

**The Sundarbans in Bangladesh**  
**Aspects of Sustainable Management and Community Involvement at a World Heritage**  
**Site**

A Thesis

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By  
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I hereby declare that I have utilized my potential in this master thesis without any direct supports from individuals or group. Necessary data and information's that are presented here to simplify the objectives are taken from recognized sources and properly referenced.

Statement of Affirmation

Md. Abul Bashar Polas

2019

## **Abstract**

### **THE SUNDARBANS IN BANGLADESH: ASPECTS OF SUSTAINABLE MANAGEMENT AND COMMUNITY INVOLVEMENT AT A WORLD HERITAGE SITE**

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March 2019

Thesis supervised by Dr. Heinz Felber

Bangladesh is an agricultural-based country. Agriculture contributes 42.70% (BER) in the labor market through 4 categories namely crops, fisheries, livestock, and forestry. Forestry has the most significant role in renovation of infrastructures and balancing the natural environment. Due to human and natural induced threats, the forest resources are in danger and currently, the percentage of forest in Bangladesh is 13.22 % (BER). The sector is still mistreated on the basis of compared to the other three parts of agriculture. A satisfactory management plan, structural administrative development, and new policy implication can change the present situation. The main goal of this study is to review the sustainable management and community involvement of the Sundarbans World Heritage Site as it is the largest portion of forest resources in Bangladesh. The findings of this study focus on the institutions that are responsible for the overall development of the world's largest mangrove forest. Various international conventions and national policies are analyzed to fulfill the objective of the study. Finally, this work accumulates the cumulative goals and objective of the UNESCO-WHS management and the government of Bangladesh for the sustainable forest management.

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If this work brings any feasibility to my homeland, environmental students, and researchers throughout the country and outsides, it will be my best pleasure. Thank you very much.

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## List of Abbreviations

ACC	Annual Allowable Cut
AEZ	Agro ecological Zone
AEZ	Agro Ecological Zone
AF	Agro-Forestry
BCCT	Bangladesh Climate Change Trust
BER	Bangladesh Economic Review
BFD	Bangladesh Forest Department
BFIDC	Bangladesh Forest Industries Development Cooperation
BFRI	Bangladesh Forest Research Institute
BLC	Boat License Certificate
BNH	Bangladesh National Herbarium
CBD	Convention on Biological Diversity
CBFM	Community Based Forest Management
CCF	Chief Conservator of Forest
CF	Community Forestry
CWB	Concern Worldwide Bangladesh
Do E	Department of Environment
ECA	Ecological Critical Area
ESA	Ecologically Sensitive Area
FAO	Food and Agricultural Organization
FD	Forest Department
FYP	Five Year Plan
GIS	Geographical Information System
Go B	Government of Bangladesh

IPAC	Integrated Protected Area Co management
IPCC	Intergovernmental Panel on Climate change
IRMP	Integrated Resource Management Plan
IUCN	International Union for Conservation of Nature
MAB	Man and Biosphere
MDGs	Millennium Development Goals
MOP	Ministry of Planning
MI Na H	Managing Inhabited Natural Heritage.
Mo EF	Ministry of Environment and forestry
NFP	National Forest Policy
NTFP	Non Timber Forest Products
OA	Ocean Acidification
OUV	Outstanding Universal Value
PFM	Participatory Forest Management
REDD+	Reducing Emissions from Deforestation and Forest Degradation
RIS	Ramsar Information Sheet
SAHR	South Asians for Human Rights
SD	Sustainable Development
SDGs	Sustainable Development Goals
SF	Social Forestry
SIZ	Sundarbans Impacts Zone
SLR	Sea Level Rising
SMART	Spatial Monitoring and Reporting Tool
SRF	Sundarbans Reserve Forest
SWOT	Strength, Weakness, Opportunity, and Threats

UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
WH	World Heritage
WHC	World Heritage Centre
WHS	World Heritage Site

## **1. Introduction**

### **1.1 Nomination history of the Sundarbans as World Heritage Site (WHS)**

The 21<sup>st</sup> session of the World Heritage Centre (WHC) was held in Naples, Italy in the year 1997 with members of the WHC and state party. In that session, the Committee identified the Sundarbans insufficient as an initial nomination. The state party of Bangladesh was encouraged to enlarge the boundaries of the site along with two wildlife sanctuaries namely the Sundarbans east and south, which includes three wildlife sanctuaries today. These three wildlife sanctuaries bear the most significant value of the Sundarbans (WHS). The three wildlife sanctuaries of the Sundarbans cover the area of 139700 hectares and were declared as wildlife sanctuary according to the Wildlife Conservation Act 1977. Later on, in the year 1997 these three wildlife sanctuaries were declared as a WHS by the UNESCO (WHC, 1998).

### **1.2 Importance of the study**

Bangladesh is bordered by India to the east, west, and north, by Myanmar to the east and by the Bay of Bengal to the south with a total area of 147,570 km<sup>2</sup>. Bangladesh is an agricultural-based country; most of the people are dependent on agriculture directly or indirectly. Natural resources like river and forestry have also contributed to the livelihood of many people. The Sundarbans, the world's largest mangrove forest, home to diverse flora and fauna including the Royal Bengal tiger, and has major dependency for the livelihood of people living around it. This world-renowned mangrove forest is being destroyed day by day due to unsustainable management, unequal distribution of resources, and natural calamities like cyclone, human induced threat like oil spill, etc.

The Sundarbans is situated in Bangladesh, and is intersected by a complex network of tidal waterways and mudflats and presents an excellent example of ongoing ecological process. It is a delta located on the Ganges-Brahmaputra-Meghna river system, one of the largest river systems of the world (CBD, 2015). It has a great impact to local, regional and national economy, and biodiversity conservation as well. The Sundarbans is a wide apartment for habitation of birds and other wild animals like tiger, deer, and estuarine crocodile, Irrawaddy dolphins etc. According to world heritage criteria (IX) and (X), the Sundarbans represents the process of delta formation and the subsequent colonization of the newly formed deltaic island and associated mangrove communities. The Sundarbans supports an exceptional level of biodiversity in both the terrestrial and marine environments. Population census of Royal Bengal tiger estimates a number of 400-450 individuals, a higher density than any other population of tigers in the world.

### **Wildlife sanctuary**

The World Heritage property is comprised of three wildlife sanctuaries which form the core breeding area of a number of species of endangered wildlife.

- Firstly, The Sundarbans West wildlife sanctuary. This part of sanctuary contains Gewa, Goran woody species, riverbank and levees. It includes diverse of fauna with 40 species of mammals, 260 species of birds and 35 species of reptiles. Estimation about 350 Bengal tigers remains in this sanctuary with two endangered reptiles like estuarine crocodile and Indian python.
- Secondly, The Sundarbans East wildlife sanctuaries. This part covers an area of 31,227 hectares with Sundari and Passur woody species.

- Thirdly, The Sundarbans South wildlife sanctuary. Area of this part covers 36,970 hectares of lands. Maximum seasonal variation in salinity and area of relatively longer duration of moderate salinity observed here that is suitable for Gewa woody species. There is less number of Sundari and sometimes Passur trees are generated here.

## **Ramsar site**

The Sundarbans has been listed as a Ramsar site in May, 1992. The Government of Bangladesh in the year 2003 provided an updated Ramsar Information Sheet (RIS) on the Sundarbans Ramsar site, enlarging its area from 596,000 to 601,700 hectares (Ramsar Convention, 2003). The Sundarbans supports more than 30 mangrove species (IUCN, 1997) and is a hotspot of rich flora and fauna. It also helps to protect coastal regions against natural disasters such as cyclones and storm surges.

## **1.3 Objective of the study**

### **General objective**

General objective of the study is to assess the role of administration and community involvements for the sustainable management of the Sundarbans-the world's largest mangrove forest.

## **Specific objective**

- To assess the management plan and activities for the sustainable developments of the Sundarbans.
- To identify legal aspects for the efficient management and protection of the Sundarbans reserve forest.
- To assess the impact and dependency of local people regarding the management.

## **1.4 Limitation of the study**

Although the study went well, there are some limitations observed during the study are as follows:

- Shortage of time. It was not possible to visit completely into the Sundarbans forest because of its wideness. The complete study would take several months.
- It was not possible to enter into the deepest region of the forest because of strict regulations. Individuals are not allowed to access.
- Communication system was not flexible; Boats were the only means of transportation in the study area.
- Sometimes local inhabitants weren't supportive when they knew they wouldn't be benefitted. In some cases, they were totally disagreeing in providing information because they feel always to be used by the researcher and visitors.

## 1.5 Structure of the study

This study includes 7 individual chapters, where each chapter represents the specific (but not equal) significance of the study.

**Chapter one** includes the following issues: Nomination history, importance, general and specific objectives, limitations, and structure of the study.

**Chapter two** contains research design, selection of respondent, data collection technique, preparation of questionnaire, interview with the local people, and interview with experts, direct observation, secondary data collection, data processing and analysis.

**Chapter three** is the amalgam of all physical, biological and natural characteristics of the study area. It also presented the location of the study area.

**Chapter four** presents primary sources of information through field work and reports from written primary sources by the administration and other organizational sources like the UNESCO.

**Chapter five** represents the contemporary data and information related to the study and some overviews of the recent study done by other researchers and the phenomena of other territory related to objectives of the study like India, the European context etc.

**Chapter six** is very important with further discussion on the outcome of the study including some quantitative examples. Several threats of the Sundarbans ecosystem are also addressed here.

**Chapter Seven** comprises comments, finding research gaps and policy recommendations of the researcher.

## **2. Methodology**

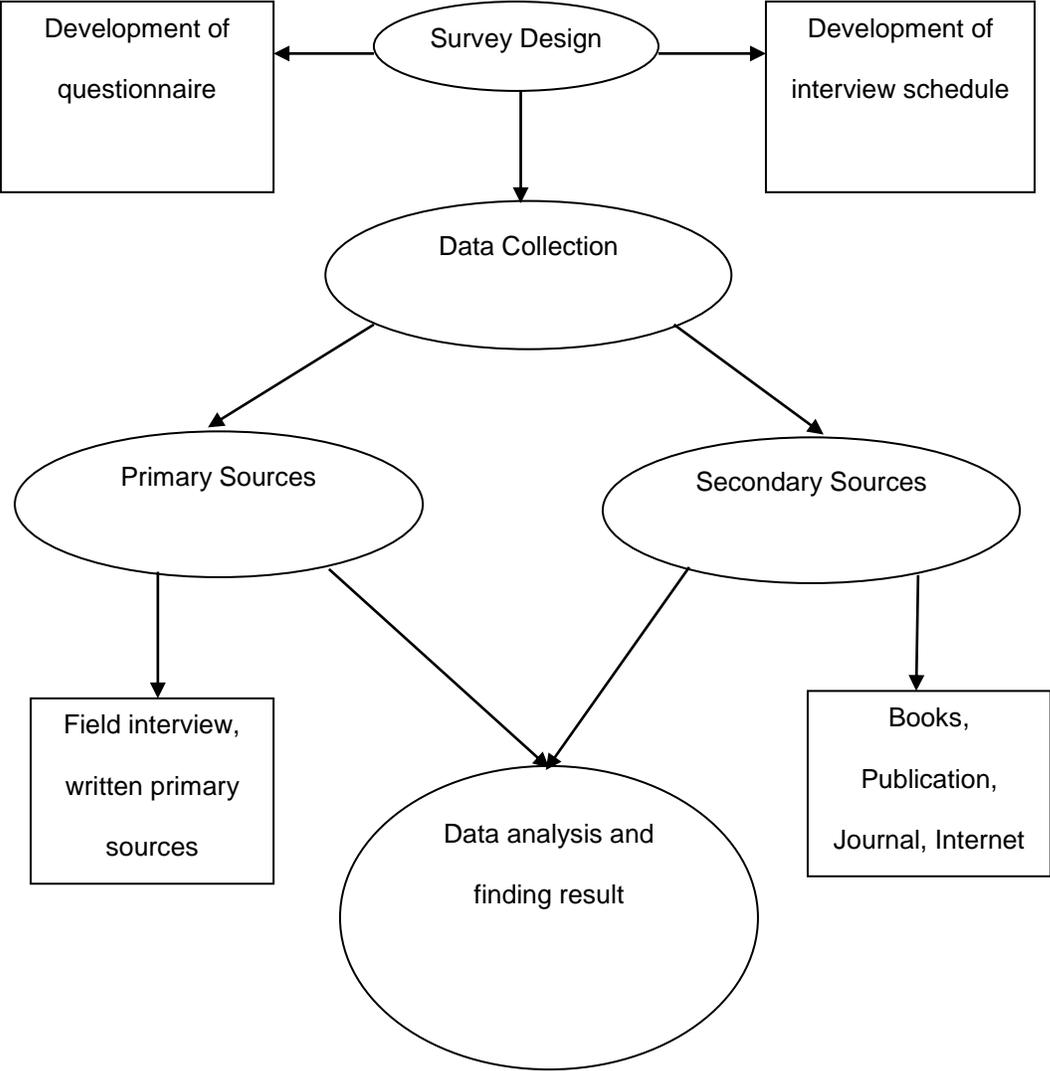
This chapter will present, clarify and describe how the study took place at the Sundarbans, and the method and strategies applied during the field work. It simply describes the research methodology, tools of data collection, respondent groups, sampling procedure, primary sources, secondary sources, and processes of data analysis.

For this study, a qualitative research method has been used. For that purposes, the researcher used possible instruments for the data collection like interviews. Furthermore, observation and focus group discussion were the key instruments during the field work.

### **2.1.1 Research design**

A well-defined questionnaire was prepared for this study. With this questionnaire, data and information were collected from the various sources of respondents. During the data collection process, a recording device was used to record the conversation with respondents. Later on, all collected data and information were summarized to understand easily and effectively. After the collection of all data and information, a qualitative analysis was done.

**Figure 1:**Research design



## 2.1.2 Selection of respondent

The selection of the study area/respondent was based on objectives of the study. There were two categories of respondent's namely local people and the experts to fulfill the general and specific objectives of the study. Different categories of respondents are shown in Table 1 below:

**Table 1:** Respondents of various categories in the study area.

SL No.	Name of Category	Location of the Respondent	No. of respondents
1	Local People	Karamjal village, Chandpai Range.	6
2	Experts		
	Divisional Forest Officer	Management Plan Division, Sundarbans East Forest Division, Khulna.	1
	University Expert	Dr. Saifullah, Department of Environmental Science and Resources Management, Mawlana Bhashani Science and Technology University, Tangail, Bangladesh.	1
	Legal Expert	Bangladesh Environmental Lawyer Association (BELA), Dhaka, Bangladesh.	1

### **2.1.3 Data collection techniques**

Before the field interview, a preliminary observation was done based on maps, posters, banners, etc. to get an idea about the local community and their livelihoods. Projects of various action plans and funding authorities also have been checked for getting an idea about protection of the mangrove forest. These techniques helped to get a basic understanding of the management activities of the forest. Appointment with expert respondents was made 3 months prior to the survey by telephone and/or electronic mail.

### **2.1.4 Preparation of questionnaire**

To fulfill research objectives, a questionnaire was prepared related to concerned respondents. After preparing the questionnaire, it was tested if it fulfills the objectives of the study (with instruction of Supervisor).

### **2.1.5 Tools of data collection**

During the data collection, I observed respondents carefully, listening attentively what they were saying, writing my short notes and memorizing about the work. Survey with local people on the spot gave me practical experiences related to the social and cultural practices of the common people and their involvements with the Sundarbans as well.

During the field work, a good understanding with the local people was made. While entering into the river with motor boat, I witnessed the scenario of the Sundarbans very closely. The tidal-effect of the mangrove forest was observed clearly, and I gathered some information from the boatmen during the boat trip and took some close snapshots of the forest.

Interviews started with a structured questionnaire, but then I had to choose semi-structured interview, because during the survey respondents were answering informally. Then I asked the respondents to follow their own style for answering my questions, what they have experienced since living here. This procedure of collecting information helped me to get more specific information.

### **2.1.6 Sampling procedure**

Total area of the Sundarbans in Bangladesh is 6000 km<sup>2</sup>. It was of course not possible to visit all or even many places across the forest. I selected randomly the Karamjal entrance and the Karamjal village for my survey because it was easier for me to go there. Information regarding the route plan was taken from a relative who is living in Khulna city. I had never been in the Sundarbans, so I just followed the instruction of my relative. A total of 6 local peoples and 3 experts constituted the sample size of my study.

### **2.1.7 Data collection**

During the field survey in the Sundarbans, I had to take an assistant to assist me, because the location of the Sundarbans was too far from my home town. The area was remote and unknown to me. There was no electricity, no transportation (except boat) facilities but I had known that before I went there. We started from Khulna city around 8.00 am by bus. We reached at Mongla port at 10.00a.m. After getting down at Mongla port, we were feeling so nervous because there were a lot of people and tourists but we didn't know anybody. From Mongla port to Karamjal entrance, the whole way we had to go by motor boat. While hiring the boat, I was feeling scared because every boatman was asking us to go with him.

It was very difficult to take a decision with which we will go, because the rest of the distance was only reachable by river. Then we were thinking to share boat with some groups. But no groups allowed us to go with them because they were going with friends and family. Suddenly, I saw a police man around us; I talked to him and explained details. Then he told me that the whole area is under supervision of the port authority, so we don't need to worry about.

Finally, we got escape from the situation after talking with the police man. We hired a motor boat for 900 BDT. We started our boat journey towards Karamjal eco-park entrance of the mangrove forest. It took around 40 minutes from the Mongla port. When we reached there, I talked to the information section and described them why I am here. They understood it easily and told me that here most of the people are tourists only. If I want to talk with the local people I must go inside the village. Then I talked to the gatekeeper to get an idea how to go to the village, and he described the route. When I came to know that the gate keeper is also from the village and he was working here as an employee, I did an interview with him as well.

Then we moved our boat to the village. It was one kilometer back from one of the main entrances of the forest. Finally, we reached the village, and I and my friend started walking through the village. The road was narrow and mud was everywhere. It was a hamlet, and river erosion destroyed their homestead. Most of the household area was too small because of river erosion.

## 2.2 Primary data collection

### 2.2.1 Interview with the local people

I started to do interviews with each of the owners of a house. For getting information from the local community, I followed a questionnaire to cover all aspects. Primary data and information were obtained through interviews with local people. Various scales of questions were asked to get information like name, age, personal experiences, income generating activities, threats to their livelihood, restriction entering into the forest, economic benefits of local people from ecotourism and disadvantages of ecotourism, government activities for their livelihood etc.

All the questions regarding to the local community were asked very carefully and specifically. At first, I was asking questions according to questionnaire. They were answering smoothly but inconsequently. It was taking too much time, each interview lasted for a minimum of 50 minutes. A total of six semi-structured interviews followed by the open-ended question were executed.

**Picture 1:** Interview with the local people.



**Picture 2:** Interview with the forest expert.



### 2.2.2 Interview with the expert

Other sources of primary information were interviews with officials and the university experts. Appointment was taken before the date of interview. Individual questions were asked according to the type of activities of the experts: Past management, present management and future strengthening plan for sustainable management were asked to the divisional forest officer; the member of the Bangladesh Environmental Lawyer Association (BELA) provided information about sources of environmental law and its application to forestry sectors; and questions related to sustainable management and impact of climate change on the Sundarbans mangrove forest were asked to the university specialist.

**Picture 3:** Interview with the environmental legal expert.



### **2.2.3 Direct observation**

Direct observation was very helpful for getting immediate ideas and impressions about the local area. Participatory observations were also taken into consideration during conversations with local people and visitors while asking about problems and prospects.

### **2.2.4 Focus group discussion**

There was a focus group discussion with 7 randomly selected local people. The discussion went on for 9 minutes and it was about their lives related to the Sundarbans.

## **2.3 Secondary data collection**

Secondary information's were collected from relevant literature related to the study. Published results of various sources of government and non-government institutions like Department of Environment, Department of Forestry, and case study of various publications, papers, and journals through internet search were used. Books on heritage management, on wetlands management, and previous master and PhD thesis related to the present study were also reviewed.

## **2.4 Analysis of collected data and information**

After collection of all information from primary and secondary sources, information's were summarized according to thematic topics. Information from secondary sources was analyzed critically, and different management strategies from written primary sources were evaluated. Case studies were done carefully.

During discussions, graphs and tables were arranged properly. Findings from various publication and journal were summarized, criticized, and evaluated in good order.

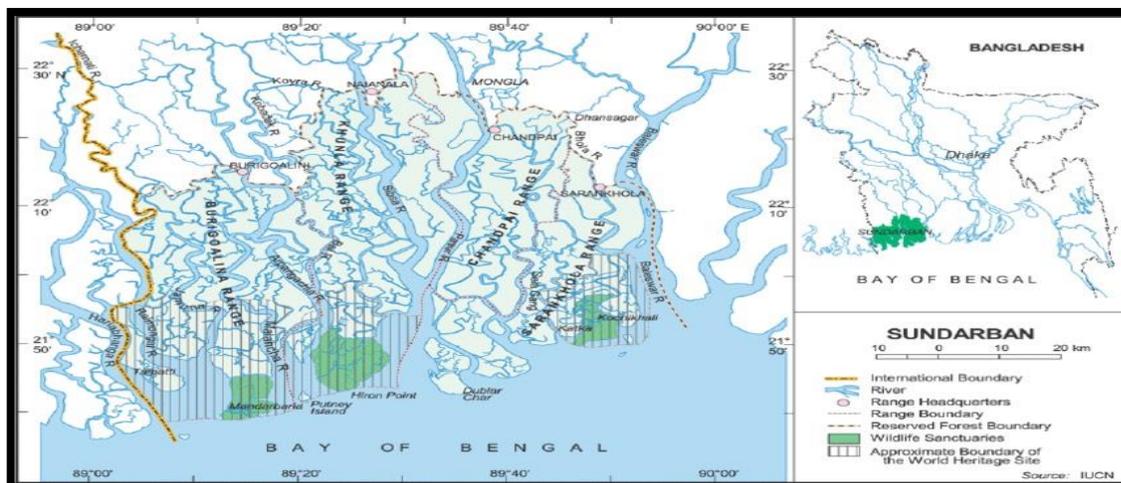
### 3. Description of the Study Area

Description of the study area is very important in the sense of identity of the research area. This chapter will introduce the location of the study area in a way that readers will get to know the Sundarbans reserve forest from the various aspects of significance. The location, climate, catchment area and especially the ecology of the Sundarbans will draw the attention of natural science student, research fellow, heritage scholars and other organization.

#### 3.1 Geographic location of the Sundarbans

The Sundarbans is situated in the south-western part of Bangladesh sharing its total area with three districts namely Satkhira, Bagerhat and Khulna. It also located on the Ganges Delta where the latitudes is between  $89^{\circ}01'$  and  $89^{\circ}52'$  in the East and longitudes is between  $21^{\circ}39'$  and  $22^{\circ}30'$  in the North(DOE, 2015).

**Picture 4:** Location of the Sundarbans (IUCN).



### **3.2 History of the Sundarbans**

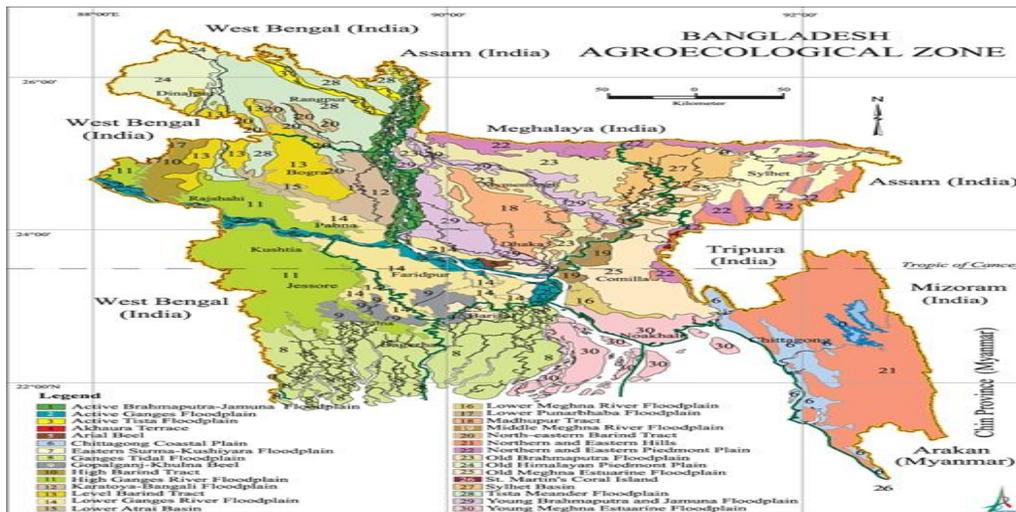
The Sundarbans bears a long history since its origin. It is said that the Sundarbans forest was first recognized 500 years ago. Even the management of the Sundarbans came into consideration more than 100 years ago. Under the rule of Mughal emperor in Indian sub-continent, the forest was leased out and it was taken over by the East Indian Company in 1757. In the year 1875, the British government declared it as un-leased forest reserve and placed this land under control of the Forest Department, which formed what is known today as the Sundarbans forest. At that point, the Sundarbans was declared as reserve forest (Hussain and Acharya, 1994).

### **3.3 Agro-Ecological Zone (AEZ) of the Sundarbans**

An agro-ecological zone is a zone or region which has unique combination of physiographic, soil, hydrological and agro-climatic characteristics. It is very important to know the land use pattern (Highland, Medium highland, Medium lowland, Lowland and Very lowland) and agricultural potential of the specific area.

There are 30 AEZ's in Bangladesh. The surroundings of the Sundarbans forest are located both in the following 4 of the AEZ regions, namely High Ganges River Floodplain, Lower Ganges River Floodplain, Ganges Tidal Floodplain and Gopalganj-Khulna Beels. As the Sundarbans is located in the three districts Khulna, Bagerhat and Satkhira, the whole reserve forest of Khulna and Bagerhat districts are located in Ganges Tidal floodplain (Hasanuzzaman).

**Picture 5:** Agro-ecological zone of the Sundarbans (Banglapedia).



### 3.4 Climate

The Sundarbans is located south of the tropic of cancer and at the northern limits of the Bay of Bengal, which may be classified as tropical moist forest. Annual average rainfall varies from 1600-2000 mm. The relative humidity is 80 %. Temperature ranges from 7.70 C (January, 1999) to 38.80 C (April, 1972) round the year (RIS, 2001).

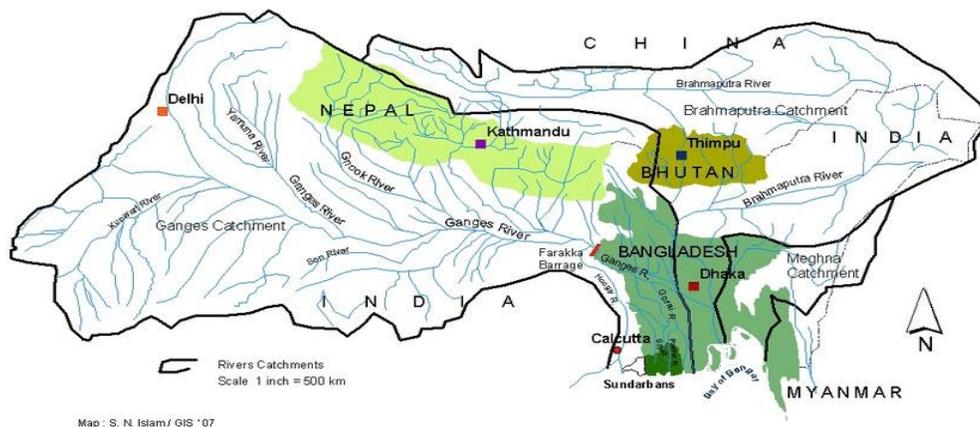
**Picture 6:** The effect of cyclone Aila in the Sundarbans (<http://archive.indianexpress.com>).



### 3.5 Catchment area

Four countries namely India, Nepal, Bhutan and China share the upper catchment area of the Sundarbans along with the largest and highest mountain range of the world. The three big rivers: the Ganges, Brahmaputra and Meghna formed the middle catchment with their floodplains, and the proximate catchment consists of the Ganges-Gori drainage system located to the East of the Hooghly and West of Meghna River. As Bangladesh is in a delta, a vast amount of sediments are carried downstream from the upper catchment and deposited in Bangladesh. The transported sediments are the base material, which formed the Sundarbans deltas and continued to accumulate these sediments to the Bay of Bengal (RIS, 2001).

**Picture 7:** The catchment area of the Sundarbans (S.N Islam/GIS 07/google).



### 3.6 Social and cultural values

The Sundarbans is a unique ecosystem containing the most varied and abundant natural resources of Bangladesh and supporting huge stocks of fish and produces biomass, which supplies food and income for the community living there. Depending on their activities, different categories of people engaged with the forest having specific local names are as follows:

**Jele:** Literal translation of the word Jele would be “fisherman”. A large number of people do fishing in and around the Sundarbans round the year; they live near and far from the water bodies of the Sundarbans and catch fishes for their livelihoods are known as Jele.

**Bawali:** A large proportion of people living around the Sundarbans also depend on the forestry operation like harvesting of wood and Golpata (Nipafruticans) leaf for their livelihood. They are called Bawali.

**Mele:** Leaf collecting community is called Mele. Their collected leaves would usually be used for making ceiling of houses and also as fuel for cooking purposes.

**Mouwali:** This Group of people collects honey.

For the devotees of Hindu religion, the Sundarbans wetlands possess a cultural value where they assemble on the 30<sup>th</sup> November every year for a day to have a holy bath in the seawater of Alorkol. About 5000 devotees get together for the religious rituals. There is an old relict of a Hindu temple, which is locally known as Shekher Mandir (Temple of Sheikh) at Shekher Tek (RIS, 2001).

### **3.7 Forest community and ethnic groups in the Sundarbans**

When a group of people depends on the forest directly and indirectly, their socio-economic condition and culture is called forest community. They are basically independent for their thinking and life pattern which are completely related to the forest territory. According to the population census of 1991, there are 27 ethnic groups (Hasan and Sultana, 2009) in Bangladesh, as Chakma, Tripura, Khumi and Marma etc. These ethnic groups are spread all over the country forest side. Munda is also an ethnic group. They live in Khulna, Satkhira and Bagerhat districts where most of the regions are covered by the mangrove forest. They not only live in the Sundarbans, their livelihoods also depend on it. Most of the forest communities live in the Sundarbans. An around 292418 Forest Community (FC) directly and 1081940 FC indirectly depends on the Sundarbans. There are Mahato communities similar to Bawali and Mouwali are also available in the Sundarbans. Most of them do not live in the forest but they are still known as FC because, they earn their livelihood from the Sundarbans. The Sundarbans provides livelihood to 3.5 million of people. They collect wood for cooking purposes, repairing houses etc. Their religious beliefs are closely rooted in the Sundarbans. They think, Banbibi (Goddess of Sundarbans) protects them from tigers, so they don't spoil the Sundari, Pashur and Dhundol trees. The Maual (Mouwali) community is known for collecting honey waxes from the Sundarbans. They also have faith on Banbibi. A total of 50 % honeys of the country are collected from the Sundarabns. Golpata collector, fishermen and chunari (Jhinuk collector) are also living in the Sundarbans (Hasan and Sultana, 2009).

### 3.8 Faunal diversity

The Sundarbans is a huge source of fauna including birds, mammals and reptiles. It is estimated that around 448 vertebrate species are available in the Sundarbans among which 10 amphibians, 58 reptiles, 339 birds and 41 mammals. Besides that and part of it, a significant number of the Royal Bengal tiger, spotted deer, Ganges dolphins, river terrapin and Himalayan squirrel are also available in the Sundarbans. One of the threatened species of estuarine crocodile is also seen in the Sundarbans. On an average, 237 finfish, 24 shrimps, 7 crabs and locust lobster species exist in the Sundarbans. The rich diversity of fauna including 240 species of insects also made the Sundarbans ecologically significant (IUCN, 2014).

**Picture 8:** The endangered Bengal tiger of the Sundarbans (Wikipedia).



### 3.9 Distribution of flora

The Sundarbans is an example of a continuous ecological process where 334 plant species are available. The famous Sundari, Gewa, Goran trees made the Sundarbans aesthetically so beautiful that it attracts thousands of tourists and nature lovers. On one side, it makes the environment ecologically balanced and on the other side, it provides significant forest products to the community people for repairing houses and cooking fuels.

The mangrove forest itself is a combination of littoral forest, salt-water mixed forest, brackish water mixed forest, and swamp forest. A large number of Keora and Golpata are also available in the Sundarbans. <sup>1</sup>

**Picture 9:** The Golpata tree in the Sundarbans (Wikipedia).



### 3.10 Physical characteristics

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<sup>1</sup>More specific characteristics and properties with an appropriate examples are available at the Sundarbans. Available at <https://en.wikipedia.org/wiki/Sundarbans> visited on 18.01.2018.

From the area of mangrove that existed 200 years ago, the land area must have had twice the size of the present day's Sundarbans, and the rest has been cleared for the extension of the land for agriculture. Because of tidal actions, the land has a distinctive physiographic feature and the deposited clay and silt protect against the erosion. An intricate network of interconnecting waterways intersects the whole area. This intricate network is composed of the larger channels and numerous small Khals which drain the land at each flow away. Rivers tend to be long and straight. Easily eroded sands blown into dunes above the high-water mark by the strong southwest monsoon collect at the river mouths and form banks and chars. Finer silts are washed out into the Bay of Bengal, but where they are protected from wave action, mud flats form in the lee of the dunes and cover the dunes and are turned into grassy maddens. This is how the island building continues for as long as the area on the windward side is exposed to wave action. With the formation of the next island further out, silt begins to accumulate along the shore of the island and sand is blown or washed away. The waterways (except Baleswar river) carry little freshwater, because they are cut off from the Ganges. They are kept open largely by the diurnal tidal flow. The soil is a silky clay loam with alternate layers of clay, silt and sand. Alluvial deposits are geologically very recent and deep. Sandy beaches (except on the seaward side of islands in the coastal limits) have a surface of clay. In the eastern part of the Sundarbans, the surface soil is soft and fertile. In the western part of the Sundarbans the surface soil is harder and less suitable for tree growth of plants (see detail in chapter 4). In the region the average Potential of Hydrogen (pH) is 8.0 (Rahman and Asaduzzaman, 2010).

### **3.11 Ecosystem in the Sundarbans**

In the Sundarbans, during the monsoon rains, the estuarine regime is influenced by the interaction of the headwater discharge and the tides, which together influence the seaward drift of the sediment. During reduced inflow of freshwater, strong tidal currents govern the estuary and influence the upstream sediment movement. The tidal mud flats provide suitable micro-environment for colonization of the mangrove plants, which grow into dense and tall mangrove plant communities. Approximately, 2.5 million people live in small villages surrounding the Sundarbans. The area provides a livelihood at certain seasons of the year for an estimated 300,000 people, working variously as wood-cutters, fishermen, and gatherers of honey, Golpata leaves (*Nipafruticans*) and grass (Rahman and Asaduzzaman, 2010).

### **3.12 River systems**

The rivers system acts as natural boundaries in the Bangladeshi part of the Sundarbans. The Sundarbans reserve forest is intersected by an elaborated network of rivers, channels and creeks with varying width and length and occupy an area of 18,741 km<sup>2</sup>. Depending upon the manner in which the tidal wave propagates through the major rivers systems are classified into three different series: Raimangal-Sibsa series, Pashur-Sibsa series and Pashur-Baleswar series. From east to west, the river systems also comprise four estuaries: Bangra estuary, Kunga estuary, Malancha estuary and Raimangal estuary (Rahman and Asaduzzaman, 2010)

## **4. Presentation of Primary Information**

This chapter will discuss the results of field research that has been done by researcher himself with the questionnaire. As part of the primary sources of information, there were two categories of field interview. Firstly, interview with the local people at the Sundarbans and secondly, interview with the experts regarding to the objective of the study done with members of the Forest Department, University expert, and legal expert from Bangladesh Environmental Lawyer Association. Another source of primary information is the report from the state party of Bangladesh that has been submitted to the UNESCO World Heritage Centre on 27 November 2016 in the session 39 COM 7B.8, and The Integrated Resources Management Plan (IRMP) for the Sundarbans.

### **4.1 Interviews**

#### **4.1.1 Expert from the forest division**

According to the Forest Officer of the Sundarbans East forest division in Khulna, previously timber harvesting from the Sundarbans was the main goal. Harvested resources were supply for industry, for example harvesting of Gewa tree was done for Gewa newsprint mill. In the year 1989, timber harvesting totally stopped. Nowadays, non-timber forest products like Golpata, wax, honey, and fish are harvested according to the management plan. For this purpose, a co-management committee has been organized to monitor the wildlife habitation and forestation, but not activated yet. In the future plan, it has been decided that 50 % of total revenue collected from the Sundarbans including tourism will be distributed to that co-management committee to maintain the management activities.

For the better management of the Sundarbans, the total area of the Sundarbans has been divided into 55 compartments through 2 divisions and four ranges. The two divisions are called the Sundarbans East forest division and the Sundarbans West forest division. Each division is divided into 2 ranges namely Chandpai and Sarankhola range in the Sundarbans East forest division, and Khulna and Burigualini range in the Sundarbans West forest division. Different stations and patrol posts are working under these ranges to manage the whole property.

There is no artificial boundary around the reserve forest to protect it from the natural calamities and human attacks. In the case of the Sundarbans-Bangladesh, there are no human habitats inside the forest. The whole forest is surrounded by rivers and canals of different size. These rivers and canals are working as natural boundaries and protecting the forest from natural and human threats. Poaching, hunting, and other illegal activities like woodcutting and fishing have been reduced. As it is the world's largest mangrove forest and a huge origin of resources, a very few rules and regulations have been developed. There is regular patrolling to protect from illegal harvesting and poaching. Recently, SMART (Spatial Monitoring and Reporting Tool) patrolling system has been organized to protect the forest resources because of the large area and a larger amount of poor population around the forest. Illegal activities are rare in the Sundarbans in the present day. The WHS itself consists of 3 wildlife sanctuaries (see chapter 1). The Sundarbans East, West and South wildlife sanctuaries are managed by dual management by two forest divisions of the Sundarbans. Sometimes the proper management of the mangrove forest is hampered by the dual management.

### **4.1.2 Interview with the legal expert**

Concerning environmental legal issues, during the interview with the member of the Bangladesh Environmental Lawyer Association (BELA), it was observed that, there exists no specific environmental or forestry law for the Sundarbans. In that case, all national laws regarding the environment and forestry are applicable for the management and conservation of the mangrove forest of the Sundarbans. Some environmental laws of Bangladesh are Environmental Conservation Law 1995, Environmental Conservation Regulations 1997, Environmental Court Law 2010, the Forest Acts 1997, The Social Forestry Regulations 2008, and the Private Forest Ordinance 1959 etc. The sources of law will be described in chapter 6.

### **4.1.3 Interview with the environmental expert**

As part of primary sources of information, it was necessary for this study to receive comments and recommendations from environmental experts. I conducted an interview with Dr. Saifullah, former Professor from Mawlana Bhashani Science and Technology (MBST) University, Bangladesh. He described the causes of deforestation, climate change and its effect on the natural resources, especially to forestry sector. According to his explanations, institutional deficiency and lack of transparency of administrative body of the mangrove forest are the main reasons for degradation of the Sundarbans (Field survey, 2017). He was supposed to hand-over his personal policy recommendation, but unfortunately it did not happen.

#### **4.1.4 Interview with the local community**

Jalal Kha, 77 years old man, has been living in the village, named Karamjal for 40 years. He observed a lot of things in the Sundarbans and surrounding the forest. He described that fishing, wood collection, honey collection and hunting crabs are the main occupations of the villagers. Before five years, they could do easily whatever they wanted to do inside the forest for livelihood, but recently they cannot do because of strict management activity and administrative rearrangement. Two years back, the government made very strict law for the harvesting of non-timber forest products. Nowadays, local people are totally restricted to enter into the forest. They can only enter into the forest when they achieve a Boat License Certificate (BLC). With this BLC and only during the harvesting season, local people can collect honey and fishes. Every year a large number of tourists come to the Sundarbans but that makes little benefit to the local people, because they don't have electricity, roads and hotel facilities for tourist. In that case, Mongla port authority gets the maximum benefit from the tourist. Although the administration is very strict, there is no guarantee confirming no illegal activities are going on in the forest. The local people do not have the answer to this question?

Another respondent is named Lal Mia from Kanai Nagar village. He is a 72 years old man, and also a custodian of the Sundarbans mangrove forest. He is taking care of Karamjal eco-park since 5 years and has mostly worked in the park as temporary employee (hints in the chapter 2). Sometimes, he goes with the staff inside the forest. He argued that, although he is working inside the eco-park, the forest has also great effects on him as a nearby villager. He said, villagers have benefited in various ways from the forest, for example the Sundarbans forest protects the villages from the havoc of flood, cyclone and Sidr.

He talked about the regulations in a way that, when doing illegal activities, if someone is caught by the authority, they would be financially penalized and immediately would be taken to the jail. Sometimes, during patrolling with the staff they discover traps for deer hunting. He also mentioned that nowadays, administrative laws and regulations to protect illegal activities are much stricter than earlier. The government stationed police and volunteers to protect the forest from poachers and thieves. The overall current condition of the forest is really quite clean and controlled so to ensure no or less environmental damages by the tourists (Field survey, 2017).

#### **4.1.5 Comparative primary information from the Indian part of the Sundarbans**

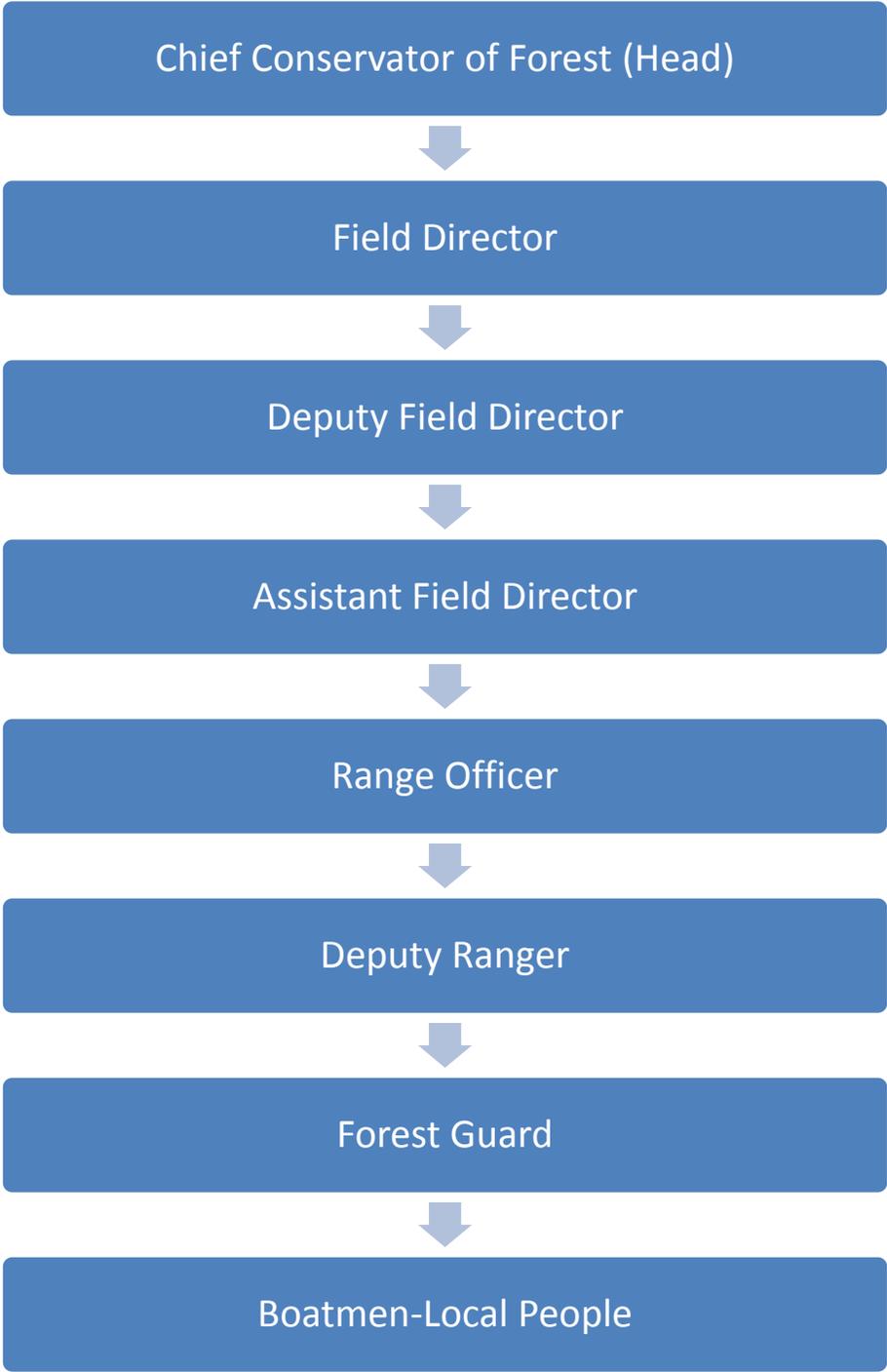
During a research stay in November/December 2018 in India, interviews also were conducted with members of different bodies related to the Indian part of the Sundarbans. Some first information's shall be presented here for comparison. The Sundarbans in India covers almost half of the total area of the Sundarbans mangrove forest compared to the Bangladeshi part. Although both regions in India and Bangladesh almost have the same geographical structure, there are some differences in the management, researcher's point of view, community involvement and the governmental initiative. Information was collected through direct interview with university specialist, members of the forest administrative body, local people, and also some tourists.

#### **4.1.5.1 Interview with members of the administrative body**

The administrative body of the Sundarbans mangrove forest is working hardly in a chain of commands and consequences to protect the forest against natural and man-made damages.

A total of 2585 km<sup>2</sup> of core zone and 1699 km<sup>2</sup> of buffer zone are organized properly with various duty stations and patrol posts. When some area of the core and buffer zone loses trees due to an unwanted event, the forest authority immediately starts a plantation program and fills the fellow lands. According to the forest officer, the whole property is managed by a Joint Forest Management Committee (JFMC) actively collaborating with local peoples. The Forest Department undertakes several programs like social awareness program, environmental awareness program, and alternative livelihood program. As part of the alternative livelihood program, the Forest Department in collaboration with government supply small funds and materials for fish culture, chicken farming etc. The Indian Sundarbans is the summation of 104 islands where two types of duty observing the whole forest exist namely fencing duty and patrolling duty. Local people are also part of this patrolling. They are working for the conservation of the forest as legal stakeholders. To protect the villagers from wild animal, especially from the tiger, the Forest Department made a boundary with a plastic fence in the buffer zone, which is basically a border between Man and Biosphere (MAB). However, the total management organs of the Indian Sundarbans from top to bottom are presented in Figure 2 below:

**Figure 2:** Administrative arrangements in Indian part of the Sundarbans.



#### **4.1.5.2 Interview with expert**

Specialists are all always aware of unwanted damages of the Sundarbans mangrove forest due to climate change and its negative impacts on global environment. According to Dr. Kanjilal at Jawaharlal Nehru University (JNU), restoration of mangrove would be the most possible and effective way to protect the mangrove forest and conserve it for the future. They specified some conservation techniques for the mangrove are as follows:

- i. Stop urbanization
- ii. Reduce domestic affluences and
- iii. Maintain fresh water flow

As climate change is the most powerful attack against the environmental balances, finding the reasons behind climate change are also a possible solution. Loose of islands and human dislocations due to climate changes are enforcing the environmental damage. According to the specialist, maintaining watershed and salt-water desiltations are also helpful for the mangrove areas. Recently, the IUCN completed a project in some South-east Asian countries including India, Bangladesh, and Sri Lanka etc. The project is called “Mangrove for the Future”. The main objectives were conservation, restoration and sustainable management of coastal ecosystem. They think empowering local community and engaging them in decision making would improve the sustainable use of coastal ecosystem.

### **4.1.5.3 Interview with the local people**

Interview was conducted with the following local people (male): Jamini Mandal, Orobindo Bawali, Shuven Bawali, Bankim Mandal, Gopal Goswami, Ganesh Roy, and Shuvonkar Thakur in the Rajatjubily village which is only 100 meter away from the world's largest mangrove forest. Local people were very much curious and interested to share stories about what they have observed during their livelihood activities. One of the respondents Jamini Mandal, experienced 35 years working in the Sundarbans. Previously they collected fish, honey, tree leaves and other utilities from the Sundarbans illegally. Recently, since 5-10 years it is not possible to enter into the forest without BLC certificate like in the Bangladeshi part too. BLC charges vary in the two countries. In India, one BLC belongs to one boat and costs around 30000 rupees/ year. One boat contains 5-6 boatmen where each boatman is obligated to pay minimum 200 rupees/day.

Concerning dependency on Sundarbans, the old man described very clearly that “if the earning member of a family depends on the Sundarbans for his livelihood then we may say the whole family is dependent on the Sundarbans”. Nowadays, the case is most often different than earlier. People are engaging themselves with some other income generating activities like rice cultivation, small farming, vegetation, and small and medium enterprise in the nearest port Gosaba village. Reasons behind the shifting of professions are administrative difficulties and panic of Royal Bengal tiger. It may happen that all male persons go to another place for work, and then a tiger comes to the house-yard and kills children and women. Although still about 50 percent of the villagers are dependent on the Sundarbans, the overall situation is much better than in Bangladesh. They have electricity, construction of road is going on, and a primary school for the children exists.

They need a hospital urgently because in case of serious health problems they have to go to the nearest city Kolkata which is even 100 km far, and also communication is not smooth. Local people are much conscious about the necessity of the Sundarbans and its usefulness to the world environment. Forest authorities made them understand why they should conserve the forest. According to the local people, the Indian government through the forest administration is supporting them quite often. To reduce the dependency of local people and make them engage with alternative occupation, the central regional government and the state government are providing respectively 2kg rice/ family and 16 kg rice/family on each month during critical period. The NGO “Purbasha Ecotourism Society” is working for the conservation of the Sundarbans through plantation of Sundari trees, making people aware and writing several articles on the Sundarbans to motivate the civil society. During my entire stay with the local people, I got a very strong impression that local people are really true conservators and they are working together with the forest authority to protect the mangrove forest.

## **4.2 Written primary sources**

### **An overview on updated report of government of Bangladesh on decision 39 COM 7B.8 by the World Heritage Committee**

The report includes all important steps that have been taken by the state party Bangladesh in response to the Decision 39 COM 7B.8 by the World Heritage Committee for the mismanagement of the property.

The Department of forest submits online periodic report on the Sundarbans to UNESCO World Heritage Committee every 6 years, the last periodic report submitted in 2012. Some decision by the WHC and strong response by the state party in the 39 session of the World Heritage Committee are discussed below;

### **Decision Item no. 3 of 39 COM 7B.8 (Bonn 2015)**

*“Environmental Impact Assessment for the dredging of Pashur River adjacent to the property did not include a specific assessment of the potential impacts of the property’s outstanding universal value.”*

### **Response of the state party (Decision 39 COM 7B.8)**

State party responded that occasional dredging in Pashur river has been done, otherwise the river would have been silted up threatening the very existence of the mangrove ecosystem, because Pashur is a tidal river and tide brings silt and clay that cause erosion and make problems in navigation. The government of Bangladesh has planned to dredge the Pashur river from Mongla port to the Rampal project (see chapter 6) site which is around 4 km away from the SRF and around 80 km away from the WHS. State party mentioned in the future plan, “dredging in the Pashur river will be carried out on the basis of Environmental Impact Assessment (EIA) with a special consideration of impacts on the property’s outstanding universal value (OUV) to avoid any negative impact on the Sundarbans”.

#### **Decision Item no. 4 of 39 COM 7B.8**

*“Request to undertake a comprehensive strategic environmental assessment (SEA) in order to assess the indirect and cumulative impacts from the power plant and other development in the vicinity of the property, including a specific assessment of potential impacts on its OUV”.*

#### **Response of the state party**

The government of Bangladesh has decided to carry out a strategic environmental assessment for the south-western region of Bangladesh including the Sundarbans. Department of forest has already taken an initiative to assess the indirect and cumulative impacts from the Rampal power plant and other developments in the vicinity of the property and the region to specially assess the potential impacts on the OUV of the Sundarbans, world heritage site.

#### **Decision Item no. 5 of 39 COM 7B.8**

*“Request to provide further details on the mitigation measures taken for the power plant project, which should fully consider the findings of the SEA”.*

#### **Response of the state party**

The Rampal power plant project is a flagship project between Bangladesh and India. The project was decided when the present prime minister Sheik Hasina visited India. The feasibility study suggested 3 possible sites for the Rampal power plant. The final site has been selected for its navigation facilities. For a 1320 MW coal based power plant, a flexible navigation system and ease of coal transportation is needed, which is only possible in the Rampal site in the southwestern part of Bangladesh.

Land use pattern and resettlement are also considered in the site selection. Bangladesh gives high priority to food security because of the large number of population. There is a smaller amount of agricultural lands in the project area and population density also lays around 121 people per sq.km whereas the country's overall density is around 1000 people per km<sup>2</sup>. Some of the important mitigation measures that have already been taken for the Rampal power plant project are as follows:

### **Measures against air and water pollution**

Rampal project has been developed with modern ultra-supercritical technology and environmental friendly technology that ensures less air and water pollution. The project is adopted by the US Environmental Protection Agency that determines low incremental pollutant like SO<sub>x</sub>, NO<sub>x</sub> etc.

### **Movement of lightering vessel for coal transportation**

It is said that coal transportation for the project will be done very carefully with closed vessel and unloading of coal will be done with covered conveyer that will ensure very less air and water pollution.

### **Water withdrawal for the project**

In this project water will be withdrawn from Pashur river although its saline water, only 2.5 cum/sec water will be used as makeup water out of 6000 cum/sec available water during drought.

## **Decision Item no. 6 of 39 COM 7B.8**

*“Regrets that the ecological monitoring data for the property requested by the committee in Decision 35 COM 7B.11 has not been provided, and urges the state party to submit the results of the ecological monitoring program for the property without delay, to the World Heritage Centre for review by IUCN, ensuring that the impact of climate change on the OUV is documented, as initially requested in Decision 33 COM 7B.12”.*

## **Response of the state party**

Department of forest, Bangladesh submits a periodic online report on the world heritage site to UNESCO-WHC every six years. Last periodic report submitted by the state party in the year 2012 that has been published in “World Heritage Papers 35” (2010-2012). The reports include various aspects of ecological monitoring of the property, for example conservation of the property, factor affecting the property, pollution, management, species, etc. The report also shows the various changes of the property since last few years. Changes are identified on the following sectors, for example areas, restoration and plant growth, non-timber forest product, tiger estimation etc.

## **Decision Item no. 7 of 39 COM 7B.8**

*“Further requests to the state party to continue monitoring the effects of the December 2014 oil spill on the aquatic environment, and to take measures to prevent such accident, drawing on the lessons learned so as to strengthen its oil spill preparedness and response capacity, in particular in view of the anticipated increase in river navigation related to the power plant developments upstream”.*

## **Response of the state party**

It was an accident and the damage has been minimized in time. The government has taken the necessary steps and formulated National Oil Spill Contingency Plan. State part submitted a full report on its cooperation with the United Nations, which is available in UNESCO website. After the accident various parameters of water quality of Pashur, and Shila is monitored regularly.

## **Decision Item no. 8 of 39 COM 7B.8**

*“Request furthermore the state party to invite a joint world heritage center /IUCN Reactive monitoring mission to the property to review the state of conservation of the property, and the potential impacts of the thermal power plant development and dredging of the Pashur River”.*

## **Response of the state party**

A joint WHC-IUCN Reactive Monitoring Mission visited Bangladesh to review the state of conservation of the property and the potential impacts of the thermal power plant development and dredging of the Pashur river in 2016. The WHC sent to Bangladesh an RMM report in august 2016 with a request to notify the WHC of any factual error in RMM report.

The state party reviewed and examined the report and identified many factual errors in the report and transmitted a 63 page response with 36 annexes to the WHC on 10 October 2016 with a request to revise the RMM report by incorporating the factual errors identifying by a state party before uploading the report on the website of WHC.<sup>2</sup>

Above responses were examined in 41<sup>st</sup> session and The WHC recalled decision items, the WHC was satisfied with some responses. Furthermore, The State party was requested to response with two recall decision; dredging the Pashur river under EIA and ensuring the OUV of the property due to air and water pollution from the Rampal power plant (decision 8 of 39 COM 7B.8).

In the sense, The State party was requested to submit to the WHC further report by December 1, 2018 for 43<sup>rd</sup> session for the examination by the WHC in 2019. The State party submitted the report on 29 November 2018 with following responses:

- i. The National Oil Spill and Chemical Contingency Plan have been implemented to protect and maintain emergency condition during oil and chemical spill that ensure the safety of the property.
- ii. The Government confirms that the Rampal power plant will continue its activity with all possible measures that ensures no damages of the property.

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<sup>2</sup>The above information mentions the direct response from the state party, Bangladesh to the WHC on Decision 39 COM 7B.8 by the World Heritage Committee in 2016. It is a primary source of information used in the study that represent the present status and initiatives that have undertaken by the state party. Available at <http://whc.unesco.org/document/155112> and <http://whc.unesco.org/document/140155>

## **Integrated resources management plans for the Sundarbans (2010-2020)**

Another source of primary information is integrated resources management plans for the Sundarbans. This report was made jointly with Forest Department, Bangladesh and the USAID. The report describes the current resources status and management situation of the Sundarbans reserve forest. It is a ten year management plan that has ten strategic management programs. It has five planning goals and outcomes for the sustainable management of the Sundarbans reserve forest and surrounding area. The five planning goals and outcomes are as follows:

**Goal1.** Protect, restore, sustain and enhance the bio-diversity of the SRF and its interface landscape.

**Outcomes:** Forests and terrestrial resources, and wetlands and aquatic resources with the representative capacity to maintain their health, productivity, diversity and resilience.

**Goal2.** Provide for resilience-based food security through the provision of a variety of subsistence uses, including fisheries, values, benefits, products and services while ensuring the sustainable supply of these resources for future generations.

**Outcome:** Resources use is managed on the basis of sustainability and co-management based on best available science and through the consultation of stakeholders.

**Goal3.** Provide for and enhance eco-tourism and visitor recreation opportunities.

**Outcome:** Eco-tourism revenues are sufficient to provide enhanced alternative incomes as well as provide for increased emphases on biodiversity conservation.

**Goal4.** Support and improve community based co-management approaches for the activities taking place in the SRF and its surrounding landscape.

**Outcome:** The FD facilitates and engages with the landscape communities and stakeholders in determining appropriate co-management practices and benefit sharing.

**Goal5.** Provide for and implement appropriate climate change mitigation and adaptation options and opportunities.

**Outcome:** The FD ensures the continuation of the Sundarbans as carbon sink (both for green carbon and blue carbon), and contribute in enhancing the ecosystem resilience for improved adaptation of local communities to climate change impacts including cyclones and storms.

The present IRMP recommended ten strategic programs for the sustainable Sundarbans. These programs are discussed as follows:

### **Habitat protection programs**

A secured habitation is necessary for ecological balance, food security, conserving biological diversity and protection of adverse climate situation for SRF and for the whole country as well. Main objective of this program is to protect the SRF including its forest, wetlands, and wildlife sanctuaries and surrounding buffer zone of the Sundarbans. A management zone is an area of specific management category, distinguishable on account of its management objective (IRMP). Zonation under the habitat protection program will help to achieve the goal and objective of the management plan.

Under this program the total SRF is divided into two main zones as Core zone and Buffer zone. The three wildlife sanctuaries are in the core zone. The whole SRF except these three wildlife sanctuaries is in the buffer zone. The core zone has the top most value of protection compared to other two zones because of the wildlife sanctuaries.

### **Wildlife sanctuaries management programs**

Wildlife includes all plants and animals, normally wild by nature and so not domesticated (IRMP). Main objectives of the wildlife sanctuaries management programs are to manage the three sanctuaries, provide effective protection for the wildlife and aquatic resources and to rehabilitate and maintain good quality forest cover with natural structure and composition. Under this program activities are emphasized on tiger conservation and Cetacean diversity management. Cetacean diversity is a scientific grouping of dolphins, whales and porpoises, and its abundance and habitat in Bangladesh are found in 120 km wide belt estuarine, coastal and deep sea water across the SRF (IRMP, 2010).

### **Sustainable forest management program**

Under this program, activities are implemented only in buffer zone in SRF. Harvesting of timber and NTFPs activities are prioritized under this programs. Main objectives are to maintain ecological succession in the constituent forest in order to ensure long term existence of the Sundarbans ecosystem, develop and maintain mangrove forests as carbon sinks and good habitat favoring the conservation of flora and fauna including tiger. For the reduction of emissions from deforestation and forest degradation, ban on tree felling will be continuing. Harvest plan for non-timber forest produces and special trees in the Sundarbans has been implemented.

## **Food security and waste management program**

Main objective of this program is to ensure sustainable management of fisheries products and NTFP of the Sundarbans. It also ensures the local community to access into the resources of the terrestrial and aquatic resources. Increases the salinity, water pollution and over-fishing reduced the fisheries resources and increase the degradation of wetland in the surroundings areas of the Sundarbans. Main reasons behind the wetlands damage are excessive population, natural disaster like cyclone, Sidr, and man-made threat like oil spill etc. To fulfill the objectives of the program; wetland co-management and fisheries resources management program are main initiatives.

## **Climate change mitigation program**

Climate change has great impacts on the Sundarbans wetlands, resources like fisheries and ecosystem as well. So changing climate also affects community people around the forest and beyond. Most of the inhabitants in the SRF are very roughly affected by the climate change because of climate dependent profession like fishing, agriculture and forestry. However, main objective of the climate change and mitigation program is i) to identify and review possible climate change impacts on the Sundarbans ecosystem, ii) to quantitatively asses carbon sequestrated and stored in the mangrove forest for developing a REDD+ proposal for carbon financing.

## **Climate change adaptation program**

SRF supplies various categories of resources like timber: Sundari and other trees, non-timber: grasses, Golpata, fishes, aquatic resources: crabs, non-aquatic resources: honey etc. Climate change affects these resources directly.

Sustainable development and management will be more effective than any other activities. Climate change adaptation program can help to develop community people and landscape and increase the option to be involved in local people. Value chain mapping design and implementation program is very essential to improve the forest produces from collector to retailer through intermediaries for the marketing of timber and non-timber forest produces.

## **Eco-tourism program**

To create nature based tourist, improve their nature based education and promoting the bio-diversity conservation are the main objectives of eco-tourism program in developing SRF. There is Strength, Weakness, Opportunity and Threats (SWOT) analysis by integrated protected area co-management project (IPAC) field staff that will help to achieve the eco-tourism goal of SRF. Different sectors of information of the SWOT analysis are information and accessibility on the Sundarbans, visitor's management, community benefits etc.

## **Facilities development program**

This program will be very useful for management authority, visitors and researcher as well. As part of facilities development, most important objective is to minimize the adverse environmental impacts that will be very preferable for the visitors and wildlife in SRF. To make

the SRF a safe place, 26 sites have been recommended to build eco-friendly infrastructure like drinking water facility, food supply chain and medical support for the patrol and information staff etc.

### **Conservation outreach, conservation research, participatory monitoring and capacity building program**

To make the SRF well known nationally and internationally, conservation outreach, conservation research, participatory monitoring and capacity building will play vital role. However, main objectives of this program are as follows:

- To identify priority research theme.
- To establish a participatory monitoring mechanism to help guide the Sundarbans development and
- To build capacity of stakeholders. Implementing communication tools like electronic and print media, nature study and conservation as a part of academic core are the main element to develop this program. Capacity building strategy like identifying the skills and capabilities, imparting new skill and capabilities and using new skills and capabilities has been identified during the recommended project period 2010-2020.

### **Administration and budget program**

This program includes identifying the funding organization and develop the internal team those who are closely related to the conservation and management of the property. Creating necessary vacancy and filling the existence vacancy, arranging the management and administrative unit, organizing the range offices are also important initiatives in the program.

## 5. Review of Literature

The literature review is an essential part of any kind of research because it helps to understand the importance of the research area and getting an idea about the past condition and future scope of the research area. This chapter will discuss the basic concept of the research topic involved with the objectives of the research. Basic terminologies related to the study such as sustainable management, legal and conservation aspects and community involvement will be described. Finally, research related previous studies will be reviewed.

### 5.1.1 Basic concepts of forest and resource management in general

There are some basic concepts and terminologies that appear often in any kind of natural resource management. Some of the basic concepts related to this study are as follows:

- **Preservation:** Protection of resources that involves placing them in a non-use state.
- **Conservation:** Includes both use and preservation of resources in a manner that sustains them.
- **Management:** Method applies to organize preservation and conservation activities.
- **Sustainable development:** Use of resources in a way that considers the future state of the environment and future generation.
- **Stakeholder:** Partners in conservation, preservation, management and development.<sup>3</sup>

## Heritage

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<sup>3</sup>Osireditse, (2016) describes the African heritage conservation techniques in the article “African cultural heritage conservation and management: Theory and practice from southern Africa”. Terminologies are found in this article. Although, it is about the cultural but also refers to the natural heritage management. Heritage policy planner should follow the technique. Springer International Publishing AG.

Inherited property from the past to the present by contemporary societies is called heritage. According to the Oxford English dictionary, '**heritage**' as 'property that is or may be inherited; an inheritance', 'valued things such as historic buildings that have been passed down from previous generations', and 'relating to things of historic or cultural value that are worthy of preservation'. It is cultural and natural. Natural heritage is that has significant value to nature, ecology, biodiversity such as water bodies, natural landscape etc. Cultural heritage shows the wide sense of diversity through its cultural objects including cultural landscapes or historical buildings, parks, and cities (Harrison, 2010).

### **Wildlife sanctuary**

“A sanctuary is a protected area which is reserved for the conservation of only animal and human activities like harvesting of timber, collecting minor forest products, and private ownership rights are allowed as long as they do not interfere with well-being of animals” (Wildlife Protection Act, 1972).

### **Ecological critical area**

Ecologically critical areas (ECA) are defined areas or ecosystems affected adversely by the changes brought through human activities. An area of highly concentrated biological activity of a type that is especially valuable for maintaining biodiversity and or resource productivity. It is also called an ecologically sensitive area (ESA).<sup>4</sup>

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<sup>4</sup>In the natural resource management ECA is very significant. Special considerations are needed to conserve an ECA due to natural and human induced threats for the sustainable use of it. Visited on 26.10.2017, available at [www.coastalpractice.net/glossary/ecologically%20critical%20area%20\(eca\).htm](http://www.coastalpractice.net/glossary/ecologically%20critical%20area%20(eca).htm).

## **Sustainable Development (SD)**

When we talk about sustainable management, the term sustainable development comes thoroughly because each and every proper management of resources led to a development. As we know, development is the cause and consequences of positive changes. On the other hand, sustainable development can be defined as a broad policy frame-work that provides the guidelines towards the equitable use of bio-physical resources as well as emphasizes equal access to all. The literature on sustainable development identifies two broad categories of SD known as weaker and stronger sustainability. The weaker sustainability is popularly attributed to development, while the stronger sustainability is commonly attributed to the environment (Williams and Millington, 2004).

## **Wetlands**

Wetlands are salient features of any kind of landscape which play a vital role in the ecosystem services. It is also responsible for the climate change and emissions of methane although, it drew a less significant compare to any other part of ecosystem (Prusty et al. 2016). In addition, wetlands are also the areas of marsh, fen, peat land, or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish, or salty, including areas of marine water, the depth of which at low tide does not exceed 6 m (Ramsar, 1971).

## 5.1.2 Sustainable forest management

“Sustainable forest management addresses forest degradation and deforestation while increasing direct benefits to people and the environment. At the social level, sustainable forest management contributes to livelihood, income generating and employment. At the environmental level, it contributes to important services such as carbon sequestration, water, and soil and biodiversity conservation”.<sup>5</sup>

Sustainable forest management is the management of forest according to the principles of sustainable development. Sustainable forest management has to keep the balance among the three main pillars of sustainability such as ecological, economic and socio-cultural. Successfully achieving sustainable forest management will provide integrated benefits to all, ranging from safeguarding local livelihood to protecting the biodiversity and ecosystems provided by forests, reducing rural poverty and mitigating some of the effects of climate change.<sup>6</sup>

Sustainable forest management, as a dynamic and evolving concept aims to maintain and enhance the economic, social and environmental value of all types of forests, for the benefit of present and future generations. It is characterized by seven elements such as extent of forest resources, forest biological diversity, forest health and vitality, productive functions of forest resources, protective functions of forest resources, and socio-economic functions of forests and (vii) legal, policy and institutional framework (UN, 2008).

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<sup>5</sup> Sustainable forest management. Food and Agricultural Organization of the united nation. Visited on 06.08.2018, available at <http://www.fao.org/forestry/sfm/en>.

<sup>6</sup> LEDSGP emphasized on three pillars of sustainability of forest management for low carbon emissions. More info available at [http://ledsgp.org/wp-content/uploads/2015/12/CDKN\\_LEDS\\_Forestry\\_WG\\_factsheet.pdf](http://ledsgp.org/wp-content/uploads/2015/12/CDKN_LEDS_Forestry_WG_factsheet.pdf) revisited on 05.08.2018.

In general, we know that management is what a manager does. So forest management defines the activities of a forest manager to keep the forest in good order, taking care of other elements incurred to the forest, for example animals, birds, flora and fauna etc. whereas sustainable forest management ensures also the social and economic benefit of the people of the communities who are involved with the forest. The term sustainable forest management was unknown to many nations and forest administrators before the implementation of forest principle at the UN Conference on Environment and Development in Rio de Janeiro in 1992.<sup>7</sup>

Now as it is a generally accepted term around the globe, a question arises how sustainable forest management makes sense in practice? There are some examples of sustainable forest management as of selective logging: it is the practice of removing or cutting certain selected trees to keep the balance in the forest but not clearing the forest. Another example is keeping the tree until it gets mature. Normally, a mature portion of wood will bring more value than a young and tender tree. A good manager must think about the economic return from the forest. So the sustainable forest management helps to achieve long term value.<sup>8</sup>

### **5.1.3 Why sustainable forest management?**

When a forest resource is not operated in a sustainable way it may have several negative impacts like biodiversity loss, illegal hunting, illegal settlements, and climate change. High demand for woods and wood products creates a degradation of forest that leads to biodiversity losses.

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<sup>7</sup> Dr. Gillaspay from the University of Phoenix has described in detail sustainable forest management, defined its principles and given examples. More details are available at the following link (visited on 29.08.2017): <http://study.com/academy/lesson/what-is-sustainable-forest-management-definition-and-examples.html>

<sup>8</sup> See detail information in the reference given in footnote 7.

When sustainable forest management plays an important role in forest resources conservation and conservation of biodiversity, it also can contribute to economic development by providing income, employment, food security and shelter where it is most urgently needed. Some important aspects of SFM are as follows: improve governance for SFM at the local and regional level by means of strengthening the rule of law, improving local accountability and transparency, promoting forest-based economic development on the local and regional level by means of security of legal status of the community, microenterprise etc. Therefore, sustainable forest management is highly important (UN, 2007).

Teshoma (2010) mentions in her master thesis that forest and forest products contribute 5-37 % to household's cash income in Cameroon. This figure is very high in India in the case of Manipur district. An average 90 % of the population in Manipur district depends on forest products as a source of income. Natural resources and forestry contribute 35% income in Zimbabwe (Teshoma, 2010). People from a very remote area and from developing countries also depend on forest trees and small plants as a means of medicine. People who live below the poverty line are relying on traditional medicinal plants because of lack of money. For the total environmental sustainability forest resources provide a vital contribution.

Agarwal (2001) identified four important factors for successful common resources management: resource system characteristics, user group community characteristics, institutional arrangements, and external environment. Resource system characteristics determine a clearly defined boundary of the resources and its size ensuring the movement of the community from one place to another with the resource boundary.

User groups are very important for sustainable resources management; in most cases, user groups bear some past experiences that might be helpful for the present user group as well as for researchers today. Good leadership in user group enhances the management of resources in a more sustainable way. Another important factor in sustainable common resource management is the institutional arrangement that only helps to differentiate between local and external management rules and regulations. The proper institutional arrangement ensures easier to monitor the rule. The fourth factor is external environment that defines the activities of the central government through the local community, and it maintains and processes fund for the resources etc. These four factors of resources management are equally applicable for natural resource management and forest management.

#### **5.1.4 Participatory forest management**

Participatory forest management (PFM) is a form of forest management that relies on formalized forest management agreements between local communities and government. It is one kind of community forest management that ensures the benefit and living from forest equally to every community. It is a common practice across the developing countries, for example in Ethiopia; the PFM is a leading approach of forest management. PFM was first introduced in Ethiopian forest and natural resources management policies, and later on, it spread out in Tanzania and around the globe.<sup>9</sup>

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<sup>9</sup> Farm Africa is an African based organization that helps to remove poverty in rural Africa. It has been established in Ethiopia at first but now contributes the concept of participatory forest management throughout the world, available at: <https://www.farmafrica.org/downloads/farm-africas-approach-on-pfm.pdf>. Last visited on 24.03.2019.

### **5.1.5 Theory of changes of PFM**

Farm Africa is a non-government organization who is working for rural development in Africa. It has developed a theory called “theory of change” through the PFM. The general mission of the theory of changes is to ensure the management of forest is both environmentally sustainable and financially sustainable for smallholder farmers. The final output/outcomes show very clearly how the theory of changes is beneficial to smallholder farmers and the local community. In the theory of change, PFM has two goals of forest conservation and development of income generation activities. These two goals can be equally benefitting to several stakeholders like the government, forest-dependent community and the private sector as well, where local community and government can agree on shared forest management and the private sector can develop forest-based business. In that way, Participatory Forest Management will bring a sustainable outcome through forest management, increased management capacity, easy access to finance, trade facilitation and business policy.<sup>10</sup>

### **5.1.6 Community Based Forest Management (CBFM)**

“Community forestry is contributing to livelihood promotion in many ways, that includes fulfilling the basic needs of local communities, investing money in supporting income generation activities for the financially insolvent people and providing access to the forest land for additional income or employment” (Pokharel 2008, 2011).

CBFM is an important approach to manage forest resources that improves the relationship between forest officials and local community. Although it is a new approach in Bangladesh, it helps to reduce the deforestation rate too.

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<sup>10</sup>See detail information in the reference given in footnote 9.

The implementation of CBFM was enhanced by the 1994 forest policy, the forest act 2000 and the social forestry rule 2004. Around 100 years old CBFM concepts help to diversify economic activities in rural communities. With respect to forestry in Bangladesh, the CBFM is an amalgam of Community forestry (CF), Social Forestry(SF), Participatory Forestry (PF) and Agro Forestry (AF) (T.K. Nath et al. 2016).

### 5.1.7 The CBFM practices in Bangladesh

**Table 2:** An overview of the CBFM development in Bangladesh since 1871 (Jashimuddin and Inoue, 2012).

Sl.	Program	Period
1	Taungya System	1871
2	Forestry Extension Service Phase I	1962-1963
3	Betagi-Pomra Community Forestry Project	1979-1980
4	Jhumia Rehabilitation Programme in CHT Phase I	1979-1989
5	Development of Forestry Extension Service Phase II	1980-1985
6	Community Forestry Project	1982-1987
7	Thana Afforestation and Nursery Development Project	1987-1995
8	Jhumia Rehabilitation Programme in CHT Phase II	1990-1995
9	Participatory Social Afforestation	1991-1998
10	Forest Resources Management Project: Forest Directorate Component	1992-2001
11	Extended Social Forestry Project	1995-1997
12	Coastal Greenbelt Project	1995-2000
13	Forestry Sector Project	1997-2004
14	Sundarbans Biodiversity Conservation Project	1999-2006
15	Nishorgo Support Project	1999-2008
16	Integrated protected area co-management	2004-2013

17	Char Development and Settlement Project-III (2nd Phase)	2005-2010
18	Reedland Integrated Social Forestry Project	2005-2010
19	Afforestation in the Denuded Hill Areas of Chittagong North Forest Division (2nd Phase)	2008-2012
20	Biodiversity Conservation and Poverty Alleviation Through Afforestation in the Greater Rajshahi and Kushtia Districts	2008-2012
21	Participatory Social and Extension Forestry in Chittagong Hill Tracts	2008-2012
22	Community-Based Adaptation to Climate Change through Coastal Afforestation	2009-2012
23	Re-vegetation of Madhupur Forests through Rehabilitation of Forest Depended Local and Ethnic Communities	2010-2012
24	Poverty Alleviation through Social Forestry	2010-2013
25	Management of Natural Resources and CF in Chunati Wildlife Sanctuary	2009-2015

From above Table 2 we can observe that most of the CBFM projects have developed in present Bangladesh although it has been started in 1871 in the Indian sub-continent under British rule. In the above mentioned projects, community people were the main stakeholders. These CBFM projects have been playing a vital role in the development of forest resources in Bangladesh.

S. N. Islam (2007) mentioned in his PhD thesis that downstream freshwater flow through the Ganges is very important for the ecological balance in the mangrove forest. But India has developed Farakka barrage that reduces the water flow in the Ganges, as a result salinity is increasing in the South-western part of Bangladesh where the mangrove forest is located. This saline water has great negative impacts on industry, agriculture, fisheries, navigation, and drinking water and also on the landscapes of mangrove ecosystem.

According to his opinion, it is immediately necessary to take some steps such as to improve internal river connection, dredging the river and a new management plan for monitoring fresh water supply. Only with these rapid initiatives by management authorities, the long term conservation and sustainable use of the mangrove forest can be ensured.

The Sundarbans in Bangladesh contributes 3.5 % of the world mangroves and plays a vital role to protect the coastal area of the country from cyclone and other natural calamities, although the effectiveness of this forest is decreasing day by day due to the increase of salinity in water because of insufficient fresh water flows. As a result, main trees of the Sundarbans forest, mostly the Sundari, Goran trees are also affected through the salinity impacts. In this sense, it is time to take further steps for water salinity simulation and water modeling through proper management and understanding between the concerned parties. The buffer zone of the mangrove forest is losing its own characteristics due to the massive application of chemicals and fertilizers in the shrimp farms which is destroying the vegetation in that area. Proper observation on water allocation policy between Bangladesh and India may bring a proper solution of this problem (Islam et al. 2009).

## **5.2 Legal aspects**

This sub chapter presents the legal status of the contemporary forestry sector with historical background of environmental law and forest policies to fulfill the specific objective.

The forest policy is the amalgam of all the policies, laws, plans, budgets, programs and practices relevant to forest conservation, use and management. The national forest policy should not be separated from any other instrument which has impact on the forestry sector directly or

indirectly. The national forest policy, climate change policy and protected areas policy are also part of the legal instruments for the conservation and management of the forest resources everywhere. Hence, climate change policy provides adaptation and mitigation approaches so it is an important policy instrument for the forestry sector (NFP, 2011).

### **5.2.1 Importance of forest policy ensuring sustainability**

Most recently, the forest management is a very emergent concern for individuals, government and private business whereas the individual government is trying to achieve economic stability through renewable energy, private business is trying to increase the productivity due to global competition. The local community always has been dependent on forest resources for fuel, construction material, food, and income. Awareness about global climate change and conservation of biodiversity also increases the importance of sustainable forest management to the common people and experts. So in this sense, it is very necessary to know the forest management policy, legislation and other management principle for the sustainable forest management. Hence, policy and legal aspect always bring the significance for any other resources management and safe uses of resources. To cope with the unlimited demand for the forest resources, traditional concepts of forest management already have been changed to sustainable forest management since it makes a large contribution to economic, social and environmental stability. A sound policy framework only can ensure a sustainable forest management because the individual politics are not aware of balanced actors and beneficiaries of forest resources. So the government of each country should realize that forest property is common for public and private sector and local people, and they should contribute together according to the law of equality (Franz and Montalembert, 1993).

## 5.2.2 European context

Since 1990, the European forest sector got a new shape because of rebuilding of forest law and cooperative policy making through the EU forest strategy. Balanced forest governance played an important role on it although, there were some political interventions. The classic governance instrument could be a solution but mutual participation of all forest users is needed. The cross-border concept enhanced the growth of the European forest sector but it has also negative impact on ecological process and climate change. Increasing specific forest governance is speeding up classical policy and involving young policy maker that can only reduce the degradation and ensure the involvement and benefits for local stakeholders (Cesaro et al. 2008).

One of the important ways for the development of the forest sector is the active participation of different stakeholders. The EU forest strategy 1998, organized the stakeholder consultation program. In that stakeholder consultation program, every stakeholder was asked to answer question, opinion and recommendation. Around 58 contributors participated in the program including private individual, private companies, academia, NGOs, association and federation. Through the questionnaire consultation, the National Forest Program (NFP) was developed.

The environmental NGOs marked it as a very relevant to conservation of biological diversity in global level. Some stakeholders commented to carry it on national and international government level for the global forestry development (EU, 2005).

### **5.2.3 Indian context**

The early farm forestry or social forestry has been started in Tamil Nadu, India around 1964 to increase the plantation of trees for the fuel wood. Plantation was raised by Forest Department but guarded by local villagers. Due to a low number of social involvements of the people, it was very hard to safeguard and finally production got down. Around 1970, industries found difficulties in collecting raw materials for production purpose. They started to buy Eucalyptus tree from the farmer that increased the number of farmers and influenced them for plantation (Madhav et al. 1983).

Forest policy 1988 is a revision of national forest policy in India. Due to excessive needs of forest products as fuel and wood, the forest sectors were destroyed. Therefore, a new resolution was needed for the maintenance of environmental stability, conservation of biodiversity including flora and fauna and increasing the forest productivity for the national requirement of forest products. The optimum solution for the development of forest sectors is as follows: keeping the area under forest to cover 1/3 of the total land, influencing forestation, social forestry and farm forestry, stopping diversion of forest land to non-forest purposes etc. (MOEF, 1988). National forest policy 2016 is the upgraded version of forest policy in India where community based forest management is the ruling management strategy to ensure the sustainability. The policy indicated the shift of forest to landscape, canopy over the ecosystem, participatory approach to empowerment. This policy is very communicative to reach new policy frameworks like climate change in forest management, forest catchment management and involving community in management (NFP, 2016).

## **5.2.4 Forest policy and institutional arrangement in Bangladesh**

The Forest Act 1927 was a common institutional framework for the Indian sub-continent. After the birth of Bangladesh, the country has developed several acts, laws and ordinances for the development of the forest sector; Bangladesh wildlife preservation order 1973, National Forest Policy 1994, Environment Conservation Rules 1997, Social Forestry Rules 2004, Gazette Wetlands Management Act 2009, Social Forestry Rules Revised 2010. Besides these, the national Fifth Five Year plan, report on Conservation of Biodiversity (CBD), Ministry of environment and forest etc. are the most important institutions for the development of forestry sector in Bangladesh (Nishorgo).

## **5.2.5 Three historical ruling periods in the forestry sector in Bangladesh (Indian sub-continent)**

1757-1947	British Colonial period  Earning revenue for supplying raw material to the ship factory and to the industry
1947-1971	Pakistan period  Supply raw materials for the forest industries like paper mill and earning revenue
1971-present	Some forest degradation for population pressure and increasing demand for forest products. The whole system is under planned management with formal policies and laws (T.K. Nath et al. 2016).

The forestry sector in Bangladesh has diversified characteristics that play a great role in the economy of Bangladesh and to the livelihood of the local people. The first forest policy was implemented in 1994 although it was announced 100 years ago in 1894 in the Indian sub-continent under British constitution. At that period, the main purpose of the forestry sector was to develop the state revenues. Nowadays motive has been changed, community participation is the main purpose of recent forest policy. So the main focus is now on the people not in the forest. There are some policy constraints for the development of forest sector because of inadequate institutional capacity; law enforcement and legislative backup (Alam, 2009). As the natural resources in Bangladesh are not managed properly, there are some unwanted issues like over population, natural calamities and improper use of resources which are destroying and reducing the resources.

Mohammad (2013) mentioned in his article that most of the forest policies and laws originated from the British period. After the birth of Bangladesh, some amendments were made for the protection of the forest and forest resources in Bangladesh. The Bangladesh Environment Conservation Act 1995 and its rules 1997 and the Environment Court 2000 are the enactive institutional structures for the forest and environmental sector. Lack of enforcement, non-coordination and corruption are the main barriers for better implementation of the forest law and forest policy in Bangladesh.

Homestead forestry such as trees, plants, herbs and creepers are also playing an important role in the economy of Bangladesh. It also could form a part of forest policy. Although this type of forestry is organized and managed by rural people but it still is an important contribution to the overall development of the forest sector. It is very hard for the local people to cope with the commercial forest owners but still it has opportunity to grow and to control the rural economy if no social and political disorder happens. The author observed that people from various professions can do their job and continue with homestead forestry in parallel (Hossain, 1995).

The Sundarbans as a wetland has great impact on the coastal and territorial ecosystem because the wetland itself provides varieties of ecosystem services. High level of resource exploitation and pollution are the major threats to the wetland. In that case, individual policy framework is very essential for the wetlands management and the proper management of the Sundarbans as one of the Ramsar site in Bangladesh. The National water policy 1999 and the Coastal zone policy 2005 are playing an important role for the improvement of watershed degradation, reduction of biodiversity, wetland loss and socio-economic status of the coastal livelihoods (Ramesh et al. 2017).

## **5.3 Community engagement in the Sundarbans reserve forest**

### **5.3.1 Why community involvement?**

Community involvement is very important for the coastal resources in South Asia including Bangladesh. A large number of communities depend on the coastal resources like the Sundarbans.

Proper community involvement, stewardship and accountability of resources are essential due to the decline of resources because of threats and other causes which have significant impacts on community lives. Community involvement increases the yield of resources in one hand and on the other hand, it ensures the food securities through the income from tourism (Ramesh et al. 2017).

The engagement of local people acts as a central character in the management process of cultural and natural heritage site. Although the heritage scholars were habituated to protect and conservation of heritage site with limited involvement of local people but in the sustainable management process, they are still playing the major role. To fulfill the UN SDGs agenda as well as the Operational Guidelines for WH sites, the involvement of community people in heritage site management will definitely enhance the efficiency and effectiveness of the management process (Makuvaza, 2018).

“People inhabit and change environments using social, cultural and psycho-social behaviors and process and use their socio-cultural understanding of phenomena to interact with the environment.” So community plays a vital role to upgrade the environment by engaging themselves. Hence, community based resources management is very important for any kind of conservation activities” (Osireditse, 2016).

Human practices through the local community are natural characteristics of any sites. Although the local players are sometimes be measured as a threat to the conservation process, actually based on their knowledge, local communities should be seen as the true preservers of such a heritage site (MINaH, 2013).

Although the local community has some personal business or other farming activities, they are still involved with the forest products and activities. Nowadays, the forest resources are under control of elites and private organizations, but still the community people are the major part to protect the forest from reduction. Age, educational status, per capita income is also an important factor to involve community people in forest management. In SFM, local people can play two roles, either as manager or participant. If they act as manager, they need a deeper understanding of the activities and the importance of the resources they are managing. On the other hand, as participant they must have limited access without administrative difficulties (Monsi, 2014).

In the management of heritage, tourism plays a crucial role, whether the heritage is cultural or natural. In that case, local people should be the major beneficiaries as they are also most affected by it, but in most cases, they are not involved properly or lack awareness (Makuvaza, 2014). Although without proper management tourism can have negative impacts on a heritage site as to degrade the land patterns, increase pollution and generate social disorder, it can have a positive influence on local people by increasing employment opportunities. So involving local people in the management process also through tourism activities and raising consciousness about their benefits could increase the sustainability of any site.

### **5.3.2 Present scenario of the community people in the SRF in Bangladesh**

S. Roy (2013) observed in his study that after two big natural calamities (cyclones and oil spill accident), still the Sundarbans reserve forest is one of the most important sources of livelihood for the local people. In the study area, he observed that women and men are involved in the income-generating activities in parallel. In that sense, men are more aggressive because they are braver than women and women are also engaged with income-generating activities. The group of women in the SRF has some bindings because of the religious and patriarchal family system but still, they are earning money in a sustainable way. The author also observed that during post calamities periods, the inhabitants of the Sundarbans were also looking for some alternative way of livelihood by which the SRF getting escape from local community day by day. It will ensure further conservation of the forest. The local community is getting consciousness regarding the conservation of the forest through the elder person and the lessons are taught in primary school.

As part of balancing the environmental factors, the SRF also supports a lot of community people directly and indirectly for their livelihood and daily activities. In one hand, they are earning money from the forest products; on the other hand, they are using forest products and timber for repairing the house and as fuel for cooking purposes. Such a protected area like the SRF is a great source for the poverty reduction and livelihood improvement for the dependent community, although they still have some problems like administrative disarrangement, ignorance of the officials etc. (Islam, 2011).

About 1.4 million people are living in the 7 SIZ (Sundarbans Impacts Zone) region of SRF. These impacts zones are Assasuni, Batiaghata, Dacope, Kaliganj, Koira, Paikgacha, and Shymnagar, that covers three districts namely Khulna, Bagerhat and Satkhira. They are much dependent on the resources of the Sundarbans for their livelihood. Around 15000 Sundarbans dependent people have started seed and vegetable business with the support of SUNDARI projects, some of them cultivating rice and fish in the same land, some are rearing cattle. Most of them got alternative sources of income. As a result, between 2012 and 2015 longer stays in the Sundarbans for resources collection was reduced by 95 % (CWB, 2015).

## **6. Results and Discussion**

In this chapter, an overall outcome is presented with available primary and secondary information. Effects of climate change and possible threats of the SRF are also discussed here. An adequate number of progress and prospects regarding management is presented in this chapter to show the final progress of the SRF.

### **6.1.1 Management authority for the forest and environmental sector in Bangladesh**

Forest and environmental sector are the noticeable and vital sectors of development for the People's Republic of Bangladesh. These two sectors come together because environment and forest are closely related to each other. For the sustainable development and proper management of the forest resources and environmental sector, the ministry of environment and Forest (MOEF) is working along with 6 co-operative assistants such as Department of Environment (DOE), Forest Department (FD), Bangladesh Forest Industries Development Corporation (BFIDC), Bangladesh Forest Research Institute (BFRI), Bangladesh Climate Change Trust (BCCT), and Bangladesh National Herbarium (BNH) as well. The MOEF is responsible for the overall government policy regarding forest and environment. The technical environmental issues like regulations of the conservation acts and monitoring is maintained by the DOE. The ECA is also managed by the DOE. The individual functions of these institutions are discussed below:

The Forest Department is the main body of the government which deals with all of the state owned forests, their management including wildlife habitation, maintaining the social forestry program and implement scientifically sound, economically viable and ecologically sustainable forestry management program as well as implement the forestry policy through acts, rules and regulations. The DOF is organized with 8681 staffs including Chief Conservator of Forest (CCF) (FYP, 2015).

**Table 3:**Total forest areas in Bangladesh managed by Forest Division (Alam, 2008).

Forest type	Area (million hectare)	% of total land
Hill Forests	.67	4.65
Natural mangrove forests	.60	4.07
Mangrove plantations	.14	.97
Plain Land Sal forests	.12	.83
Total	1.53	10.54

The FD is also responsible for the management of Protected Areas (PA) and wildlife sanctuaries. Bangladesh owns 40 PAs and 12 Wildlife sanctuaries including three wildlife sanctuaries in SRF. Along with other government organizations and in co-operation with national and International NGOs, the GOB has taken various initiatives to protect the forest and environment of the Bangladesh. The 5<sup>th</sup> CBD report ensures the resources availability and actions against the threats to protect the environment. The report indentified the growing population as the major threat of the forest and environment to meet the extra demand. However, the wildlife conservation security act 2012 is an important action that focused on the endangered wildlife conservation which has a role for the conservation and management of wildlife in the Sundarbans (DOE, 2015).

The BFIDC is playing a vital role in agricultural and industrial forestry resources. In one hand, it is using forest products for domestic purposes like household equipment's, rubber production, processing, and commercialization. On the other hand, this sector is earning foreign currency through exporting forest products and generating economic activities in the rural areas. To assist the UNFCCC goals, BCCT is working to cope with the adverse effect of the climate change (DOE, 2015).

The BFRI is the only institution of the government which is conducting research in the forestry sector for further development and utilization of forest products. It is working for the conservation of the SRF and the coastal areas through research and innovation. Implementation of research in the forest ecosystem, wetlands ecosystem and agricultural ecosystem through botanical survey are the main functions of the BNH. The output of these researches can be used in the forest management (FYP, 2015).

### **6.1.2 Programs towards a sustainable forest management**

For the sustainable forest management process, the IRMP is the most remarkable initiative that has taken for the decade 2010-2020 by the Forest Department with the support of ministry of environment and forestry. In chapter Four, the 10 strategic programs for the sustainable Sundarbans have been briefly introduced. Special effort has given to the following areas of the strategic program below:

### **6.1.3 Tiger conservation program under the wildlife sanctuaries management program**

The Sundarbans and its WH core zones are the significant tiger habitats. Recently, it is estimated by the Forest Department that around 440 tigers are still available in the SRF (IRMP, 2010). For the proper management of the tiger habitation and to protect the remaining numbers of endangered Royal Bengal tiger, Forest Department has identified the following objectives such as, assess the present and desired state of predator (tiger) and prey (deer) occupancy, connectivity and population size, assess potential threats and minimize men-tiger conflict and control of poaching. To fulfill these objectives, FD field staff and CMCs are working jointly. Another important program for tiger conservation is mitigating climate change effects on tiger habitat that is working with the climate change mitigation and adaptation program. To reduce the forest degradation, the GOB in association with the IFMP has implemented harvesting prescription till to the 2020. Harvesting plan for different trees in the Sundarbans with according to the compartments location, identified annual allowable cut (AAC) formula for the different species of plants in the SRF where the formula is  $AAC = (\text{present standing mature volume} + \frac{1}{2} \text{ growth during the period}) / \text{Period of cutting cycle}$ .

### **6.1.4 Tourist management**

In the IRMP, sustainable management of the SRF eco-tourism development program has got the noticeable attention from the forest authority and the government of Bangladesh. Bangladesh National Tourism Policy 1992 and the Forest Policy 1994 recognized the eco-tourism as a forest management related activity. To improve the eco-tourism in the SRF and to manage the visitors from national and international arena, this sector has developed a lot.

The Sundarbans is not only a biodiversity based spot, it is also a UNESCO world heritage site. So the importance of the SRF to the visitors is increasing day by day. Currently, the information to be shared with the visitors and researchers is very important. For that reason at Dhaka, Khulna and Mongla city based information access have been established. Here, all information for a tour to the Sundarbans is available by telephone call, on the website, at the airport, and at the gateway of the Sundarbans (Khulna city) where lots of hotels and tourist guide are also available for the safe journey towards the forest (IRMP, 2010).

### **6.1.5 Involvement of stakeholders in the management process of the Sundarbans**

The Sundarbans ECA is surrounded by 10 km wide area in the northern and eastern boundaries of the main forest. However, the administrative body is limiting the access of local people in the ECA for the conservation and continuing the proper management process. A large number of local people are still depending on the water body of the Sundarbans wetlands for their livelihoods. They are using the services from the SRF and acting indirectly as management body with other stakeholders involved in the management process (IRMP, 2010).

**Table 4:** Different stakeholder of the Sundarbans ECA involved directly and indirectly in the management process ((IRMP, 2010, p45).

SL. No.	Stakeholder name	Description of the stakeholders	Type of stake	Level of stake
A. Primary stakeholder				
1	Occasional Fisher	Poor people: Mainly male; sometimes female and children	Fish and fisheries item	Moderate
2	PL collector	Poor people: Male, female, children	PL of Golda and Bagda	Major
3	Subsistence fisher	Poor people: Male & female	Fishes	Major
4	Fish culturist	Rich and influential people	Fish culture in closed canals	Moderate
B. Secondary stakeholders				
1	Small Mohajons (money lenders)	Local people, influential persons	Small funding, purchase product	Moderate
2	Gher Owners	Influential and powerful persons	Purchase shrimp PL, small investment to from PL collectors	Moderate
C. Other/Institutional				
1	Department of Environment	Govt. body	In charge of resource management	Major
2	Department of Fisheries	Govt. body	In charge of	Moderate

			fisheries management	
3	Upazila Administration	Govt. body	Management of Khasjalmohal and leasing	Moderate
4	Union Parishad	Local Govt.	Management of Khasjalmohal (small size) and leasing	Moderate
5	Forest Department	GOB Project	Biodiversity conservation, livelihood	Major

From above Table 4 we can see that except the institutional stakeholders, a large number of different people of the community is involved with SRF as stakeholder. Some of them are temporarily involved and some of them are permanently involved with the forest for their livelihood.

### 6.2.1 Policy implication

National five year plan is a deed where all sectors of development in Bangladesh gets the place for accelerating growth and development. Environmental sector also got an assessment on it. However, the five year plan (FYP) is implemented only for each five years and after the end of each FYP new one comes into existence. Recently, the period is 7<sup>th</sup> FYP. We will see the outcome of 5<sup>th</sup> and 6<sup>th</sup> FYP with the similarities and dissimilarities with the recent 7<sup>th</sup> FYP. In the 5<sup>th</sup> FYP, two sectors got importance regarding the environment management and development and it was Air quality management project and Bangladesh environment management project.

In the 6<sup>th</sup> FYP, government of Bangladesh emphasized on various environmental sectors especially on forestry sectors. During the 6<sup>th</sup> FYP, Bangladesh owned total of 17.49 % forest of total land coverage. Previously out of 64 districts, 28 districts had no public forest but after the implementation of 6<sup>th</sup> FYP, all districts came under forest coverage through social forestry program. Bangladesh forest research institute (BFRI) and Bangladesh forest industry development corporation are also conducting research in conservation of forest resources with the assistance of the DOE of the Government of Bangladesh (MOP, 2011).

**Table 5:** A short achievement of the 6<sup>th</sup> FYP strategies in the environmental sector related to forestry sector (7<sup>th</sup> FYP, 2015).

Sub sector	Strategies
Environment	Environment committees at Division, District and Upazila levels have been activated.
	Existing environment laws and regulations have been amended to address new issues.
	The manpower of DoE has been increased to 735 because of increasing of the activities.
	To conserve biodiversity in the Ecological Critical Area (ECAs), community-based Adaptation approach has been implemented.
Climate change	A pro-poor Climate Change Management Strategy has been adopted which prioritizes adaptation and disaster risk reduction and also addresses low carbon development, mitigation, technology transfer and mobilization and international provision of adequate finance.

## **6.2.2 7<sup>th</sup> Five Year Plan (FYP) (2016-2020): A wide range of activities in the forest and environmental sector**

The 6<sup>th</sup> FYP targeted to achieve 20 percent of forest coverage but has not been fulfilled. At the beginning of implementation of 7<sup>th</sup> FYP, forest coverage was reduced from 17.49 % to 13.14 %. So the major improvements are committed to be done in the period of 7<sup>th</sup> FYP. For the conservation of the SRF possible intervention has already been taken. To protect the Royal Bengal tiger, a tiger action plan has been taken into consideration and realization for the period of 2009-2017. Under the 7<sup>th</sup> FYP following activities has been taken into account to improve the forest resources and conservation of forest lands are as follow; promote participatory, community-based environmental resource management and environmental protection (considering the access for the poor, equity, as well as gender issues) along with community based adaptation.

To achieve tree cover over 20 % of the land surface (with tree density > 70%) and ecologically healthy native forests are restored and protected in all public forest lands (about 16% of land).

- Ensure greater contribution of the forestry sector in the economic development.
- Strengthen forestry extension activities to transfer improved technology and research information to end-users, e.g., local people and private homesteads.
- Expand forest resources; make the forests adequately productive.
- Conserve the Sundarbans mangrove forest without any further deforestation and forest degradation.
- Develop institutional capabilities including human resource and involve local people as much as possible in forestry activities.

- Develop capacity of national government and regional/local offices to map and analyze land use through data-driven approaches/GIS.
- Further promote the people oriented programs covering forestry on marginal lands, char lands, road sides, etc.
- Ensure no forest land shall be converted for non-forest use.
- Ensure no commercial plantation in protected forest area where only native species for enrichment and restoration purposes can be undertaken.
- Ensure all PA management shall be inclusive of and respectful to the rights of the forest dwellers.
- Consider out-sourcing forest protection measures, utilizing community members on the ground as forest stewards.

### **6.2.3 Special efforts for the protection of the Sundarbans and coastal forestation**

The following activities will be emphasized for the development of the Sundarbans and coastal area:

- Greater efforts shall be taken by the government for sustainable conservation of the Sundarbans and its resources during the plan period.
- Measures will be taken to involve local community with allocating appropriate property rights in the management of the Sundarbans
- Creation of alternative livelihood opportunities for the people, depending on the Sundarbans mangrove forest, to lessen anthropogenic pressure on the Sundarbans mangrove forest.

- Rivers and canals will not be used for transporting goods and materials and other business purposes.
- Special attention will be given to the Sundarbans Reserve Forest (SRF) for its biodiversity conservation. All sorts of protective measures will be taken to keep the Sundarbans bio-physical characteristics intact (FYP, 2015).

#### **6.2.4 International conventions mentoring the forest management in Bangladesh**

In addition to the existing forest laws and regulations, forest acts, amendments and national FYP which were described in chapter five, Bangladesh achieved some international standards in the forest related sector and forest management including cultural and natural heritage resources management. The FD and the Ministry of Environment and Forestry are obeying to follow the rules and regulations of these conventions which are very professional in the forest management practices in Bangladesh. These conventions are described as below:

##### **i.) Convention concerning the protection of the world cultural and natural heritage 1972**

The state party Bangladesh signed the convention on 3<sup>rd</sup> November 1983. By signing this convention Bangladesh is responsible to protect the world heritage site including all other heritage inside the territory and obey to follow the 5Cs of WHS (UNESCO, 2005), according to the valid and updated Operational Guidelines for the Implementation of the WH Convention (last update 2017).

## **ii.) UN convention on climate change and biological diversity 1992**

According to the convention, state parties are aware that biological diversity is common for all humankind. Each contracting parties should develop appropriate measures, goals and programs for the conservation of the biological diversity. The state party Bangladesh signed the convention on June 1992 (UN, 1992).

## **iii.) Plant protection agreements for the Asia and specific regions**

Bangladesh signed the agreement on September, 1978. The agreement ensures that any member country needs legal permission to move any plant within the region, import and export plants from outside of the regions (FAO).

## **iv.) The UN 2030 Agenda**

It is known that after successful completion of MDGs 2015, the UN has implemented SDGs 2030 to ensure sustainable development throughout the globe. As a member state of the UN, The Government has integrated the SDGs into its 7th FYP (2016-2020), which reflects its core sustainable development goals. To fulfill the SDGs goal number 13 regarding the environment, where the goal is “Urgent Action to Combat Climate Change and Its Impacts”, the GOB has taken following targets: Environmental, Climate Change, and disaster risk reduction considerations are integrated into project design, budgetary allocations and implementation process, and 500 meters wide green belt to be established and protected along the coast (FYP, 2015).

From the above discussion, it is easily observed that the government of Bangladesh with its supporting ministry and department are working significantly in the development of environmental sector especially for the development of Sundarbans mangrove forest. Various functional areas of MOEF, organized legal institutions and existent laws also proved that the overall management activities regarding the SRF are functioning in a good order. However, if we concentrate on last few year's progress related to the mangrove forest, it will be much cleared.

**Table 6:** Forest products and revenue (in US Dollar) collected during the year 2001-02 and 2014-15 from the Sundarbans, Bangladesh (DOF, 2015).

Types of ecosystem services		2001-2002		2014-2015	
Provisioning	Produces (unit)	Amount	Revenue	Amount	Revenue
	Excoecaria agallocha-ft <sup>3</sup>	84630	33187	6026	3894
	Ceriopsdecandra(no)	15865(MT)	47742	118451 (no)	7520
	Thatching material nypafruticans (MT)	17525	33123	16868	57338
	Thatching material grass (MT)	3621	790	668	225
	Phoenix paludosa	543(MT)	348	19761 (no)	1044
	Fuel wood ft <sup>3</sup>	69370	47523	14455	10190
	Honey (MT)	84	7970	67	24048
	Wax (MT)	23	1665	63	8108
	Fish (MT)	2061	58374	3432	158368
	Crab (MT)	123	2148	1123	52026
	Dry fish(MT)	1095	18998	2773	179761
Cultural	Tourist (no)	59169	14588	100817	144832

From above Table 6 we can see that from the last few years including the IRMP projects some sectors developed much better compared to others. Tourism, fisheries, honey and wax sector improved much better in the IRMP duration compared to past management strategies. It also proves the effectiveness of recent management capacity. As tourism is a very important sector, many of national and international tourists are interested to visit the Sundarbans, authority should interfere interestedly in this sector. The ecosystem services from the Sundarbans mangrove forest also implies the proper management activities, where it is very clear that the product of the Sundarbans are distributing all over the world after meeting the domestic needs.

**Table 7:** Ecosystem services from the Sundarbans and their usage (Islam and Hossain, 2017, p.312).

<b>Extracted resources</b>	<b>Usage pattern</b>	<b>Harvesting season/peak season</b>	<b>Countries involved in utilization</b>
Fish( <i>Tenualosailisha</i> , <i>Pangasiuspangasius</i> , <i>Plotosuscanius</i> )	Fresh and dried food	All the year round	Bangladesh , Middle East , India
Crab( <i>Scylla serrata</i> )	Live food	All the year round	South East Asia
Shrimp( adult and fingerlings)	Frozen food, input in aquaculture pond for rearing	All the year round	Bangladesh
Timber	Pole, furniture, housing	December to march	Bangladesh
Other non-wood products	Nipa palm for thatching, malia grass for thatching and matting, reed for fencing, keora fruits as food and culinary,	Mid November to Mid-March	Bangladesh

	Nipa nectar as drink		
Honey, wax	Honey as food, medicine, wax for commercial uses	March to June	Bangladesh
Mollusca (oyster, gastropods)	Food and lime	All the year round	Bangladesh
Aesthetic	Tourism	All the year round with peak season in winter	Bangladesh , EU , Japan and USA

### 6.3 Community engagement in the Sundarbans terrain

As we came to know already that the Sundarbans has not only provided the ecological services, it has large contribution to the local community development too. Approximately, 2.5 million people live in small villages surrounding the Sundarbans. They depend on the Sundarbans directly and indirectly in a certain season of harvesting and sometimes the whole year as well. During the harvesting period around 300000 peoples get their income through working as wood cutters, fishermen and gatherers of honey and Golpata leaves (IUCN, 1997)

**Table 8:**The community dependency in the Sundarbans for their livelihoods(Islam, 2011).

Name of occupation	% of occupation	Annual income in euro	Annual net income
Fishermen	67.74	1402.20	587.65
Crab catcher	14.19	1455.84	567.17
Honey collector	9.03	653.88	333.93
Nypapalm collector	9.03	1795.08	701.43

From above Table 8 we can see that the real situation of the Sundarbans dependent people and their income status. As we already know the various categories of community who are directly and indirectly depends on the Sundarbans. However, these four categories are most dependent on the forest as fishermen, crab catcher, honey collector and Nypa palm collectors.

Maximum numbers of dependent people are Fishermen (67.74 %), their annual net income from the Sundarbans is 587.65 Euros, where crab collector, honey collector and Nypa palm collector also earn respectively 567.17, 333.93 and 701.43 Euros per year. However, from Table 9 below we can see, there are some other temporary income generating fields related to the Sundarbans as: Collector, Majhi, Chotomohajon, Boromohajon, Aratdar, Wholesaler and Retailer. So the SRF provides a vast area of profession for the local community.

**Table 9:** Annual income level of SRF Actors: All products (IRMP, 2010, p 177).

<b>Actors</b>	<b>Annual income( SRF product)</b>	<b>%</b>
Collector	53632	4.90
Majhi/Bepari	98936	9.05
Choto Mahajan	100361	9.18
Boro Mahajan	261664	23.92
Aratdar	349197	31.93
Wholesaler	158195	14.46
Retailer	71813	6.57
Total	1093799	100

## **6.4 Impacts of climate change in the SRF and its possible measures**

Rise of temperature, Sea Level Rising (SLR) and Ocean Acidification (OA) are the three major outcomes of the changing climate that has influences on the environment of wetlands and the biodiversity of the SRF. It is well known that the most important feature of the SRF is salt tolerant trees and plants like Sundari, Gewa, Goran, Golpate, Keora etc. SLR is the most harmful threats to all of these unique varieties of trees. SLR is damaging the habitation of plant growing patterns and finally, affecting the biodiversity. Some measures that may help to reduce the impact of climate change are as follow:

Reforestation: it is a mitigation program that helps to reduce the CO<sub>2</sub> from the atmosphere. It also helps to reduce the effects of disaster and improves diversity, ecotourism and livelihood. The 3F (Forestry, Food and Fish) model works as adaptation and mitigation program. The 3F model will also be very helpful to reduce the vulnerability in the coastal zone of Bangladesh like in the Sundarbans. Mangrove cultivation in the homestead will protect the household from the cyclone and other natural calamities, vegetable production in the backward and fish production in the pond will meet up the demand of the community people (Kibria et al. 2013).

## **6.5 Threats to the mangrove forest**

The Sundarbans as a WH site has the OUV for its resources and contribution to environment in keeping ecological balance, supplying oxygen to the living organism etc. Overexploitation of resources, natural calamities and human induced threats are reducing the value of the world largest mangrove forest. Two major cyclones destroyed a lot of resources in the SRF.

## 6.5.1 Cyclone Sidr

Cyclone Sidr was the biggest natural disaster that affected the Sundarbans dangerously. It was occurred in the year 2007. Around 3000 people died and thousands of families were affected. Severe loss of physical infrastructure of the Sundarbans happened during the Cyclone Sidr. From Table 10 below, it will be cleared to us.

**Table 10:** Physical and infrastructural damages of the Sundarbans due to Cyclone Sidr in 2007 (IRMP, 2010, p29).

Sl. No.	Physical damage	Amount (lakh taka)
1	Heavily damaged forest 30,000ha	100000
2	Partially damaged forest 80000 ha	
	<b>Sub total</b>	100000
	<b>Infrastructure (completely damaged)</b>	
1	Office and residents- 126 nos.	900
2	Water vessels- 50 nos.	198.84
3	Jetty and poltoon- 59 nos.	146.32
4	Wireless tower, RT sets and base set- 32 nos.	166.60
	<b>Subtotal</b>	1411.76
	<b>Infrastructure (partially damaged)</b>	
1	Office and residents- 93 nos.	127.03
2	Water vessels- 9 nos.	60.87
3	Jetty and poltoon- 12 nos.	6.76
4	Others	393.58
	<b>Sub total</b>	588.24
	<b>Grand total</b>	102,000

From above Table 10 we can see a total of 30000 hectares of forest land are heavily damaged and several numbers of infrastructures and offices are also damaged because of the cyclone Sidr.

### **6.5.2 Cyclone Aila**

Cyclone Aila occurred in 2009 in the Western part of the forest, as a result 200 people died, thousands were affected, saline water damaged the crop fields especially the shrimp field (DOF, 2010). Shrimp cultivation in the Sundarbans waterbed, poaching, illegal wood cutting, excessive uses of fertilizer in the crop field especially for agricultural dependency on the Sundarbans are responsible for the degradation of the mangrove forest. Poisoning in the shrimp field and throwing wastages like cane, bottles, and plastic material by the tourist are also damaging the aesthetic value of the Sundarbans and its surrounding environment. Poaching is a major threat to the Sundarbans. A report has been done by Forest Department that the people living around the Sundarbans are very fond of deer meet. They killed the deer for meet purpose very often. Since 2010 to 2015 around 8 tigers are killed in the Sundarbans through poaching (FD, 2015).

### **6.5.3 Oil spill**

Another devastating man-made threat to the Sundarbans was oil tanker accident. It was happened in the year 2014. As the Sundarbans delta formed by three big rivers namely The Ganges, Brahmaputra and Yamuna, the route is still using as main channel of communication for various vehicles. A ship was carrying 357,664 liters of fuel oil that sank in the Shila River.

Oil extended over the whole water bodies and deposited into the soil, trees and in the forest resources. It covered 14 villages of the Sundarbans, destroyed the ecological balance and transmitted diseases through community with symptoms like itching, vomiting, eye burning, headache and breathing problem (Sunny, 2017).

## **6.6 Rampal power plant: A remarkable man-made threat to a world heritage site**

The Rampal power plant is a proposed coal-based power plant. It has been implemented by the Government of India and the Government of Bangladesh. The full name of the project is Bangladesh-India Friendship Power Company limited. It is located in the Rampal Upazila of Bagerhat district. The project area demands 1834 acres of agricultural lands where most of the lands are used for rice and fish production (Chowdhury AH, 2017).

The power plant is located 4 km away from the buffer zone of the Sundarbans and 115 km from the sea (see detail about the project in the chapter 4). Environmental damages are possible from the power plant. EIA report said around 150 families has to be transferred and lot of livelihood assets will be damaged. Various environmental pollutions like air, water and sound pollution will be occurred. Clearing of forest for the transportation of fuel, disposal of waste and leaked oil from the coal-based plant will destroy the ecological balance of the surrounding areas which is very harmful for the world largest mangrove forest and its wildlife sanctuaries, although the GOB is proposed to compensate BDT. 625000000, it is still nothing to compare with the biodiversity losses and with the OUV of a world heritage site (SAHR, 2015).

## 7. Conclusion and Recommendation

A heritage management practice includes several stages of consistency where the government, administration and the local community should have similar access to it. Rapid urbanization is making heritage sites very special in academia (Ngoro et al. 2018), which are pushing the local management strategies away from its line. In various regions, the traditional management system shared the ownership of a site by various communities with a balanced relationship between natural and cultural environment. Globalization could be one of the reasons for downshifting of concept about managing a heritage site. Therefore, without considering the involvement of local people and their knowledge, proper management will never be possible because the heritage site was and is always located near a local community.

However, after a critical observation of primary and secondary information, it has been observed that there are some research gaps in the study area and in the overall organization and process of management of the SRF as follows;

- As mentioned in chapter 4, there is a co-management committee who is going to take a 50 % share of total forest income, but still the committee is inactive.
- Due to shortage of time it was not possible to research properly the activities of the Sundarbans west forest division (as part of dual management), although it is also a part of the whole management activity.
- There should be a boundary surrounding the wildlife sanctuary and in the buffer zone to protect the forest from illegal activities but still there are no initiatives regarding that point. The rivers and canals are working as natural boundaries as mentioned in chapter 4, but that is not enough concerning the proper conservation of the environment. An appreciable solution was found in the Indian part (border between man and biosphere).

- According to the forest officer of the Sundarbans east forest division, sometimes the activities of administration are hampered by the dual management, but there are no specific reasons or symptoms of the problems regarding the dual management.
- The location of the entrance of the Sundarbans is in remote area, so the community people are not getting any direct benefit from the tourism and other activities. Most of the beneficiaries belong to the Mongla port region. The administration and government authority have not taken any initiatives for the benefit of the local people yet.
- From the secondary sources of information it is easily visible that there exists a whole set of laws and regulations regarding the environment and the forest sector in Bangladesh, but it is really matter of sadness that there are no forest laws specifically for the development of the SRF.

The Sundarbans, the world's largest mangrove forest is located in the south-western region of Bangladesh (and in the neighboring part of India). Saline water mixes with brackish water and develops a suitable environment for mangrove trees. Another important feature of the mangrove forest is tidal effects. Development of forest in the bay of the ocean is called mangrove forest. The bio-diversity of the mangrove forest depends on the salinity of the water. The more salinity induces less growth and height of trees. Salinity increases from east to west, so the height and diversity of trees in the Sundarbans east division are better than the Sundarbans west forest division. Due to salinity, forest quality in the Bangladeshi part of the Sundarbans is better than the forest quality in the Indian part. In maintaining ecological balance, providing livelihood support to the localized people and habitation of wildlife including birds, the Sundarbans mangrove forest is playing a fundamental role.

From the latest report of the state party (see in chapter 4), we can see that the state party is always responding properly to WHC for maintaining a balance in the ongoing ecological process in the Sundarbans. An adequate management and conservation plan is very important for the sustainable development of the Sundarbans mangrove forest but not implemented yet. Immediate feedback from WHC is necessary for the latest correction of the Reactive Monitoring Mission Report (that has been done by the state party Bangladesh).

## **7.1 Policy recommendation**

Although the overall progress in the management of the SRF is considerable, however, further steps and adequate policy and regulation could make the Sundarbans mangrove forest more sustainable. In this case, the government, the private sector, NGOs, and other stakeholders involved in the forest can play an appropriate role. As an environmental science student, I would like to propose the GOB a few recommendations:

- Sundarbans East and Sundarbans West forest division should work together to fulfill the goal of conservation of the mangrove forest.
- Forest Department should develop and implement an adequate management plan and take immediate steps to speed up the active participation of the co-management committee.
- Respective authority should make a fence boundary between the forest and community habitats to protect the forest against illegal activities.
- Forest Department and the ministry of environment and forestry should divide the function of the each forest division, so that the dual management does not get any difficulties in the management process in future.
- Administrative body and the government of Bangladesh should take necessary initiative to identify the actual community and should ensure the benefit from the world's largest

mangrove forest, and community people should be involved directly in the management and conservation process.

- Forest Department, the government and respective body should make and implement some special rules and regulations for the SRF and for the heritage conservation.
- The MOEF is working with 6 sisters concerns but there is no mutual assessment among them, so the government should make some seminar and symposium annually or half-yearly to evaluate the progress of each sector.
- From the result and discussion chapter (Chapter 6) we can see that tourism plays an important role in Bangladesh's economy. The government should implement some new projects for further development of the tourism sector. Here, we can follow the strategy of tourism development in African heritage and its developing management activities both in the natural and cultural heritage resources to diversify both stakeholders and conservation strategies for tourism development (Osireditse, 2016).
- As a world heritage site, the Sundarbans provides several utilities to the livelihood for the faster growing population in Bangladesh. Adequate management of this resource is an evolving issue. Employment opportunities for the local community, legal aspects, tourism, museum or information center, fundraising, and health and safety issues in natural heritage management are crucial headline to be considered.
- Forest officer should advocate well enough to the local community and should provide training so that they can also take part in the conservation process.
- Government should provide micro-credit facility for the poor local people so that they can purchase fishing gears and other instruments for proficient harvesting in the forest in a legal way during harvesting season.

- Government should introduce mandatory education related to the heritage study and nature conservation in school level.
- National and international NGOs and private organizations should take part in the conservation process of the SRF for Bangladesh's present and future environmental safety.
- Government should introduce alternative livelihood activities for the local community to reduce the dependency of local people on the SRF. Here, the GOB can follow the steps from the Indian part of the Sundarbans (see detail in chapter 4).

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## **Annex 1. Questionnaire**

### **THE SUNDARBANS IN BANGLADESH ASPECTS OF SUSTAINABLE MANAGEMENT AND COMMUNITY INVOLVEMENT AT A WORLD HERITAGE SITE**

#### **Questionnaire for the Field Interview:**

##### **1. Interview with the Forest Administration**

- What are the management activities to protect the Sundarbans from environmental damages?
- What are the organizational frameworks for the Sundarbans?
- Is there any natural boundary to protect the Sundarbans?
- What is dual Management?
- Impacts of Rampal power station on the Sundarbans?

##### **2. Interview with the Local Community**

- What are the income generating activities of local people depending on the Sundarbans?
- What are the threats to the livelihood because of the Sundarbans?
- Are there any restrictions to enter into the forest?
- What are the advantages from ecotourism?
- What are the disadvantages from ecotourism?

### 3. Interview with the University Expert

- What are the management techniques to manage such a world largest mangrove forest?
- What are the impacts of climate change on the Sundarbans ecosystem?

### 4. Interview with the Environmental Legal Expert

- What are the sources of environmental laws in Bangladesh?
- How does it work for forestry sector especially in the Sundarban?