 1) Yes 2) No

K) Does your house have television? 1) Yes 2) No

L) Do your family have boat? 1) Yes 2) No

M) Do your family breed poultry? 1) Yes 2) No

(Many thanks to you and your family for your valuable time and information)

FOCUS GROUP DISCUSSION

Focus Group Discussion (FGD) Session

Group of the Participants	Current Issues in the Study Area: Existing Functions, Management and Environmental Issues	Suggestions and Integration of Local People in *Haor* Conservation

KEY INFOERMANT INTERVIEW

KII Checklist

Name:

Designation:

Phone number:

Present Issues (*Haor* degradation) in the study area	Taken Initiatives for *Haor* conservation	Suggestions for *Haor* conservation

PHOTOGRAPHS

Photographs of Study Area

Photographs of Household Survey of the Respondents

Photographs of Focus Group Discussion

Photographs of Key Informant Interviews