M.Sc. Programme

“Management of Protected Areas”

**Biodiversity and livelihoods: A case study in Sundarbans Reserve Forest, World Heritage and Ramsar Site (Bangladesh)**

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Klagenfurt, 29 May 2011

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DECLARATION OF HONOURD

I herewith declare that I am the sole author of the current master thesis according to art. 51 par. 2 no. 8 and art. 51 par. 2 no. 13 Universitätsgesetz 2002 (Austrian University Law) and that I have conducted all works connected with the master thesis on my own. Furthermore, I declare that I only used those resources that are referenced in the work. All formulations and concepts taken from printed, verbal or online sources – be they word-for-word quotations or corresponding in their meaning – are quoted according to the rules of good scientific conduct and are indicated by footnotes, in the text or other forms of detailed references.

Support during the work including significant supervision is indicated accordingly.

The master thesis has not been presented to any other examination authority. The work has been submitted in printed and electronic form. I herewith confirm that the electronic form is completely congruent with the printed version.

I am aware of legal consequences of a false declaration of honour.

Klagenfurt, 29 May 2011

Signature:
DEDICATION

This work is dedicated to my best teacher Prof. Dr. Michael Getzner. I am very grateful to him for his support and encouragement of MPA study programme and promoting my mission and commitment on working for biodiversity conservation and sustainable development.
ACKNOWLEDGEMENT

I would like to express my appreciation to all the people whose effort and input made it possible for this research to carry on to completion. First, my sincere gratitude goes to my supervisor Prof. Dr. Michael Getzner for his valuable advice, guidance and encouragement during the entire process of this research. My Special thanks go to Dr. Hasan Mahmud, Honorable State Minister, Ministry of Environment and Forest, Government of the Republic of Bangladesh for his cooperation and support of my research work. I wish to express my heartfelt thanks Mr. Michael Jungmeier who organize an excellent series of research sessions and delivered thesis lecture on our MPA programme that was really helpful for preparing of my research. I am grateful to Dr. Shaheed Hossain for his inspiration of my MPA study programme. I am grateful to the local journalist Mr. Md. Reafhad Ali and Mr. Md. Kharul Alam, forester, sundarbans west division for their support and guide in my research study area. I express my deep gratitude to the community’s people of the study area for their heartiest cooperation throughout the study period. Specially, I would like to give my cordial thanks to my beloved parents and brother for their continuous support and inspiration through out the study period.
Abstract

The Sundarbans Reserved Forest and its surrounding buffer zone are one of the most diverse and richest natural resource areas in the People’s Republic of Bangladesh. It holds one of the largest continuous mangrove forests in the world and has been recognized as an international important World Heritage and Ramsar site. It is considered a highly productive ecosystem that provides a wide range of valuable forest product. Sundarbans play a significant role for supporting wide range of floral and faunal biodiversity and ecosystem services that support livelihoods of local communities. Most of the communities in buffer zone of Sundarbans are depends on Sundarbans resources for their livelihoods. This study explores different resources users of sundarbans forest dependents livelihoods and compares their living standard. This research finds the big difference between the annual selling income (1481,70 Euro) and net income (602,14 Euro) from harvesting products of forest dependents. The research explore that the resources harvesters are not able to get actual benefit from the sundarbans resources for the factors of Water Hijackers, Forest staffs illegal money collection and that led the lower income of forest dependents. For low income they borrow loan for their annual harvesting operating cost. Forest dependents also lose significant amount of money from their selling income for paying loan interest (loan provider takes average 8.29% interest from harvesting selling income). Research finds that the users are highly depends on sundarbans for their livelihood, each household total income about 89.76% come from forest resources and their average harvesting resources consumption values 101,86 Euro. All households are depends on sundarbans fuel wood for their fuel consumption. The paper shows if the forest dependents be free from the factors of water hijacker, forest staff and loan interest their income well be increased 60.25% from present net annual income. The paper recommendations for actual benefit of user form sundarbans resources harvesting and recover from vulnerable livelihoods and suggests on essentially of good governance, strong low enforcement and effective management system for improving livelihood of sunderbans dependents.
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1 CHAPTER I – INTRODUCTION

1.1 Preface

Protected areas are a cornerstone of conservation policies and provide multiple benefits for humankind (Balmford & Whitten 2003, Mulongoy & Gidda 2008, Kettunen et al. 2009, Dudley et al. 2010). Well managed protected areas tend to be particularly important in terms of providing vital ecosystem services, such as water purification and retention, erosion control and reduced flooding and unnatural wild fires. They buffer human communities against different environmental risks and support food and health security by maintaining crop diversity and species with economic and/or subsistence value (Dudley & Stolton 2003, Stolton et al. 2006, Stolton et al. 2008). Many rural communities depend on protected areas for subsistence and livelihoods, protected areas contribute directly to global sustainable development and poverty reduction targets (Dudley et al. 2010, Mulongoy & Gidda 2008). As for protected areas, it has been estimated that worldwide nearly 1.1 billion people – one sixth of the world’s population – depend on protected areas for a significant percentage of their livelihoods (UN Millennium Project 2005). Ecosystems within protected areas provide benefits of various natures at all levels: locally, nationally and globally. Bangladesh is a developing country and most of the people livelihood depends on natural resources. Bangladesh is very high flood affected and one of the most vulnerable countries to climate change in the world. Natural Resources dependents people are facing difficulties for unsustainable management, unequal distribution of resources, corruption, natural calamities that makes vulnerable livelihoods.

Sundarbans is the world largest mangrove forest and international recognized protected areas. Most of the people in the sundarbas buffer zone livelihoods dependent on sundarbans. Sundarbans plays a significant role for local, regional and national economy as well as biodiversity conservation. Sundarbans provide verities and abounded resources specially fisheries resources and various non-timber forest products. Fishes resources of sundarbans export around the globe. Sundarbans resources harvesters are playing a vital role for national economy of Bangladesh. Biodiversity and livelihoods study in sundarbans Protected area is very important for measuring the role of protected area for sustainable livelihoods and develop innovative idea that useful for protected areas management.
1.2 Objectives of the study

**General Objective**

The general objective of this study is to assess forest resources dependent people livelihood in buffer zone of Sundarbans reserve forest.

**Specific Objectives**

- To assess community dependency on Sundarbans natural resources
- To assess socioeconomic status of Sundarbans resources dependents community
- To find factors that affect the income of sundarbans forest dependents
- To identify Problems of sundarbans forest dependents people livelihoods
- To determine value of sundarbans resources for livelihoods
- To recommend for mitigating problems and livelihoods improvement

1.3 Limitation of the study

- The study period was short due to fund and time constraints.
- Difficult to move around sundarbans buffer zone due to destroyed road network by cyclone affected (2009)
2 CHAPTER II - LITERATURE REVIEW

2.1 Biodiversity of Bangladesh
Bangladesh, the world largest deltaic region lies in the northeastern part of South Asia between 22° 34' and 26° 34' North latitude and 88° 1' and 92° 41' East longitude (Hossain, 2001). The majority of country’s land is formed by river alluvium from the Ganges and the Brahmaputra and their tributaries which, consists mostly of flood plains (80%) with some hilly areas (12%), with a sub-tropical monsoon climate (Islam, 2003). Geographically, Bangladesh falls near the Indo-Burma region which is one of the ten global prime spot areas and supposed to have 7000 endemic plant species (Mittermeier et. al. 1998). Due to its unique geo-physical location Bangladesh is exceptionally characterized by a rich biological diversity (Nishat et. al. 2002; Hossain, 2001; Barua et. al. 2001; Chowdhury, 2001). An estimated 5,700 species of angiosperms alone, including 68 woody legumes, 130 fiber yielding plants, 500 medicinal plants, 29 orchids, three species of gymnosperms and 1700 pteridophytes. (Firoz et. al. 2004; Khan, 1977; Troup, 1975). Again, in Bangladesh, some 2,260 species alone have been reported from the hilly regions of the country (i.e., Chittagong and CHT), which falls between two major floristic regions of Asia. Subsequently, Bangladesh possesses a rich faunal diversity. The country has approximately 113 species of mammals, more than 628 species of birds (both passerine and non passerine), 126 species of reptiles, 22 species of amphibians, 708 species of marine and freshwater fish, 2,493 species of insects, 19 species of mites, 164 species of algae (or seaweed) and 4 species of echinoderms (IUCN, 2000; Islam et. al. 2003).

2.2 Deforestation and diminishing global biodiversity
According to the World Resources Institute (WRI), the world has lost about half of its forest cover from 62 million km2 to 33 million km2 (Sundrlin et. al. 2005; Kaimowitz and Angelson, 1998). The magnitude of global biodiversity situation is undoubtedly threatened million times higher than any time of its history. Over 15 million ha of natural forest are lost in the tropic every year which is more than the area of Nepal or Arkansas
in the United States (FAO, 2006), again the present rate of species extinction is estimated to be between 1000 and 10,000 times the historical (pre 10,000 years BP) rate (Wilson, 1988). According to ‘2004 IUCN Red List’ currently 15,589 species are threatened with extinction; 12% of world’s known birds, 23% of mammals, and 32% of amphibians are also threatened (Baillie et al. 2004). Most recent form of deforestation takes place in developing countries, particularly in tropical areas. Deforestation and forest degradation directly threatens the life and living of 400 million people out of which 50 million are forest indigenous people- who depend on forests for subsistence. The underlying causes of forest decline are diverse and include a variety of reasons (Figure 2.1).

*Figure 2.1: The underlying causes of deforestation*

Source: Center for International Forestry Research, 2000
Interestingly, most of the world’s biodiversity have been held by majority of the economically poorest countries (Koziell, 2001; Blockhus et. al. 1992) where the people depend most immediately upon local ecosystems for their livelihoods are somehow responsible for the degradation of biodiversity and will mostly affected by the consequence of this biodiversity loss (CBD, 2006 and 2007). Biodiversity conservation is however essential to improve and alter this crisis. Biodiversity conservation through environmental sustainability (Goal 7) is one of the prime objectives of Millennium Development Goals (Box 2.1) which strongly linked with its first objective, i.e., eradication of poverty and hunger. To date, various international treaties and conventions with intergovernmental bodies have been formed to work on biodiversity issues in national, regional and international level.

**Box 2.1: Millennium Development Goals**

| GOAL 1: Eradicate extreme poverty and hunger |
| GOAL 2: Achieve universal primary education |
| GOAL 3: Promote gender equality and empower women |
| GOAL 4: Reduce child mortality |
| GOAL 5: Improve maternal health |
| GOAL 6: Combat HIV/AIDS, malaria and other diseases |
| GOAL 7: Ensure environmental sustainability |
| GOAL 8: Develop a Global Partnership for Development |

*Source: IPGRI (2006)*
2.3 Biodiversity Related Conventions signatory of Bangladesh

Bangladesh is a signatory to some international conventions (Islam 1996), which have bearing on Protected Areas. These conventions are:

2.3.1 Convention on International Trade

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The purpose of CITES is to protect certain endangered species from over-exploitation by means of a system of import and export control.

2.3.2 World Cultural and Natural Heritage

Convention Concerning the Protection of the World Cultural and Natural Heritage. The purpose is to establish an effective system of collective protection of the cultural and natural heritage of outstanding universal value, organized on a permanent basis and in accordance with modern scientific methods.

2.3.3 International Plant Protection Convention

The objective is to maintain and increase international cooperation in controlling pests and diseases of plants and plant products, and in preventing their introduction and spread across national boundaries.

2.3.4 Ramsar Convention

Convention on Wetlands of International Importance especially as Water fowl Habitat (Ramsar Convention) to stem the progressive encroachment on and loss of wetlands now and in the future, recognizing the fundamental ecological functions of wetlands and their economic, cultural, scientific and recreational value.
2.3.5 Convention on Biological Diversity
Convention on Biological Diversity (CBD) to conserve biological diversity, promote the sustainable use of its components, and encourage equitable sharing of the benefits arising out of the utilization of genetic resources.

2.4 Biodiversity and Livelihoods in Bangladesh
Ecosystem services form the basis of human survival. They help to meet the livelihood needs of the farmers, fisher folk, forest dwellers, craft persons and others. So, ecological security and livelihood security in Bangladesh are critically dependent on biodiversity and its components.

Biodiversity in Bangladesh contributes significantly to the country’s economy. The people of Bangladesh depend on biodiversity for their day-to-day sustenance as well as overall livelihood security. For example, over 60 million people are dependent on aquatic resources everyday. One million people are full-time fisher folk and another 11 million have taken to part-time fishing in the country. Fifty to sixty-five per cent of the country’s protein requirement is met by the consumption of fish. The fisheries sector contributes about 3.3% of the GDP of Bangladesh, earning more than 11% or more of the total export revenue, and employs 5% of the country’s total work force (Parveen and Faisal 2001). The agriculture sector provides 63.5% of the country’s employment, contributing a considerable 24% to the GDP. Of the sector’s contribution to the GDP, approximately 7.1% is covered by the forestry. The various forestry-related projects in the country together generate 90 million person-days of job opportunities every year. The Sundarbans provides livelihood and employment to an estimated 112,000 people (Khan 2001).

With more than 130 million people, a population growth rate of 1.48%, and a population density of 834 people per square kilometre, the pressure on the nation’s natural resources is tremendous. Box 2.2 provides more information on the future trends of Bangladesh’s populations and the natural resources on which it depends.
Box 2.2: The Future scenario

**The Future Scenario**

In the year 2020, the estimated population of Bangladesh will be 170 million and population density, 1118 per sq km. Seventy per cent of the country’s land is currently under cultivation. Land resources for agriculture consist approximately of nine million hectares which renders a per capita figure of 13 persons per ha. With the population reaching 170 million by 2020, this figure will increase to 20 persons per hectare counting the possible loss of cultivable land to alternative uses like housing, urbanisation, etc. The pressure of the rising number of people on finite amounts of land, water and other natural resources has already resulted in mounting deforestation (a reduction from 10 to 6 percent in forest cover) that may become irreversible within the next 20 years, rising salinity and water logging of cultivated land, declining water tables and soil fertility and high levels of erosion in the hills. The riches of floodplain fisheries and wetlands have all been depleting precariously, caused by both natural forces and human interventions. If the negative trends cannot be reversed, they could reduce the current levels of fish production by 12 – 14 per cent. If the current two per cent per year deforestation rate is not reversed at all, the country’s forests will probably disappear totally by 2020, and with them vanish the centuries old heritage of biodiversity.

Source: *The World Bank and Bangladesh Centre for Advance Studies, 1998*

The contribution of biodiversity in the primary sector is immense, because a lion’s share of the employment and rural livelihoods lie within formal and informal industries. The over-extraction of resources for livelihood sustenance is a major reason for the depletion of biodiversity in Bangladesh. Along with that, development initiatives that do not consider biodiversity can also be held responsible for this loss. At the same time, ecological threats from climate change, water and air pollution, and build-up of solid wastes will degrade the ecosystems, which will ultimately exacerbate the social costs of poverty. Hence there exists a direct link between poverty and biodiversity in Bangladesh. Conserving biodiversity poses a formidable challenge without considering alleviation of poverty simultaneously. Figure 2.2 highlights the linkages between biodiversity and dimensions of poverty. While these linkages apply to every country, the particular circumstances of Bangladesh, in which a huge and still rapidly growing population is forced to rely on limited natural resources, mean that they are especially important for the country. Improving environmental management to reduce poverty requires comprehensive understanding of how local environmental conditions relate to
poverty, the ability to identify and set priorities with regard to alternative policy options and the capacity of evaluating their effectiveness and impact.

*Figure 2.2: Biodiversity-Poverty Linkages*

<table>
<thead>
<tr>
<th>Biodiversity Factors</th>
<th>Dimensions of Poverty</th>
<th>Elements of Wellbeing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecological Integrity</td>
<td>vulnerability to biodiversity loss incl. food and nutritional securities</td>
<td>Sustainable Livelihoods</td>
</tr>
<tr>
<td>Ecosystem Approach</td>
<td>Access to income and resources</td>
<td></td>
</tr>
<tr>
<td>Access to Resources</td>
<td>Life insurance policy for life</td>
<td>Reducing Vulnerabilities</td>
</tr>
<tr>
<td>Benefit Sharing</td>
<td>Ecosystem Approach</td>
<td></td>
</tr>
<tr>
<td><em>In situ</em> Conservation</td>
<td>Environmental Management</td>
<td></td>
</tr>
<tr>
<td>Sustainable Use</td>
<td>Health, Sanitation, Energy, Water and Governance</td>
<td></td>
</tr>
</tbody>
</table>

*Source: World Bank, 2002*
2.5 Forests and rural livelihoods

Forests are among the most diverse and widespread ecosystems on earth and millions of people living in most tropical countries derive a significant part of their livelihoods from various forest products for centuries. These products also play a vital role to the livelihoods of people living in or adjacent to forests. According to the World Bank (2002), more than 1.6 billion people throughout the world relying heavily on forests for their livelihoods and some 350 million people depends only on forest both for their subsistence and income. Over two billion people, a third of the world’s population, use biomass fuels, mainly firewood, to cook and heat their homes, and billions rely on traditional medicines for their ailment harvested from the forests. In some 60 developing countries, hunting and fishing on forested land supplies a significant amount of the protein requirements’ (Mery et al. 2005). Over the last two decades, the significant role of various forest products for household’s food and livelihood security is increasingly recognized and the main emphasis was given on the Non-Timber Forest Products (NTFPs). In fact, for a large number of peoples of the world, NTFPs are more important forest resources than timber. Some estimates suggests that, part of South East Asia’s tropical forest promote up to 50 US$ per month per hectare to local people from exploiting forest resources, without considering the commercial timber values (Sedjo, 2002; Caldecott, 1988)
2.6 Protected areas of Bangladesh

There are 18 Protected Areas in Bangladesh, covering 2400km2 and representing 1.63% of the country’s surface area, but 9.14% of its forested area (Gani, 2003). The Forest Department has the mandate for management of these protected areas. The Bangladesh Wildlife Preservation (Amendment) Act, 1974, recognises three categories of Protected Areas, namely National Park, Wildlife Sanctuary and Game Reserve. These are defined in the Act as:

“Game Reserve means an area declared by the Government as such for the protection of wildlife and increase in population of important species where capturing of wild animals shall be unlawful”.
“National Park means comparatively large areas of outstanding scenic and natural beauty with the primary object of protection and preservation of scenery, flora, fauna in natural state to which access for public recreation, education and research may be allowed”.

“Wildlife Sanctuary means an area closed to hunting, shooting or trapping of wild animals and declared as such under Article 23 by the government as undisturbed breeding ground primarily for the protection of wildlife inclusive of all natural resources, such as vegetation, soil and water”

Declaration of PAs has long been the most effective and widespread measure for conserving nature and natural resources around the world, which cover 11.5% of the earth’s land surface (Chape et al. 2003) and only 5% of the tropical forest area (Dupuy et al. 1999). The Bangladesh government realized the weakness of conventional forest management and continued depletion of forest resources and started to establish PAs in its national forests since 1960. The first declaration of PAs was under the provision of the Forest Act 1927, which got the momentum after the enactment of the Bangladesh Wildlife (Preservation) Order 1973. With the course of this Order, the government articulated national responsibility for the conservation of wildlife species, their habitats as well by allowing the designation of three IUCN categories of PAs: national parks, wildlife sanctuaries and game, corresponding to the IUCN categories II, IV and VI, respectively (IUCN 1994). Till to date, there are 19 PAs in Bangladesh. Among these, 10 are national parks, 9 wildlife sanctuaries and only 1 is game reserve and also 1 World heritage and 2 Ramsar sites (Table 2.1)
### Table 2.1: List of protected areas of Bangladesh

<table>
<thead>
<tr>
<th>SL.</th>
<th>Protected areas</th>
<th>Forest Types</th>
<th>Location (District)</th>
<th>Area (ha)</th>
<th>Established</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sundarbans (East) Wildlife Sanctuary</td>
<td>Natural Mangrove</td>
<td>Bagerhat</td>
<td>31,226.94</td>
<td>1996</td>
</tr>
<tr>
<td>2</td>
<td>Sundarbans (West) Wildlife Sanctuary</td>
<td>Natural Mangrove</td>
<td>Satkhira</td>
<td>71,502.13</td>
<td>1996</td>
</tr>
<tr>
<td>3</td>
<td>Sundarbans (South) Wildlife Sanctuary</td>
<td>Natural Mangrove</td>
<td>Khulna</td>
<td>36,970.45</td>
<td>1996</td>
</tr>
<tr>
<td>4</td>
<td>Rema-Kalenga Wildlife Sanctuary</td>
<td>Hill Forest</td>
<td>Habiganj</td>
<td>1,795.54</td>
<td>1996</td>
</tr>
<tr>
<td>5</td>
<td>Pablakali Wildlife Sanctuary</td>
<td>Hill Forest</td>
<td>Rangamati</td>
<td>42,087</td>
<td>1983</td>
</tr>
<tr>
<td>6</td>
<td>Chunati Wildlife Sanctuary</td>
<td>Hill Forest</td>
<td>Chittagong</td>
<td>7,761</td>
<td>1986</td>
</tr>
<tr>
<td>7</td>
<td>Char Kukri-Mukri Wildlife Sanctuary</td>
<td>Coastal Mangrove</td>
<td>Bhola</td>
<td>40</td>
<td>1981</td>
</tr>
<tr>
<td>8</td>
<td>Fashiakhali WS</td>
<td>Hill Forest</td>
<td>Cox’s Bazar</td>
<td>1,302</td>
<td>2007</td>
</tr>
</tbody>
</table>

**Wild life sanctuary (IUCN Category IV)**

<table>
<thead>
<tr>
<th>SL.</th>
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<td>Pablakali Wildlife Sanctuary</td>
<td>Hill Forest</td>
<td>Rangamati</td>
<td>42,087</td>
<td>1983</td>
</tr>
<tr>
<td>6</td>
<td>Chunati Wildlife Sanctuary</td>
<td>Hill Forest</td>
<td>Chittagong</td>
<td>7,761</td>
<td>1986</td>
</tr>
<tr>
<td>7</td>
<td>Char Kukri-Mukri Wildlife Sanctuary</td>
<td>Coastal Mangrove</td>
<td>Bhola</td>
<td>40</td>
<td>1981</td>
</tr>
<tr>
<td>8</td>
<td>Fashiakhali WS</td>
<td>Hill Forest</td>
<td>Cox’s Bazar</td>
<td>1,302</td>
<td>2007</td>
</tr>
</tbody>
</table>

**National Park (IUCN Category V)**

<table>
<thead>
<tr>
<th>SL.</th>
<th>Protected areas</th>
<th>Forest Types</th>
<th>Location (District)</th>
<th>Area (ha)</th>
<th>Established</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Himchari National Park</td>
<td>Hill Forest</td>
<td>Cox’s Bazar</td>
<td>1,729</td>
<td>1980</td>
</tr>
<tr>
<td>10</td>
<td>Lawachara National Park</td>
<td>Hill forest</td>
<td>Maulivazar</td>
<td>1,250</td>
<td>1996</td>
</tr>
<tr>
<td>11</td>
<td>Kaptai National Park</td>
<td>Hill forest</td>
<td>Rangamati</td>
<td>5,464</td>
<td>1999</td>
</tr>
<tr>
<td>12</td>
<td>Medha kachapia National Park</td>
<td>Hill forest</td>
<td>Cox’s Bazar</td>
<td>395.92</td>
<td>2004</td>
</tr>
<tr>
<td>No.</td>
<td>Park Name</td>
<td>Type</td>
<td>District</td>
<td>Area</td>
<td>Year</td>
</tr>
<tr>
<td>-----</td>
<td>----------------------------------</td>
<td>---------------</td>
<td>----------</td>
<td>------------</td>
<td>------</td>
</tr>
<tr>
<td>13</td>
<td>Bhawal National Park</td>
<td>Sal Forest</td>
<td>Gazipur</td>
<td>5,022</td>
<td>1982</td>
</tr>
<tr>
<td>14</td>
<td>Modhupur national Park</td>
<td>Sal Forest</td>
<td>Tangail</td>
<td>8436</td>
<td>1982</td>
</tr>
<tr>
<td>15</td>
<td>Ramsagar National Park</td>
<td>Sal Forest</td>
<td>Dinajpur</td>
<td>27.75</td>
<td>2001</td>
</tr>
<tr>
<td>16</td>
<td>Nijhum Dweep National Park</td>
<td>Coastal Mangrove</td>
<td>Noakhali</td>
<td>16,352.23</td>
<td>2001</td>
</tr>
<tr>
<td>17</td>
<td>Satchari National Park</td>
<td>Hill Forest</td>
<td>Habiganj</td>
<td>242.82</td>
<td>2005</td>
</tr>
<tr>
<td>18</td>
<td>Khadimnaga National Park</td>
<td>Hill</td>
<td>Sylhet</td>
<td>679</td>
<td>2006</td>
</tr>
</tbody>
</table>

**Game Reserve (IUCN Category VI)**

<table>
<thead>
<tr>
<th>No.</th>
<th>Park Name</th>
<th>Type</th>
<th>District</th>
<th>Area</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>Teknaf Game Reserve</td>
<td>Hill Forest</td>
<td>Forest Cox's Baza</td>
<td>11,615</td>
<td>1983</td>
</tr>
</tbody>
</table>

**World Heritage site**

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>District</th>
<th>Area</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunarbans world heritage</td>
<td>Natural Mangrove</td>
<td>Khulna, Satkhira and Bagerhat</td>
<td>139,500</td>
<td>1997</td>
</tr>
</tbody>
</table>

**Ramsar Site**

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>District</th>
<th>Area</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sundarbans Reserve Forest</td>
<td>Natural Mangrove</td>
<td>Khulna, Satkhira and Bagerhat</td>
<td>601,700</td>
<td>1992</td>
</tr>
<tr>
<td>Tanguar haor</td>
<td>Wetland</td>
<td>Sunamganj</td>
<td>9,500</td>
<td>2000</td>
</tr>
</tbody>
</table>

Sources: (Nishorgo 2008), List of Wetlands of International Importance (Ramsar Convention 2011), World Heritage List (World Heritage convention 2010)
2.7 Forest of Bangladesh

The total area of forestland of Bangladesh is 2.52 million ha of which the Forest Department (hereafter FD) manages 1.52 million ha. The other 0.73 million ha
designated as Unclassed State Forest (USF) are under the control of Ministry of Land and the remaining 0.27 million ha fall under the category of village forests that are under private ownership (BFD 2008). However, contradiction exists on the actual coverage of the forests. Forest Resources Assessment 2005 (FAO 2007) shows the total area of forest is 0.87 million ha (some 6.7% of the country’s total area). This includes only the designated government reserved and protected forests excluding the USF, plantations, village forests and other private forests (Muhammed et al. 2005).

Table 2.2: Total forest lands of Bangladesh

<table>
<thead>
<tr>
<th>Category</th>
<th>Area</th>
<th>Percentage total of land</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest department (FD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Managed Forests</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hill Forest</td>
<td>0.67</td>
<td>4.54</td>
</tr>
<tr>
<td>Natural Mangrove Forests</td>
<td>0.60</td>
<td>4.07</td>
</tr>
<tr>
<td>Mangrove Plantations</td>
<td>0.13</td>
<td>0.88</td>
</tr>
<tr>
<td>Plain Land sal forest</td>
<td>0.12</td>
<td>0.81</td>
</tr>
<tr>
<td>Total</td>
<td>1.52</td>
<td>10.30</td>
</tr>
<tr>
<td>Unclassed State Forest (USF)</td>
<td>0.73</td>
<td>4.95</td>
</tr>
<tr>
<td>Village forest</td>
<td>0.27</td>
<td>1.83</td>
</tr>
<tr>
<td>Grand Total</td>
<td><strong>12.52</strong></td>
<td><strong>17.08</strong></td>
</tr>
</tbody>
</table>

Source: Bangladesh Forest Department, 2008

The tropical evergreen and semi-evergreen forests (commonly known as hill forests) of Bangladesh occur in hilly areas of the northeastern and southeastern region, tropical moist deciduous forests (commonly known as Sal forests) are distributed in the central and a little part of northwestern region, the mangrove forest (commonly known as Sundarban) lie in the southwestern portion facing the Bay of Bengal, and the freshwater swamp forest (commonly known as reed-land forest) is located in the low lying wetland areas of northeastern region of the country. According to recent estimate, the total growing stock of Bangladesh’s forests is 30 million m3 and the total biomass 63 million tons (FAO 2007), which contributes to wellbeing of the countrymen both in tangible and intangible ways such as by maintaining the quality of local and national environment,
adding input in GDP, and providing livelihoods to local communities (Iftekhar 2006). The village forests or village groves in the country are the homesteads and are entirely private properties (Khan et al. 2007). These traditional homesteads are the dominating feature in the rural landscape of Bangladesh (Iftekhar 2006), forming the most productive tree resources of the country (BFD 2008). Vergara (1997) revealed that about 70% of fuel wood and timber and 90% of bamboos used in construction and cottage industries come from homesteads whilst Mustafa et al. (2002) reported about 55% of the national requirement of timber, fuel wood, and bamboo are met from those informal forests.

Figure 2.5: Forest of Bangladesh

Source: Bangladesh Forest Department, 1990
2.8 The benefits of protected areas for local livelihoods

Local livelihoods may be enhanced by diversifying sources of assets, or switching livelihood strategies to a singular but rewarding activity (Twyman, 2001). Diversification entails opening up the correct assembly of opportunities for a specific community (Salafsky & Wollenberg, 2000), which can be challenging to achieve. Despite the costs discussed above, protected areas can provide significant livelihood benefits to local communities. This section reviews the benefits of protected areas; both those provided by successful protection of forest ecosystem services, and those directly gained from the management structure of the protected area, ranging from direct income to provision of local amenities. Forest ecosystem services include supporting and regulating services, provisioning services, and cultural services, as defined in the Millennium Ecosystem Assessment (Figure 2.6).

It is sometimes difficult to recognise ecosystem services and to quantify them accurately, partly because they often provide indirect benefits, meaning that they remain poorly understood in relation to their importance (Myers, 1996). In 1997, Constanza et al. estimated the global value of biodiversity to be roughly $38 trillion, although this remains a highly controversial figure. Using a careful analysis of existing case studies, Balmford et al. (2002) found that the benefits of conversion of land (and subsequent loss of ecosystem services) were always outweighed by the costs. In each case, private benefits were accrued at the cost of social (community) benefits.
2.8.1 The effectiveness of forest protected areas in biodiversity conservation

Forest protected areas and community conservation initiatives generally have lower deforestation rates than the surrounding non-protected areas (Clark et al. 2008). Less has been published, on the effectiveness of protected areas in conserving the animal and plant species contained within them, although the studies that have been carried out are often positive. WWF’s analysis of over 200 forest protected areas suggested that biodiversity condition in protected areas was perceived to be good, and suggested that protected areas with an IUCN management category of I or II were likely to be more effective than less restrictive categories such as V or VI (Dudley et al., 2004). The benefit of biodiversity conservation is clear at the global scale. Intact ecosystems are...
thought to have more resilience to change, and to provide more ecosystem services (e.g. Cardinale et al., 2006; Fox, 2006). However, the direct benefits to local livelihoods depend upon protected area management strategies: the inclusion or exclusion of those local communities and their livelihood activities, or the sharing of protected area benefits with surrounding communities.

2.8.2 Supporting and regulating services
Supporting and regulating services include generating and maintaining soils, primary production, sustaining hydrological cycles, runoff control, prevention of soil erosion and storing and cycling essential nutrients. For example, the forests of the Korup National Park, Cameroon provide flood control for agricultural land, and help to sustain downstream mangrove fisheries. The annual net benefit of these watershed functions has been estimated at US$85 per hectare of forest (Ruitenbeck, 1992; Myers, 1996).

Local communities may not recognise or value these services when their benefits accrue at the regional, national and global scales (Myers, 1996), especially given that the costs of protection are mainly incurred at the local scale (Balmford et al., 2002). There may also be trade-offs between short-term and long-term benefits. An often-cited example of ecosystem service loss follows the conversion of forest land to rangeland for cattle ranching. Whilst economic returns can be high for the first few years, soil degradation and related nutrient depletion renders the land economically unviable and unable to regenerate as forest within a short amount of time, with corresponding long term impacts upon local livelihood options and security (Chomitz et al., 2006).

Despite the problems surrounding the identification and distribution of benefits, many are recognised by local communities. In the Kerinci Seblat National Park, Indonesia, 94%, 88% and 66% percent of farmers, thought that forest loss would result in flooding, soil erosion and attacks from insect pests respectively (Linkie et al., 2007). In the Annapurna community reserve, Nepal, communities have reported improved water resources after an increase in forest cover in the reserve (Bajracharya et al., 2006). In Huertar Norte, Costa Rica, participants in a payment for ecosystem services scheme
Islam Muhammad Shariful reported that reforestation in the area had improved soils and promoted tourism (Miranda et al., 2004).

2.8.3 Provisioning services
It is often possible to identify and quantify the provisioning services provided by forest protected areas, as they are mostly direct benefits with visible economic impacts. The reliance of local communities on forest resources has already been highlighted, and it could be suggested that one of the biggest benefits of protected areas for local people is the protection of forest resources for future generations. Any analysis of the costs and benefits of resource restrictions must therefore be considered in the context of sustainability, and the livelihood costs that would result from the future loss of forest resources. There must be a balance between resource restriction and resource use if provisioning services are to be exploited by local communities today. Brown et al. (2000) argue that the designation and sustainable use of protected areas can also lead to a more reliable resource base, whilst safeguarding the natural resources of a region for future use. The pattern of boom and bust in forest resource exploitation cycles can be replaced with a steadier economic base and the direction of benefits to local communities. For these reasons, some communities have set up their own restrictions on forest use, citing the value of future use of forest resources as their primary motivation. Amongst several examples from Mexico, the community of La Trinidad has declared 29% of its forest as a biodiversity area and has begun reforestation in former agricultural plots (Bray et al., 2003, Barton-Bray et al. 2002). The native Americans of the Hoopa Reservation, California, have begun a programme of forest management and ecosystem enhancement, as part of a drive to rebuild community and culture (Baker, 2003). It is clearly possible for community management to deliver sustainable incomes and biodiversity protection at the local scale.

Resource extraction from protected areas, including timber and non-timber forest products (NTFPs), has been cited by local communities as one of the greatest available benefits (Sekhar, 1998; Bauer, 2003; Holmes, 2003; Bajracharya et al., 2006; Allendorf et al., 2006). At Lake Mburo National Park, Uganda (a Category II protected area), 44% of respondents involved in community conservation programmes reported that the
protected area was positive because it conserved wildlife, and other benefits including the provision of water, grazing and access to protected area resources were reported (Infield & Namara, 2001). Similarly, an attitudinal survey in three wildlife sanctuaries in Myanmar, Burma (Categories II and III), showed that 45% of residents were in favour of the protected area, with 63% citing the conservation of natural resources as the reason for their support, and another 16% citing the extraction of natural resources from the protected area. Some studies have shown that an increase in forest production through protection has benefited local communities. In the Annapurna Conservation Area, Nepal (Category VI), 72% of community respondents gave the sustainable use of resources as their main reason for becoming involved in conservation projects set up by the protected area, and reported an increase in fodder, fuelwood trees, forest cover, water resources and wildlife populations (Bajracharya et al., 2006). Such positive attitudes towards resource provision have been shown to lead to support of protected areas even when significant costs are incurred.

Whilst not focusing specifically on protected areas, Belcher et al. (2005) review the use and management of NTFPs and their implications for livelihoods and conservation. NTFPs can include food, fibre, incense, medicinal plants or rubber. A small percentage of NTFPs enter local, regional or international markets, providing a cash income to producer households. They are more often consumed directly by the communities that extract them; in either case they may act as a daily net (e.g. providing food for subsistence or sale), or an infrequent safety-net. In the latter case, lives may depend upon NTFP availability, particularly as the poorest groups within a community make disproportionate use of NTFPs. Hamilton (2004) further argues that medicinal plants can be key to including local people in conservation strategies. Protected areas may be designated because of these plants, and/or their harvest may be encouraged to support local livelihoods. As well as playing an important role in traditional healthcare, some forest medicines are sold into the expanding market in herbal remedies, or used as the basis for manufacture of modern drugs (Hamilton, 2004).

Finally, the protection of wildlife within forests can have spillover effects onto surrounding areas, providing a ‘source’ population of wildlife, which will then move
towards the ‘sink’ areas outside the protected areas as their populations move towards carrying capacity (Joshi & Gadgil, 1991; Novaro et al., 2000; Salas & Kim, 2002). This can lead to crop raiding and livestock predation, as already discussed, but can also increase hunting opportunities for communities surrounding the reserve. An analogous situation is seen in marine protected areas, where no fishing zones act as reservoirs for fish stocks (Roberts et al., 2001; Shanks et al., 2003), delivering significant benefits to the fishing industry and fishing communities. These source-sink dynamics are currently being trialled as a way of ensuring sustainable bushmeat harvesting around the Nouabalé-Ndoki National Park, Republic of Congo (WCSCongo, no date).

Sustainability in a livelihoods context can be defined as the ability of the stakeholder to withstand short-term fluctuations in circumstances, and adapt to longer-term fluctuations (Scoones, 1998). NTFPs in particular can be regarded as a ‘sustainable livelihoods gateway’, diversifying sources of income and sometimes providing a stepping-stone to a non-poor life (Marshall et al., 2006). There is an obvious economic potential to the sustainable harvest of the more valuable NTFPs such as medicinal plants from protected areas, but their potential to benefit local communities is often affected by unstable markets, poor infrastructure and market access, and lack of bargaining power and market information (Belcher et al., 2005; Marshall et al., 2006). To realise this potential, investment would be required not only in the sustainable harvest and processing of NTFPs by local communities, but also in the facilitation of market access. An analysis of the sustainable yields possible is essential to underpin the long-term viability of NTFP-based livelihoods.

2.8.4 Cultural services

Deforestation, whether by communities or external actors, can result in the loss of the cultural traditions and religions connected with the forest (Dearden et al., 1998). Whilst the services discussed in the preceding sections are probably more easily quantifiable, the cultural and social benefits of forest protected areas are an intrinsic aspect of their role in local livelihoods. McNeely (1994) discusses the opportunities for social benefits of protected areas, and concludes that protected areas can play a crucial role in maintaining cultural identity, preserving traditional landscapes and empowering local
knowledge. For example, attitudinal surveys undertaken in the Wolong Biosphere Reserve, in southwestern China, indicate that the principal social development benefit of the reserve is that of increased social stability and cultural identity (Lü et al., 2003). These benefits may be less visible and tangible, but can be highly valued by local communities. The inclusion of local communities in planning stages and management decisions can help protected area managers to reach beyond socio-political factors, such as land tenure and resource access, to make local populations also stakeholders in conservation priorities.

NTFPs such as medicinal plants can be symbolically and culturally important, providing livelihood benefits through their social significance. Their value is not limited to that of a financial asset. Hamilton (2004, p.1482) describes how medicinal plants may be “held in special religious, nationalistic or ideological esteem”, which he argues can be advantageous for conservation, by helping to establish culturally-based support for the value of flora and fauna. Various attempts are underway to link conservation projects with local livelihoods through medicinal plant agreements; at Shey Phoksundo National Park, WWF-Nepal is implementing a community-based system of sustainable harvesting of medicinal plants alongside the facilitation of customary medicinal practices in local communities, working with traditional Tibetan medicine practitioners (amchis; Hamilton, 2004). Amchis are respected members of the community, and key stakeholders in conservation initiatives to maintain healthy resource bases of medicinal plants.

Local knowledge of traditional medicinal practices and resources can be a source of employment opportunities for local communities, to serve local needs and sometimes through assistance to research projects. Its value is also intrinsic, however; providing a source of local empowerment and identity. A thorough assessment of local livelihoods would include these more difficult to quantify aspects of the relationship between local communities and the environment.
2.9 Protected areas and poverty reduction

The poorest members of society are the most vulnerable – vulnerable to natural disasters, but also for instance, to economic downturns. This group is characterised by few, if any assets and minimal options. In such precarious conditions, the slightest extreme event may have major repercussions. A flood, a hurricane or a tsunami will have more dire consequences on those living in poverty than on those with healthy bank accounts, land and a good social network. Equally, a major rise in the price of a commodity will impact poor people dependent on this commodity more severely than wealthier people who may have a more varied income base or at least more options (including education) to vary that income base. Protected areas may have a role to play in physically protecting poor people. They may also offer more alternatives for poor people when economic conditions are worsened. In many cases, the most important social role of protected areas is through benefits that are not narrowly economic. Because for decades poverty has been interpreted as merely a financial issue, examples of protected areas’ contributions to poverty reduction have been confined to the financial aspects of poverty and support packages reflect this. Thus, in some instances where protected areas were set up on ancestral lands, local people were given money to abandon these same lands rather than looking at co-management options or different ways of generating benefits. Alternatively, such compensation was sometimes ‘in kind’ through the establishment of new schools or hospitals. Unfortunately, the compensation often fell far short of the value of the land (Oviedo, 2005). Also, in more recent examples, approaches such as ICDPs sought to develop alternative income-generating activities to help local people develop long-term economic activities compatible with biodiversity such as bee-keeping or tree-nurseries.

If, on the other hand, poverty is understood as about more than just dollars, there appears to be more scope for protected areas to contribute to poverty reduction. We can begin to see the different ways in which protected areas could potentially contribute to poverty reduction. Based on such a multidimensional approach to poverty, DFID undertook a study on wildlife and poverty (DFID, 2002).
The researchers identified five categories of positive livelihood outcomes that wildlife can provide poor people, namely: more income, reduced vulnerability, well-being, improved food security and environmental sustainability. These are delivered through for instance, ecotourism income, jobs as park guards, income from handicraft sales, natural medicines, building materials, NTFPs, bushmeat, provision of water etc.
3 CHAPTER III - STUDY AREA

3.1 Geographical Location

The Sundarbans Reserved Forest (SRF) is situated in the extreme south-west corner of Bangladesh between the river Baleswar and Harinbhanga adjoining to the Bay of Bengal and it covers 6017 sq. km. out of which 4,143 sq. km is land area and 1,874 sq. km is water area comprising rivers and tidal waterways. The SRF is situated at the southern part of Khulna, Bagerhat and Satkhira civil district lying in between latitude 21° 27’ 30" & 22° 30' 00" North, and longitude 89° 02' 00" & 90° 00' 00" East. The forest is bounded in the north by the private settlement, in the south by the Bay of Bengal, in the east by the Baleshwar River and in the west by the Harinbhanga, Raimongal and Kalindi river which is also the international boundary with India and to the north. There is a sharp interface with intensively cultivated agricultural land of the north with the Sundarbans mangrove forest of the south, which is intersected by a network of tidal rivers, canals and creeks. The Khulna, Bagerhat and Satkhira district towns are located at a distance of 35 km, 23 km, and 70 km north respectively in straight line from the edge of the forest. (Information Sheet on Ramsar Wetlands, 2001)
3.2 Catchment area

The upper catchment area of the Sundarbans is shared by four countries viz. India, Nepal, Bhutan and China with the largest and highest mountain range of the world. The middle catchment is formed by the floodplains of the three big rivers, the Ganges, Brahmaputra and Meghna and the proximate catchment consists of the have the Ganges-Gori drainage system located to the east of the Hoogly and west of Meghna river. Vast quantities of sediment 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 there carried further to the Bay of Bengal. (Information Sheet on Ramsar Wetlands, 2001)
3.3 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 percent. Temperature ranges from 7.70°C to 38.80°C round the year (Information Sheet on Ramsar Wetlands, 2001).

*Picture 3.1: Areal Photo of sundarbans*
3.4 Hydrology and river systems of the Sundarbans

The Sundarbans mangrove wetland is intersected by an elaborate network of rivers, channels and creeks (Chaffey et al., 1985). A complex net of streams and rivers varying considerably in width and depth intersects the entire area. Some of the big rivers are several kilometres in width (Siddiqi, 2001). Rivers tend to be long and straight, also a consequence of the strong tidal forces and the clay and silt deposits which resist erosion. The width of these estuaries sometimes extends to about 10 km. The rivers such as the Passur, Sibsa and Raimangal are deep and wide (Hussain and Acharya, 1994). Generally the rivers flow from north to south and are connected with a large number of side channels. These side channels connect two rivers and facilitate exchange of water between them. The larger rivers, while passing through the Sundarbans forest, join together and form estuaries at the confluence where they meet near the sea (Figure 3.3). The Sundarbans receives large volumes of freshwater from inland rivers flowing from the north and of saline water from the tidal incursions from the sea. The salinity of tidal water is the major force in the productivity of mangrove forest ecosystems. At a comparatively recent period all rivers were connected with the Ganges. The Baleswar River’s waterways carry little fresh water as they are cut off from the Ganges; the main outflow has shifted from the Hoogly-Bhagirathi channels in India (Seidenstiker and Hai, 1983).
Currently the Baleswar and Gorai Rivers have direct connection with eastern part of the Sundarbans carrying with them a substantial amount of fresh water to the area (Siddiqi, 2002). These ecological niches occur mainly along the Baleswar, Bhola, Passur, Marjata, Arpongasia, Shibsa, Jamuna and Raimangol Rivers. A number of rivers namely Passur, Sibsa, Selagang, Arpongasia, Kobadak, and Malancha and to a lesser extent Jamuna and Raimangal have indirect connections and receive the overflow of the Ganges during the rainy season.

*Figure 3.3: Map Major rivers, river systems and estuaries in the Sundarbans*
3.5 History of Sundarbans

In the 16th century, the Sundarbans forest was the property of the local king or Zamindar who imposed levy on the extraction of wood from the forest. During the British period, the proprietary right over the forest was assumed by the Crown. Forests were leased under the Act in 1830 to Europeans. This resulted in the progressive conversion of forests into agricultural land that continued up to 1875. A number of prominent British foresters visited the Sundarbans between 1863 to 1874 and succeeded in raising awareness in the colonial administration about the value of the forest. Their recommendations resulted in the introduction of a set of guidelines initiating the first conservation activities. Leasing out of forest land was thus stopped in 1875 and the remaining unleased forest was declared as Reserve Forest under the Forest Act of 1876. A Forest Management Division was established in 1879 at Khulna that regulated export of timber and was in charge of management. The Boundary of the Bangladesh portion of the forest has remained mostly unchanged for the last 125 years. The conservation effort received a boost when in 1977 the government set aside 139,700 hectares for three wildlife sanctuaries under the Wildlife Act of 1973. The Sundarbans has been declared as a 560th Ramsar site in 1992 due to covering all criteria of wetland as well as Ramsar site. World Heritage committee of UNESCO inscribed the Sundarban of Bangladesh in the World Heritage list by their 21st session in 1997 and accordingly the Government of the People’s Republic of Bangladesh declared the Sundarban as World Heritage Site in 1999.

3.6 Flora

Sundarbans have a considerably high floral diversity. A total of 245 genera and 334 plant species were recorded in this forest. The more prominent and important tree species found include the Sundri (Heritiera fomes), Gewa (Excoecaria agallocha), Keora (Sonneratia apetala), Goran (Ceriops decandra), Singra (Cynometra ramiflora), Dhundul (Xylocarpus granatum), Amur (Amoora walichii), Passur (Xylocarpus mekongensis), Kripa (Lumnitzera racimosa), Dakur (Cerbera odollum) and Kankra (Bruguiera gymnorrhiza).
Golpatta (Nypa fruticans) is a very useful palm commonly found in the Sundarbans. It is widely gathered for thatching purposes of the rural dwelling houses. Hantal (Phoenix palludosa) is another palm species, which is used extensively in the construction of small huts as roof rafters and frame of walls. Ullu grass (Sacharum officinalis) is widely gathered for thatching rural houses though it is the main fodder species of deer. Hogla (Typha elephantiana) is gathered and split for cheap fencing and mat making. Nal (Eriochloea procera) is used extensively for making mats. Hargoza (Acanthus illicifolious), tiger fern and Ora (Sonneratia caseolaris) are canal bank protection species that prominently grow along riverbanks.

All the plant species found in the Sundarbans are growing naturally and considered as indigenous. There is no knowledge of endemic, exotic and invasive species in Sundarbans. The Sundri (Heritiera fomes) is considered threatened due to the occurrence of a disease commonly known as top dying Sundri disease. It is known that some species are becoming rare in the present time. The Bhat Kati (Bruguiera parviflora), Kala Baen (Avicennia marina) is now a days a rare plant in the Sundarbans.
The Sundri is the unique species of the Sundarbans Ramsar Site (Hussain and Acharya 1994, Canonizado and Hossain 1998).

3.7 Fauna

The Sundarbans is the only remaining habitat in the lower Bengal Basin for a variety of faunal species. With regard to wildlife, the Sundarbans possesses a rich faunal diversity even after disappearance of a good number of interesting species. With regard to mammals, birds, reptiles and the amphibians, the Sundarbans shares 45, 42, 46 and 36 percent with the rest to the country. However, seven species have become extinct in the beginning of the last century. Besides, 10 species of mammals, 11 species of birds, 16 species of reptiles and one species of amphibian is endangered (Siddiqi, 2001). They include Royal Bengal Tiger (*Panthera tigers*), Jungle Cat (*Felis chaus*), Irrawaddy dolphin (*Orcaella brevirostris*), Blyth’s Kingfisher (*Alcedo hercules*), Estuarine Crocodile (*Crocodilus porosus*), Yellows Monitor (*Varanus flavescens*), Rock python (*Python molurus*), Green Frog (*Euphlyctis hexadactylus*) and others (Siddiqi, 2001).

*Picture 3.6 Sundarbans Deer*  
*Picture 3.7: Sundarbans Rayal Bengal Tiger*
Table 3.1: Status of Mammals, birds, reptiles and amphibians in the Sundarbans

<table>
<thead>
<tr>
<th>Class</th>
<th>Total number of species in Bangladesh</th>
<th>Existing species in Sundarbans (No)</th>
<th>Sundarbans share with Bangladesh (%)</th>
<th>Extinct species (No)</th>
<th>Endangered species (No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mammalia</td>
<td>110</td>
<td>49</td>
<td>45</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Aves</td>
<td>628</td>
<td>261</td>
<td>42</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>Reptilia</td>
<td>109</td>
<td>50</td>
<td>46</td>
<td>1</td>
<td>16</td>
</tr>
<tr>
<td>Amphibian</td>
<td>22</td>
<td>8</td>
<td>36</td>
<td>-</td>
<td>2</td>
</tr>
</tbody>
</table>

Source: (after Rashid et al., 1994; Siddiqi, 2001)

At present 49 mammals species have been recognised, and of these no less than eight spectacular species, namely Javan rhinoceros (*Rhinoceros sondaicus*), Single horned rhinoceros (*Rhinoceros unicornis*), Water buffalo (*Bubalus bubalis*), Swamp deer (*Cervus duvauceli*), Mugger crocodile (*Crocodylus palustris*), Gaur (*Bos frontalis*) and Hog deer (*Axis porcinus*) have become extirpated in the Sundarbans since the last century (Salter, 1987; Sarker, 1992). Generally, the wildlife population of the Sundarbans is under stressed that is why evaluation and better wildlife management strategies are needed as soon as possible and should be immediately implemented for the protection of natural heritage and the ecosystem. The terrestrial type of animals is available for its suitable periodic inundation environment. The river terrapin (*Betagur baska*), Indian flap-shelled turtle (*Lissemys punctata*), Peacock soft-shelled turtle (*Trionyx hurum*), yellow monitor (*Varanus flavescens*), water monitor (*Varanus*
Islam Muhammad Shariful

salvator), Indian Python (*Python molurus*) and the Bengal tiger (*Panthera tigris trigis*) are some of the resident species

*Picture: 3.10 Crocodile in Sundarbans*  
*Picture 3.11: Shark in sundarbans*

*Picture 3.12: Dolphin in Sundarbans*

3.8 Local communities and buffer zone of Sundarbans

A large number of communities live in the proximity of the forest (to its North and East), an area called Sundarban Impact Zone (SIZ). Most of these communities rely largely on the resources of the Sundarban for their livelihood. An estimated population of 3.5 million people (including the traditional resource users) inhabits the SIZ. Local people
are dependent on the forest and waterways for such necessities as firewood, timber for boats, poles for house-posts and rafters, *Golpata* leaf for roofing, grass such as *Mele* grass (*Cyperus javanicas*), *ulu* grass (*Imperata cylindrical*), *nal khagra* (*eriocholea procera*) for matting, reeds for fencing and fish mostly for their own consumption, and medicinal plants for herbal treatment. The traditional resource users of the Sundarban are the indigenous Munda community and local Bawali (wood cutters), Mouali (honey collectors), Golpata (nypah palm) collectors and Jele (fisherman) communities (Kabir and Hossain, 2006).

3.9 Aquatic and fisheries resources of Sundarbans

The aquatic resources of the Sundarban Mangrove Forest (SMF) are an important component of its biodiversity and are an important source of food and income for human populations.

Over 200 species of fish identified in the SMF are harvested by between 110,000 and 291,000 fishermen using approximately 25,000 registered small fishing boats. The water body inside the SMF, i.e. inshore fishing area, covers an area of 1,874 km², and the estimated annual production of finfish and crustaceans is about 3,054 t, equivalent to a yield of 16.3 kg/ha. The Sundarbans also includes a 20 km wide marine zone, i.e. offshore fishing area, which covers 1,603 km². A seasonal winter fishery of Dubla Island operates in this zone, consisting of about 30,000 fishermen and associated people. The annual production of the marine zone is estimated at 8,733 metric tonnes, or 54.5 kg/ha. Apart from the obvious structural complexity of this fishing area, the fishing area is strongly influenced by climate: fishing in the offshore area is very hazardous from May to August due to severe weather conditions.

(http://www2.fisheries.com/archive/publications/reports/11-1/46_haque.pdf)
The Sundarbans ecosystem supports rich fisheries diversity. Its water-bodies support 27 families and 53 species of pelagic fish, 49 families and 124 species of demersal fish, 5 families and 24 species of shrimps, 3 families and 7 species of crabs, 2 species of gastropods, 6 species of pelecypods, 8 species of locust lobster and 1 family and 3 species of turtles (IUCN 1994).

The fisheries of Sundarbans are very important for local economy and livelihoods of thousands of poor people living around and outside the landscape area. There are many other stakeholders. It produces 2-5% of the total capture fisheries (Rabbani and Sarker 1997). In 2003-04 the Forest Department (FD) production estimate was 433,000MT (Hoq, 2008). IPAC PRA finding is an average of 47% (Biswas, 2009; Ghosh, 2009) households within the 5km area in the landscape in Bagerhat & Satkhira district are engaged in fishing. Approximately 40,000-70,000 boats operate in the SRF for fishing. Forest Department revenue collection data has been considered for representing the value of different groups of fish. Mangroves are important nursery areas for many commercially important shrimp and crab species. In terms of value per unit catch and total value of catch, the penaeid shrimps are among the most important resources for coastal fisheries. Many species of palaemonid shrimps are also associated with mangroves, including the commercially important giant freshwater shrimp, *Macrobrachium rosenbergii* (Macnae, 1974; Matthes and Kapetsky, 1988; Singh *et al.*, 1994). Mangroves also support vast numbers of small shrimp of which Acetes spp. (Sergestidae) are the most important to fisheries (Macnae, 1974; Macintosh, 1982). Hoq *et al.* (2001) reported 10 shrimp species occurring in the major river systems flowing through the mangrove forest in Bangladesh. The species are *Penaeus monodon, P. indicus, Metapenaeus monoceros, M. brevicornis, Palaemon styliferus, Macrobrachium rosenbergii, M. villosimanus, M. dyanus, M. dolichodactylyus and M. rude*. The main macrozooplankton included Acetes spp., mysids, alima larvae, copepods, isopods and megalopa larvae. Crustacea accounts for by far the largest proportion of animal biomass, with an estimated 40 million kilograms of fiddler crabs and 100 million kilograms of mud crabs (Hendrichs, 1975). The mangrove crab fauna is of major ecological and economic importance (Macnae, 1974; Macintosh, 1982; Matthes and Kapetsky, 1988), including the high-priced mangrove mud crab, *Scylla*

3.10 Ecological important
The ecological importance of the SRF is associated with its rich biodiversity and the ecosystem’s valuable ecological services. It is estimated that the SRF is home to 425 species of wildlife, including 300 species of birds and 42 species of mammals. The area serves a vital role in a variety of ecosystem functions including trapping of sediment and land formation, protection of human lives and habitation from regular cyclones, acting as a nursery for fish and other aquatic life, oxygen production, waste recycling, timber production, supply of food and building materials, and carbon cycling (Biswas et al. 2007; Islam and Peterson 2008). These functions are increasingly at risk from the effects associated with climate change and sea level rise. The ecological importance of the SRF has been recognized and its conservation and management an obligation under a number of international treaties and conventions to which Bangladesh is signatory. (Strategic Management Plan for the Sundarbans Reserve Forest, 2010)
4 CHAPTER IV – METHOD

4.1 Research Design

The use of questionnaires and semi-structured interviews conduct in this study allowed for the collection of data from large and varied groups of households. After the data collection and analysis phase is completed.
4.2 Selection of villages

The selection of surveyed villages were based on the nearest of those villages from the core protected area (Sundarbans Reserve Forest) and dependency on Sundarbas resources. Selected villages and districts shown in the following Map and table

*Table 4.1: Surveyed villages in Khulna and Satkhira Districts*

<table>
<thead>
<tr>
<th>Study Area</th>
<th>Total Number of Household in the villages</th>
<th>Sample Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Villages</td>
<td>Union</td>
<td></td>
</tr>
<tr>
<td>Pathor Khali</td>
<td>Uttar bathkashi</td>
<td>200</td>
</tr>
<tr>
<td>4 no. Koyra</td>
<td>Koyra</td>
<td>400</td>
</tr>
<tr>
<td>Gobra</td>
<td>Koyra</td>
<td>210</td>
</tr>
<tr>
<td>Modinabad</td>
<td>Koyra</td>
<td>250</td>
</tr>
<tr>
<td>Munshiganj</td>
<td>Munshiganj</td>
<td>200</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,260</strong></td>
<td><strong>155</strong></td>
</tr>
</tbody>
</table>
Figure: 4.1 selected survey Villages

Source: Banglapedia, 2011
4.3 Data Collection Techniques

4.3.1 Reconnaissance Survey

In order to get a view of the nature of the study area and prior to data collection, a reconnaissance survey was initiated to acquire some basic ideas regarding to biodiversity and livelihoods through the personal interview with the local people of the study area. During the survey, views were exchanged with the peoples about the objectives. The survey has helped to realize the existing condition of the area.

4.3.2 Questionnaire Preparation and Testing

Considering the objectives of the study a questionnaire was prepared for the selected community after prepared the questionnaire, questionnaire was testing to fulfill objectives of the study and to collect the selected information of the study. Then some points were adding or cutting and final questionnaire was prepared.

4.3.3 Household Questionnaire Survey

To obtain information questionnaire was prepared to correspond all the aspects. Interviewing method was applied to collect information. Randomness was strictly ensured for better output. Primary data were obtained through Household survey. Total household were 155 for interviews. Data were collected by interview procedure. Direct questions and different scales were used to obtain information like age, education, family size, land area, amount of harvesting product, consumption and income. All of the information required for the study was collected with meticulous care.
4.3.4 Focus Group interviews

The focus group interview were initially held in 5 villages around sundarbans forest with selected groups comprised of five to 10 people, using a semi-structured question guide and a checklist. The groups in the discussions included Fishermen, Honey collectors, Crab Catcher, Nypa palm collectors, employed workers, women, and youth people selected from the community. The aim of the discussions was to collect quantitative economic data and qualitative data about forest products extracted, their prices, marketing chain, seasonal variability different kinds of products.
4.3.5 Direct Observation

It was very useful method for understanding actual condition of field by researcher himself. Observations were also made by systematically walking with informants and local leaders through the villages while observing, asking, seeking problems and solutions.
4.3.6 Secondary Data Collection
Secondary information such as statistical data, reports, maps have been collected from various Government and Non-government organizations such as: Department of Environment (DoE), Dhaka, Department of Forestry (DoF), Dhaka, Sundarbans Biodiversity Conservation Project (SBCP), Khulna, Khulna Forest Office, Relevant papers and reports of International Organizations through internet search, Journals and papers relevant to the study from NGO’s, Seminar library of Urban and Rural Planning Discipline.

4.4 Data Processing and Analysis
The data were processed, analyzed and interpreted to find the result the study. After completion of data collection the responses to the questions of livelihoods in the Sundarbans and Its surrounding interview schedule were transferred to a master sheet to facilitate tabulation. The analyzed data are represented through tabular and graphical form. The report of the study is written through the systematic way by using the computer program MS Word, MS Excel. Firstly I prepared the draft report and then the final report of the study is written.
5  CHAPTER V - RESULTS AND DISCUSSION

5.1 Status of Sundarbans dependents household

5.1.1 Occupations and categories of sundarbans forest dependents

The study area has found 4 categories of sundarbans forest dependent occupations. All of the household head involve these occupations. Occupations are Fishermen, Crab catcher, Honey collector and Nypa Palm collector. Forest department of Sundarbans reserve forest allows for harvesting the forest resources of fish, crab, honey and nypa Palm (Non-timber forest products).

*Figure 5.1: occupation categories and percentage of household head occupation of the study area*

<table>
<thead>
<tr>
<th>Percentage of sundarbans Forest dependents occupations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fishermen</td>
</tr>
<tr>
<td>Crab Catcher</td>
</tr>
<tr>
<td>Honey Collector</td>
</tr>
<tr>
<td>Nypa Plam Collector</td>
</tr>
<tr>
<td>67.74%</td>
</tr>
<tr>
<td>14.19%</td>
</tr>
<tr>
<td>9.03%</td>
</tr>
<tr>
<td>9.03%</td>
</tr>
</tbody>
</table>

In the study area most of the household head occupation is fishing about 67.74%. 14.19% household head occupation is Crab catcher, Honey collector and Nypa palm collector both occupations are about 9.03% (Figure 5.1). Honey collector and Nypa palm collector are lower percentage. Major sources of income in the family come from these occupations.
5.1.2 Family members

Table 5.1: Average Male and Female Member in forest dependent households

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Gender</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>Average of all types of family member</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fishermen</td>
<td></td>
<td>2.6</td>
<td>2.3</td>
<td>4.9</td>
<td>4.8</td>
</tr>
<tr>
<td>Crab Catcher</td>
<td></td>
<td>2.5</td>
<td>2.2</td>
<td>4.7</td>
<td></td>
</tr>
<tr>
<td>Honey Collector</td>
<td></td>
<td>2.4</td>
<td>2.4</td>
<td>4.8</td>
<td></td>
</tr>
<tr>
<td>Leaf Collector</td>
<td></td>
<td>2.6</td>
<td>2.2</td>
<td>4.8</td>
<td></td>
</tr>
</tbody>
</table>

Source: Field Survey, 2011

The above table shows the family size of different dependents household. Average family member of Fishermen is higher (4.9 persons) than other occupations household. All forest dependents family's averages household member is about 4.8 persons.

Picture 5.1: Household of Crab Catcher

Picture 5.2: Household of Fisherman
5.1.3 Educational status

Table 5.2: Educational status of forest dependents people

<table>
<thead>
<tr>
<th>Family</th>
<th>No formal education</th>
<th>Primary education</th>
<th>Secondary education</th>
<th>Higher secondary education</th>
<th>Graduation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fishermen</td>
<td>29.27%</td>
<td>55.69%</td>
<td>13.82%</td>
<td>0.81%</td>
<td>0.41%</td>
</tr>
<tr>
<td>Crab Catcher</td>
<td>30.21%</td>
<td>53.12%</td>
<td>23.19%</td>
<td>00%</td>
<td>00%</td>
</tr>
<tr>
<td>Honey Collector</td>
<td>25.81%</td>
<td>58.04%</td>
<td>16.13%</td>
<td>00%</td>
<td>00%</td>
</tr>
<tr>
<td>Leaf Collector</td>
<td>23.08%</td>
<td>52.31%</td>
<td>20%</td>
<td>1.54%</td>
<td>3.08%</td>
</tr>
</tbody>
</table>

Source: Field Survey, 2011

Significant percentages of the family members are non formal education (Table 5.2). Lower level of higher secondary and graduation level education. Leaf collector’s families are comparatively better than other occupational families.
Higher secondary and graduation level are very low (0.70% and 0.56 respectively) in all forest dependents households (Figure 5.2). Large number of the family members level are non formal education (28.53). 55.25% people gain primary education.

### 5.1.4 Land status

Significant numbers of households are landless (Table 5.3). Crab catcher households land status is very poor about 40.91% households are landless and their average land amount is 0.06 ha. Most of the Nypa palm collectors households have own land

#### Table 5.3: Land Status of Households

<table>
<thead>
<tr>
<th>Household</th>
<th>Landless %</th>
<th>Own land %</th>
<th>Average Amount of land of land owner (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fishermen</td>
<td>36.19</td>
<td>63.81</td>
<td>0.10</td>
</tr>
<tr>
<td>Crab catcher</td>
<td>40.91</td>
<td>59.09</td>
<td>0.06</td>
</tr>
<tr>
<td>Honey collector</td>
<td>35.71</td>
<td>64.28</td>
<td>0.10</td>
</tr>
<tr>
<td>Nypa palm Collector</td>
<td>14.28</td>
<td>85.71</td>
<td>0.18</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>31.77</strong></td>
<td><strong>68.22</strong></td>
<td><strong>0.11</strong></td>
</tr>
</tbody>
</table>

*Source: Field Survey, 2011*

(85.71%) but their land amount is very limit (0.18). landless fishermen and honey collectors are 36.19% and 35.71% respectively.
Overall 68.22% forest dependents households have own land but their land is very low amount (0.11 ha). Landless households live in along the embankment and roadside in government land. Most of the land owners have small amount of land some of them have small scale of home state forest and pond. Few household have agricultural land but this land is not suitable for agricultural production due to high salinity of land.

*Picture 5.5: Landless Fisherman in 4 no. koyra Village*

*Picture 5.6: Land owner household of Fisherman in Gobra Village*
5.2.1 Harvesting and consumption of sundarbans resources

For harvesting of the sundarbans resources the harvesters of forest dependent people need permission from forest department and pay revenue for harvesting. Forest department allow to harvests the fishes, Crabs, Honey and Nypa palm. Timber and other resources are prohibited to extraction. Forest department gives instruction for harvesting areas and prepare month tables for harvesting in a year for different harvesters. Fishermen and Crab catchers can harvest every month in a year, honey collects get permission 3 months in a year and Nypa palm get permission 5 months in a year. Every harvesters use boat for harvesting of the sundarbans resources. Fishermen use different types of nets for fishing and harvest various types of fish species. They harvest fishes in river, canal and marine zone of Sundarbans i.e. inshore and offshore fishing area of sundarbans. Crab catchers also harvest inshore and offshore zone of Sundarbans. Honey collectors collect honey from various tree species in sundarbans forest (Aegiceras corniculatum, Ceriops decandra, Sonneratia apetala, Xylocarpus mekongensis, Excoecaria agallocha, Avicennia officinalis tree species are the most suitable for making bee hives in the Sundarbans). One bee hive has 2 kg to 40 kg honey. Nypa palm collectors harvest Nypa Fruticans Specis of Palm, local name golpata (useful for making house, roof) from the sundarbans forest. Every harvesters use boat during harvesting periods. About 14-25 days they stay in sundarbans forest in a month for harvesting. Fishermen, Crab catchers use labor for supporting their harvesting. Honey collector’s entire the forest group wise (each group in 4-8) for harvesting without using labor for collecting honey. Nypa palm collectors also entire the forest with group and use labor.
5.2.2 Harvesting and consumption of Non-timer forest products

Figure 5.3 shows total amount of annual harvesting of each harvester from the sundarbans reserve forest and annual amount of consumption form their harvesting products. Each Fisherman annually average harvest 14.43 Quintals of fishes and consume 0.68 Quintal for own household.

Figure 5.3: Total Annual amount of Harvesting from sundarbans and consumption from harvesting products

Source: Field Survey, 2011

(Note: 1 Quintal equal 100 Kg)

Every Crab catcher harvest 11.13 Quintal of crabs in annually and consume 0.1 quintal for household. Honey collectors and Nypa palm collectors annually collect 7.5 quintal honey and 278.40 quintals Nypa palm respectively. Honey collectors consume 0.1 Quintal and Nypa palm consume 10.47 Quintals from their harvesting products.
Picture 5.7 Crab catcher catching crabs

Picture 5.8: Fishermen harvesting Fishes

Picture 5.9: Honey collector Collecting honey

Picture 5.10: Nypa Palm collector harvesting Nypa
5.2.3 Consumption’s sharing of Non-timber forest products

Fishermen shares the highest percentage (4.72%) of his harvesting products for household consumption than others harvesters. Nypa palm collectors sharing of harvesting product for consumption comparatively higher (3.76%) than crab and honey collectors (Figure 5.4). Very lower portion of harvesting product consume by honey (1.35%) and crab collectors (1.38%).

![Figure 5.4 Household Consumption of harvesting products](image)

Source: Field Survey, 2011

Fish and Nypa palm are the important harvesting products that meet harvesters household basic need. Fish provide protein for their daily need. Nypa palm is essential product household use for making their house, roof and pole. Most of the crab collector’s families are not interest to consume the crab (Great portion of the household tradition is not allow to consume crab). Honey collectors collect low amount of honey for this reason they are interest for selling of the most part.
5.2.4 Harvesting periods and duration of harvester stay inside the forest

Forest department make time table for the harvesters for harvesting. Every harvester need permissions before harvesting the sundarbans forest resources and forest department collects revenue from all harvesters for harvesting. After getting the permission they entire inside the forest and during harvesting period they stay longer period stay in the forest (14-26 days in a month). Every harvesters using boat for harvesting and they arrange their cooking, sleeping inside the boat. They carry their foods with them during harvesting periods.

*Picture 5.11: Forest officer giving permission for harvesting Picture 5.12: permission document*

*Table 5.4: Harvesting period and harvesters living days inside the forest*

<table>
<thead>
<tr>
<th>Harvesters</th>
<th>Permission period for harvesting (Harvesting Seasons)</th>
<th>Total month In a year</th>
<th>Day of staying inside the forest for Harvesting per month</th>
<th>In a year Day of stay inside the forest for harvesting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish</td>
<td>January-December</td>
<td>12</td>
<td>14</td>
<td>168</td>
</tr>
<tr>
<td>Crab</td>
<td>January-December</td>
<td>12</td>
<td>14</td>
<td>168</td>
</tr>
<tr>
<td>Honey</td>
<td>April-June</td>
<td>3</td>
<td>15</td>
<td>45</td>
</tr>
<tr>
<td>Nypa Palm</td>
<td>Nov-March</td>
<td>5</td>
<td>20-26</td>
<td>100-130</td>
</tr>
</tbody>
</table>

*Source: Field Survey, 2011*
Table 5.4. shows the harvesting period of different resources products and the duration of harvester stay inside the forest for harvesting. Fishermen and Crab collectors get permission every month in a year but in a month 14 days they have permission for harvesting. Both of the harvesters stay inside the forest 168 days in a year. Honey collector get permission for collecting honey in April to June. Duration of June to April is the honey yielding season. Honey collector stay inside the forest 45 days in a year. Nypa palm collector get permission in November to March and stay 100 to 130 days inside the forest in a year. Honey and Nypa collectors harvesting and stay in the boat in a group (each group 4-8 persons). All harvesters face different challenging during harvesting period such as tiger, crocodile and Shark attack, storm and cyclone.

*Picture 5.13: Fishermen carry cooking instrument on the boat during harvesting period*

*Picture 5.14: Fishermen Group in boat during harvesting period*
5.3 Non timber forest product for selling

5.3.1 Selling amount of Non –timber forest products

From the harvesting products every harvester consumes some part for their households use and large part they sale in the market.

*Figure 5.5: Total annual harvesting product for selling*

<table>
<thead>
<tr>
<th>Harvesting Product</th>
<th>Annual Amount Sold (Quintals)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish</td>
<td>13.77</td>
</tr>
<tr>
<td>Crab</td>
<td>11.04</td>
</tr>
<tr>
<td>Honey</td>
<td>7.35</td>
</tr>
<tr>
<td>Nypa palm</td>
<td>267.92</td>
</tr>
</tbody>
</table>

*Source: Field Survey, 2011*

Fisherman average annually sold 13.77 Quintals of fishes of his harvesting products. Crab catcher and honey collectors sold annually 11.04 Quintals and 7.35 Quintals respectively. Nypa palm collector sold 267.92 Quintals of his harvesting product annually (Figure 5.5).

*Picture 5.15: Finfish ready for selling*  
*Picture 5.16: Shrimp selling in Market*
Picture 5.17: Finfish selling in Market

Picture 5.18: Crab selling in market

Picture 5.19: Nypa Palm ready for selling
5.3.2 Selling price of Non-timber harvesting products

Figure: 5.6. show the selling price per unit of the harvesting products that selling by harvesters. All harvests receive these prices of their harvesting products. Each Fisherman sold average 1.02 Euro per Kg of their harvesting fishes. Crab and honey collectors sold their products average 1.32 € and 1.82 € per kg respectively. Average price of Nypa palm sold by Nypa palm harvester 0.07 € per kg

Figure 5.6: selling price of harvesting product by Harvesters

Source: Field Survey, 2011
5.4 Values (price) of consumption of Non-timber forest products

Figure 5.7 shows the values of each household annual consumption of their harvesting products. Fishermen and crab collector each household annually consume 69.52 Euro and 13.62 Euro value (price) of fishes and crab respectively. Honey and Nypa palm collector each household annual consumption values are 18.34 € and 73.31 € respectively.

Figure 5.7: Values of annually consumption of harvesting products

Source: Field Survey, 2011

Nypa palm household consume highest value than other harvesters. Fisherman consumption is higher than crab and honey collectors. Crab catcher household consume lowest values.
5.5 Fuel wood harvesting and consumption

In the study area Fishermen, Crab Catcher, Honey and Nypa Palm collectors, all forest dependents harvesters harvest fuel wood from the sundarbans. Each harvester carries the fuel wood with their Major harvesting product on the boat. They use this fuel wood only for their household fuel consumption. (Sundarbans Reserve forest has no permission to harvest any timber species).

5.5.1 Harvesting of Fuel wood

Fisherman average annually harvest highest amount (11.63 Quintals) of fuel wood than others harvesters (Figure 5.8).

*Figure 5.8: Total annual amount of fuel wood harvest*

Each Crab catcher and nypa palm collector harvest average 11.06 Quintals and 10.97 Quintals respectively. Honey collector harvest lowest amount of fuel wood annually in average 8.64 Quintals.

*Picture 5.20: Harvesting fuel wood in Boat  Picture 5.21: Fuel wood drying*
5.5.2 Household demanding fuel wood for consumption

In the study area all households dependent on fuel wood for their daily cooking. Different amount of fuel wood need in different household i.e. depends on the size of the family. They use fuel wood from mostly from their own harvesting some time buy from market also use fuel of village forest.

*Figure: 5.9: household use annually amount of fuel wood*

![Graph showing total annual amount of fuel wood use for cooking of harvesters household](image)

*Source: Field Survey, 2011*

*Picture 5.22: women chopping forest fuel wood*  
*Picture 5.23: women use fuel wood for cooking*
Fisherman and crab catcher household average use of fuel wood 13.84 Quintals and 13.09 Quintal annually respectively for their cooking (Figure 5.9). Nypa palm collector households average annual fuel wood use is higher than others households (14.57 Quintals). Honey collector average annual fuel wood use is comparatively lowers than others (11.86 quintals).

5.5.3 Sharing of Fuel wood for cooking

All of the household of harvesters commonly use of the forest fuel wood for cooking. Forest fuel wood consumption varies among the households. They sharing the forest fuel wood in different ways

*Figure 5.10: Household sharing of forest harvesting fuel wood*

Most of the house holds (about 45.16%) are sharing half portion of forest fuel wood (harvesting from forest) of their total use of fuel for cooking. about 25.81% households use only forest fuel wood for their daily cooking i.e. they are fully depends on forest fuel wood for their daily cooking. About 23.22% household are use three Quarter of forest fuel wood for their cooking. Quarter amount of forest fuel wood use very lower percentages of household (5.81%)
5.6 Value (price) of consumption of harvesting Forest fuel wood

All harvesters harvest forest fuel wood for their household consumption.

*Figure 5.11: Value of consumption of harvesting fuel wood*

Figure 5.11 shows the Market values of annual consume of forest fuel wood of each household that they harvest from the sundarbans forest. Each fishermen household consume annually average 63,96 Euro. Fishermen house hold consumes highest values of forest fuel wood. Crab catcher and Nypa palm collectors’ household annually consume the values 60,83 Euro and 60,33 Euro of Forest fuel wood respectively. Honey collector consumes lower value of forest fuel wood 47,52 Euro annually.
5.7 Income from Non timber harvesting products

Nypa palm get money of 149,59 Euro monthly by selling of their harvesting product of Nypa palm. Nypa palm collector monthly selling income is highest among all harvesters (Figure 5.12).

Figure 5.12: harvester’s monthly income from selling of harvesting products

Each Crab collector average monthly income from the selling of Crab is 121,32 Euro. Fishermen average monthly income from the selling of fishes is 116, 85 Euro. Honey collector monthly selling income form the honey is 54,49 Euro.
5.8 Tax for harvesting

All harvesters pay tax to the forest department for harvesting of forest resources.

It include license fee (permission fee) to entire the forest that need before harvesting and after harvesting they provide revenue that measure on the basis of weight of their harvesting products.

*Figure: 5.13 Harvesters Tax paying to Forest Department*

![Graph showing monthly amount of tax paid to forest department by different harvestors: Fishermen pay €7.37, Crab Catcher pay €6.34, Honey Collector pay €1.71, and Nypa Palm Collector pay €2.97.]

*Source: Field Survey, 2011*

Each Fisherman average monthly pays Tax 7, 37 Euro to forest department for their harvesting. A fisherman pays highest tax than other harvesters. Crab catcher and Nypa palm collector pay monthly tax 6.34 € and 2, 97 € respectively. Honey collector pays lowest tax 1,71€ for honey collection (Figure 5.13).
5.9 Factor affects on harvester’s income

All of the harvesters lose money during harvesting periods. Different factors related for losing their money and these factors significantly affect their income that lead their low income. These factor highly impact on their livelihoods. These factors are water hijacker, Forest staff and small loan provider. Water hijacker highly influence on the Harvesters. They collect money from all harvesters by enforcing. All harvesters are bind to pay money water hijacker for their torturing like kidnapping, capturing even some time harvesters lose their life. Forest staff another factor, they collect money from the harvesters illegally. They collect extra money for license and impose the harvesters (after harvesting when they return carry with harvesting products) for money collection (illegal) and make enragemnt towards harvesters. During harvesting period every harvesters need capital for arranging harvesting (food, boat and harvest equipment’s repairing cost). Harvesters have no ability to arranging the harvesting cost (need capital) . For this reason they borrow loan from the small loan provider. Small loan provider provide loan to harvesters and receive interest (make a written agreement). Their loan interest is basis on the harvesting selling income and harvesting products not basis on loan money. Every harvester pays tax to forest department for harvesting of forest resources (count as Government revenue)

In the following tables (Tables 5.5, 5.6, 5.7,5.8 and 5.9) shows separately all harvesters of their annual harvesting income and expense for annual tax to forest department, labor cost, loan money and losing money for water hijacker, forest staff illegal money collection and pay for loan interest. Finally the annual net income has measured in tables.
5.9.1 Fishermen affect on income

Each Fisherman average annual income from the selling of harvesting is 1402,20 Euro. They expense money for tax (forest department) 88,44 € annually. 168,00 € and 200,00 € expense annually for labor cost and the loan money respectively (loan money use for food, equipment, other cost during harvesting period). 240,00 € and 48,00 € lose for water hijacker and forest staff (illegal money collection from harvesters) respectively (Table 5.5). 70,11 € lose for paying loan interest. (Loan provider collects 5% interest from the fishermen’s harvesting selling income).

Table 5.5: Fishermen’s Annual income from selling of harvesting products Fishes, expenditure, losing money and annual net income from harvesting product of Fishes

<table>
<thead>
<tr>
<th>Fishermen</th>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Income from selling of harvesting product</td>
<td>1402,20</td>
<td>88,44</td>
<td>240,00</td>
<td>48,00</td>
<td>200,00</td>
<td>70,11</td>
<td>168,00</td>
<td>814,55</td>
<td>587,65</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expense and losing money (Euro)</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tax to Forest department</td>
<td>88,44</td>
<td></td>
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<td></td>
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<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Water Hijacker</td>
<td>240,00</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forest staff</td>
<td>48,00</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loan annually Use for maintaining cost</td>
<td>200,00</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loan Interest (5% from selling of harvesting income)</td>
<td>70,11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labor</td>
<td>168,00</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Expense</td>
<td>814,55</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual Net Income from harvesting product</td>
<td>587,65</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

Source: Field Survey, 2011

Fisherman annual total expense 814,55 € and annual net income 587,65 €. Water hijacker, Forest staff and loan interest significantly affect on their income and led to low income.
5.9.2 Crab collectors’ affect on income

Each Crab catcher annual average income from the selling of Crabs is 1455.48 Euro. Crab catcher pay tax to forest department annually 76.08 € and 162.00 €, expense for labor cost (supporter of his harvesting work).

Table 5.6: Crabs collector’s Annual income from selling of harvesting product, expenditure, losing money and annual Net income from harvesting product of Crab

<table>
<thead>
<tr>
<th>Crab Catcher</th>
<th>Annual Income from selling of harvesting product</th>
<th>Expense and losing money (Euro)</th>
<th>Total Expense</th>
<th>Annual Net Income from harvesting product</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Tax to Forest department</td>
<td>Water Hijacker</td>
<td>Forest staff</td>
</tr>
<tr>
<td>1455,84</td>
<td></td>
<td>76,08</td>
<td>264,00</td>
<td>51,00</td>
</tr>
</tbody>
</table>

Source: Field Survey, 2011

190,00 € expense of the loan money (harvesting maintaining cost i.e. use for food, equipment cost during harvesting period). 264,00 €, 51,00 € and 145,58 € losing for paying money to water Hijaker, Forest staff and loan interest respectively. Total annual average expense of each Crab catcher is 888,66 € and annual total net income is 567,17 (Table 5.6). Crab catcher loses significant amount money for water hijacker and Forest department and loan interest.

Picture 5.24 Crab selling in market
5.9.3 Honey collector affect on income during honey collection

Honey collector average annual income from selling of honey is 653,88 €. During honey collection Honey collector expense money annually 20,52 € and 200,00 € for tax paying and using loan money respectively. 18,30 €, 15,75 € and 65,38 € losing for water Hijackers, forest staff and loan interest respectively. Total annual expense is 319,95 € during honey collection. Net annual average income of each honey collector from honey is 333.93 Euro (Table 5.7). Honey collector have no labor cost.

Table 5.7: Honey Collector’s Annual income from selling of honey, expenditure, losing money and annual net income from harvesting product of Honey

<table>
<thead>
<tr>
<th>Honey collector for harvesting of Honey</th>
<th>Expense and losing money (Euro)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Income from selling of harvesting Honey</td>
<td>Tax to Forest department</td>
</tr>
<tr>
<td>653,88</td>
<td>20,52</td>
</tr>
</tbody>
</table>

Source: Field Survey, 2011

5.9.4 Honey collector affect on income during fishes harvesting

Table 5.8: Honey Collector’s Annual income from selling of fish, expenditure, losing money and annual net income from harvesting product of fish

<table>
<thead>
<tr>
<th>Honey collector’s fish harvesting</th>
<th>Expense and losing money (Euro)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Income from selling of harvesting fish</td>
<td>Tax to Forest department</td>
</tr>
<tr>
<td>620,00</td>
<td>42,60</td>
</tr>
</tbody>
</table>

Source: Field Survey, 2011

Honey collection season is only 3 months (April-June). Each Honey collector involves 3 months for honey collection and their income from the selling of honey is very low for
limit month extraction. In off seasons every honey collector harvest fishes for their extra money income. About 6 months they are involve with fish harvesting. (Table 5.8) shows honey collector net income from fish harvesting and their expense during fish harvesting. Honey collector average selling income of harvesting fishes is 620,00 €. Expense money 42,60 €, 84,00€ for tax paying and labor cost respectively. 100,00 € expense (loan money use for food, equipment cost during harvesting period) that they borrow from the loan provider. Honey collector lose during fish harvesting 120,00 €, 24,00 € and 31,00 € for water Hijacker, Forest staff and loan interest. Average annually total expense of honey collector during fish harvesting 401,60 € and annual net income from fish harvesting 218,40 €. From (Table 5.7) and (table 5.8) it seen that Honey collector annual average net income from both honey and fish is 552, 33 €. (Note. Honey collectors also involve with fish harvesting but their identity is honey collector)

5.9.5 Honey collector affect on income during both honey and fishes harvesting

This table is (Table 5.9) calculate from Table 5.7 and Table 5.8 i.e. total selling income, net income, expense of Honey collector from harvesting of honey and fishes.

Table 5.9: Honey Collector’s Annual income from selling of honey and fish, expenditure, losing money and net annual income from both honey and fishes

<table>
<thead>
<tr>
<th>Honey collector’s both honey and fish harvesting</th>
<th>Expense and losing money (Euro)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Income from selling of harvesting Honey and fish</td>
<td>Tax to Forest department</td>
</tr>
<tr>
<td>1273,88</td>
<td>63,12</td>
</tr>
</tbody>
</table>

Source: Field Survey, 2011

Honey collector average selling income from both honey and fish 1273,88 €. Total average expense from both honey and fishes 721,55 €. Average 63,12 €, 300,00 €
expense for tax and use loan money respectively. For both honey and fish harvesting loan provider collect interest about 7.56% from the selling of harvesting product of both honey and fishes. Expense 84,00 € for labor cost. Losing 138,30 € and 39.75 € for water hijacker and forest staff respectively. Honey collector total average annual expense from both honey and fish 552,33 € and net income 552,33 €.

5.9.6 Nypa palm collector affect on income

Nypa palm Collector annual average selling income from their harvesting products is 1795,08 Euro. Each of them pay 35,64 € for tax to forest department. 35,64 €, 200,00 € and 179,50 € expense annually for tax payment, labor cost and loan money respectively.

Table 5.10: Nypa Palm collector’s Annual income selling of harvesting products, expenditure, losing money and annual net income from harvesting products of Nypa Palm Collector

<table>
<thead>
<tr>
<th>Annual Income from selling of harvesting product</th>
<th>Tax to Forest department</th>
<th>Water Hijacker</th>
<th>Forest staff</th>
<th>Loan annually use for maintaining cost</th>
<th>Loan Interest (10% from selling of harvesting income)</th>
<th>Labor cost</th>
<th>Total Expense</th>
<th>Annual Net Income from harvesting product</th>
</tr>
</thead>
<tbody>
<tr>
<td>1795,08</td>
<td>35,64</td>
<td>165,00</td>
<td>13,50</td>
<td>500,00</td>
<td>179,50</td>
<td>200,00</td>
<td>1093,64</td>
<td>701,43</td>
</tr>
</tbody>
</table>

Source: Field Survey, 2011

Each of them lose 165,00 € and 13,50 € for water Hijacker and forest staff respectively. Nypa palm collector lose 179,50 € annually for loan interest (loan provider get 10% interest from harvester selling income). Nypa palm collector annual total expense 1093,64 € and annual net income 701,43 €.
5.9.7 All harvesters affect on income

Table 5.11 shows all harvesters (Fisherman, Crab Catcher, Honey collector and Nypa palm collector) average Net annual income, annual selling income from their harvesting products, average expense and losing money annually.

Table 5.11: All harvesters’ Annual average income selling of harvesting products, expenditure, losing money and annual net income from harvesting products

<table>
<thead>
<tr>
<th>All harvester average</th>
<th>Expense and losing money (Euro)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Income from selling of harvesting product</td>
<td>Tax to Forest department</td>
</tr>
<tr>
<td>1481,70</td>
<td>65,82</td>
</tr>
</tbody>
</table>

Source: Field Survey, 2011

All of the harvesters average annual income from selling of harvesting products is 1481,70 €. All of them expense annually average 65,82 € 153,5 € and 297,5 € for tax paying, labor cost and use loan money respectively. Lose 201.82 €, 38,06 € and 122,89 € annually for Water Hijacker, Forest staff and loan interest respectively. Loan providers take average 8.29% interest from all harvesters from their selling income of harvesting products. All harvesters average expense annually 879,6 € and total net annual income 602,14 €. Water hijacker, forest staff, loan interest significantly affect their income (losing 362,77 €) and lead to low income. This losing amount is 60.25% of net annual income.

5.9.8 Factors affect on income percentages

All forest harvesters losing money impose by Water Hijacker and Forest staffs. Water Hijacker collect money by forcing and Forest staff collect money illegal way through creating pressure.
5.9.8.1 Fishermen affect from percentage from selling income

Figure 5.14 Fishermen losing percentage of money for different factors

Source: Field Survey, 2011

Figure 5.14 shows factors that influencing to reduce harvesting income and percentage of reduction for Fishermen. Water hijacker highly affected the fishermen income about 17.11% loses from the harvesting product selling income. Forest staff and loan interest led 3.42 and 5% loss respectively from selling income of harvesting products.

5.9.8.2 Crab Catcher affect from percentage from selling income

Figure 5.15 Crab Catcher losing percentage of money for different factors

Source: Field Survey, 2011

Crab catchers lose about 18.13% money from their selling income for Water Hijacker. Significant amount of money lose for water Hijacker. 3.50% and 10% lose for forest staff and loan interest respectively (Figure 5.15).
5.9.8.3 Honey Collector affect from percentage from selling income

*Figure 5.16 Honey collector losing percentage of money for different factors*

Honey collector loses about 2.80% of money from the selling income of honey for Water hijacker. 2.4% and 10% lose for forest staff and loan interest respectively.

5.9.8.4 Nypa palm affect from percentage from selling income

*Figure 5.17 Nypa palm collector losing percentage of money for different factors*

Water Hijackers lead to loss 9.20% of money from selling income of palm collector’s harvesting products. Nypa palm collector loses 0.75% for forest staff and 10% lose for loan interest (Figure 5.17).
5.10 Household income and income persons

5.10.1 Income person’s in household

Table 5.12: Average income person in a Household

<table>
<thead>
<tr>
<th>Households</th>
<th>Income persons in household</th>
<th>Average income persons in household</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fishermen</td>
<td>1.6</td>
<td>1.5</td>
</tr>
<tr>
<td>Crab Catcher</td>
<td>1.4</td>
<td></td>
</tr>
<tr>
<td>Honey Collector</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td>Nypa palm Collector</td>
<td>1.6</td>
<td></td>
</tr>
</tbody>
</table>

Source: Field Survey, 2011

Table 5.12 shows average income persons in household. Head of the household income come from harvesting product (Fish, Crab, Honey and Nypa palm). In household of fishermen’s average 1.6 members involve with income and contribution for household income. Crab catcher, Honey collector, Nypa palm Collector average income members 1.4, 1.3 and 1.6 persons respectively. All harvester household average income members are 1.5 persons. Except the head of the household other income member’s income comes from laboring, small trade and service.

5.10.2 Household income

Table 5.13: Annual Average household income (Euro)

<table>
<thead>
<tr>
<th>Household (Harvester)</th>
<th>Income from harvesting</th>
<th>Income from other sources</th>
<th>Total annual income of Household</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Household (Harvester)</strong></td>
<td><strong>Income from harvesting products</strong></td>
<td><strong>Contribute to annual household income (%)</strong></td>
<td><strong>Contribute to annual household income (income from other sources) (%)</strong></td>
</tr>
<tr>
<td>Fishermen</td>
<td>587,65 €</td>
<td>86.72%</td>
<td>90,00 €</td>
</tr>
<tr>
<td>Crab catcher</td>
<td>567,17 €</td>
<td>90.40%</td>
<td>60,00 €</td>
</tr>
<tr>
<td>Honey collector</td>
<td>552.33 €</td>
<td>93.31%</td>
<td>45,00 €</td>
</tr>
<tr>
<td>Nypa Palm Collector</td>
<td>701,43 €</td>
<td>88.63%</td>
<td>90,00 €</td>
</tr>
<tr>
<td>Average(All harvesters)</td>
<td>602,14 €</td>
<td>89.76%</td>
<td>71,25 €</td>
</tr>
</tbody>
</table>

Source: Field Survey, 2011
Fishermen average annual income is 6677.65 Euro that 587.65 Euro come from harvesting income and 90.00 Euro come from other sources of income (Table 5.13). Crab catcher household average annual income is 627.17 € which 567.17 € come from harvesting income and 45.00 € come from other sources of income. Honey collector household annual income 597.33 € which 552.33 € come from harvesting income and 45.00€ come from other source of income. Nypa palm collector household average household income is 791.43 € which 701.43 € come from harvesting income and 90.00 € come from other sources of income. In fishermen household annual income 86.72% come from harvesting income and 13.28% come from other source of income. Crab catcher household annual income harvesting income contributes 90.4% and other sources of income contribute 9.6%. In Honey collector annual income 93.31% come from harvesting and 6.69% come from other source of income. Annual Income of the Nypa palm collector 88.63% come from harvesting income and 11.37% come from other sources of income. All harvesters household average annual income is 673.39 € which 89.73% come from sundarbans forest harvesting products and 10.23% come from other sources of income.

5.11 Problems of Livelihoods of sundarbans dependents

Every forest dependents people of sundarban are facing different challenges. Their income affect by water Hijacker, forest staff, loan and suffering for natural calamities like cyclone, flood, strom hijacke risky for tiger attack, enforcing of water hijacker, and scarcity of drinking water, lack of land property, salinity, low scope of alternative income, lack of government support make their vulnerable livelihoods. The figure (figure5.18) of livelihoods problems has drown from the study survey in Sundarbans.
Figure 5.18: Problems of Sundarbans forest dependents livelihoods

- Water hijacker collect money from harvesters by creating force
- Forest staffs illegal way collect extra money from harvesters
- Loan provider receives interest from harvesters
- Limit land for income generating
- Less scope of employment opportunities
- Lack scope of extra income generating
- Unproductive land for salinity
- Limit of land properties
- Risk of damage house, agricultural land, home state and livestock frequently affect by natural calamities
- Lack of education
- Less member income in a family
- Most of the women are workless
- Unown marketing system
- Limit scope of extra income
- Poor marketing system
- Lack of drinking water
- Lack of fuel
- Irregularity of Relief fund distribution
- Corruption and bureaucracy for disaster relief distribution
- Natural Calamities (Cyclone, storm, Flood)
- Wildlife attack (Tiger, Crocodile, Shark)
- Torturing and kidnapping by Water hijacker
- Salinity of rivers and canals water
- Dependence on pond water
- Salinity of underground water
- Expensive for set up deep tube well
- Lack of filtering instruments
- Expensive boiling of water need fuel

Source: Field survey, 2011
5.12 Discussion

In the above findings it is clearly seen that the household income level of fishermen, Crab catcher, Honey collector and Nyapa palm collector is very similar not so differ.

Fisherman (677,65 €) and crab collector (627,17 €) annual household income level is very close. Nyper palm collector comparatively better than fishermen and Crab catcher (791,43 €). Honey collector (597,33 €) income level comparatively lower than others. Family size of all categories of harvesters are also very similar. Land properties of fishermen, crab and honey collector are more or less similar. Nypa palm collector land property is better than other harvester but not high variation. So from the study we can say all of the sundarbans forest resources harvesters’ economic condition is not so difference to each other.

But overall every harvesters land status is very poor 31.77% households are land less own land householders land are very limit average (0.11 ha). So they have limit scope to use of land for income generating. Sundarbas buffer zone soil salinity is very high, unsuitable for agriculture production. This condition is also adverse for their land use. In the study found all household income person is very low (1.5) most of the family depends on one person income. All forest dependent household annual income is very low (673,39 Euro) in context of the economy of Bangladesh and other sources of income of households is very poor. For the low income they have no capacity to educate their children. After primary level most children are not able to continue their study.

All harvesters are highly dependent on forest recourses. About 89.77% household incomes come from their forest harvesting products. Average each forest dependent household consumption from his harvesting products (non-timber forest products) which value is 43,70 €. Average each household consume fuel wood from the forest which market value is 58,16 €. Each household total annual consumption (Non timber forest fuel wood) value is 101.86 €. About 25.82% households totally dependent on sundarbans forest fuel for their cooking. For cooking about 45.16 % household use half portion from forest fuel wood.
Total consumption of harvesting products value is higher than household others source of income (Household average annual other source of income 71.25 €).

Sundarbans forest is very rich and largest mangrove forest in the world. Significant amount of resources are harvested by all harvesters. They harvest satisfactory amount of forest resources that average annual selling income is 1481.75 €. But their annual net income from harvesting is 602.14€. Between annual harvesting selling income and annual net income from harvesting are vary big gap. i.e. 879.61 € they expense for purpose of harvesting in harvesting period (In table 5.11 mention how way they expense money).

Water Hijacker, Forest staff significantly affects the income of sundarbans forest harvesters (239.88 € lose annually). Water hijacker collect money from all harvesters by forcing and forest staff collect money illegal way. Water Hijacker and Forest staff led the low income of forest harvester. For this low income condition they borrow loan from the loan provider in condition of average 8.29% interest from harvester’s selling income of harvesting product (During harvesting period all harvest need money for arranging harvest operating). For this reason they lose significant amount of money for loan interest that amount 122.89 €. For their low income it is difficult to all harvesters for paying the loan money. They are always depends on loan. Harvesters are not able to come out from the loan dependency. Loan provider always gets 8.92% profit form the harvesters selling income.

These two factors (water Hijaker, and Forest Staff) very crucial point because that highly affect livelihood of sundarbans forest dependents. Water Hijaker makes worse and stress condition for all harvesters also make high risky life.

Fisherman pay extra money 358.11 Euro during harvesting period (Annually). If they could be free from water hijacker and forest staff illegal money collections (288.00 €) they are able to invest this money for maintenance cost (during harvesting period). In this situation fishermen have no need to borrow loan in harvesting period and also can free from 5% interest (70.11 €) for loan. Their income will be rise from 587.65 € to 945.76 €.
Same condition also for Crab catchers. Crab catchers paying extra money 460, 58 Euro. If possible to stop the Water hijacker and forest staff illegal money collection (315, 00 €) and invest this money for maintenance cost. In this situation crab catcher no need to borrow loan in harvesting period and also free from 10% loan interest (145, 58 €). Their income will be rise from 567,17 to 1027,75 Euro.

Similarly Honey collector and nypa palm collector also be able to increase their harvesting income if they keep free from water Hijacker and forest staff illegal money collection.

All of the forest dependent annual average net income from the harvesting products is 602,14 €. If all forest dependents be able to free from water Hijacker, Forest staff and loan interest. It will be create a great opportunity for them to increase 60.25% income from net income. This increase income will be support for improving their livelihoods. If we see the problem figure it is clear that the sundarbans dependent people livelihood is very vulnerable. Discuss in the recommendations for recovering of their vulnerable livelihood.
6 CHAPTER IV - CONCLUSION & RECOMMENDATION

6.1 Conclusion
At present demand of protected area is increasing in the globe for human well-being. Protected areas play a significant role for biodiversity conservation and sustainable development. Protected areas provide a diverse benefit to people. Protected area establishment makes a systematic way that people get proper benefit through sustainable use of PA resources and ensuring local people participation and involvement for management and decision making process. Nowadays people found that protected areas highly contribute for poverty reduction and livelihood improvement of the PA dependents people.

In this study we see Sundarbans is a very large protected area, diverse ecosystem and very productive for forest product. Sundarbans forest dependent can harvest satisfactory amount of forest products (Non-timber). Their average harvesting product values is 1481.70 Euro (annual selling income) and consume value is 101.86 Euro. In context of Bangladesh it is a satisfactory benefit that the Sundarbans provide for each harvester. But the harvesters Annual average net income is 602.14 Euro. It is a big differ between annual harvesting selling income and net income. From the study we observed that during harvesting period harvester’s expense and losing greater amount of money. Water Hijacker and forest staffs are responsible for losing their significant amount of money (239.88 Euro annually). These two factors led their low income. For low income every year all harvesters borrow loan for harvesting maintaining cost (during harvesting period they expense for food and equipments repairing cost). They loss a very high rate money for loan interest (Loan interest is 8.29% from harvesting selling income). They are not able to free from the loan dependency for their low income. If we compare with net income they losing about 60.25% money for water hijacker, forest staff and loan interest. We conclude that Sundarbans resources are available but dependents people are not getting actual benefits from Sundarbans resources. On the other side Sundarbans dependent people facing high risky for tiger attack during...
harvesting period and suffering for cyclone, storm and floods every year, also crisis for drinking water (high salinity of water). Harvesters are highly dependents on forest resources. Household major sources of income come from harvesting income (about 89.76% household income). Households other source of income is very negligible, very limit scope of alternative source of income in Sundarbans region. Sundarbas dependents people livelihood is very vulnerable. For low income they are not able to change their living condition. Sundarbans is both international and national designate of Protected area system but not effective for poverty reduction and livelihood improvement of forest dependents people for several factors. Good governance, strong low enforcement and active management system are important for ensuring actual benefit of dependent people from sundarbans resources. National and international PA authority, policy makers should care for improving livelihood of sundarbans dependent people.
6.2 Recommendations

Sundarbans dependents people livelihood is very vulnerable. They are facing different challenges and fighting with natural calamites, tiger attack, water hijacker enforcing, pressure of forest staff and crisis for drinking water. They have limit scope of land use and other source of income. Water hijacker, forest staff and loan interest significantly affecting their income and lead to low income. For low income they are not able to change their fortune. It is very urgent to free from the water hijacker and forest staffs influence that affect the forest dependents people income. It is also essential to remove from the loan dependency. Good governance, strong low enforcement and effective management system should be ensuring for actual benefit from the sundarbans resources and improving livelihoods of dependents communities.

For improving and securing livelihoods for sundarbans forest dependency people, I give my recommends in the followings

- Government should be implement strong low enforcement for protect water Hijacker influencing on forest harvesters income and torturing

- Ensure good governance for eliminating corruption of forest staffs for extra money collection from harvesters in illegal way.

- It should be free from the loan dependency of the harvesters for harvesting cost that make them stress and paying significant amount of interest. It can be solved easily if stop the water hijacker money collection and invest this money for harvesting cost.

- Harvesters can make own cooperative society for their unity and deposit their money and use this money during their harvesting for removing their loan dependency

- Government can create a loan scheme without interest for the harvesters
- GOs and NGOs can support for extra income generating for household by creating scope for alternative income generating

- Empowerment of women and support aid for their income generating i.e. establishment of small trade, tailoring and handicraft business

- Develop sustainable eco-tourism and ensure the local community involvement and benefit form eco-tourism.

- Harvesters can build their own harvesting product market direct selling their product (reduce dependency on middle man) for their benefit.

- Government should support for educating the forest dependency family through free education and set up programme for forest dependency community education.

- GOs or NGOs can support for development of livestock for forest dependency communities

- Build up sufficient cyclone center and effective disaster management system for life secure of the sundarbans dependents communities

- Government, NGOs should support for ensuring pure drinking water for sundarbans dependents communities through set up sufficient deep tube wall, surface water treatment plant and water filtering plant and promote for rain water harvesting.

- Government and NGOs should support for Setup bio gas plant and solar energy reducing pressure on forest wood consumption and availability of energy use.
- Government should ensure proper distribution of the relief money (government, national and international Agencies) after damaging the properties of forest dependences due to disaster i.e. cyclone, flood.

- Salinity tolerant agricultural crops should be developed and introduced for increase productivity of agricultural crops in sundarbans high salinity region.

- It should be ensuring effective management system of sundarbans resources management that will be well-being of local communities of sundarbans and community participation approach and involving them in decision making process.
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