IMPACT OF DEPLETION OF FOREST ON ENVIRONMENT: A CASE STUDY OF MADHUPUR PLEISTOCENE TERRACE AREA IN DISTRICT OF TANGAIL

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BY

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NOVEMBER, 2014

DEDICATED

TO

MY PARENTS

Certificate

This is to certify that this thesis entitled "Impact of Depletion of Forest on Environment: A Case Study of Madhupur Pleistocene Terrace Area in District of Tangail " submitted by **Manika Mitra** *has been carried out under my supervision. This is further to certify that it is her own work and suitable in partial fulfillment for the degree of Master of Philosophy in Geography and Environment Department, University of Dhaka.*

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ABSTRACT

Forest provides with environmental balance, bio-diversity & economic development. In Bangladesh intensive use of land and mostly forest land reduces forest area very rapidly. In the long run, Bangladesh will be losing her valuable forest resources and people in such areas almost will lose their past traditional activities. The traditional Sal forest lands are mostly misused and abused. With the increase of population and expansion of urban areas, forest land has been converted into settlement. As a result, the environment of such an area has degraded and wildlife and traditional plant species are going into extinction. The present study has been conducted in Madhupur Sal Forest by using face-to-face questionnaire administration to elicit information of people regarding depletion of forests. The questionnaire survey conducted on the basis of random sampling comprises answers to queries in the form of both open and fixed responses. The main objective of this study is to examine the causes of depletion of forest and its impact on the environment.

The causes and process of depletion of forest in the study area are somewhat different from other parts of Bangladesh as this area is dominated by Adibasis. Depletion of forest by Adibasis is not much as they know how to derive benefits from the forest without destroying it. But people who are engaged in preserving this forest are to be accused, along with the local Bangalis for destroying the forest cover. Due to depletion of forest both flora and fauna are threatened by the loss of habitat. As activities of man increases, the forest becomes less dense. Following depletion of forest among the total number of flora and fauna of Madhupur Sal Forest, 75% of the species have become rare or very rare. The temperature within the forest has risen. The quantity of sand has been found to be high in the deforested fallow land and the quantity of silt and clay low and also the quantity of organic carbon, nitrogen, phosphorus and potassium is found to be very high in cultivated lands. The quantity of these elements is very low in timber monoculture and deforested fallow land.

The above findings demonstrate the changes to the overall environment of the study area due to clearing forest. If the present trend of depletion goes on, the concerned area may, in course of time, lose its forest characteristics turn into an area of human settlement only.

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List of Acronyms

AF : Agroforestry

ACF : Assistant Conservator of Forests

BBS : Bangladesh Bureau of Statistics

BFD : Bangladesh Forest Department

BFRI : Bangladesh Forest Research Institute

BPC : Bangladesh Population Census

BSE : Bangladesh State of the Environment

C-GIS : Center for Environmental and Geographic Information Services

CTHs : Chittagong Hill Tracts

CR : Critically Endangered

CS : Cadastral Survey

DD : Data Deficient

EN : Endangered

EX : Extinct

FAO : Food and Agricultural Organization

FD : Forest Department

FRI : Forest Research Institute

FSP : Forestry Sector Project

GDP : Gross Domestic Production

GIS : Geographic Information System

GOB : Government of Bangladesh

Ha : Hectare

HYV : High Yielding Variety

IUCN : International Union for Conservation of Nature

ISODAT : Iterative Self-Organizing Data Analysis Technique

MNP : Madhupur National Park

MSS : Multispectral Scanner

MSF : Madhupur Sal Forest

NF : Natural Forest

NFA : National Forest Assessment / FAO's support programme for national forest Assessments

NGO : Non Government Organization

NO : Not Threatened

NSP : Nishargo Support Project

NTFP : Non Timber Forest Products

PRA : Participatory Rural Appraisal

PSF : Participatory Social Forestry

RS : Remote Sensing

SF : Social Forestry

SHED : Society for Environment and Human Development

SOB : Survey of Bangladesh

SPARRSO : Space Research and Remote Sensing Organization

SPOT : System Probatoire del' Observation de la Terre

SRDI : Soil Research Development Institute

TANDA : Thana Afforestation and Nursery Development Project

TM : Thematic Mapper

UNO : Upazila Nirbahi Officer (Officer in charge of a sub-district)

UN : United Nations

UNDP : United Nations Development Program

UNEP : United Nations Environmental Program

UNESCO : United Nations Educational, Scientific and Cultural Organization

UPL : University Press Limited

USF : Un-classed State Fore

WB : World Bank

WL : Woodlot

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1.1: Introduction:

Forest statistics in Bangladesh is anybody's guess; a real number of the percent of forest area is hard to come by. The National Forest and Tree Resources Assessment 2005-2007 classified approximately 10% of the surface area of the country under forest (BFD, 2008). The validity of the statistics remains questionable. Available data suggests that 90% of Bangladesh's forestry are lost or degraded due to the various pressures of a growing population (with an already existing base of 162 million people), development interventions, gaps in policy and legislation, and conflicting institutional mandates (Rasul *et al*., 2004; Rahman *et al*., 2008; ESCAP, 2009). The protected area network of the country represents 1.4% of the surface area, one of the smallest proportions of protected forest in the world (Kibria G.M., Sunderland T., Rahman A. S. and Imtiaj A.; Journal of Biodiversity and Ecological Sciences 1(1): 53-64, 2011). Even though the current deforestation rate is low (less than 1%), Bangladesh is at a major risk of losing its forest resources and biodiversity unless the trend is reversed (FAO, 2009). One eighth of the country's land area is affected by deforestation due to land clearances for agriculture, principally through shifting cultivation in the hill forests (Rahman *et al*., 2008). Other causes of forest loss include forest land encroachments, grazing, fire, uncontrolled commercial and subsistence logging, and fuel wood collection (BBS, 2008). While existing forest cover is lost on a large scale, there are very small gains by afforestation of denuded areas and newly accreted land. Local wood supply cannot keep up with the demand for raw materials resulting in shortages and increased use of imports. Biomass fuels are predominantly used in household cooking. Outdated inefficient technology is evident in forest resource harvesting and manufacturing, resulting in unnecessary wastage.

In this context, forest should have special attention for the government, and the people should be more concerned. Each and every country requires one fourth of her surface area under forest, which is congenial to ecological balance. But, Bangladesh is far beyond this equation. To arrest or at least to minimize the processes and drivers of deforestation, mass awareness should be taken into serious consideration. The multifaceted importance of forest in the lives of the country's inhabitants and the danger of deforestation should be well publicized and to build up awareness, different measures should be taken seriously by the government, NGOs and other social organizations.

Deltaic Bangladesh does not have enough forest cover. But the patches of forests that still survive are unique and are homes to hundreds of thousands of life forms. The forests are also homes to many unique traditions, knowledge systems, history and cultures. So, the forests in the true sense are integral parts of our existence and civilizations. (Gain Philip, 2006)

The word forest is derived from the Latin 'Foris', meaning outside the reference being to a village boundary or fence, and it must have included all uncultivated and uninhabited land. Today a forest is any land managed for the diverse purposes of forestry, whether covered with trees, shrubs, climbers, etc., or not. (Source: http://www.Independentbd. com/index.php)

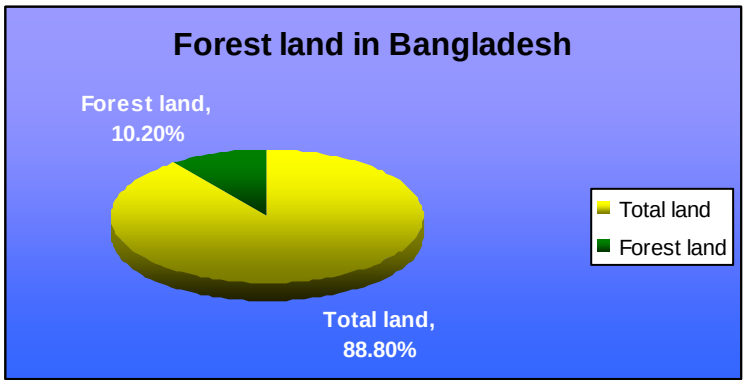
Technically forest has been defined as:

a. (In general) An area set aside for the production of timbers and other forest Produce, or maintained under woody vegetation for certain indirect benefits which it provides, e.g., climate or protective;
b. (In ecology) A plant community predominantly of trees and other woody Vegetation, usually with a closed canopy; and
c. (In law) An area of land proclaimed to be a forest under a forest law.

Forests are vital for maintaining the earth's ecological balance. The accepted standard according to the experts of environmental science is that a country must have 25 percent of its total land area covered with trees or forests (Huda and Roy, 1999). Once covered by dense forests, Bangladesh is now almost devoid of forested land, except in a few selected areas of the country (Giri and Shreshtha, 1996). In terms of per capita forestland, Bangladesh ranks amongst the lowest in the world, which is about 0.02 ha per person (UNEP, 2002). According to the Forestry Master Plan (FMP) and surveys by multi-lateral donor agencies, a total of 769,000 hectares or 6 percent of the country's land mass have actual tree cover (Huda and Roy, 2001). However, according to the Bangladesh Forest Department (BFD), the country now has about 7.7 percent of the land area under forest cover (MOEF, 2002). Food and Agricultural Organization of the United Nations (FAO , 2003) reported higher statistics for forest cover in Bangladesh , which is 10.2

percent of the total land area . In any case, the area covered by forest is far below than the required level for maintaining ecological balance in Bangladesh.

Figure-1.1: Forest Land in Bangladesh.



Source: According to FAO, (2003).

A renewable natural resource is forest. According to Spurr et al. (1980), forest is a unique ecosystem in which plants and animals live together through their mutual interaction. In the terrestrial ecosystem, forests are both environmentally and economically important natural resources (BSE, 2001). In recent years, forests with their .great natural ecological resources, serving humanity for thousands of years are declined on the wear in Bangladesh and have reached an all time low. The forest supply fuel wood, thatching materials, honey, fish and wax etc, but the shrinking of forest is gradually failing to supply the increasing demand apart from timber. Forests play an important role in maintaining the biological productivity of land, especially by water resource management, soil and water conservation. According to NEMAP (1998), preservation of inherited resources is both a matter of insurance and investment that is necessary to sustain and improve the production in agriculture, forestry and fishery, to protect against harmful environmental changes, and to prevent extinction of species whose virtues are not yet known.

Only about 14 percent of the earth's land surface covers tropical forests, but they are exceptional in the wealth of biodiversity. Almost half of all vertebrates, 60 percent of known plant species and possibly 90 percent of the world's total species occur in the tropical forests. Forests covered much larger areas of the tropics, which experience a prolonged dry season and have a more open canopy. In terms of species concentration

and biological resources, these tropical dry forests are comparatively much poorer than tropical moist forests (rainforests). But they may contain genetic resources of populations with potentially valuable adaptations to withstand environmental stresses and to survive on degraded sites. For many tree species, dry forests (Like 'Sal' forests in Bangladesh) in some areas are particularly significant such as Central America are famous for being recognized as a central of genetic diversity as well as for the wild relatives of some crop plants. These forests, particularly the 'Sal' forests of Bangladesh, India and Nepal have already been severely depleted owing to encroachment and other anthropogenic activities, especially agriculture, pisciculture, litter collection, over-exploitation and lack of management practices etc.

According to the "Forest Master plan" (1993), Bangladesh never had huge forest cover. Total forest lands managed by the forest department, land ministry and individual are 24,60,000 ha-16.85% of the land surface of the country. But the information generated in the "Forestry Master Plan" suggest that the actual forest cover in the country will not exceed 6% per capita forest in Bangladesh, has shrunk to 0.022 ha, which is said to be the lowest in the world. This little percentage of forest cover can not retain the ecological balance.

The area under forest is estimated to be 2.46 million ha which in about 16.7% of the total land areas. Out of this forest lands, 1.461 million ha are managed by the Forest Department, 0.728 million ha are unclassed state forest under the control of the district administration and 0.271 million ha are privately owned rural woodlots (Rahman, 2000).

1.2. Forest Distribution of Bangladesh:

In Bangladesh, the total forest area including unclassed state forest land is about 2.25 million ha. A large part of the area, however, has no tree cover. Over the last three decades forest cover declined by 2.1% annually (Source: http//www.banglapedia.org).
Village forest or village groves play a very important role in the economy of the country. A significant portion of the wood and firewood supply of the country is provided by these. Village forests have several important uses besides wood production. They provide fruit, fodder, fuel, raw material for small and cottage industries, house construction materials, agricultural implements, cart wheel, etc. The area covered by village groves or forest is estimated to be about 0.27 million ha. This is not forest as per

definition. In the context of Bangladesh, however this tree cover is very significant in many ways.

Tea garden which needs mention is another category. Within the tea garden, a good quantity of tree resources is available. The tree cover areas of tea gardens are fast depleting. Approximately 2800 ha are available under this kind of tree cover, and distributed in Chittagong, Sylhet and Rangamati (Source: http://www.banglapedia.org).

The third category of forest which is fast emerging is the plantations on non-forest public land, such as road side, railway embankment, and canal banks. These marginal land plantations in one way are substituting for the decreasing village forests, and are adding a new dimension to fallow land utilization.

The state owned forests (See table 1.1) of Bangladesh are distributed in three zones:

a) Hill forests in the greater districts of Chittagong, Chittagong Hill Tracts, and Sylhet;
b) Inland forests in the central and northern zones; and
c) Littoral forests in the delta and coastal regions.

Table-1.1: Status of the state-owned forest land (in Hectare)

Forest Type	Reserve Forest	Protected Forest	Vested Forest	Acquired Forest	BWDB and Khas	Un Classed State Forest	Total
Hill	594,383	32,303	2,636	11,004	---	721,344	1361,670
Inland	68,140	2,689	19,985	31,198	---	---	122,012
Littoral	656,579	---	---	6	101,526	---	758,111
Total	13,19,102	34,992	22,621	42,208	101,526	721,344	22,41,793

Source: Banglapedia: Forest and Forestry.

Map-1.1: Map of Bangladesh Showing the Forests and the Location of Protected Areas.

Source: Nishorgo (A Program of the Forest Dept., Ministry of Environment & Forests, 2008).

Bangladesh has a tropical humid climate with annual precipitation ranging between 1500 mm and 5000 mm. The ecology is tremendously suitable for tree growth, yet pressure on land by increasing population leaves little area available for forestry. The country is divided into three forest ecological units, such as:

(a) Tropical evergreen and semi-evergreen (640,000 ha) hill forests in the Southeast;

(b) Tropical moist deciduous inland Sal forests (122,000 ha) in the central and northern Parts;

(c) Tidal forests (520,000 ha) in the southwest.

(Source: Stolen Forest by Philip Gain, 2006)

A significant source of wood products in villages is homestead forests also. Forests represent an important reserve for fuel, timber, food, and medicine. In Bangladesh about 83 percent of all wood consumption is in the form of fuel wood yet (UNDP 1989). The bulk of which is used for cooking in rural areas. Higher demand for fuel wood and other forest products has resulted into progressive encroachment of forestlands and depletion of tree formations over the past four decades. The status of the people who inhabit the peripheries of forest lands and depend on forest products for their livelihood has also adversely affected by this process of deforestation.

Bangladesh forests comprises the land of 2.46 million ha which is about 16.7 percent coverage (Anon, 1998) of the total land, but the actual forest cover is much less than this official estimate. There are a number of forest cover estimates available, often conflicting and difficult to compare, but they all indicate forest cover is of less than 14 percent of the total land. As far back as 1976 and 1979, UNESCO/MAB and the Asian Development Bank respectively estimated forest cover at 10.5% and 9.0%. Actually, forest cover presently predicted to be one million ha or 6.9% of the total land, a reduction of more than 50% over the past 20 years (Rahaman, 2000). But in the last report, the actual forest cover in Bangladesh is only 0.84 million ha or 5.8 % which was published by the Forest Department itself.

In Bangladesh the traditional Sal forests belong to the category of tropical moist or dry deciduous forest (Gain, 2002). The condition of topography, geology and soil is controlled by the distribution of Sal forest. Sal forests are mainly distributed in the South

and Southeast Asia, occurring along the base of Tropical Himalayas from Assam to Punjab, in the eastern districts of central India, and on the western Bengal Hills. Sal forests have the widest distribution among all dipterocarps, extending over an estimated area of 13 million ha in India alone; while Bangladesh and Nepal together have over one million ha. In Bangladesh, an area of about 121,000 ha of Sal forests cover which is about 32% of the total forestland (Rahaman, 2003). In central and eastern part of Bangladesh Sal forests used to cover vast areas traditionally. In addition to the 'Sal' trees (*Shorea robusta*) which constitute 70 to 75% of the forest composition, this type of forest includes several valuable tree and herbaceous species like the sun grass (WRM, 2001). Some parts of Dhaka, Rangpur, Dinajpur and Rajshashi districts of greater Mymensingh and Tangail which is the largest belt, distributed between the Bramaputra and the Jamuna river extending a length of about 8 to 24 km running from north to south is covered by the traditional Sal forests. This belt is known as "Madhupur Ghar". Sal forests are one of the main forest areas in Bangladesh where a cross section of tribal people have been dwelling and they are dependent on forests for their total livelihood (Rahman, 2003).

1.3. Importance of Forest Resources:

Forest is functionally to the satisfaction of individual wants and achievement of social objectives in two different ways-(1) Direct and (2) Indirect.

Directs utilities of forests can be enumerated as follows:

a) It keeps up the atmospheric balance of oxygen and carbon-dioxide, which always tends to be disturbed by human expiration of carbon-dioxide and inspiration of oxygen.
b) In the modern world man obtains his basic requirements i.e. food, clothing and shelter from forest. But man gets multitude of articles from forest in the modern world. They get food, fuel, fiber, timber, drugs, nut, tan materials, cork, rubber and other things.
c) The lumbering industry is exclusively based on forest.
d) Forests provide the foundation of shipbuilding industries, maritime expansion and naval prowess in countries bordering sea.
e) The art of making paper from wood pulp developed in the 9^{th} century, the manufacturing of rayon, cellophane and other, cellulose products, almost entirely an achievement of 20^{th} century are dependent on forest resource.

Indirect utilities of forests can be enumerated as follows:

a) Forests put forth a profound influence on which vegetation transpiration increases atmospheric humidity and by there, enhance the possibility of rainfall.
b) The roots of trees hold the fertile grains of soil tightly together and do not allow them to be washed away or swept out by flowing water or blowing wind nor do they permit the splashing action of rain drops to take the toll of soil fertility.
c) Forest also has no depending influence on violent with wind and hence it minimizes the effect of wind action on erosion.
d) Forests provide the habitat for wild life.
e) Decomposed leaf litters add humus and nitrogen to soil and enhance soil fertility.
f) Forests control flood by preventing sedimentation in the river and consequent rise in the river bed.

1.4. Concept of Depletion and Forest Conservation:

Depletion refers to the permanent conversion of natural forest area to other uses, including shifting cultivation, permanent agriculture, ranching, settlements, and infrastructure development. Deforested areas do not include areas logged but intended for regeneration or areas degraded by fuel wood gathering, acid precipitation, or forest fires. Negative numbers indicate an increase in forest area. The indicator is measured as the average annual percentage change in forest area during the last 10 years [Data source: The World Bank: Annual deforestation (% of change) (ER.FST.DFST.ZG): Food and Agriculture Organization, Global Forest Resources Assessment].

Depletion means disappearance of forest area and abolishment of forest environment, i.e. destruction of animal shelter, significant decrease of tree density, and loss of bushy area, disappearance of forest rainfall etc.

Depletion or deforestation is a land use and land cover problem. It is the permanent change from forest to non-forest such as agriculture, human settlement, and grazing land. The Food and Agriculture Organization (FAO) estimates that some 135,680 sq. km of tropical forest have been destroyed each year since the 1980s. Deforestation and the destruction of other vegetation increase the amount of carbon dioxide (CO_2) and other green house gases in the atmosphere. When a forest is cleared to establish cropland or for other uses, the carbon stored in the biomass is released into the atmosphere as CO_2.

Most scientists assume that global warming is caused by burning oil and gas. But in fact between 25 and 30 percent of the greenhouse gases released into the atmosphere each year amounting about 1.6 billion tones- is caused by deforestation. Trees are considered to store about 50 percent carbon. When they are felled or burned, the CO_2 they store escapes back into the air. (Islam Jinnahtul, 2011 on Forestry Congress) According to FAO figures, some 13 million ha of forests worldwide are lost every year, almost entirely in the tropics. Deforestation remains high in Africa, Latin America and Southeast Asia.

The forest ecosystem in Bangladesh has been severely damaged by the destructive anthropogenic and natural impacts coupled with overexploitation of forest resources (Rahman et al., 2010). Of the total area in Bangladesh, forest lands account for approximately 2.52 million hectares (m ha), which is about 17.08% of the country counting all the public forestland, unclassed state forests and village forests together (Forest Department 2010). The forest of Bangladesh fall broadly into 3 major types. These are (1) the semi –evergreen forests occurring in the eastern hills of Chittagong, the Chittagong Hill Tracts (CHT) and the Sylhet District (hill forest) and comprise roughly 50% of the total forest area where main prevailing species are natural Dipterocarpus and associated species; (2) the deciduous Sal (*Shoria robusta*) forests on the central and northwestern terraces in the district of Dhaka, Tangail, Mymensing and Dinajpur constitute a mere 10% of the remaining forest area of Bangladesh; and (3) the extensive littoral Mangrove forest adjacent to the Bay of Bengal, the Sundarbans, the world's largest mangrove forest. Being at the mouth of the great Ganges-Brahmaputtra-Meghna river system, the Sundarbans is the tidal swamp of a vast delta. The Bangladesh portion of the Sunderbans stands within the districts of Barisal, Patuakhali, Bagerhat and Khulna. Its total area is 6,000sq. km, of which 4,200sq km are forest covered and remaining 1,800 sq kmare water Bodies. ITS average elevation above mean sea level is only about 1.5 meters (Islam Jinnahtul, 2011).

Evidently all forest areas in Bangladesh are suffering from clear-cutting and depletion or degradation, and are contributing the Green House Gas emissions. Other sources GHG emissions include grazing animals, land cultivation, fossil fuel burning, marshland destruction, industrial wastes, brickfield kilns, and rural chulas for cooking, natural gas combustion by industries, animal and other wastes.

Accordingly to a global survey conducted in 1970 A.D about one-fifth of earth's land was covered by closed forests with a canopy cover of 20% or more while another 12% was under the open woodland with 5-19 percent of canopy cover. This forest cover is already considered a meager one and even this too is shrinking at a fast rate.

Such regional or global estimates of deforestation, however, do not yield a clear picture of the deteriorating situation. The extent of wasteful depletion is usually found to be much higher than the estimated or reported figures (Asthana, 2001). The total annual rate of depletion of forest in Tropical Regions is 7,300,000 ha. while Tropical America has 4,200,000 ha.; Tropical Asia has 1,300,000 ha. and Tropical Africa has 1,300,000 ha. (FAO-UNDP Study, 1998).

Depletion is a consequence of over-exploitation of our natural ecosystems for space, energy and materials. The basic reasons for such extensive depletion of forests are:

1. Poverty with rapid population growth;
2. Expansion of agriculture;
3. Expansion cultivation on hill slopes;
4. Shifting cultivation;
5. Cattle ranging;
6. Firewood collection;
7. Timber harvesting.

To maintain a healthy environment and obtain a sustainable supply of a number of forest products, natural forests should be carefully managed and conservation of forests should involve the following two aspects:

a) Prevention of depletion;
b) Extension of our forest wealth.

a) Prevention of depletion:

So far, Relied upon the natural regeneration capability of forests to obtain various products such as fuel wood, timber, fodder etc. However, at many places and in most of the third world countries we have been extracting materials much more than the average productivity of the system. As a consequence our forests are shrinking and are gradually

degenerating into useless waste lands. In order to prevent further degeneration of our forest wealth we should adopt rather strict measures, which involve:

(1) Controlling unregulated expansion of agriculture and cattle ranching at the expense of our natural forests.
(2) Controlling unregulated fuel wood collection and timber harvesting.
(3) Controlling unregulated grazing and destruction of green cover.

b) Extension of our forest wealth:

There is plenty of space, large stretches of degraded barren wasteland, hill slopes, arid and semi-arid regions on which forests can extent. A combination of soil conservation measures and techniques of growing and maintaining plant life are needed to carry out the reforestation and afforestation drive. Active co-operation of local people in reforestation and afforestation drive should be sought as without it all our efforts could end in utter failure.

1.5. Significance of the Study:

In the central region of Bangladesh, the Sal forests are the remnants of a much more extensive forest which formerly extended from south central Bangladesh westwards well into the Indian sub continent. The remnants of the Sal forests are an important component of the natural heritage of Bangladesh and it is therefore important to preserve living examples of this forest type and its associated flora and fauna. Most of the remaining Sal forest is degraded both in terms of forest structure and biodiversity. For economic development every country needs 25% of forestland of its total land surface. For environmental balance, biodiversity, watershed and humidity of atmosphere every country needs forest. But at the present status of forest in Bangladesh is very hopeless. The annual deforestation rate in Bangladesh is also alarming 3.3%, which is 0.6% in South Asia (http://www.fao.org/docrep/ARTICLE/WFC/XII/0293-C1.HTM#fn1). Rare wildlife and biological diversity have also reduced quite rapidly due to forest disappeared. Many species have gone totally extinct. While severe deforestation has taken place in the Sal forest areas. Traditional Sal forest is becoming a history. After the introduction of commercial monoculture of rubber and eucalyptus and other exotic varieties the shoots of Sal forest have been clear cut in areas where regeneration could take place with minimum expenses. In many areas for the preparation of beds for

monoculture of commercial plantations the stumps of Sal trees have been up rooted even. This has destroyed the last change of protecting biodiversity in the unique Sal forest.

The forests are situated in 488 mauzas in 23 Upazila according to Gain.et.al. (1990). The three forest divisions prepared a statement of areas by mouzas showing areas notified as forest area under tree cover, degraded land plantation and encroachment in 1986. Based on 1981-population census and 1983/84-agriculture census, the statement contains the basic data on area of the mouzas population, number of cattle and poultry.

In the statement, wooded land refers to areas under tree cover crop of 10 years or older which is generally composed of Sal coppice origin. However, in the Madhupur forest and the forestland along the border belt of Sherpur and Mymensingh districts, there are stands of Sal seed origin. There are other species seen growing as associates of Sal in these two zones. The common species are dilemma pentagyna (ajuli), adina cord folia (haldu), artocarpus chaplasha (chapalish) and lagerstroemia parviflora (jarul). So we have needed to preserve the traditional forest management concept for economical, social and environmental balance. We have also needed to taken care of our biological diversity. Many species of wildlife are going to be extinct. We have a commitment to our future generation for a sound environment. For these reason this research study is important.

This study will investigate the preview of existing forestland in Bangladesh and there will be an attempt of measure which factors are mostly involves in the depletion of forest activities. Through this study sources of opportunity will be find out to improve existing environmental coverage and agriculture based economy.

1.6. Aim and Objectives of the Study:

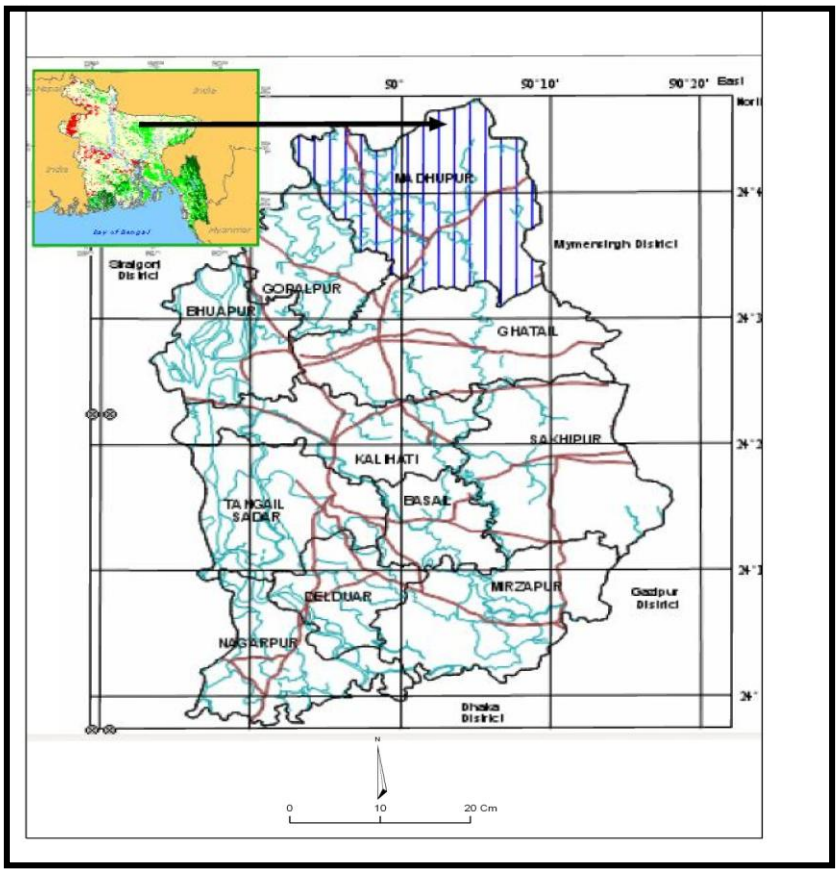
The main aim of the study is to find out the process of depletion of forest and its impact on environment. Keeping this aim in view the objectives of the study is set as follows:

- To collect information and data about forest status in the study area;
- To identify the causes of depletion of forest of the study area;
- To identify the environmental degradations due to depletion of forest, i.e. change in the characteristics of soil, biodiversity, micro-climate; etc.
- To assess the existence of flora and fauna by using “IUCN Method”.

1.7. Site Selection for the Study:

Most of the research works on forest related topic had done in Bangladesh are on Sundarbans and the forest of Chittagong and Chittagong Hill Tracts. In this aspects, the present study attempts to focus on the region of Madhupur Upazila (see Map-1.2). Sal forest of this Upazilla is the oldest and famous forests. But today it is almost destroyed. The present study has chosen "Madhupur National Park" which covering fully or partly: Aronkhola, Beribaid, Gachhabari, Pirgachha, Dokhola, Rasulpur and Chunia etc.

Map-1.2: Location of Madhupur Upazilla.



Source: Modified after Islam Sheikh Tawhidul, Khan H. Mamunul and Marinova Dora (2006).

1.8. Ecological background of the Study Area:

Madhupur forest tract is part of the eco-region named as 'Moist Deciduous Forests of the Lower Gangetic plains'. It is a tropical moist broadleaf forest eco-region of Bangladesh and eastern India. This eco-region once stretched along the lower reaches of the Ganges and Brahmaputra river plains across the Indian states of Bihar, West Bengal, Assam, Uttar Pradesh, and Orissa, and most of Bangladesh which is historically represented

these tropical moist deciduous forests. At present, the Madhupur forest covers an area of 8,436 ha.

"Madhupur Garh" is a slightly elevated tract not exceeding 20 m in height over the general surrounding lands. The ridges locally known as "Chala" are not continuous and are covered with forest formations. There are numerous depressions with gentle slopes intercepting the ridges. Almost all the depressions, commonly known as "Baid", are cultivated for growing rice.

According to Puri et al. (1989), the upper canopy contains the deciduous species, the vegetation is semi-deciduous and the second story is dominated by evergreen species. The dominant species of the upper canopy is Sal (*Shorea robusta*). The common associates of Sal at the top canopy are Ajuli (*Dillenia pentagyna),* Amlaki *(Phyllanthus emblica)* and *Terminalia* sp. Some Shimul (*Bombax ceiba),* Koroi (*Albizzia procera)* and Palas *(Butea monosperma)* can also be found in this stratum. The second story contains *Mallotus philippinensis, Mimosa rubricaulis, Bauhinia* sp, *Wrightia tomentosa* and *Zizyphus rugosa*. The undergrowths are of a few species. These are *Holarrhena antidysenterica, Glycosmis arborea, Randia* sp., *Chromolaena odorata, Clerodendrum viscosum, Curcuma* sp. *Elephantopus scaber, Oplismenus compositus* and *Asparagus acerosus*. In this area a few leguminous herbs such as *Desmodium laxiflorum* and *Desmodium triflorum* are also present. The common climbers are *Spatholobus roxburghii, Dioscorea pentaphylla, Smilax macrophylla* and *Scindapsus officinalis*.

The One-horned Rhinoceros (*Rhinoceros unicornis*) and the Bengal Tiger (*Panthera tigris*), both of which were previously many in number are now extinct from this forest tract. Other large mammals, which include Swamp deer (*C. duvauceli*) Hog deer (*Axis porcinus*), Samber (*Cervus unicolor*), Barking deer (*Muntiacus muntjak*), Rhesus macaque (*Macaca mulatta*) and 2 Wild boars (*Sus scrofa*) were also common. Among the smaller wildlife the common Mongoose (*Herpestes edwardsi*), small Indian Mongoose (*H. autopunctatus*), small Indian Civet (*Viverricula indica*), Hispid Hare (*Caprolagus hispidus*), jackal (*Canis aureus*), fox (*Vulpes bengalensis*), Fishing Cat (*Felis viverrina*), squirrel and porcupine are still present, although they are now seriously reduced in number. Amongst the reptiles, the Bengal Grey Lizard (*Veranus negalensis*), the Common Skink (*Mabuya carinata*) and the Garden Lizard (*Calotes versicolor*) can

be commonly found in the open areas of the forest patches. Madhupur tract is also a good habitat for snakes, especially cobras. Although important species like the Common Peafowl have become extinct from the forest, the diversity of avi-fauna is also rich. Streams flowing between the ridges support a special group of fish species which depend on these clean and fast flowing waters.

Madhupur 'Sal' forest's overall health is extremely poor. The forest has been greatly disturbed by human activities through encroachment, tree felling, burning and grazing. Fruit orchards and human settlements have been converted from. In the course of time, the disturbance created by humans and their domestic animals is so great that it altogether changes the appearance of the forest. There are virtually no primary Sal trees in the forest, as the existing ones are all coppices. From this kind of successive coppices and under such disruptive conditions are deformed when trees produced it did not produce any good quality timber. Due to the depletion and clearing of forest cover, incidences of invasion from invaders, such as the *Chromolaena odorata*, are very high. Ismail and Mia reported the presence of this invader in Madhupur forest tract as early as in 1972.

Still the dense human population is growing rapidly. The urbanization, industrialization, and agriculture associated with this growing population and its resource and economic needs pose serious threats to the remaining forest fragments. The small, protected areas are vulnerable to this tidal wave of human growth and are inadequate for conserving the biodiversity of this eco-region. Finding additional habitats for protection will challenge. Therefore, critical habitat restoration should be considered where necessary and the existing protected areas should be effectively managed and protected.

1.9. Methods of Data Collection:

To accomplish this study properly both the primary and the secondary data were collected based on the objectives of the study. The data collection methods used, are placed below.

1.9.1. Primary Data Collection Methods:

The research work is mainly based on accumulation of primary data. The primary data are collected by using the following methods:

(i) Questionnaire Survey:

The present study used face-to-face questionnaire administration to elicit information to people. The questionnaire survey is conducted on the basis of 'Disproportionate Random Sampling', which are not distributed according to the population of the selected side. The questionnaire comprising 44 queries in question or statement from and design pre-tested to accommodate both open and fixed responses. It is divided into three different parts such as socio-economic profile of the respondents, causes and process of depletion and their impacts on the environment (both social and physical).

(ii) In-depth Interview:

In-depth interviews are carried out using the questionnaire prepared on the basis of study objectives to cross-check the Questionnaire Survey Data. Forest officers [e.g. Assistant Conservator of Forests (ACF), Range Officer (RO), Beat Officer (BO), Forester concerned], NGOs representatives, UNO (Upazilla Nirbahi Officer), Agriculture Officer were interviewed with comprising 20 questions for in-depth interview to carry out their valuable comments (See appendix-B).

(iii) Observation:

Observation is an inseparable part of the methods discussed above. Direct observation, questionnaire survey and PRA are prepared as a checklist of both flora and fauna. Then the rate of disappears of biodiversity is identified to use the 'IUCN Method' (see-Appendix-D).

1.9.2. Secondary Data Collection:

To accomplish the study, secondary data along with the primary data were also considered. These are mostly official documents and records, journals, books, thesis, reports, dissertations, maps, satellite imageries of Madhupur forest area are collected from different libraries of govt., semi-govt., universities, NGO, etc.

1.10. Methods of Data Processing and Analysis:

Data (qualitative and quantitative data) collected from the study area are processed and analyzed by using Ms- Excel, Ms-word etc. for exploring the objectives of the study.

1.10.1. Preparation of Map:

Maps of the study area are considered and analyzed. Overlay and analysis of maps are done by graphical software like Ms-map point, Ms-word, Adobe Photoshop and Adobe Illustrator, Arc GIS software.

1.10.2. Conducting Survey:

The survey is conducted to get about the socio economic conditions of the people, process and impacts of depletion of forest in the study area. The source of data analysis of environmental impacts on depletion of forests at Madhupur Upazila was collected through the questionnaire survey and also the In-depth Interview of the forest experts.

1.11. Limitations of the study:

Although in the present study information was collected from both primary and secondary sources, there are huge limitations observed:

1. The study involves small span of time. More time should be allotted for the study.

2. Money is another most important factor to influence the various procedures of research activities. Big amount of money need to acquire complete research activities.

3. Manpower is the important factor to influence the research study. As it's the individual research study; there is no opportunity to engage other persons. As a student, individual initiative has been taken to done the research activities. But in other social research activities it has needed a large number of manpower and skills.

4. The communication system of Madhupur Forest is very bad. Bicycle and Tricycle is the main transportation to go any area of this place. On the other hand the unmetalled road becomes muddy by little rain.

5. At present Madhupur Forest is not only situated successively but also scattered far-spreading. As a result, it takes more time and more labour to collect data from forests areas.

6. The Respondents who were local dweller, thought the interviewer as a man of Govt.or forest department or income tax and they avoid answer of the questions. It is noticed that the families which were economically solvent and involved in collecting wood from forest illegally didn't give answer because they thought the interviewer man of forest department. They conceived they will be punished by the forest authorities.

Moreover, there may have some limitations of the research study. These are collection of maps, data summarization and analysis. But it has been tried hardly to avoid those unexpected problems in order to carry out the study in a sound manner.

2.1. Literature Review:

Reviewing literature is a continuous process without any limitation. It always enriches one store house of knowledge and skill. Naturally it helps formulating, defining and verifying problem and developing the theoretical conceptual framework for the problem under study. In fact finding, simply descriptive and explanatory studies, review of related literature, recapitulation of long standing memories, day to day flashing of various information related to forestry may be more visibly present instead of theoretical conceptual framework. However, carrying out research is not possible until and unless the development process of the problem, its present status and the trend towards future is thoroughly understood and how the problems are being confronted or dealt with by concerned people. Reviewing of existing literature is important irrespective of the nature of study and the extent of formularization and systematization of research procedure. Pertinent literature and personal experiences in the field of study helps all the ways and at all levels. To my credit innumerable related books, journals proceedings of various conference seminars, workshop studied.

A good number of studies on various aspects of forests have been conducted in the recent years, but only a paucity of literature of the current purpose of the study have been found in Bangladesh. A thorough search has been made in different libraries of govt., semi-govt., autonomous institutions, universities, etc. for various published and unpublished materials, books, journals, documents, etc. Although a considerable literature on depletion of forest is available on global scale, but there appears few studies in the context of Bangladesh. An effort was made at the preparatory stage to look for and review relevant studies reports in order to obtain background and ancillary information of Madhupur Sal forests of Bangladesh. The stock of such literature that relates directly to the research is very limited.

An in-depth study of Sal forest regeneration strategies was found rich in information on basic characteristics of the Sal forests in central Bangladesh which is given by Ghani et. al.(1990). This study, consisting of three parts, offers a definitive plan to rehabilitate and regenerate the depleted and encroached Sal forests. In these volumes Ghani et. al. have given a status report of the Sal forests, narrated some of the historical aspects, discussed land capability factors and evaluated various land use options for Sal forest area. The study also made a series of recommendation in management, legal and financial sectors.

A significant recommendation of this report was to replace Sal forest by growing species in the long run.

The physical and socio-economic structure of Madhupur Tract after deforestation was explained by Alam and Habib (1999). They also identified causes of depletion as well as the degradation of the environment.

Asthana and Asthana (2001) stated in the sixth chapter of their book of Environment problem and solution which narrates the causes of deforestation, its consequences and forest conservation.

The types of deforestation in various parts of Bangladesh are described by Gain (1997). He also denotes the causes of degradation including the deforestation and its effects.

Hirst (1916) thought that the Barind & Madhupur Tracts are locally uplifted "as compensation to the line of subsistence "passing between them. According to Morgan & Mclntire (1959) the Madhupur area, the northeasterly fault black, is bounded on the west by a series of six en echelon faults, up thrown on the east & this uplift has caused some of the old Brahmaputra distributaries to become antecedent which probably helped of the old Brahmaputra to its channel.

Bhuiya and Kamal (1995) explicate various attributes of land use change in five mauzas of Kaliakor Thana in Gazipur district during 1921-90 after depletion.

Gain (2000) describes the types of depletion of forest in various parts of Bangladesh. He also denotes the causes of depletion of forest and their effects on physical and cultural environment.

The causes of depletion of forest and desertification, and the relationship between depletion of forest and desertification is illustrated by Khuda (2001).

Morgan, J.P. and McIntire, W.G., (1959) did a reconnaissance survey of the Bengal provinces of East Pakistan and India (Bangladesh). They observe Pleistocene terraces which are drastically modified by major structural activity. The Madhupur Pleistocene

unit is bounded on the west by a series of echelon faults and has been uplifted and tilted northeast. They suggest that the uplift of Madhupur has caused some of the Old Brahmaputra distributaries to become antecedent, which probably helped effect the diversion of the river to its present channel.

Marchak (1995) narrates the types of depletion of forest and their causes. He also denotes the devastating effects in different part in the world.

The process of depletion of forest in the Madhupur Tract and its impact on the environment is explicated by Pervin (2002).

A detail study of the Madhupur Tract named "Geology of Madhupur Tract and its Adjoining Areas in Bangladesh" has been made by A.K.M. Khorshed Alam (1988) of Geological Survey of Bangladesh (GSB). In this report he discus about the area, population, climate, structure, geomorphology, stratigraphy and drainage of the Madhupur Tract. But he gives emphasize mainly on the structure and stratigraphy of the region.

Rahman (2000) describes the present situation of the six selected sal forests of Bangladesh and prepare a comprehensive checklist of phyto-diversity after deforestation.

Shaheed et al (2000) elucidate the effects of depletion of forest on environmental setting. They also explain socio-economic causes of this mal-practice.

Gupta and Puri (1998) of their book of Forest Ecology discuss about the forest environment and human interference. They also discuss the multiple effects of deforestation on nature and human behavior.

In the book of Chittagong Hill Tracts: Environment, culture and Ecological hazard by Shaheed et al (2002) explains the process of deforestation by the different types of human activities and their adverse effect on environment in CHTs.

In the report "Forestry Master Plan-2" cited (1988), 48 crops have been rated for agro-ecological zone and land suitability assessment. Several important tree crops are included, i.e. mango, jackfruit, rubber, tea, coconut, oil palm. In addition many of the other crops rated are important species to be considered for agro-forestry systems promoted for participatory forestry. This could also provide the basis for farm systems research and development for forestlands, both classified and reduced by land clearing for human settlement and agriculture. At present, the remnants of natural vegetation types only occupies a small percentage of the land area of Bangladesh. The remnants are constantly being reduced by over exploitation, conversion to forest plantation, conversion to permanent agriculture and encroachment for shifting cultivation or bush fallow farming. If the present trends continue, the remnant of the natural vegetation of Bangladesh will be completely lost in the coming of few decades. In addition many of the other crops rated are important species to be considered for agro-forestry systems promoted for participatory forestry. This could also provide the basis of farm systems research and development for forestlands, out lined above has been greatly reduced by land clearing for human settlement and agriculture. If the present trends continue, the remnant of the natural vegetation of Bangladesh will be completely lost in the next twenty years.

Bajaraeharya (1989a, 1989b and 1989c) in his three related studies considered various management aspects and land use options for the Sal forests. He advocated for natural forest management steps in land use pattern for the Sal area.

Proshika Manobik Unnayan Kendra a local NGO has been engaged in forest management efforts for over decade, and Proshika has completed several reports on Sal forest lands. These reports (Khan 1991, Proshika 1988, Proshika 1989, and Proshika 1990) explored the prospects and needs for social forestry through participatory management, and forcefully espoused such strategy for Sal forest regeneration and protection.

Khan et. al.(1990) presents preliminary techniques for land use mapping and agro ecosystem analysis in the Sal forest area in a handbook. This report, describes the techniques for preparing thematic land use maps and agro ecological transects. Similar

methodological overviews are also available in light foot et.al. (1989) compilation of case studies from India on agro ecosystem analytic techniques.

The present status of forest land in Bangladesh is mentioned by Khaleque Kibriaul, Gain Philip, Devasish Raja Roy in their studies "Bangladesh land forest and forest people". In this paper, they have shown how the forest lands have depleted to other purposes. They have also criticized the various project establishments by the government in the forest area. Forest department and other agencies mismanagement encourage the deforestation activitices rapidly.

The various land utilization and pattern of land distribution in the rural management in the rural areas have stated by the Ministry of Environment and Forests Land Use (1992), GOB "Forestry Master Plan-2". Here in the study has cited the forest ratio and land management in the forest area of Bangladesh. National land policy in Bangladesh why needed is also mentioned here. Here in the research studies showed the land resources appraisal of Bangladesh, bio-geographical resources, landforms, soil types, climatic condition, forestland and its categories. The study finds out the complete sense of the total land surface into the various regions of Bangladesh. It also identifies how agricultural land and forestland are abused in other purposes.

The definition of general management and forest management, factors of forest management has given by Osmaston F.C. in his book "The Management of Forests". Here he also discusses how inefficient forest management destroys forest land. The qualities of a good forest manager has also cited in this study. The study enlightened the beneficial objectives of forest management in various aspects. In the study writer has described the various forest products, tangible and intangible resources.

Sharma L. C. has cited how forests are to be managed in his book "Forest Economics Planning & Management". In his study he has shown the various important factors of forest management, purposes of forest management and how forest management needs for business purposes.

Chowdhury (1985) says an initiative of national planning commission on land use plan as an input to the country in his book 'Land Use Planning in Bangladesh'. Third five

year's plan due to start from July, 1985. This study has presented, why land use planning is important for the development and efficient management of our scarce and valuable land resource. How the fertile land adjacent to the cities and towns and in the rural areas are being acquired and encroached upon for urban and non-agricultural uses without any direction is also stated here.

A.K.M Khorshed Alam (1988) of Geological Survey of Bangladesh (GSB) make a detail study of the Madhupur Tract named "Geology of Madhupur Tract and its Adjoining Areas in Bangladesh." In this report he discus about the area, population, climate, structure, geomorphology, stratigraphy and drainage of the Madhupur Tract. But he give emphasize mainly on the structure and stratigraphy of the region.

A report on "Geological Map and Report of the Western Part of Rajshahi District, Bangladesh" is prepared by Md.Anwarul Huq and John W. Whitney (1991). In this report they discus about the area, population, climate, structure, geomorphology, stratigraphy, sedimentology and mineralogy of the western part of the Barind Tract. They give emphasize mainly on the stratigraphy and sedimentology of the region.

Mr.Sohrab Hossain (1997) makes a study on "Clay Mineralogy of Mottled soils from the level Barind Tract and its Geomorphic Implications in Relation to Deep Brown/Red Soils of the Madhupur Tract". Here he finds variation in the clay mineral constituents of the Madhupur and Barind soils. He suggested that clay minerals assemblages formed on the Barind and Madhupur Tracts are different due to differential neotectonic activities which controlled the morphogenesis and thereby pedogenesis of the two areas significantly.

A.K.M. Khorshed Alam (2001) investigates on active faults of Bangladesh on his journal "Geomorphology and Neotectonic along some Faults in Bangladesh". He has been studied geomorphology and neotectonic along the fault situated in the western part of Madhupur Tract and suggest young age of the fault scarp.

A study on the "Origin of Elevated Barind, Madhupur Areas, and Bengal Basin: Result of Neotectonic Activities" is prepared by Rafiqual Alam Khondokar (1987). He explores faulting condition of the Madhupur and the Barind Tracts. The Madhupur-Barind areas

have experienced frequent shaking in the recent historical past epicenters of Bengal earthquake of 1885 (magnitude-7) was located at Manikganj near the Madhupur fault is suggested him. Sometimes violent earthquakes have occurred in and along the margins of Shilong Pleatu. The northwest-southeast Karatoya- Banar, Padma and Tista fault of Barind Tract possibly show mild seismicity. But the NNW-SSE Madhupur fault and east-west Dauki fault are characterized by the epicenter of severe earthquakes. This fault associated with the origin of Barind and Madhupur Tracts seen still active which indicates the isostatic equilibrium of different blocks of Bengal Basin is not yet complete.

The river system of the Madhupur Tract is discussed by Begum Lutfunnahar Bazlee (1967) on her thesis "Geomorphological Study of the Southern Part of the Madhupur Terrace".

Md. Hussain Monsur (1995) carries out his study on Quaternary Stratigraphy of Bangladesh on his book "An Introduction to the Quaternary Geology of Bangladesh". He performs a detail study of the Quaternary deposits exposed in the Barind, Madhupur areas. He makes his study principally on the stratigraphy, palaeomagnetism, sedimentology, neotectonic and radiocarbon dating of the exposed Barind and Madhupur deposits. From his analysis he believes that Barind and Madhupur Tracts represent not a tectonic block, but an erosional feature.

Biswas Shampa, Swanson E. Mark and Vacik Harald (2012) write an article on "Natural Resources Depletion in Hill Areas of Bangladesh: A Review" in Journal of Mountain Science, April 2012, Volume 9, Issue 2, pp 147-156, DOI: 10.1007/s11629-012-2028-z. They find that Natural resources have been exploited in the recent four decades due to excessive clearing of hill forest cover, resulting in loss of species richness, impacts related to increased water flow variability, increased hill slope erosion and flooding intensity, and a gradual decrease in the extent of hill area in Bangladesh. This review explores the major causes and effects of depletion of natural resources by linking drivers, pressures and the related impacts. A review has been conducted to structure the effects on the hilly areas and describe the responses to minimize them in the associated DPSIR framework. Population growth has been identified as a major driver contributing to high deforestation rates. This may negatively affect agricultural productivity and increase the frequency of serious flooding. Slash and burn cultivation also impacts the regeneration of

evergreen forests, which may accelerate soil erosion. Due to this and other factors, local people are facing a deficits of natural resources (food, fodder, fuel wood and water), which exacerbates the effects of poverty.

Forest is the most important component of natural resources; it is home of wildlife, resources and materials for human uses and other living organisms. Other important functions include absorbing carbon dioxcide (CO2), storing water and preventing soil erosion as well (Laarman et al., 1992).

In, Africa, 1.3 million hectares of closed broad leaved forest have been cleaned annually during the past ten years, and 2.3 million hectares of opened woodland are being lost each year. More than half of the loses takes place in West African countries such as Ghana, Guinea, Ivory Coast, Liberia and Nigeria. Madagascar alone accounts for the greatest East African loss of forest: 2000,000 hectares each year from tree felling and bush fires (Ramanankasina, 1985).

From 1976 to 1980 1.8 million hectares of closed forest were degraded in Asia, especially in Burma, India, Indonesia, Laos, Malaysia and Philippines. But the highest deforestation rates are those of Nepal (3.9% per year) and Thailand (2.4% per year). Over the past thirty years, Himalayan watershed forests have declined by 40%.

The causes of tropical deforestation is often said to be rural poverty and agricultural productivity, inequalities in land tenure, population pressure, the general ineffectiveness of forest agencies, and the lack of integrating planning of forestry, agriculture, energy and other sectors (Repetto, 1985). Westoby (1987) stated that "the main instruments of forest destruction are the disinherited of tropical forested countries: peasant farmers, shifting cultivators, rural landless. But these are the agent not the cause." For example, Laitalainent (1991) described that a private company or a state enterprise under logging concession harvests forests in large areas with capital and technology intensive skills. Harvested trees are only commercial species. Others are usually left ignored by them, but after their logging, local people come into the forest and convert it to farms. They are normally those who have no other means of livelihood but agriculture (Laitalainen, 1991). The pressure on the forests stems from the unwillingness of those holding power

to pursue policies with accord to greater access to land and other resources (Westoby, 1989).

Dr. M.A. Baqui, Sunirmal Paul and Promoth Chandra Roy (1992) carry out their study on "A Preliminary Survey of Deforestation and The Present Status of Wildlife in Bhaluka Forest Area, Madhupur Tract, Mymensingh." They find that Deforestation does not end up itself, it is alarming disintegration the ecological integrities in most of the areas. It is precipitating the process of soil erosion, exacerbating the cycle of natural calamities like floods and brought, disrupting water supplies and reducing land productivity, pushing the country to the depths of environmental degradation.

K. Nizamuddin, K.B.S. Rasheed (May 1992) mention in their study "Sal Forest Products Utilization by Rural Communities" that due to the fast depletion of wooded tracts, Bangladesh now has less than 10 percent of its land under tree formations. The deforestation process has diminishing forests. Besides, wood and timber harvesting for construction and industry is also progressively increasing. The process of deforestation has threatened the lines of the people who live in the fringe areas of the forests and depend on forest products for their livelihood.

M.Y. Mia, M.U. Hossain and S. farzana (2012) says in their article entitled "Propects and Constraints of Madhupur National Park Management" in Journal of Environmental Science & Natural Resources, 5(1): 151-158, 2012, ISSN 1999-7361. They state that due to various factors like anthropogenic disturbances, political abusement, absence of proper rules and regulations, willing less of the authority, encroachment of forest by locals/local leaders, illegal cutting of Sal trees, agro-forestry, and lack of adequate budget are main constraints for managing MNP. The study also revealed that about 1-3% of the forest is depleted each year, and about 50-80 years later, the forest will be completely vanished or scattered in somewhere. However, MNP will be a sustainable reserve forest for Sal trees and other flora and fauna, and also be a potential ecotourism spot, if it is properly managed. Findings of the study will help to identify the prospects and constraints of MNP and also in other National Parks in Bangladesh which ultimately conserve the biodiversity and help to maintain natural balance.

According to FAO forest estimates, total global forest resource is about 3.8 billion hectares while World Resources Institute's (WRI) publication suggest that only 40% of the FAO estimated current world forests (i.e. 1.5 billon hectares out of 3.8 billion hectares) can qualify as forests. WRI emphasized on the occurrence of intact native forest with the provisions of sound ecological functions where in FAO forest definition, they identified a certain area (0.5 ha) with trees higher than 5 meters as forest. FAO also mentioned that the areas that do not meet these criteria, but have a potential to reach the standards can be treated as forests.

Islam Sheikh Tawhidul, Khan H. Mamunul and Marinova Dora (2006) describe in their article "Diverse Approaches in Defining Forest Ecosystems and Its Implications on Biodiversity Management". This paper investigates diverse approaches to delineate forest ecosystems and analyze its implications in selecting principles for forest resources management. The study would use Bangladesh as a case study to substantiate its arguments. The study finally argues in favour of standardization of diverse delineation approaches for consistent and logical data generation as well as sustainable management of forest ecosystems.

National Research Council, Washington D.C. (1993) states in the report "Sustainable Agriculture and Environment in the Humid Tropics," that the committee has shown the landscape management in the global requirement. They have also presented the sustainable land use in the agricultural sector. Here in the report has shown the relation between agriculture and environment in the humid tropics. In the study has cited the forest characteristics and its various benefits. Here in the report also describe an integrated role of forest. This study has described sustainable land use and various farming systems in the global climatic belt.

Alauddin in "Rural Land use in Bangladesh" describes general land use in different sector like land uses profile of Bangladesh, how and why lands use changes, agricultural land changes into other non-agricultural uses, why forestland reduces in various purposes. This study has also cited how the socio-economic factors influence in land use. Here the land limitations and how it is creating imbalance in economic and social development have also presented. This study discuss land ownership pattern in the country too.

Rahman, Molla Mizannur Mohammod, (2006) does his thesis on "Impacts of Participatory Social Forestry Practiced in Madhupur Sal Forests, Bangladesh." Here he explains that there were gaps in between the Participatory Social Forestry (PSF) performers / implementation and the PSF objectives Forestry Sector project (FSP) (e.g. miss targeting of FSP in participants' selection procedure). Therefore, the Participatory social forestry still has a lot more to do for achieving the socioeconomic development of the target groups and ensuring the sustainable management and conservation of the Madhupur natural Sal forest with the help of advanced research findings. The constant failure of the traditional forest management to fight back the ongoing devastating depletion and the consequent shrinkage of the Madhupur natural Sal forest led the Bangladesh Forest Department to implement the participatory social forestry practices with the participations of the local people under the guide lines of the "Forest Policy-1994" (enunciated in 1979) in the Madhupur Sal Forest (GOB).

The extinction of species that occurs as a result of tropical deforestation is one of the most serious problems confronting the conservation community. Recognizing that recent estimates by the Food and Agriculture Organization (FAO) of the United Nations shows the rate of deforestation in the tropics are at least 50% higher than had previously been thought and that there is also an increase in areas of primary forest being utilized for timber (Whitemore T.C. and Sayer J.A.1992).

3.1. Sal Forest:

The traditional Sal forest used to extend over Madhupur Tract, as well as the district of Dhaka, Gazipur, Mymensingh, Tangail, Rangpur, Dinajpur, Thakurgaon, Gaibandha and Nowgaon. However, the traditional Sal forests are representative of today remnants of the Sal forest. Now the Madhupur Sal forest is the largest Sal forest patch in the country. In the Sal forest, 70-75% of the trees is Sal (*Shorea robusta*), and the soil looks yellowish-red in color.

The tropical moist deciduous Sal forest of Bangladesh is classified into (a) moist Sal forest and (b) Sal scrub forest by Ghani and Steven (1990). The moist Sal forests are the areas containing Sal trees as pure crop, mostly of coppice origin. The Sal scrub forests are the results of repeated human interference, which are also termed as 'Deforested Sal Forests'.

Most of the Sal forest has been denude, degrade, and encroached upon by people, or used for plantation of rubber monoculture and mostly exotic commercial fuel-wood species. The demand for Sal and other forest products seems unlimited. Even though now the supply has decreased drastically, Sal trees, including the stumps, are still used as fuel in brick kilns and for industry (BSE, 2001).

The Sal Forests of Madhupur Garh unlike the forest of Chittagong Hill Tracts and 'Sundarbans', originally belonged to the Zaminders. These forests were subject to irregular and uncontrolled felling, prior to their taking over by the Government under Indian Forest Act 1927.

Moreover, in different regions of Bangladesh there exists some difference in the rate of depletion of Sal forest. Because of rapid urbanization and industrialization depletion of Sal forest occurs mainly in the southern part of Madhupur Tract i.e. Dhaka and Gazipur district. After 1947, extensive areas of Sal forest is also being deforested in Lalmati Hills close to Comilla town because of infrastructure development at that region, as an inevitable outcome of which hills are being continuously cleared up.

The Sal forests of the Barind Tract lie along her frontiers in the northwestern part of Bangladesh. During the Liberation war in 1971, the neighboring Indians had cut and

carried home a lot of Sal trees which had to face tremendous devastation, the loss of which was far greater than that made by Hindu Zaminders after 1947. Once in Dinajpur at Dinajpur Forest Beet, there was a dense and extensive Sal forest. But in 1971 the Indians had destroyed large part of it. Depletion still continued. But its rate is different in various areas.

3.2. Location of Madhupur Sal Forest:

Madhupur Sal forest is known as "Madhupur Garh" in everywhere. Madhupur Sal forest is located in Madhupur thana under the district of Tangail. It is situated 80 km North East from Dhaka. It is located from 24.30^0 to 24.50^0 North axis and 90^0 to 90.10^0 East longitude. In the North West of the forest there is Jamalpur district, in South West there are Madhupur and Dhonbari upzilla and in East there are Muktagacha and Fulbaria upzilla of Mymensing district.

3.3. Brief History of Madhupur Sal Forest:

Before 1925, the present reserved and protected forest was controlled and managed by forest department under the proprietorship of Atia and Kagmari Zamiders. The government took over the management of these forest and first declared these forests as protected forests in their notification no 1878 for, dated the February 1925. Soon after, the government wanted to constitute certain areas as reserved Forests. When the forest settlement officer started his enquiry into the rights, an organized opposition from amongst the tenants started. Moreover, it was found that two thirds of the shareholders of the many mouzas (cluster of villages) did not sign the original petition. After protracted litigation, long enquiries continued agitation and Araipara Chakra, consisting of 26 mouzas was finally declared as Reserved Forest.

From the time of Naib Nazim of Dhaka to the last day of the East India Company rule, Rani Bhavani of Natore and her successors and the pannis of karatia and the Zamindar of Dhanbari was the custodian of Madhupur Forest. After enactment of East Pakistan Forest Act of 1949 (Act 1950), the Atia forest became vested forest under section 7 of East Pakistan Private Forest ACT 1949. East Pakistan State Acquisition and Tenancy act was enacted in 1950 and since 1951 many of the vested forests have been acquired by the government under the act (Source: Proceedings: First Forestry Congress-2011).

After independence, Bangladesh government has taken initiative to convert these forests into Reserve forest in early eighties. For this purpose these forest has been declared as proposed reserve forest under section of 4 & 6 of Forest Law. Unfortunately, even after three decades, the process of declaring reserve forest has not yet been completed. On the other hand, this land has been leased out by respective department sporadically. The lease owner cleans forest after getting legal document. Protest of forest department obliged the relevant authority to cancel the lease. But it was too late because forest department come to know regarding leasing only when the lease owner started to cleared forest land.

Previously, Madhupur Forest consisted of 70 to 75% sal (*shorea robusta*). According to Mr. M. R. Chowdhury, *gazari* bearing forests of this belt was essential malformed, croocked and defective coppice stands resulting from the wrongful method of exploitation and unscientific management prior to taking over the forest by forest department. Some of the patches have exhausted their copping power and there are patches where coppices are unsuccessful due to exhaustion of stumps. There are also indiscriminate felling of Sal trees under private ownership because of the partition of the sub- continent and also for fear of introduction of private Forest Act and State Acquisition and Tenancy Act of 1950. So the excessive and irregular felling under the management of private owners has resulted in this type of degenerated forest. A comparison of the Satellite image of 1967 and 2013 clearly shows 85% greenery of the area of Madhupur national park has disappeared during the last 40 years (See page no-68 and 72-78).

By synthesize the previous records; the area of Madhupur Site formed Myosin Period of Tertiary Era. It was about 2 to 3 cores of years before. According to the Geologist, the soil of this area contains huge amount of iron and aluminum. About 3 thousand years ago, the human settlements started in this area. Although considererable forest loss has occurred at Madhupur Site in recent years, the site still represents an important and treasured part of the biological as well as cultural diversity of Bangladesh. Members of the Garo (Mandi) community are living in this area for over a hundred years of time. Some of Garo ethnic community resides within the boundaries of the declared Madhupur National Park. During the Liberation War, Freedom Fighters used the surrounding Sal Forests as base areas. The Park established in 1982. The Guest House (Dhokla Guest House) is renowned as the site of the drafting of the Wildlife Act of 1973. Father of the

nation, the then Prime Minister Bangabandhu Shiiekh Mujibur Rahman stayed in this guest house for three days in 1973 and instructed to protect Madhupur Sal forest as an heritage with great importance.

Table-3.1: Madhupur Forest at a Glance:

Total Forest Area	45,565.18 acres
Total no. of Mouza	18
Madhupur National Park Area	20,837.23 acres
No. Range Office	04
No. Beat Office	10
Woodlot Plantation	3,415.08 acres
Buffer zone Plantation	623.56 acres
Agroforestry Plantation	1,296.60 acres
Sal Coppice Management	1,733.94 acres
Total no. of Beneficiaries	3327
Total area of Plantation	7,069.18 acres
Natural Sal Forests	6,891.00 acres
Agricultural Land	6,900.00 acres
Rubber Plantation (BFIDC)	10,647.02 acres
Bangladesh Air Force	305.40 acres
Bangladesh Forest Research Institute (BFRI)	58.67 acres
Homestead land	5,500.00 acres
Fellow Land	8,193.89 acres

Source: Madhupur Forest Office.

3.4. Distribution of Madhupur Sal forest:

The total Madhupur Sal Forest under Tangail forest division is under the control of ACF (North). It is divided into four ranges and 10 bits, these are given below Table:

Table-3.2: Management Units of Madhupur National Park

Range	Bit
National Park range:	1. National Park Sadar
	2. Rajabari
	3. Berbide
	4. Lohoria
	5. Gasabari
Dokhla range:	1. Dokhla sadar
	2. Chanpur
Arunkhola range:	1. Arunkhola Sadar
Madhupur range:	1. Charalgani
	2. Mahismara

Source: Forest office, Madhupur.

Map-3.1: Map of Madhupur Sal Forest (MSF)

Source: Forest Office of Madhupur, 2013.

3.5. General Information of the Study Area:

Though the study areas are located within the Madhupur Upazila, it appears reasonable to illustrate the environmental setting of Madhupur Upazila. This description will be sufficient to give ideas on various attributes (both physical and socio-economic condition of the study area).

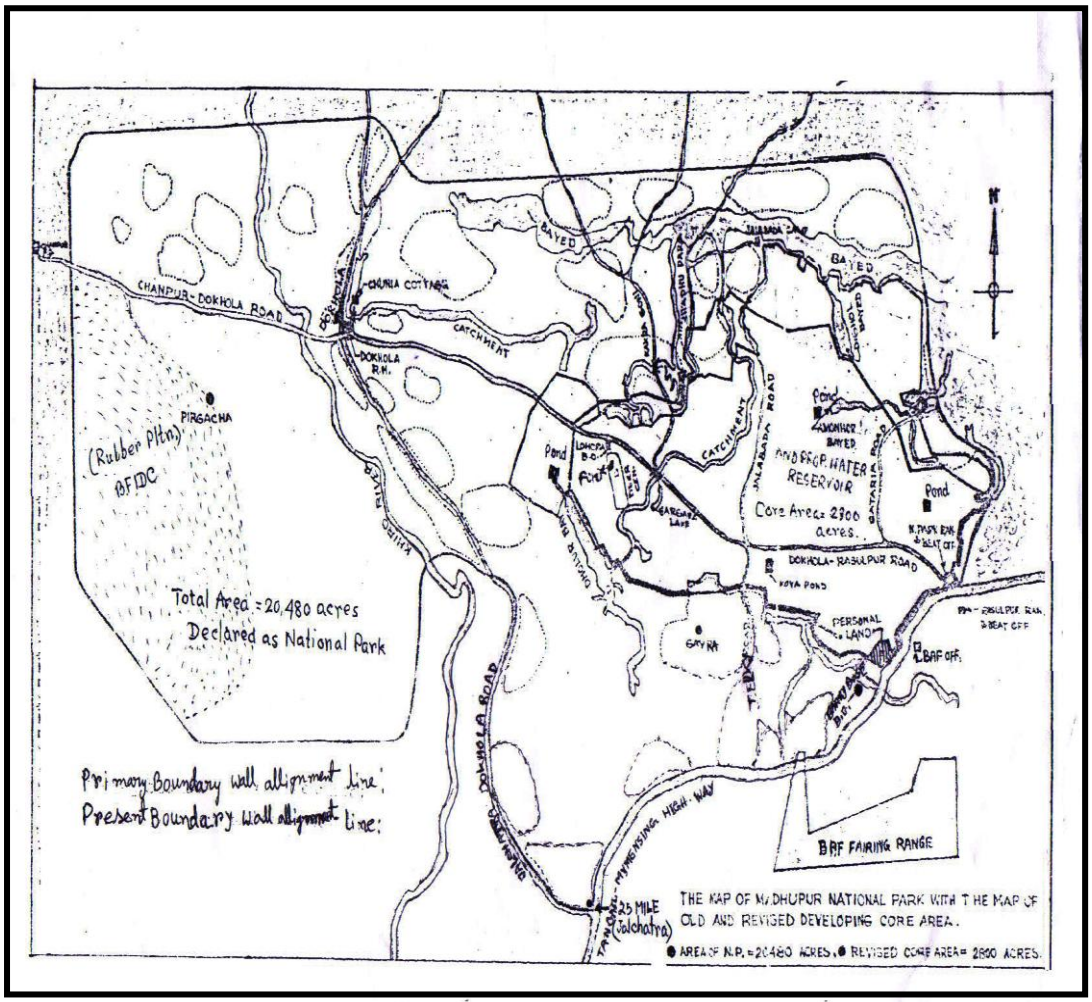
3.5.1. Area:

The total area of Madhupur Sal forest is 45,565.18 acres out of which 2525.14 acres area is declared as reserved forest and the remaining 43039.04 acres of land are under the process to be declared as reserved forest. For the purpose of biodiversity conservation govt. declared Madhupur national park comprising an area of 20837.23 acres by a gazette notification on 24th February 1982 out of that 20244.23 acres are under Madhupur thana under district of Tangail and 593.00 acres are under Muktagacha of Mymensing district.

3.5.2. Extent and Location:

In the central part of Bangladesh "Madhupur Tract" is a large upland area. This tract is divided into two 'Garh' named Madhupur Garh and Bhawal Garh. The northern part of this tract is known as Madhupur Garh and the southern part as Bhawal Garh. The total extend of this tract is 4244 sq. km. The area lies between latitude from N 23º 30' to 24º47' and longitude from 90º 5' to 90º 35'. With a length of about 96 km and a width of about 8-24 km, Madhupur Garh falls between the Jamuna and Brahmaputra rivers. Madhupur natural Sal forest falls in the Madhupur Garh. The 'Inland Sal Forest' represents the larger part of the Madhupur Garh and the moist deciduous forests of Bangladesh. The Sal forest is located in Madhupur Upazila under the administrative jurisdiction of the Tangail district and the Tangail Forest Division. The map presented below shows the geographical location of the Madhupur Forest area. (Source: http://www.banglapedia.org/HT/M_0031.htm)

Map-3.2: Sketch Map of the Study of Area



Source: Forest Office of Madhupur

3.5.3. Administrative Unit:

The Upazilla consists of 6 unions, 111 mauzas, 180 villages, 1Paurashva, 9 Paura Ward and 23 Paura Mahallahs.

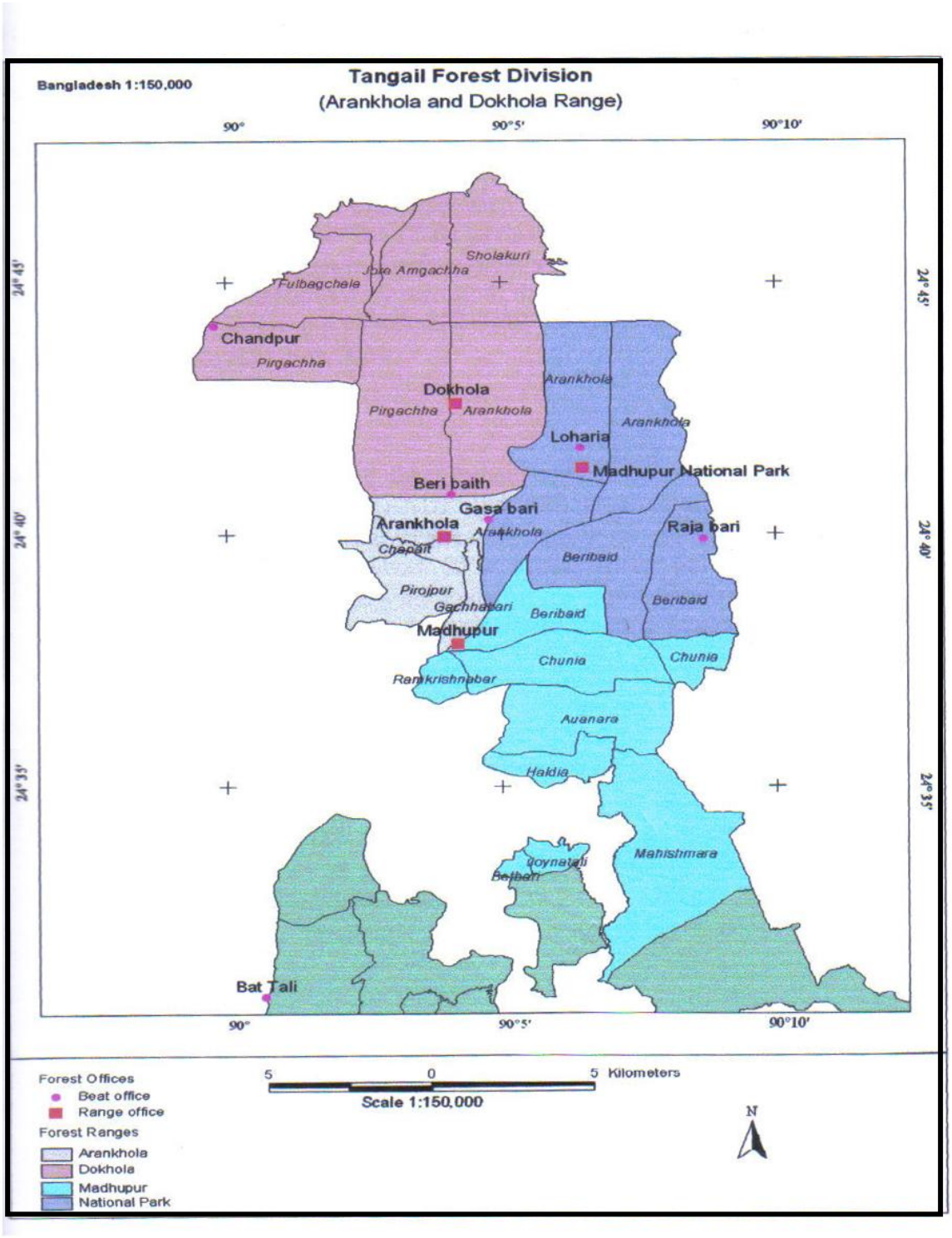
Table-3.3: Madhupur Upazilla: Census Results at a Glance:

Items	Zila		Upazila	
	2011	2001	2011	2001
Population (Enumerated)				
Both Sex	36,05,083	32,90,696	2,96,729	4,22,889
Male	17,57,370	16,69,794	1,47,734	2,16,022
Female	18,47,713	16,20,902	1,48,995	2,06,867
Urban	4,69,660	3,56,275	56,342	75,764
Other Urban	74,125	81,736	8,530	6,972
Rural	30,61,298	28,52,685	2,31,857	3,40,153
Annual growth rate	0.90	0.92	-3.43	1.20
Sex ratio				
Total	95	103	99	104
Urban	102	106	104	108
Other Urban	95	104	102	106
Rural	94	103	98	103
Households (HH)				
Total	8,70,102	7,23,111	75,903	99,542
Urban	1,09,848	77,643	13,713	17,527
Other Urban	18,252	18,051	2,209	1,666
Rural	7,42,002	6,27,417	59,981	80,349
Average HH Size				
Total	4.10	4.53	3.87	4.24
Urban	4.09	4.52	4.01	4.30
Other Urban	4.05	4.52	3.86	4.18
Rural	4.11	4.53	3.84	4.23
Area sq. km	3414.35	3375.00	366.92	500.67
Area sq. mile	1318.28	1303.09	141.66	193.31
Density per sq. km	1056	975	809	845
Density per sq. mile	2735	2525	2095	2188
Urbanization (%)	15.08	13.31	21.86	19.56
Literacy (%)				
Both Sex	46.8	40.5	41.2	37.7
Male	50.0	44.9	42.7	40.2
Female	43.8	35.9	39.7	35.0
School Attendance (5 to 24 years) (%)				
Both Sex	54.9	43.6	52.5	38.4

Items	Zila		Upazila	
	2011	2009	2011	2009
School Attendance (5 to 24 years) (%)				
Male	59.0	47.2	55.0	41.4
Female	51.0	39.9	49.9	35.3
Population (Adjusted)				
Both Sex	37,49,08	34,43,954	3,08,846	4,42,994
Male	18,27,684	17,47,593	1,53,777	2,26,299
Female	19,21,402	16,96,361	1,55,069	2,16,695
Geographic Unit				
Upazila/Thana	12	11	-	-
Union	110	103	6	11
Mauza	1,855	2,029	111	242
Village	2,443	2,425	180	298
Paurashava	9	8	1	2
Paura Ward	90	81	9	18
Paura Mahalla	239	213	23	48

Source: BBS, Bangladesh Population and Housing Census 2011, Community Report, Zila: Tangail, June 2012.

Map: 3.3: Map of the Study Area

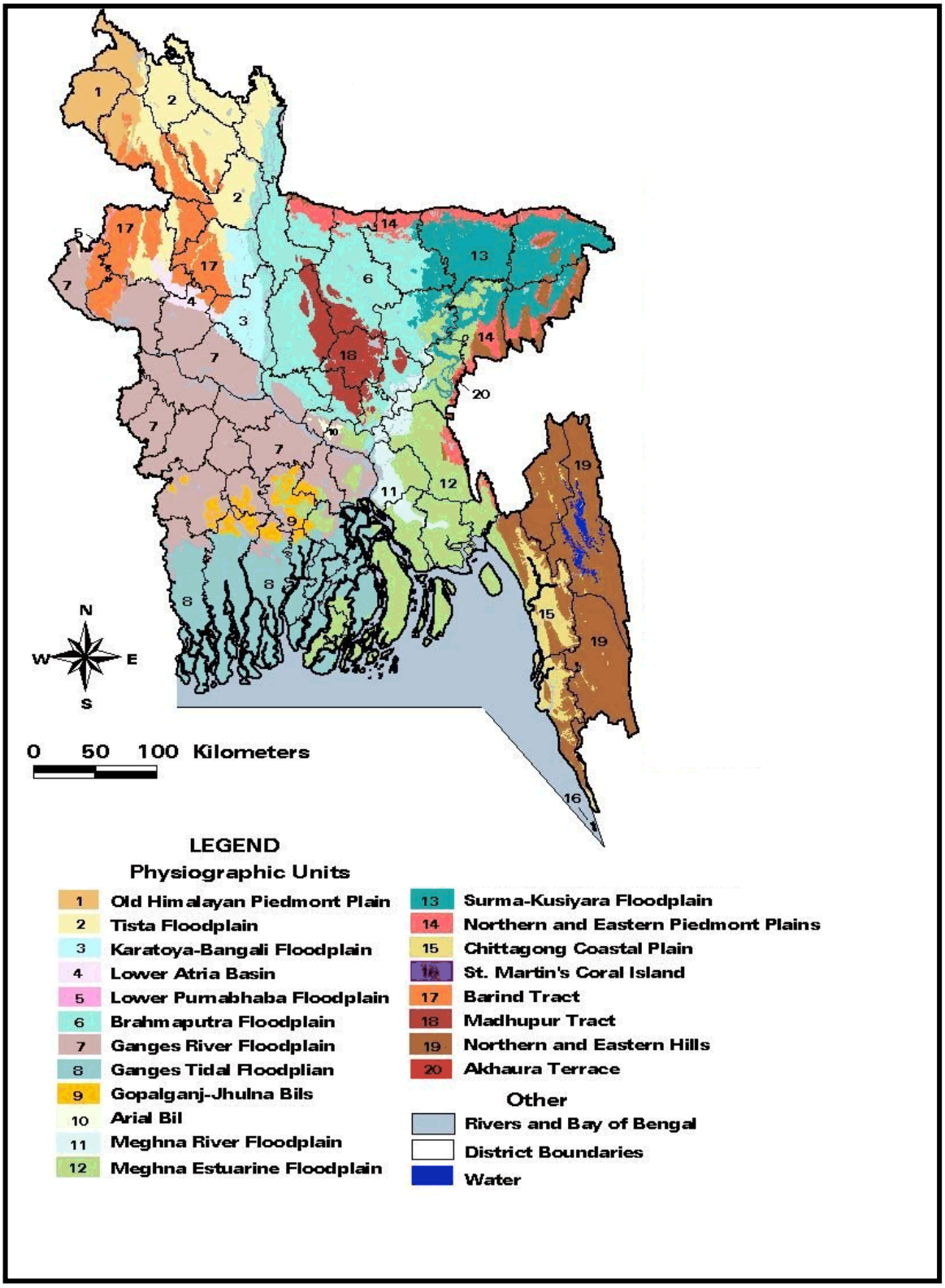


Source: Modified from RIMS, Directorate of Forests, Ban Bhaban, Dhaka.

3.5.4. Topography:

Topographically Madhupur Tract is divided into 4 divisions.

Map: 3.4- Physiographic Regions of Bangladesh



Source: Modified After BRAC/FAO/UNDP/GIS Project

3.5.4.1. Northern Tract:

The northern end of the tract is characterized by elongated and rounded hillocks which has a higher altitude. They have slightly dome-shaped tops which are 9 to 18 m in altitude and between them there are narrow widening valleys known as Baid. The river Bansi, Turag, Khinu and Banar and their tributaries have been dissected the area. It is seen that the slope of the land ranges from 25º to 35º. The feature of the area is characterized by hanging valleys near the scarp faces.

3.5.4.2. Western Madhupur Tract:

The Western Madhupur Tract is bounded by the Bansi river valley in the east and well-defined en-echelon faults in the west which is inheriting the Brahmaputra-Jamuna floodplain.

3.5.4.3. Central Madhupur Tract:

The area is comprised Joydevpur, Sreepur, Tongi, Savar and Kapasia. These lands stand at a lower elevation than the northern tract. The topography of these lands has low gradients and is not much pronounced but wide. The area is drained by the Turag drainage system and the tributaries of Shitalakhya.

3.5.4.4. Southern Madhupur Tract:

The Buriganga and Shitalakhya rivers lay this tract. The area slopes towards the south and southeast. Most of the terrace is almost flat in relief. The tributaries of Turag, the Buriganga and the Balu rivers has intensively been dissected by this area and formed numerous rounded and elongated hillocks.

3.6. Geology:

Geology is the study of the Earth, its processes, its materials, its history, and its effect on humans and life in general. Rocks, crystals, mountains, earthquakes, volcanoes, rivers, glaciers, landslides, floods, and many other subjects fall into this broad field of research.

Geology gives insight into the history of the Earth by providing the primary evidence for plate tectonics, the evolutionary history of life, and past climates. In modern times, geology is commercially important for mineral and hydrocarbon exploration/ exploitation as well as for evaluating water resources. It is publicly important for the

prediction and understanding of natural hazards, the remediation of environmental problems and for providing insights into past climate change. Geology also plays a role in geotechnical engineering and is a major academic discipline.

Geologically Madhupur Tract a terrace from one to ten meters above the adjacent flood plains. The soil of Madhupur Sal forest areas which are nutrient poor and somewhere acidic developed largely on Madhupur clays. The clay contains ferruginous nodules, manganese spots and pipe stem. Madhupur clay represents several north-south elongated Pleistocene terraces, highly dissected during the late Pleistocene climatic episodes. The drainage pattern is clearly dendritric. In Madhupur areas the clays are highly weathered and deeply oxidized reddish brown deposits. The higher level lands are known as 'Chala' and the valleys or low lying lands are called 'Baid' (From-Banglapedia.)

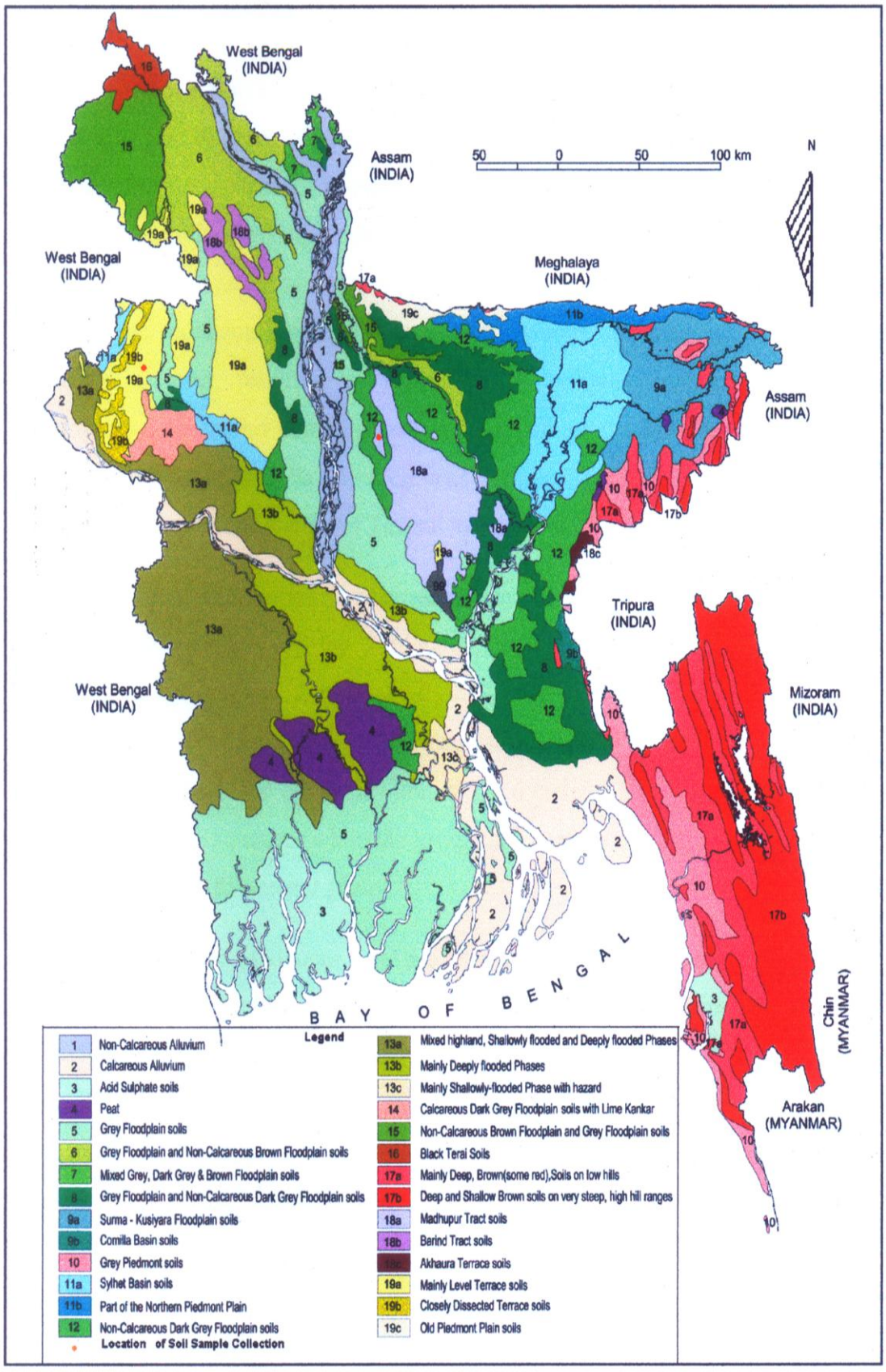
3.7. Physiochemical Composition of Madhupur Sal Forest:

Physiochemical Composition has a great significance in Madhupur Sal Forest. Some Physiochemical Composition in this forest areas are as follows:

3.7. 1. Soil:

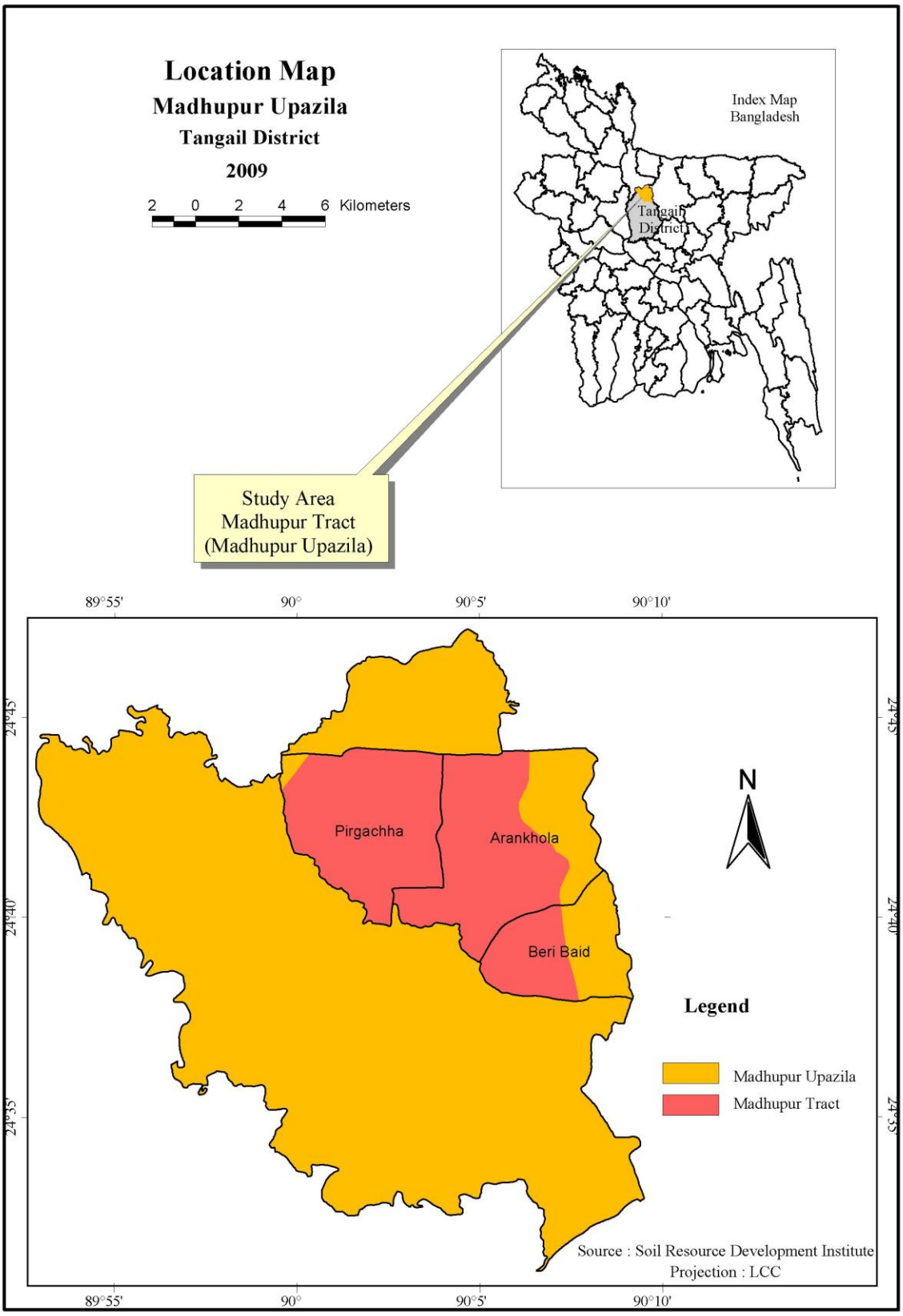
The soil of Madhupur Sal Forest mixed with yellowish red sandy clay. Mg, Fe, Kanker, is mixed with soil. The soil of this forest is very hard in dry season and very loose in rainy season. In rainy season soil are found very fertile and suitable for living plants. From the grain size analysis it can be suggested that most of the soil contains 30 to 45 percent clay, 30 to 50 percent silt and 15 to 40 percent sand. Thus it is concluded that the soil is clay loam to silty clay in texture. The quantity of sand is small in reserve forest and it is highest in the deforested land (Settlement area). Moreover the quantity of silt is highest and clay is medium in the reserve forest. The fine components of soil are preserved in reserve forest because of the dense and extensive network of roots. Moreover, in deforested land silt and clay undergo quick erosion by means of rain and wind, as a consequence if which the quantity of sand increases in deforested land. When the quantity of sand gets increased in these ways in deforested land, afforestation or reforestation becomes a very laborious task. In the Wetland area the quantity of clay and silt is very high and the quantity of sand is low.

Map: 3.5- General Soil Map of Bangladesh



Source: Modified from SRDI.

Map: 3.6- Soil Map of the Study Area



Source: Location of the soil samples collection Area.

3.7. 2. Soil p^H and Organic Carbon:

Generally the degree of acidity or alkalinity of soil is called soil pH. The term pH is used to express the negative logarithm of hydrogen ion concentration and is a measure of alkalinity or acidity of a solution (Chowdhury, 1996). pH is measured on a scale of 0 to 14. In soils, a value of 7 in the pH scale is neutral, whereas values are below 7 (4 to 7) in acid soils but above 7 (7 to 10) in alkaline soils. Soil pH of the selected of the Madhupur Tract ranges from 5.5 to 6.4. It can be said that the soil of the Madhupur Tract is strongly to very strongly acid, friable and strongly and coarsely mottled red, yellow and gray. The soils developed in this material range from deep, strong brown to yellowish red, friable loams or clay loams, becoming clay with depth, on the highest and deeply dissected broad upland sites through paler colored soils with sub soil in the seasonally or intermittently flooded depressions. Soil fertility is very low due to acidic condition. Lime requirement is essential for growing crops.

In the study area, the pH value of the soil of reserve forest, deforested land and wet land (Baid) are 6.2, 5.8 and 6.1 respectively. The pH value of the deforested land is low, i.e., the soil of this area is acidic; it later becomes unfit for afforestation or cultivation.

The quantity of organic carbon is highest in the reserve forest because the leaves fallen from the tree and the undergrowth plants (after their death) become decompose with soil, thereby increasing the amount of organic carbon. On the other hand, the quantity of organic matters is lowest in deforested land because of lack of plants. Moreover, in case of timber monoculture, there exists no undergrowth plant in wet land areas. As a result, the quantities of organic matter become low in wet land (Source: Laboratory Analysis, 2008.

3.7. 3. Moisture:

In dry season moisture of this forest remain low. Otherwise in rainy season moisture of this forest rise very high that is important for plantation.

3.7. 4. Salinity:

There remain normal salinity both in aquatic environment and lithosphere.

3.8. Climate:

Climate is a measure of the average pattern of variation in temperature, humidity, atmospheric pressure, wind, precipitation, atmospheric particle count and other meteorological variables in a given region over long periods of time. Climate is different from weather, in that weather only describes the short-term conditions of these variables in a given region. Climate means the average weather i.e. rainfall, temperature, snowfall, dew, hail storm, fog and humidity of a particular area in particular time. The amount of rainfall and temperature shows the types of natural plant and crops. That's why; different types of crop grow in different areas in different seasons.

Bangladesh is a tropical country, so Tangail Upazila is not an exception of it. The study area is characterized by typically tropical monsoon climate with high temperature, quite a good amount of humidity, moderate rainfall and faunally marked in trace seasonal variations; like rainy season (May-October) dry season (November-April) and winter (mid November-February). In 1995, highest average temperature record was 36 c while the lowest average was 10 c. The annual rainfall was about 2,094 mm. The climate is fairly peasant from November to February, but very dry in summer, that is during March to June.

3.8.1. Rainfall:

Generally rainfall is a shower or fall of rain. The quantity of water, expressed in inches, precipitated as rain, snow, hail, or sleet in a specified area and time interval. More than 85% of total annual rainfall occurs during the rainy season. In the period between mid April and early June, heavy rains mainly commence; which stops anytime in the period between the end of September and mid November. Annually rainfall ranges from 1000 mm to 1500 mm. May and October remain almost rainless and there may be a dry period of two weeks, or more during the rainy season. The winter season is the coolest and driest period in this area (Source-Banglapedia).

3.8.2. Temperature:

A temperature is a comparative objective measure of hot and cold. The comparison is through detection of heat radiation, particle velocity, kinetic energy, or most commonly, by the bulk behavior of a thermometric material. It may be calibrated in any of various temperature scales, Celsius, Fahrenheit, Kelvin, etc. The average temperatures vary from

28º C to 32º C in summer and from 20º C to 10º C in winter. Natural catastrophes; such as, storms usually hit the area several times in a year (Source-Banglapedia).

3.8. 3. Sunlight:

In Madhupur Sal forest, sunlight in winter and summer has available. The sunlight of this area is very suitable for growing plants and other species.

3.8.4. Humidity:

Humidity is the amount of water vapor in the air. Water vapor is the gaseous state of water and is invisible. Humidity indicates the likelihood of precipitation, dew, or fog. Higher humidity reduces the effectiveness of sweating in cooling the body by reducing the rate of evaporation of moisture from the skin. This effect is calculated in a heat index table, used during summer weather. The annual average value of humidity was 83.53% in 2007.

Table-3.4: Monthly Relative Humidity of Madhupur Upazila:

Year / Month	2005 Mean (%)	2006 Mean (%)	2007 Mean (%)	2008 Mean (%)	2009 Mean (%)	2010 Mean (%)	2011 Mean (%)	2012 Mean (%)	2013 Mean (%)
January	74.32	87.45	88.10	88.39	88.64	88.42	88.35	88.87	88.46
February	79.96	90.14	86.46	88.31	88.25	89.03	90.17	89.46	90.00
March	80.55	83.74	90.58	87.71	90.13	91.22	91.22	91.12	85.38
April	80.23	87.27	91.73	85.53	89.77	92.31	92.00	91.17	92.00
May	75.48	89.65	87.58	87.29	88.26	92.32	91.41	92.22	91.96
June	79.30	92.07	91.43	89.40	86.74	92.43	92.5	92.33	92.76
July	88.39	92.13	92.10	90.45	86.37	92.77	91.41	92.12	92.87
August	90.45	92.00	92.52	91.03	89.71	92.67	92.19	92.06	92.29
September	92.00	92.00	92.27	92.17	92.53	92.3	92.16	92.03	92.00
October	82.48	91.81	91.87	91.03	90.87	92.09	92.12	92	91.7
November	90.07	80.77	90.00	90.01	90.88	95.16	90.9	90.83	90.43
December	88.68	89.03	88.67	-	89.35	89.64	89.35	89.38	77.93

Source: Upazila Krishi Office, Madhupur, Tangail.

- Data is not available.

3.8.5. Wind flow, Shower and Seasonal Fluctuation:

Wind is the flow of gases on a large scale. On the surface of the Earth, wind consists of the bulk movement of air. In outer space, solar wind is the movement of gases or charged particles from the sun through space, while planetary wind is the out gassing of light

chemical elements from a planet's atmosphere into space. Winds are commonly classified by their spatial scale, their speed, and the types of forces that cause them, the regions in which they occur, and their effect. Perceptible wind flow is very little during mid October to February. But the position of sun is shifted from southern to northern direction at the beginning of March. At this time, temperature starts to rise up and the air becomes with heavy shower (locally known as 'Kalbaishakhi') commonly occur during March or beginning of April and it continues up to the end of May. In the early June, the prevailing southwest monsoon wind brings heavy rainfall for the south and southeastern areas and by the end of June; it covers the whole Bangladesh including the study area. Shower decreases from the middle of September and winter begins from November which continuous up to the February. During the winter time, there is normally no rainfall and it becomes dry.

Table-3.5: Monthly Rainfall (in mm) of Madhupur Upazila:

Year / Month	2005	Aver.	2006	Aver.	2007	Aver.	2008	Aver.	2009	Aver.	2010	Aver.	2011	Aver.	2012	Aver.	2013	Aver.
January	-	-	0	0	0	0	37	1.19	0	0	0	0	0	0	3	0.09	0	0
February	24	0.86	0	0	30	1.07	10	3.57	0	0	0	0	0	0	0	0	10	0.35
March	174	5.61	0	0	40	1.29	47	1.52	4	0.12	93	3.20	20	0.64	0	0	0	0
April	351	11.7	177	5.9	141	4.7	59	1.97	97	3.23	77	2.56	81	2.7	70	2.33	52	1.73
May	819	26.41	246	7.94	119	3.84	184	5.94	249	8.03	225	7.25	273	8.80	148	4.77	150	4.83
June	550	18.33	352	11.73	816	27.2	389	12.97	137	4.56	327	10.9	308	10.26	110	3.66	208	6.93
July	836	26.97	252	8.13	637	20.55	455	14.67	253	8.16	412	13.29	145	4.67	220	7.09	105	3.38
August	288	9.29	214	6.90	363	11.71	356	11.48	236	7.61	232	7.48	692	22.32	145	4.67	130	4.19
September	311	10.37	378	12.6	296	9.87	91	3.03	129	4.3	75	2.5	197	6.56	189	6.3	220	7.33
October	356	11.48	58	1.87	208	6.71	218	7.03	67	2.16	182	5.87	60	1.93	75	2.41	42	1.35
November	0	0	0	0	115	3.83	0	0	0	0	5	0.16	0	0	28	0.93	0	0
December	0	0	0	0	0	0	0	0	0	0	47	1.51	0	0	0	0	0	0
Total	**3709**	**21.02**	**1677**	**55.07**	**2765**	**90.77**	**1846**	**63.37**	**1172**	**38.17**	**1675**	**54.72**	**1776**	**57.88**	**988**	**32.25**	**917**	**30.09**

Source: Upazila Krishi Office, Madhupur, Tangail.

- Data is not available.

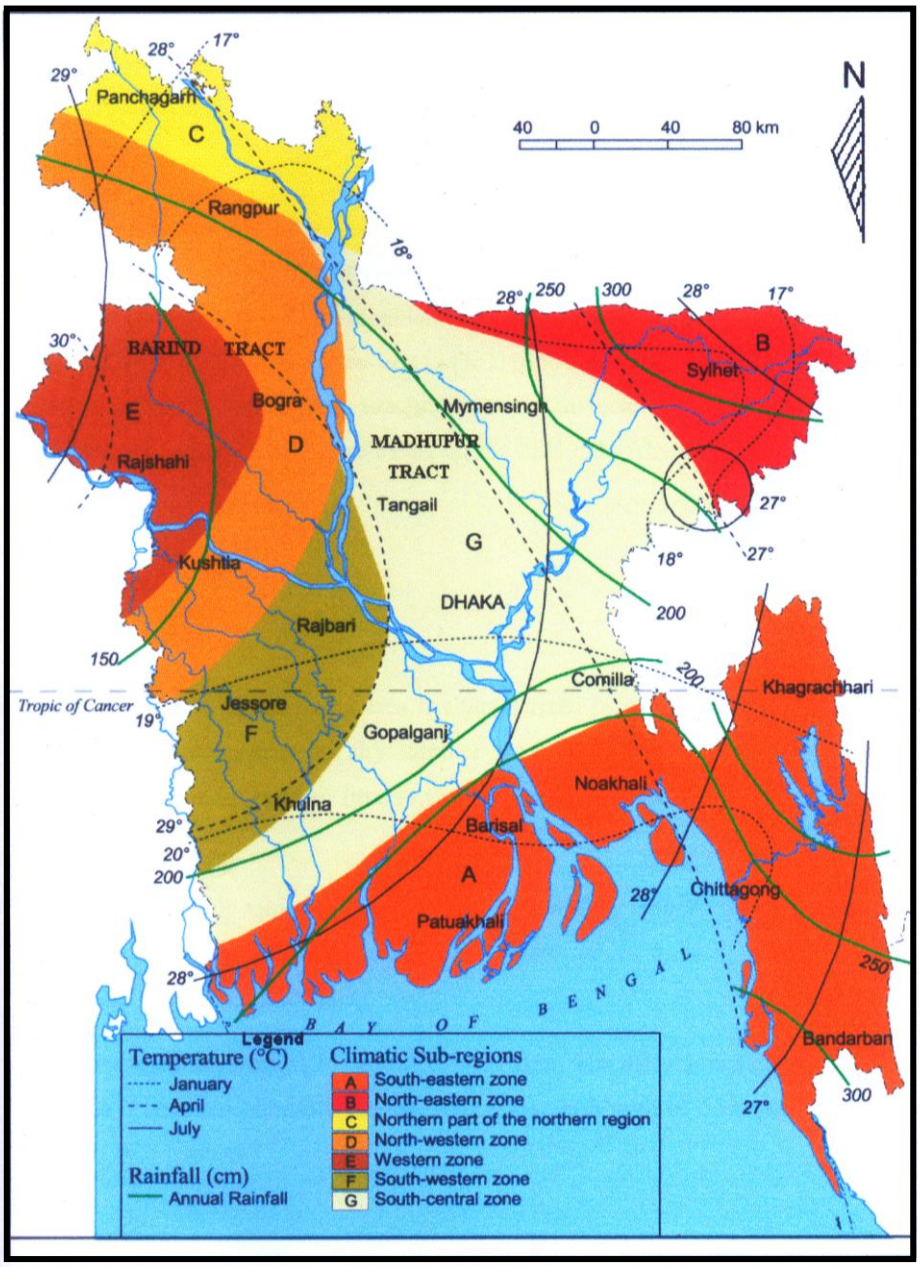
Table-3.6: Monthly Maximum and Minimum Temperature of Madhupur Upazila (º C):

Year / Month	2005		2006		2007		2008		2009		2010		2011		2012		2013	
	Max	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**
January	605	586	786	346	779	343	793	389	768	435	563	425	580	409	442	607	590	385
February	477	452	914	496	753	447	756	405	820	427	663	469	610	486	466	708	698	473
March	688	635	1106	607	1003	594	1031	642	986	567	969	721	829	683	661	951	974	688
April	854	722	1035	692	1117	702	1117	726	954	611	984	703	1005	663	738	980	1003	760
May	977	742	1094	790	1125	830	1150	798	824	599	912	831	988	791	827	1058	951	799
June	1024	814	1052	759	1035	775	1001	801	783	579	925	813	950	823	816	964	1001	845
July	975	810	1038	850	1071	827	981	833	781	611	970	826	948	851	838	923	1004	838
August	973	823	1093	821	1080	852	1000	834	720	600	973	856	934	734	839	980	945	788
September	1007	791	1011	769	999	807	1036	877	713	580	924	813	971	715	809	950	951	815
October	961	744	1088	776	1064	755	997	758	720	568	937	799	977	748	816	958	939	776
November	936	566	925	587	973	591	941	562	606	450	807	663	787	595	605	775	829	576
December	912	442	863	425	879	443	-	-	663	465	691	591	646	486	461	613	707	476
Total	**10389**	**8127**	**12005**	**7918**	**11878**	**7966**	**10803**	**7625**	**9338**	**6492**	**10318**	**8510**	**10225**	**7984**	**8318**	**10467**	**10592**	**8219**

Source: Upazila Krishi Office, Madhupur, Tangail.

- Data is not available.

Map: 3.7- Climate Map of Bangladesh



Source: Modified After Rashid, 1991

3.9. Land use:

Moist Sal (*Shorea robusta*) Forest or Tropical Moist Deciduous Forest is a distinctive feature of this area (Champion et al, 1965). On the deep and relatively well-drained soils of the area were cleared illegally for cultivation. Consisting of highlands (Chala) and lowlands (Baid), the forest floor is a gently undulating landscape. Lowlands or 'Baid' are used mainly as paddy fields. Jackfruit gardens, banana gardens, plantations and different vegetables are used for the Chalas. The Chala lands have less moisture content as it is flooded in rain waters every year. The forest stock was depleted very rapidly in the recent decade and the forest lands were converted into agri-lands and commercial lands for other land uses (e.g. industries, housing etc) (From-FD& Banglapedia).

3.10. Agriculture:

The total cultivable land of Madhupur is 32900 hectares, fallow land 2000 hectares; land under irrigation 65%. The market value of the land of the first grade is Tk 10000 per 0.01 hectare. The area is characterized by poor soil in Madhupur Tract and fertile loam in the floodplains and clayey soil in the channel bed and in the marsh. Paddy is the main summer crop. During the winter, Boro and IRRI paddy grow in the low land. Jute which grows in the flood plains and in Baids of the highland is the main cash crop. During the winter season Mug, mustard seed, bean, tobacco, sweet potato and different types of vegetables grow. The highland area is cultivated during the rainy season only and produces rice, oil seed, turmic, chilli and vegetables. The main crops of this area are paddy, jute, wheat, cotton, potato, patal, ginger, betel leaf, kasava and vegetables. The extinct and nearly extinct crops are here is Indigo, varieties of pulses and aman paddy. Main fruits are mango, jackfruit, litchi, papaya, pineapple and olive. There are 18 fisheries, 28 dairies, 103 poultries, 1 hatchery. Communication facilities Roads: pucca 150 km, semi pucca 19 km; waterways 32 nautical mile. Traditional transport Palanquin (extinct). Main exports items of this area are Pineapple, silk, cotton, jackfruit and honey.

3.11. Other Economic Activities of the People:

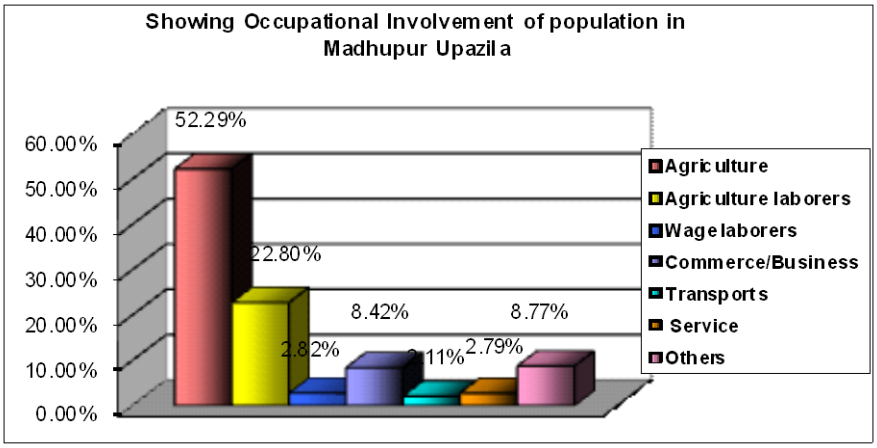
There are 1 Silk mill, 53 rice and flour mills, 17 ice factories, 63 lathes & welding, 109 saw mills, 7 bakeries and 1biri factory in Madhupur Upazila which are representing the Manufacturing activities. On the other hand there are 27 weaving, 103 goldsmith, 26 blacksmith, 320 bamboo work, 43 potteries, 42 wood works, 216 tailoring; apiculture by

private initiative which represents the Cottage Industries (According to *en.Wikipedia. org/wiki/MadhupurUpazila)*. Madhupur Upazila has 45 Hats and bazars, most noted of which are Madhupur and Garo Hat. NGO activities are also supportive for economic development. Operationally important NGOs are Brac, Asa, Proshika and Caritas, World Tourist Mission, Family and Child Welfare Centre, World Vision Bangladesh.

3.12. Population Characteristics:

The total population in Madhupur Upazila is 375295. The population distributions are Male 51.13 %, Female 48.57 %, Muslims 89 %, Hindu 7%,Christian 4% and others 0.31%. Ethnic nationals: Garo (Mande) and Koch-they fall in the Christian and other groups. Average literacy rate is 25.3 %; male 30.2% and female 20.1 %. Occupationally 52.29 % people are depend on Agriculture, Agriculture laborers 22.8 %, Wage laborers 2.82 %, Commerce/ Business 8.42 %, Transports 2.11 %, Service 2.79 % and others 8.77 % (Source:- Banglapedia)

Figure - 3.1: Occupational Involvement of population at Madhupur Upazila.



Source: Banglapedia.

4.1. Introduction:

The main aim of the study is to find out the process of depletion of Madhupur Sal forest and its environmental impacts. Keeping in view above aim a total of 100 persons at Madhupur Upazilla in Tangail District is randomly selected for and administered with the questionnaire, of which a sample appears in Appendix-A.

There have been four field visits with five to seven days stay in each time during October, 2013 and February, 2014.

4.2. Findings of the Study:

During the study, both primary and secondary data were collected. The questionnaire that was used for primary data collection had been divided into three parts which are socio-economic profile of the Respondents, causes and process of depletion of forest, and its impact on the environment. Afterwards, the information and data obtained through questionnaire survey, PRA and laboratory analysis have been presented in tables and graphs. Trough the analysis of the data some important findings were recorded. These findings are discussed below:

4.2.1. Socio-Economic Profile of the Respondents:

Personal Information of the Respondents has been shown from table 4.1 to 4.12.In this surveying period sex, age, religion, educational status; occupation, residential status etc. have been located properly.

Table-4.1: Sex Status of the Respondents:

Sex	Frequency
Male	60
Female	40
Total	100

Source: Questionnaire Survey, 2013-2014.

Table-4.1 presents number of male and female Respondents, of which the diagrammatic reflection is given in figure-4.1 easy understanding. It is obvious from table 4.1 that 60 male and 40 females have been interviewed in Madhupur Upazilla. The opinions of both males and females as regards the process of deforestation have been taken into considerable.

Figure- 4.1: Sex Status of the Respondents.

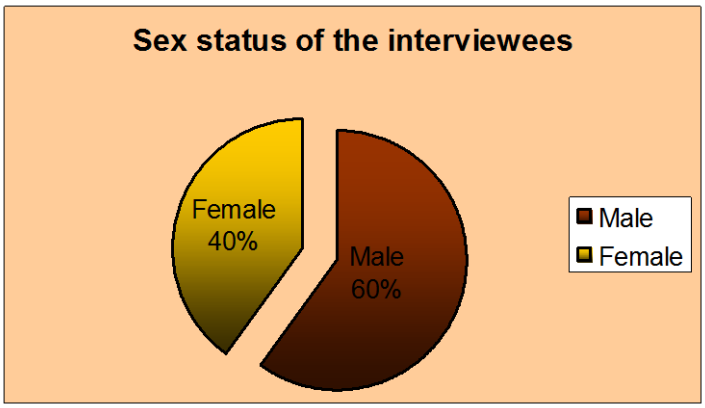


Table-4.2: Proportion of Bangali and Adibasi in the Respondents:

Item	Frequency
Bangali	65
Adibasi	35
Total	100

Source: Questionnaire Survey, 2013-2014.

Table-4.2 shows number of Bangali and Adibasi respondents, of which the diagrammatic appearance is given in figure-4.2 easy perception. It can be observed from table-4.2 that both the Bangalis and Adibasis have been interviewed in almost are not equal in Madhupur Upazilla. Here Bangalis are higher than Adibasi.

Figure - 4.2: Proportion of Bangali and Adibasi.

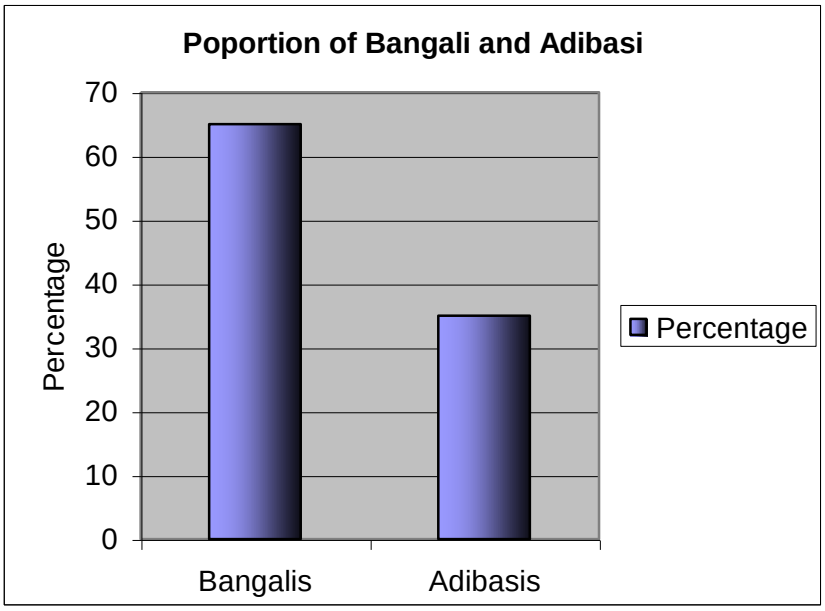


Table-4.3: Religious Status of the Respondents:

Item	Frequency
Muslim	50
Hindu	15
Christian	35
Other	0
Total	100

Source: Questionnaire Survey, 2013-2014.

Table-4.3 reveals the religious status of the respondents, of which the diagrammatic reflection is given in figure-4.3 easy understanding. From table-4.3, it can be observed that Muslims, Hindus and Christians have been interviewed in Madhupur Upazilla.

Figure – 4.3: Religious Status of the Respondents.

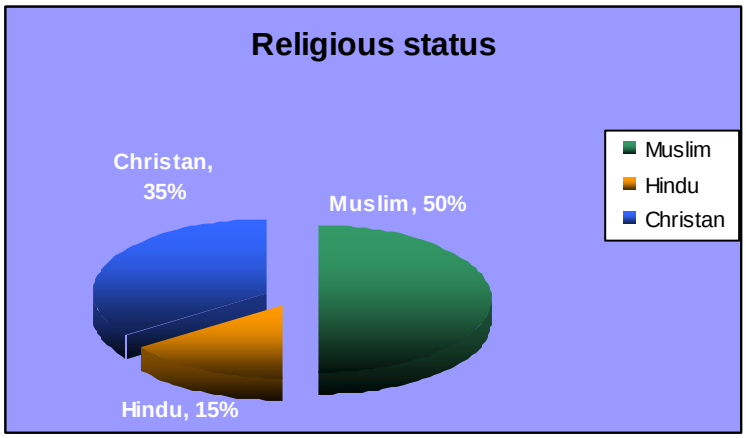


Table- 4.4: Category of the Respondents:

Item	Frequency
General People	20
People of Study area	70
Specialist	10
Total	100

Source: Questionnaire Survey, 2013-2014.

Table-4.4 shows the category of the respondents. There are 3 categories have taken here. They are General people, people of study area, and specialist. Among them the general people are 20%, study area people are 70% and specialist are 10%.

Table-4.5: Age structure of the Respondents:

Age limit(years)	Frequency
0-20	10
21-40	35
41-60	40
61+	15
Total	100

Source: Questionnaire Survey, 2013-2014.

Table-4.5 demonstrates the age structure of the respondents, of which is given in figure-4.4 easy understanding. From the table the age structure of (0-20) is 10%, (21-40) is 35%, (41-60) is 40% and (61+) is 15%.

Figure-4.4: Age Structure of the Respondents.

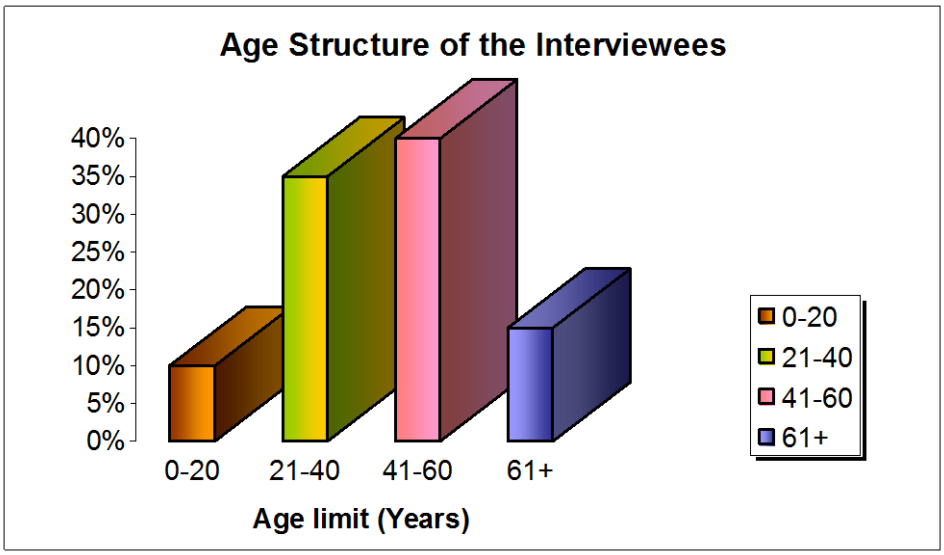


Table-4.6: Educational Status of the Respondents:

Education level	Frequency
Illiterate	20
Primary	23
Lower Secondary	13
S.S.C.	18
H.S.C.	16
Graduate & Higher	10
Total	100

Source: Questionnaire Survey, 2013-2014.

Table-4.6 presents the education status of the respondents. From table-4.6 it is obvious that 23% of the respondents have primary level education.

Table-4.7: Occupation of the Respondents:

Occupation	Frequency
Cultivator	50
Laborer	15
Service holder	5
Businessman	12
House-wife	15
Others	3
Total	100

Source: Questionnaire Survey, 2013-2014.

Table-4.7 shows the types of occupation of the respondents. Here it is found that most of the males were cultivators and females were housewives. Moreover, the Adibasis women engaged themselves both in agricultural and household activities.

Table-4.8: Residential Status of the Respondents:

Item	Frequency
Hereditarily	25
The British Period	18
The Pakistani Period	21
After 1971	36
Total	100

Source: Questionnaire Survey, 2013-2014.

Table-4.8 demonstrates the residential status of the respondents, of which is given in figure-4.5 easy perception. It can be observed from the table-4.8 that 25% of the respondents in Madhupur district are living at that place hereditability, 18% respondents are living at that place from the British Period, 21% respondents are living at that place from Pakistan Period and 36% of the respondents are living at that place after 1971. In this table it is observed that after 1971 the percentages of settlement of the people in this area have increased. As a result the natural forest coverage of this area decreased.

Figure-4.5: Residential Status of the Respondents.

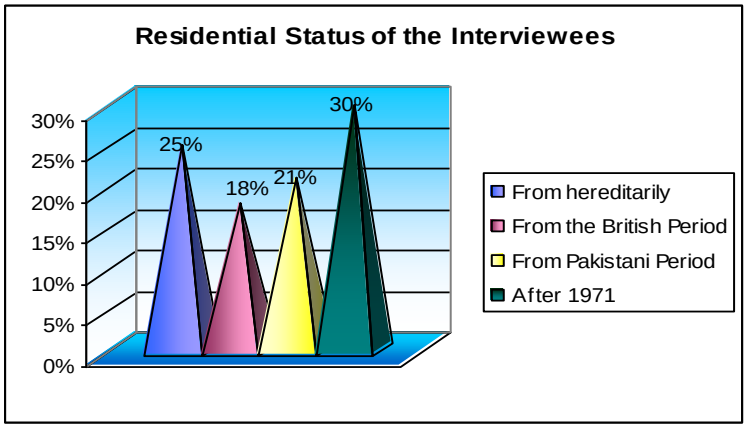


Table-4.9: Places of Migration:

Place	Frequency
From different place of Madhupur Upazilla	14
From different place of Tangail Dist.	21
From other District	18
Not migrate (Local)	47
Total	100

Source: Questionnaire Survey, 2013-2014.

Table-4.9 and figure-4.5 represents the places where migrates have settled. It is to be observed from the table-4.9 that the families whose are migrated from different places living in this forest areas; most of than are migrated from Mymensingh, Tangail and Madhupur Upazilla. But most of them have come from different places of Madhupur Upazilla which percentage is 47. The other migratory families have come from different districts such as Rangpur, Dinajpur, Jamalpur, Sherpur etc. which percentage is 21.

Figure-4.6: Places of Migration.

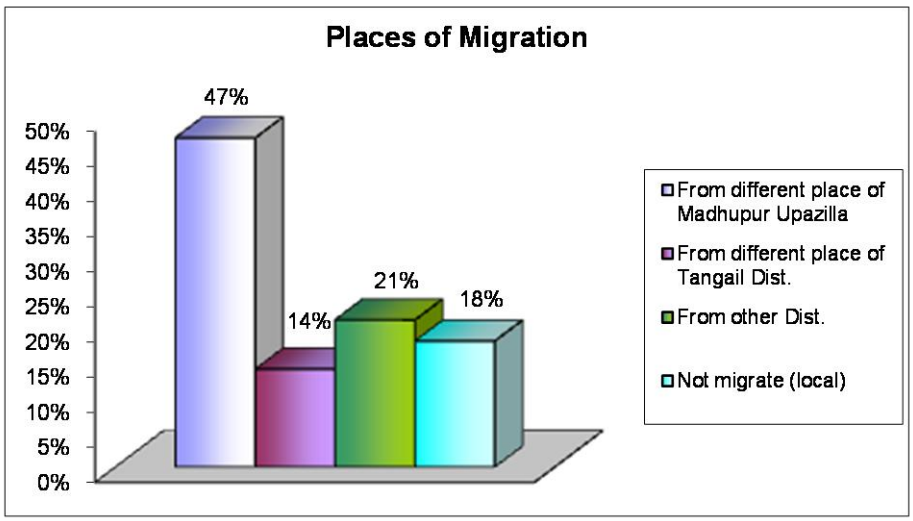


Table-4.10: Causes of Migration:

Causes of migration	Frequency
Migrated from India during the partition in 1947	15
Migrated from India after liberation war in 1971	20
Due to landless condition	30
Economic Development	10
Natural catastrophes (i.e. food, river bank erosion)	12
Other causes	13
Total	100

Source: Questionnaire Survey, 2013-2014.

Table-4.10 represents the main cause of migration in the study area (Churia, Beribaid, Aronkhola, Gachhabari mauzas) is landless condition which is 30%. Besides a considerable percentage of Muslims have migrated from India because of the partition in 1947 and after the liberation war in 1971. The other cause of migration such as poverty, increasing of population, service, hope for "Khas" land, low price of land etc. which percentage is 13.

Table-4.11: Sources of the Ownership of land:

Source	Frequency
Inheritance	58
Exchange	5
Purchase	20
Obtained from govt.	2
Others	15
Total	100

Source: Questionnaire Survey, 2013-2014.

Table-4.11reveals source of the ownership of land of the respondents. It is obvious from table-4.11 that 58% of the surveyed areas 9Beribaid, Chunia, Gachhabari) are owners of land by way of inheritance. On the other hand, the percentage of land owners who have gained the possession of lands through purchase and exchange is 25%. Those who have claimed that government has allotted them land properly have, in fact, received land of forest department under the "Agro forestry Project", which was destined to those people who migrated from India and had no land of their own. These people might have been sincere in running the project only for one or two years, but afterwards they have begun to use the forest land for agricultural purpose. Besides, the others are reluctant to point the sources (s) of their land properly have, infect, made their properly by destroying the forest land illegally.

Table-4.12: Distance of forest from Household:

Distance	Frequency
Within 1 mile	85
Within 2-3 miles	12
Within 4-5 miles	2
5 miles+	1
Total	100

Source: Questionnaire Survey, 2013-2014.

Table-4.12 demonstrates distance of forest from household of the respondents. It is evident from table-4.12 that 85% of the respondents has informed that exists within the range of one mile from their households, that is to say, forest really exists in this study area.

Table-4.13: Knowledge about Participatory/Community/Social Forestry:

Knowledge about participatory/community	Frequency
Yes	52
No	48
Total	100

Source: Questionnaire Survey, 2013-2014.

From the table-4.13, shows that 52% people of the local area know about Participatory/Community/social Forestry. But most of people don't have knowledge about Participatory/Community/Social Forestry. To plant up the degraded Sal forest area with participation of the local poor the Participatory Social Forestry programs were introduced during 1987-88. The landless poor having <50 decimals of land, destitute women, ethnic minorities etc were the target groups and participants to these PSF programs. Since 1987-88 till today two PSF projects namely-Thana Afforestation and Nursery Development Project (THNDA) and Forestry Sector Project (FSP) were implemented to achieve the objectives: i) Socioeconomic development of the target groups, and ii) Conservation and sustainable management of the natural Sal forest areas. The local people know about the participatory forestry from Forest Dept, mainly some factors influenced them to join the program. Such as hope of permanent tenure on land. No rest of losing the land, input assistance & protection of FD, group patronage, economic benefit, severance of forest etc.

Table-4.14: Participants Conflicts:

Participants Conflict with one another	Frequency
Yes	82
No	12
Total	100

Source: Questionnaire Survey, 2013-2014.

It was found that the percentage of respondents across the study area who were agreed upon the point that participants conflict with one another was 88%. On the other hand, the percentage of respondents across the study area who disagreed or opposed the said point was 12%. It was observed that the participants would conflict in the midst of them mainly for two reasons, opined by the respondents. The two reasons were: (i) Unjust demarcation and site allocation of plots for participants and (ii) Watching and safeguarding plantations against thefts and damages.

Table-4.15: Conflict Resolution:

Conflict resolution process	Frequency
Unsettled	-
Traditional Mechanism	-
Court litigation	-
Intervention of FD	95
Intervention of L.G.	22
Other Govt.agency	-
NGO	3
Total	100

Source: Questionnaire Survey, 2013-2014.

Table-4.15 shows the conflict resolution process. Participants were trained by the Forest Department and the concerned NGOs under the training programs ran by the Participatory Social Forestry projects in both the first and second rotation develop their social capital and there by to bring in team spirits among them; which really motivated them to work together for their well being and for the smooth implementation and success the PSF practices. But even there were some conflicting reasons which instigated them to quarrel and fight with one another. To fight back these irritating social problem the Forest department, NGOs and the participants' committees played vital rules from their respective positions. They resolved the conflicts arose among the participants at times. The percentage of conflict resolution by Forest Department was 95 % while the

percentage of resolution by NGOs was 3% and the percentage of resolution by the Local Group was 2%. This indicates that the Forest Department played more vital and satisfactory rules in resolving participants' conflicts than the NGOs and local group involved in the PSF programs.

4.2.2. Forest Depletion Scenario of Bangladesh and the Study Area:

The official forest coverage of Bangladesh is around 17 percent against 25 percent, the general standard that a country should maintain. Realizing the alarming situation of low forest coverage, the government has set a goal to increase the forest coverage to 25 percent by 2015 (The Daily Star, Saturday, June 11, 2011).

But in reality the coverage has gone down to 7.29 percent (1.08 million hectares) according to an unpublished joint study by Bangladesh Space Research and Remote Sensing Organization (SPARSO) and the Department of Forest in 2007. Besides, the 7.29 percent coverage includes the forest of Chittagong Hill Tracts, Sal forest, mangrove forest, bamboo or mixed forest and rubber plantation. The Forestry Sector Master Plan, 1993, under which the government started tree plantation programme, says the annual deforestation rate in Bangladesh is 3 percent.

The Madhupur Sal Forest is a unique example how the government let the foresters steal trees, clear the forest to grow wood plants and let people grab forestland violating the rights of the forest inhabitants. The Madhupur forests have almost disappeared, thanks to encroachment, neglect in preservation, corruption by forest officials and nepotism in leasing forestland and discriminatory attitudes towards indigenous people for decades.

Once a large, dense forest and home of tigers, peacocks and langurs, Madhupur has now been reshaped with banana and pineapple orchards where harmful insecticide and chemicals are commonly used. Besides the use of chemicals hampering natural environment and biodiversity, high-pitched noise of sawmills overwhelms the chirping of birds in the forests.

The country observes World Environment Day every year on this day while the vast forests continue to shrink due to years of indiscriminate grabbing by locals and

influential people. Instead of preserving the natural vegetation, the forest officials have long been encouraging the people to plant alien acacia and eucalyptus trees.

According to the Tangail Forest Department, around 58,000 acres of forestland in the district is still in possession of the encroachers. Of this grabbed land, around 20,000 acres lies in Madhupur, 19,500 acres in Sakhipur, 13,000 acres in Ghatail, 3,300 acres in Mirzapur and 150 acres in Kalihati upazilas. The forests in Tangail once stretched over 122,876 acres of land in five upazilas, 45,565 acres of which was in Madhupur, 47,220 acres in Sakhipur, 21,855 acres in Ghatail, 7,576 acres in Mirzapur and 669 acres in Kalihati, forest sources say. Of the total forests in the district, 55,476 acres is for the reserved forests, of which 38,232 acres is in Sakhipur, 7,225 acres in Mirzapur, 7,251 acres in Ghatail, 2,500 acres in Madhupur and 185 acres in Kalihati, the sources add. All these forests have shrunk due to indiscriminate cut and theft of trees and encroachment (Daily Star, Friday, June 5, 2009).

Almost two-thirds of the forests in Tangail amounting to around 80,000 acres have already disappeared due to mindless cut of trees in connivance with a section of corrupt officials; the sources allege (Tangail Forest Department, 2009). The forest officials claim they could not take prompt action against the theft and encroachment on the forestland due to a shortage of workforce and logistics. They add the influential individuals having strong political clout have grabbed a vast stretch of forests using false and forged documents. "We are virtually helpless as about 4,500 forest related cases are pending with the courts," a forest official comments.

The sources, however, claim a section of corrupt officials having links with powerful political quarters helped land grabbers encroach on the forests. Wholesale felling of trees had earlier increased following establishment of a number of brickfields and sawmills, most of which were illegal, near the forests. The forest department in the last 10 years also leased around 37,000 acres of forestland in the district under the social afforestation programe (Daily Star, 5 June, 2009). Forestland is supposed to be leased to the local landless and the poor under the programme. But allegations are rife that influential people and outsiders got most of the leaseholds of the land in exchange of hefty sums of bribe. A clique of dishonest forest officials earned a huge amount of money from those leases, the sources allege. Forest officials, however, deny the allegations.

Over 20,000 acres of forestlands out of 45,565 acres in Madhupur is still in possession of the encroachers. Besides, rubber gardening started in the area in 1987 on 10,000 acres of forestland (Mirza Shakil, The Daily Star, 5 June, 2009). Four gardens have been raised in Pirgachha, Chandpur, Santoshpur and Kamalapur in the upazila after clearing the forests. Only 8,000 acres of land now covers what is left of the Madhupur forest. Outsiders and local influential people grabbed the forestland, felled trees indiscriminately and set up different fruit orchards, say sources in the local administration. They add the deforesters also constructed makeshift structures there to strengthen their position. The forests in Sakhipur, Ghatail, Mirzapur and Kalihati have undergone similar fate. Several markets also sprang up at different places in the district to sell stolen timber openly. Stealing valuable trees from the forests and encroaching on the land continued unabated until the declaration of the state of emergency. The forest department has so far recovered around 10,000 acres of land through motivation and use of force. Interestingly, over half of that land was recovered between January and July in 2007 by the social afforestation programme which continues on the recovered forestland in association with the local people, District Forest Officer Shah-e-Alam said. Only the forest department cannot save the forests, he said, adding the residents of the forest areas need to be involved to create awareness among them to save the forests (The Daily Star, 19 June, 2006).

Reserve forests in Madhupur upazila in Tangail are shrinking due to indiscriminate cutting of trees and encroachment of forestlands. The forest department is busy to save the controversial wall built for creating an Eco Park rather than taking steps to preserve the forests. Some of the contractors who constructed the wall and are now involved in its maintenance are also behind the large scale destruction of forests, some local people alleged while talking with them. They have links with organized gangs including local sawmill owners and timber merchants. Valuable timber trees are stolen from reserve forests in Madhupur allegedly in connivance with a section of forest department staff and law enforcers. Forests officials sometimes recover stolen timber and take alleged thieves into custody but this is only eyewash, they alleged. Meer Abdul Latif, a timber merchant at Battala in Tangail, said that every day, especially at night, 15 to 20 truckloads of timber like Sal and Gajari leave the forest areas for different destinations. Parts of these are also sold at nearby sawmills. The pilferage continues due to ineffective steps by the local administration and forest department, he alleged. There are over 50 sawmills and numerous brick fields near the forests, most of which are illegal, sources said.

The reserve forests in Tangail were earlier spread over 1, 22,876 acres in five upazilas--45,565 acres in Madhupur; 47,220 in Sakhipur; 21,855 in Ghatail; 7,576 in Mirzapur and 669 acres in Kalihati, according to forest department sources. Large portions of reserve forests in Madhupur have been illegally grabbed. Local influential encroachers, most of them aligned with ruling parties, have raised banana orchards and pineapple gardens and constructed makeshift structures to strengthen their position, they said. Besides, there are 17,436 acres of reserve forest in Madhupur Gar in Mymensingh district. Over 70,000 people including indigenous and Bangalees live in forests in Tangail and Mymensingh regions, who depend on the forests for their livelihood, forest department sources said (Daily Star, 19 June, 2006).

The Conscious Citizen Committee (CCC) Convener Abdul Latif said about two-thirds of the reserve forests in Madhupur have already disappeared and the lands occupied by local influentials. They are cultivating pineapple and banana on grabbed forest lands. Use of banned DDT power, insecticides and hormone in the fruit gardens is damaging the environment and biodiversity, he said.

4.2.2.1. Time Series Satellite Image Data Analysis:

Different year's satellite images (Table-4.16) were used to derive historical land uses/forest covers of Study Area (Madhupur National Park). For the trend analysis of land use/ forest cover the study area includes 1 km buffer around the MNP area. Before classification, images were co-registered so that they spatially aligned correctly to each other.

Table-4.16: List of Historical Satellite Images:

S.N.	Satellite / Sensor	Date	Resolution
1	Corona Space Photo Satellite	1 March 1967	12 m
2	Land Sat MSS	9 February 1973	80 m
3	Land Sat TM	16 March 1989	30 m
4	Spot Multispectral Image	1999 (RIMS)	20 m
5	Quick Bird Image	2003	-
6	IRS P6 LISS-III	24 February 2007	23.5 m
7	Rapid Eye	20 Mar 2013	5 m

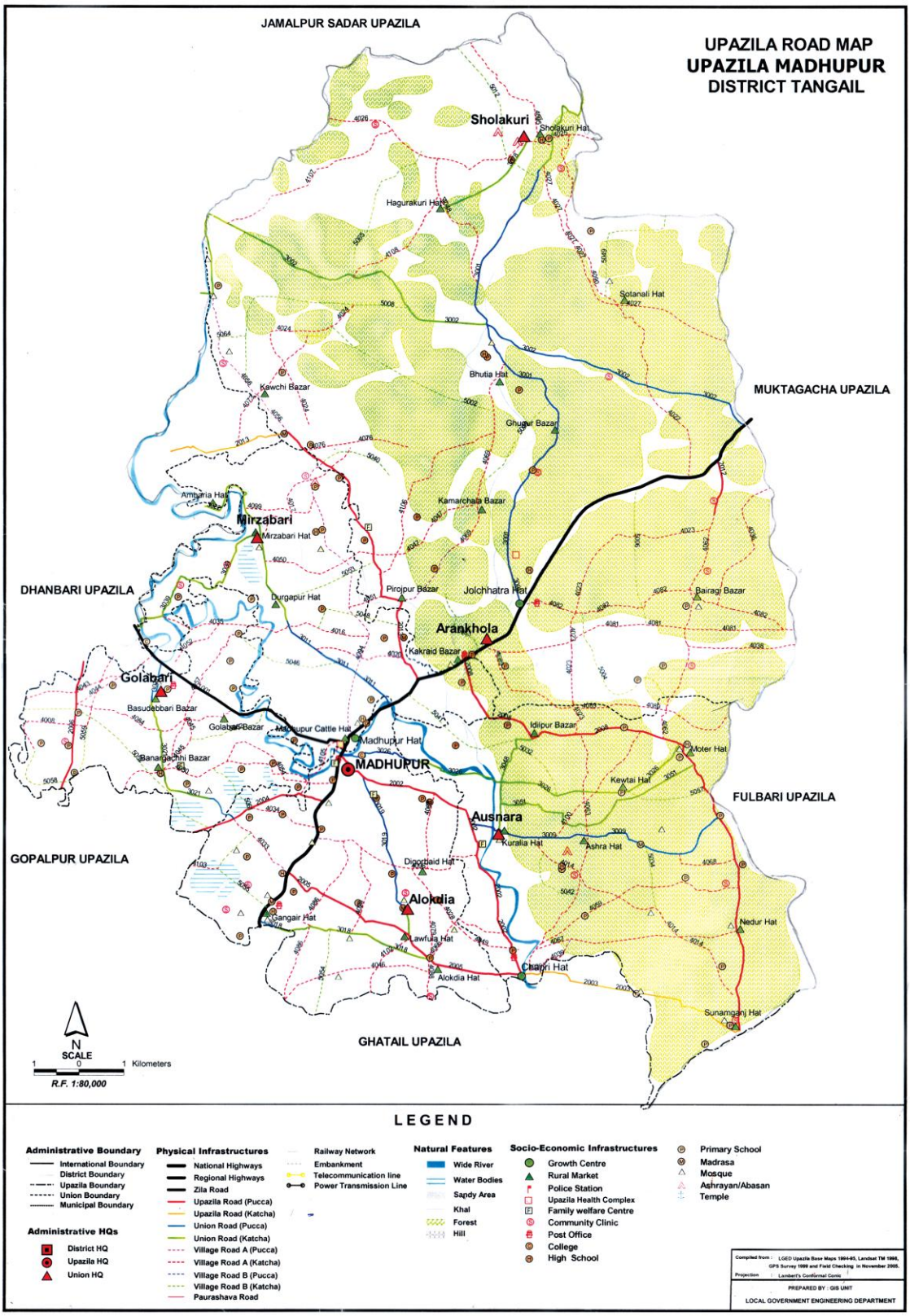
Source: C ~ GIS & CREL Project-2014.

"Forest Cover Area" and "Others" were classified for the Corona satellite image of 1967. The Land Sat MSS image of 1973 was having four-channels or bands but with very coarse (80 m) resolution. Due to this reason it was also classified into two classes: "Forest Cover Area" and "Others". The satellite images of 1989, 1999 and 2007 were classified into seven classes: Forest, Rubber Plantation, and Settlements with Homestead Vegetation, Water, Seasonal Water Bodies and Others. The satellite image of 2013 was classified into six classes: Sal Forest, SR Plantation, Rubber Plantation, Irrigated Agriculture, Settlement and Wetland.

It was found that the DN value ranging from 40 to 120 represent forest cover area while analyzing the panchromatic Corona image of 1967. An unsupervised classification method was used for the multispectral images. The ISODATA algorithm techniques were used to perform an unsupervised classification. ISODATA stands for 'Iterative Self-Organizing Data Analysis Technique'. To form clusters the minimum spectral distance formula uses the ISODATA clustering method. It begins with either arbitrary cluster means or the means of an existing signature set, and each time the clustering repeats, the means of these clusters are shifted. The new cluster means are used for the next iteration. A maximum number of iterations have been performed, or a maximum percentage of unchanged pixels have been reached between two iterations until the ISODATA utility repeats the clustering of the image. Each spectral class was verified with ground truth data. With a land use / land cover based on ground truth data the similar spectral classes were grouped together and labeled. Forest Cover Area, Rubber Plantation, and Settlements with Homestead Vegetation, Water, Seasonal Water Bodies and Others were derived as information classes finally.

It was also found that a number of minor areas could not be assigned to any class during classification of time series data. In some cases, the panchromatic corona satellite image causing some misclassification due to similarities of the tone of the degraded forestland and fallow lands. In acquisition of images the color and tone of some classes were different in different images due to seasonal variation also.

Map: 4.1: Forest Cover of Madhupur Upazila



Source: Modified from Upaliza LGED Office, 2012.

4.2.2.2. Changes in Land use/ Forest Cover-1967-2013:

The different land uses/ forest covers that were extracted from the images of 1967, 1973, 1989, 1999, 2003, 2007 and 2013 are Natural Forest, Rubber plantation, Agro Forestry, Woodlot, Bamboo, Cultivated land, Rural Settlements, Built-up areas, Rivers, Ponds and Water bodies and Seasonal Water bodies which is shown in Map - 4.2, 4.3, 4.4, 4.5, 4.6, 4.7 and 4.8 respectively (See page-72-78). The statistics of land use/ forest cover of the selected years derived from the time series satellite images are given in Table-4.16-4.18. The Table shows areas under different land uses/ Forest cover classes within the MNP area and a 1-km buffer around the MNP boundary.

Table-4.17 shows the areas of these land uses/forest covers in hectares and percentage of total area within the Madhupur National Park (MNP). The Natural Forest class includes Sal (*Shorea robusta*) Forest, which comprises about 25% of the MNP area. It is mainly distributed under Arankhola mauza and a little portion under Rasulpur mauza. The western part of the MNP area is dominated by rubber plantations, which occupies about 10% of the total MNP area. The rubber plantations are mainly distributed in Pirgachha mauza under Madhupur Upazila. The major land use within the MNP area is "Cultivated Land" which is about 37% of the total MNP area. It includes both rice and non-rice cropped areas, which include pineapple, banana and other vegetables. The rural settlement within the MNP area is about 12% of the total MNP area.

In 1967 the total forest cover within the study area was found to be 8,875 ha which is about 68.3% of the total study area. Between 1967 and 2013 it was found that the forest cover area gradually depleted and in 2013 it was found to comprise only 26% of the total study area. Most of the forest cover area has been converted to rubber plantations and some brought under agriculture practice or converted to rural settlements with homestead vegetation. It was found that the forest area had reduced by about 22.5% between 1967 and 1973. It should be noted that the 1967 image has a resolution of 12 m where as the 1973 image is of very coarse resolution i.e. 80 m. Therefore the area calculated from the 1973 image is much less than that of the 1967 image. An analysis of the image acquired in 1989 revealed that some forest areas that could not be identified from the coarse resolution satellite image of MSS (80 m) acquired in 1973 were actually visible in the 1989 image. This kind of difference is expected when images of different resolution are used for comparisons. Images of 1989, 1999, 2003 and 2007 are of very similar

resolution and hence are more comparable. It found that between 1989 and 2007 there is a further reduction in forest area of 14% and between 2007 and 2013 there is 3.8% of forest area reduction.

The rubber plantation area increased from 4.7% in 1989 to 12.7% in 1999. A large amount of forest cover area was converted to rubber plantations during this period. Between 1999 and 2007 there was no significant increase in the area of rubber plantations. From further analysis of the image it was found that the rubber plantation area has actually reduced by about 1% during this reporting period. But additional investigations have revealed that the image of 2007 had been acquired in January, a time when rubber trees shed their leaves. That is why it has been difficult to identify the full coverage of rubber plantation from the image of 2007.

The image of January 2007 was used as it was available free of charge from the C-GIS archive. It is recommended that image of April be used for better identification of rubber plantations as at that time the rubber trees have full leaf coverage. The rubber plantation area is decreased from 11.8% in 2007 to 8% in 2013.

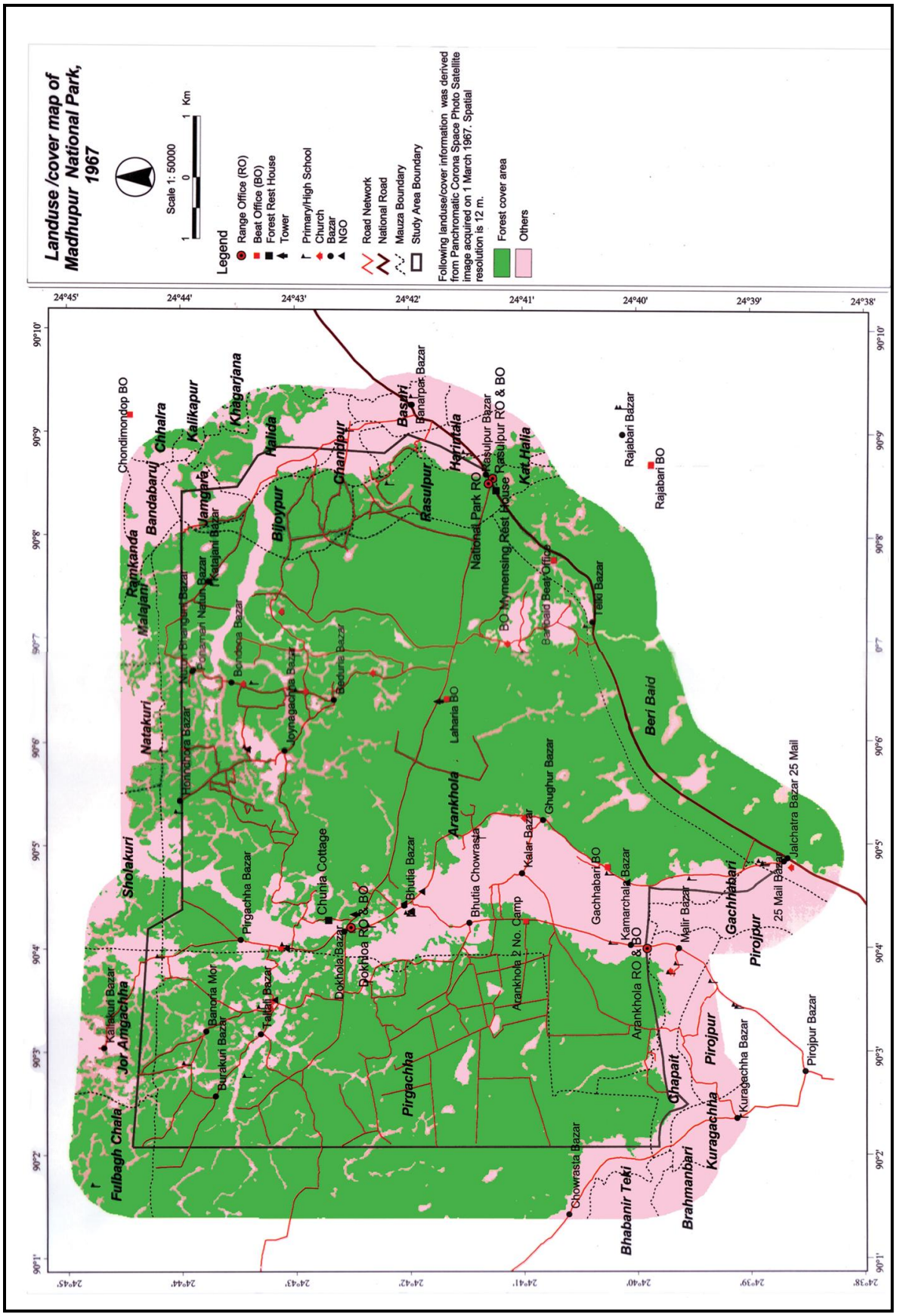
Within the study area, in 1989 the study area had about 44.5% agricultural land. After that there was no major increase (i.e. about 1% between 1989 and 1999 and 2% between 1999 and 2007). But in 2013 the study area had about 26% agricultural land. It showed that agricultural land was decreased because there agroforestry and social forestry took a vital role. Settlements with homestead vegetation were found to comprise 4.2% of the total study area in 1989. It increased to 6.7% in 1999, 8.9% in 2007 and 39% in 2013. Other land use/cover such as water bodies and seasonal water bodies has not changed significantly between 1989 and 2013.

Table-4.17: Areas of Land use/ Forest Cover in Different years:

Land Uses / Forest Covers	Year													
	1967		1973		1989		1999		2003		2007		2013	
	Area (Ha)	%	Area (Ha)	%	Area (Ha)	%	Area (Ha)	%	Area (Ha)	%	Area (Ha)	%	Area (Ha)	%
Forest cover Area	8875	68.3	6011	45.7	5718	43.8	4360	33.5	2114	24.88	3879	29.8	3,566	26
Rubber Plantation	-	-		-	612	4.7	1656	12.7	878	10.33	1537	11.8	1,119	8
Agriculture land	-	-		-	5808	44.5	5901	45.3	3103	36.51	6172	47.3	3,479	26
Settlement With-Homestead vegetation	-	-		-	545	4.2	874	6.7	1135	13.36	1165	8.9	5,250	39
Water	-	-		-	212	1.6	101	0.8	160	1.88	115	0.9		-
Seasonal Water Bodies	-	-		-	94	0.7	68	0.5	51	0.60	95	0.7	118	1
Other	4128	31.7	7,128	54.3	76	0.6	69	0.5	1057	12.44	73	0.6	-	-
Total	13,003	100	13,139	100	13,064	100	13,029	100	8,498	100	13,036	100	13,532	100

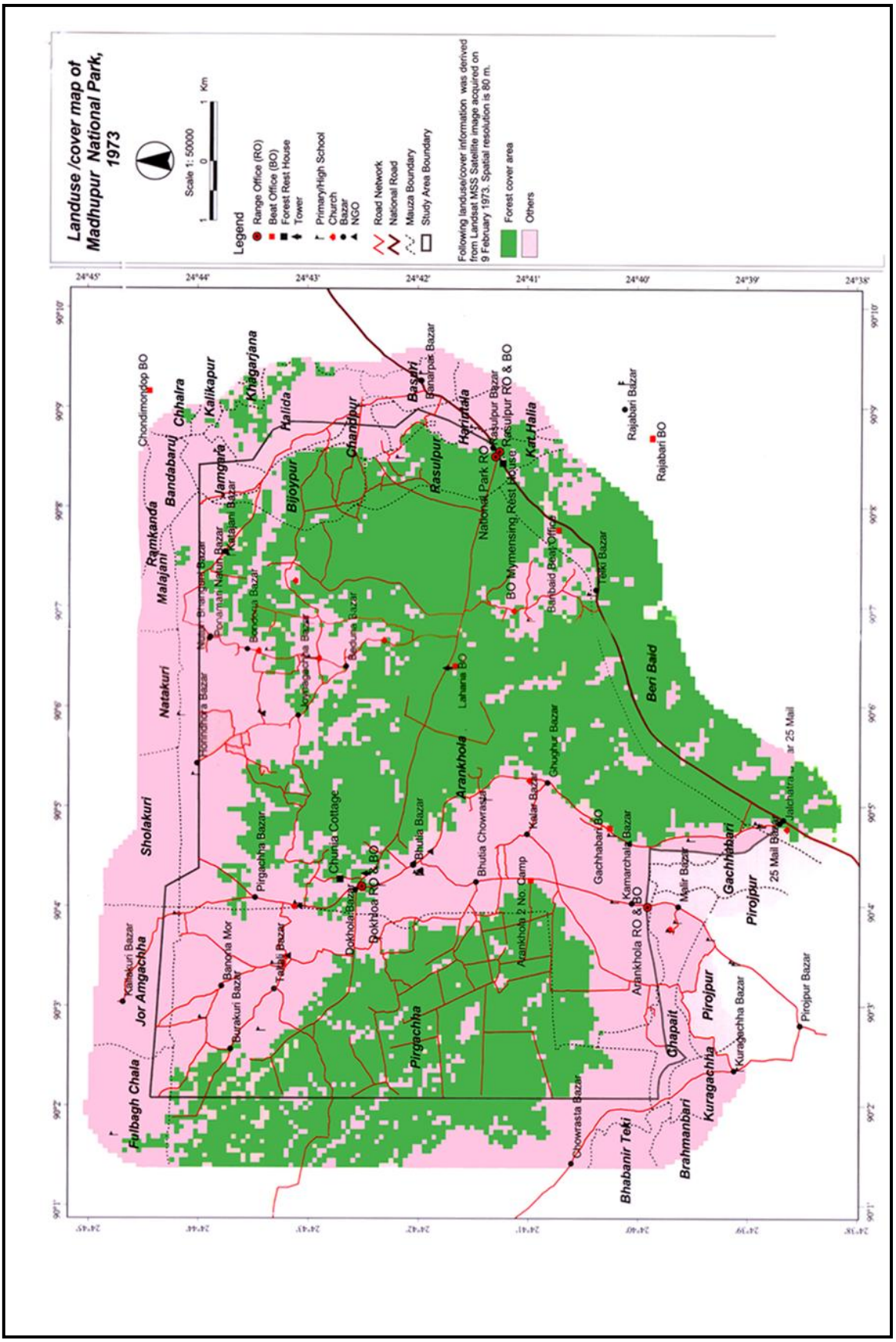
Source: C ~ GIS & CREL Project -2014.

Map: 4.2 Forest Cover of the Study Area (1967)



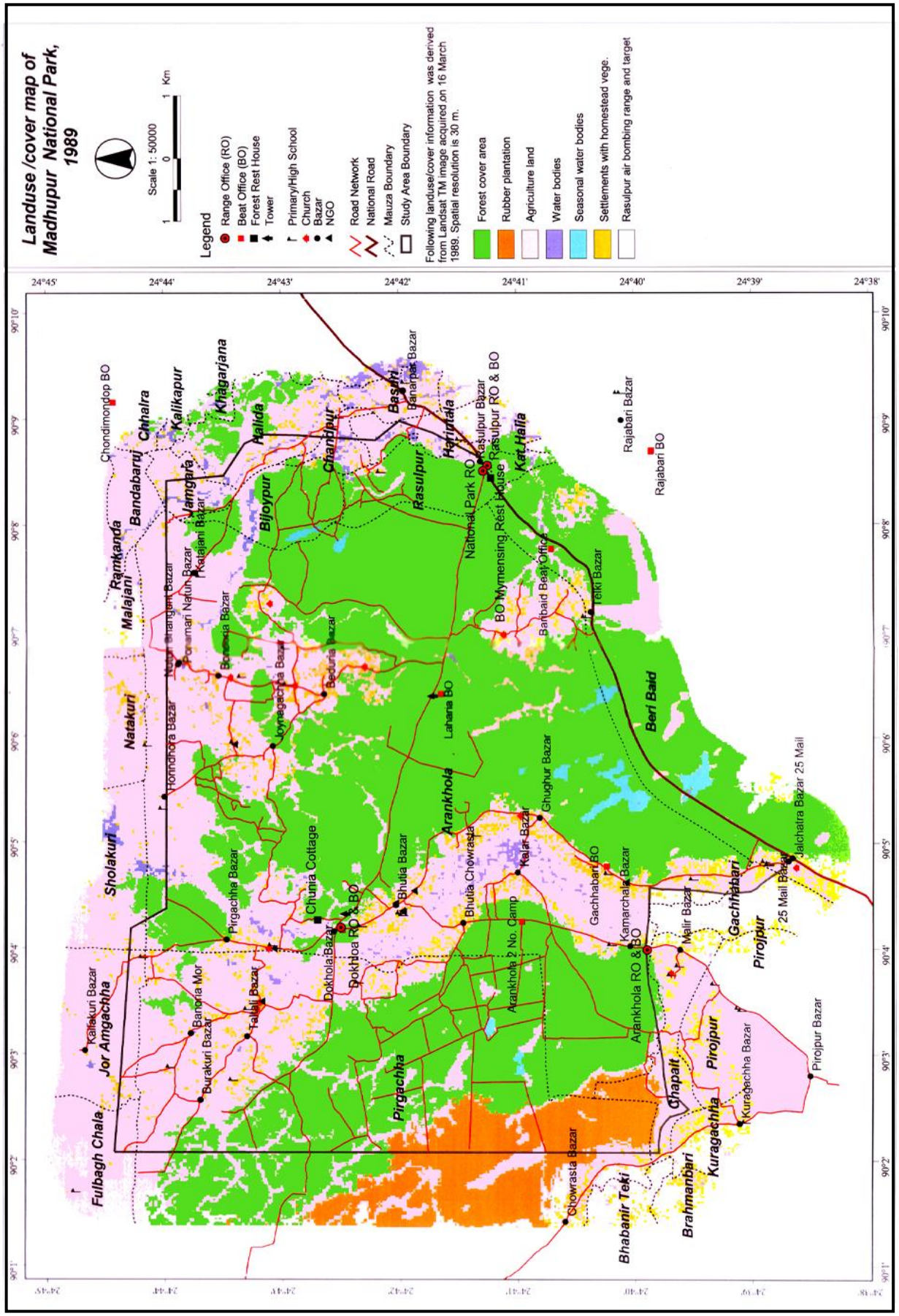
Source: C-GIS

Map: 4.3 Forest Cover of the Study Area (1973)



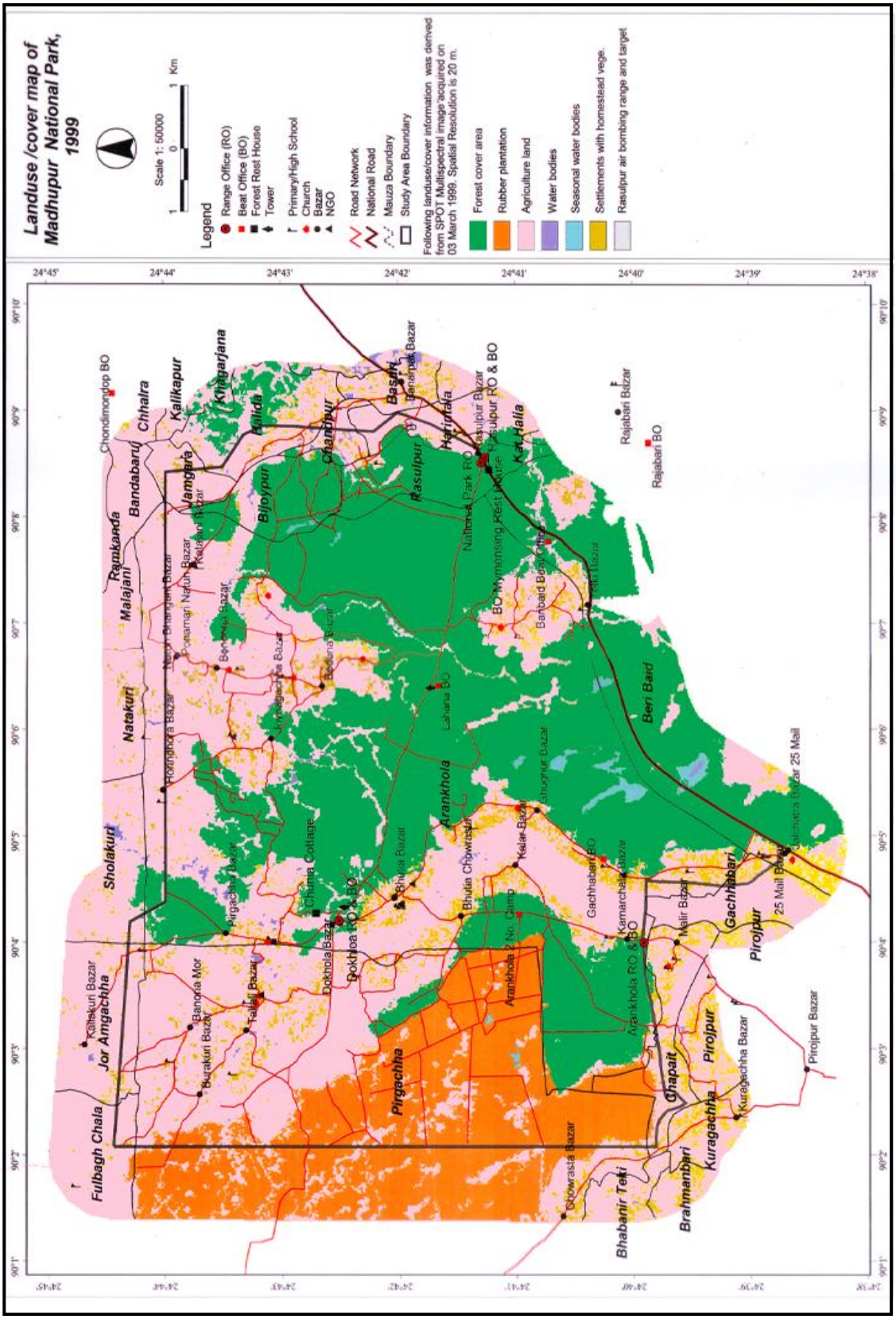
Source: C-GIS

Map: 4.4 Forest Cover of the Study Area (1989)



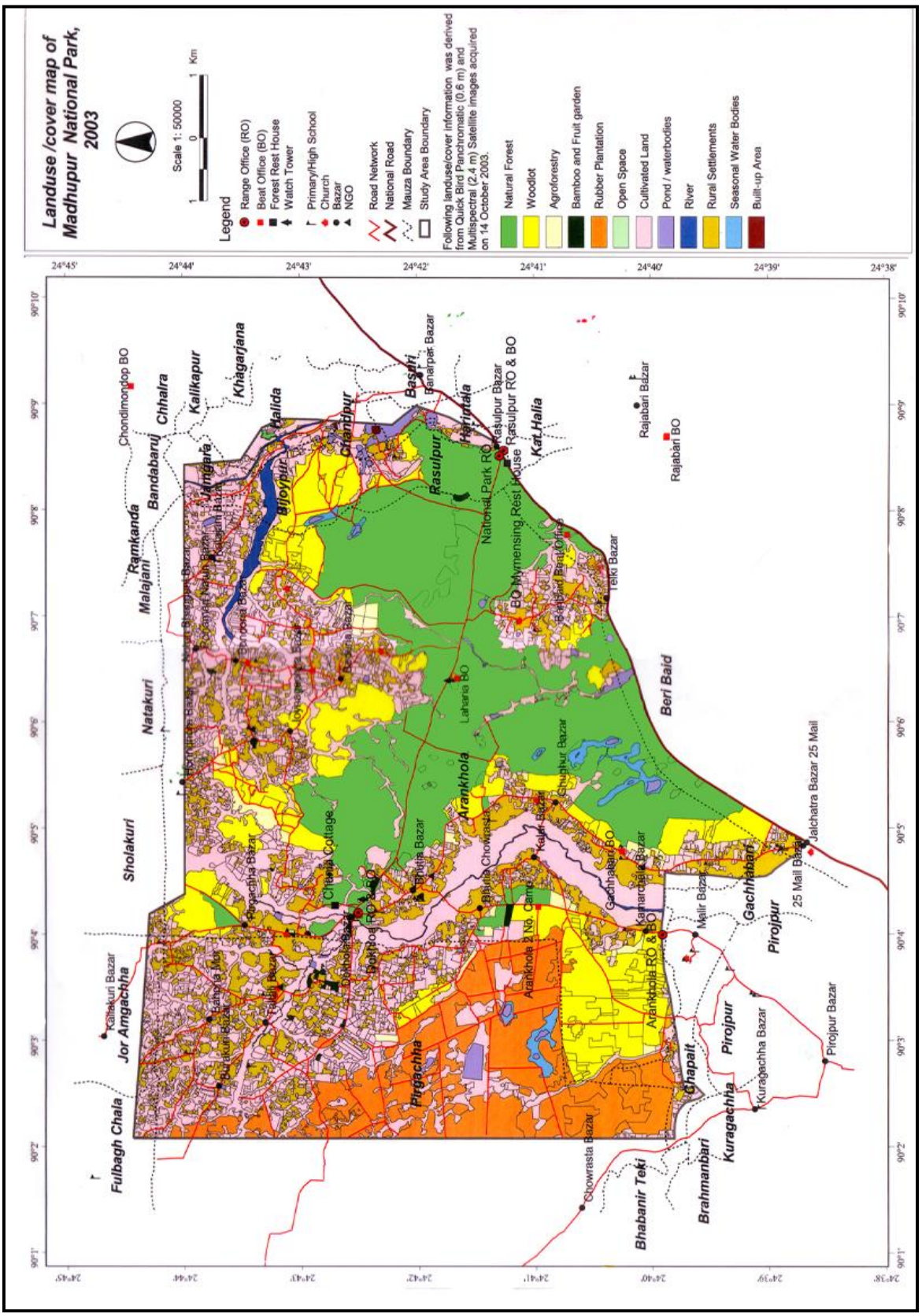
Source: C-GIS

Map: 4.5 Forest Cover of the Study Area (1999)

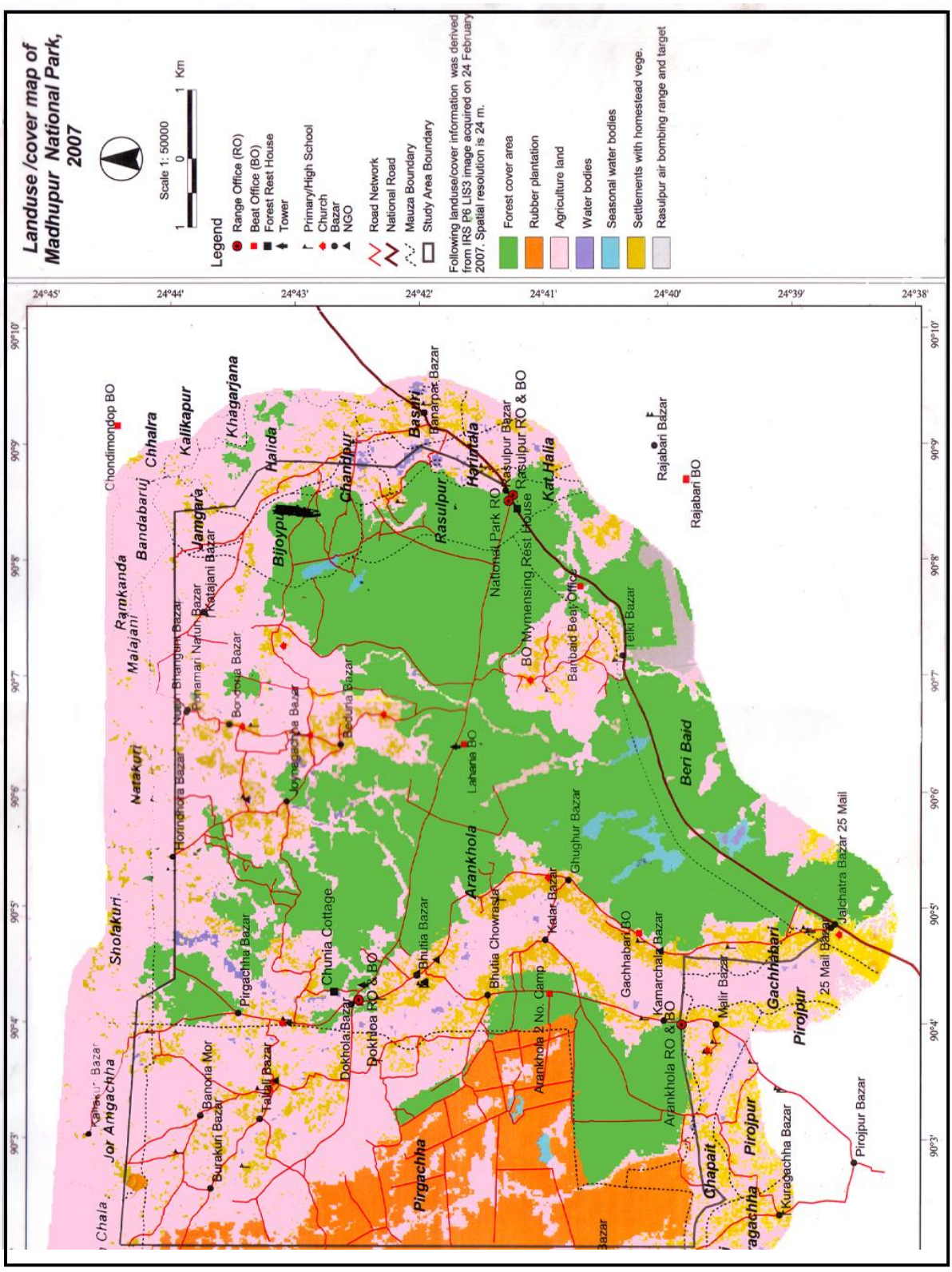


Source: C-GIS

Map: 4.6 Forest Cover of the Study Area (2003)



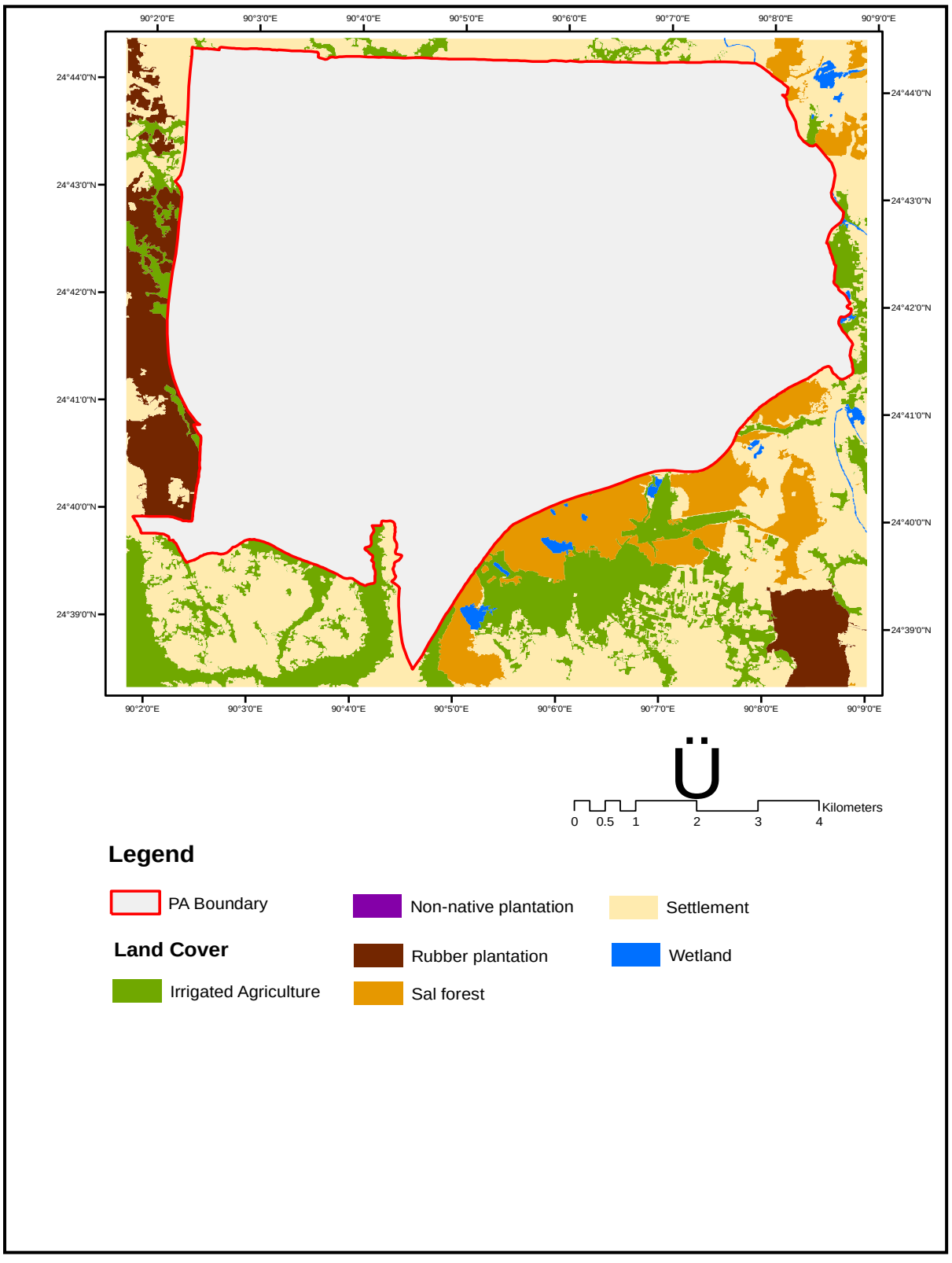
Source: C-GIS



Map: 4.7 Forest Cover of the Study Area (2007)

Source: C-GIS

Land use map of Madhupur



Map: 4.8 Forest Cover of the Study Area (2013)

Source: CREL Project, Dhaka, 2014.

Table-4.18: Percentage of Forest Cover Changes in Different Years:

Years	Total Forest Area (Ha)	Change (in %)
1967	8,875	100%
1973	6,011	28.64
1989	5,718	2.93
1999	4,360	13.58
2003	4,034	3.26
2007	3,879	1.55
2013	3,566	3.13

Source: C ~ GIS & CREL Project -2014.

In the table-4.18 shows the percentage of forest cover changes in different years. Here it is mentioned that in 2003, the total area of forest cover include natural forest, woodlot, agroforestry etc. In 1973 the rate of forest cover changes is very high and the rate of forest cover changes is low in 2013.

Figure-4.7: Percentage of Forest Cover Changes in Different Years

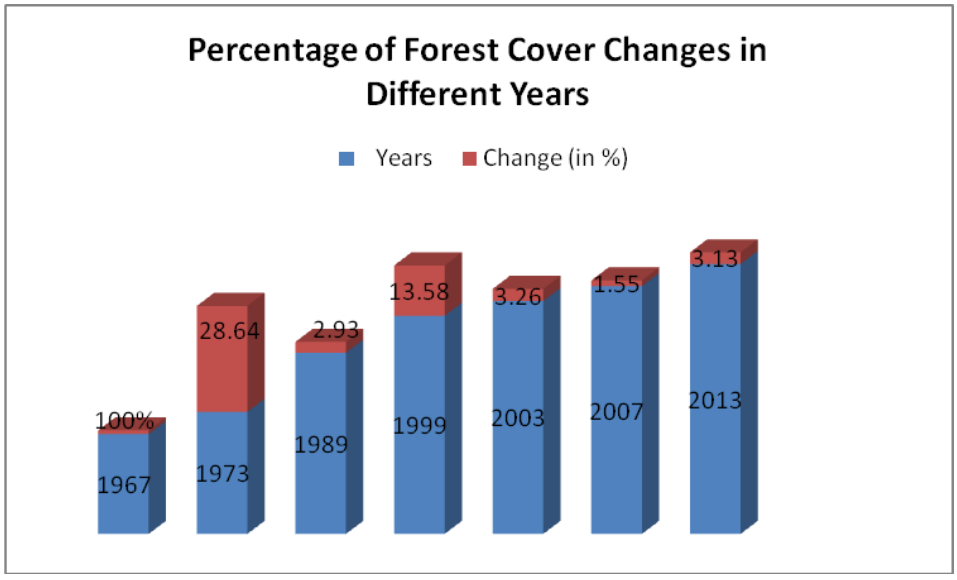


Figure-4.7 shows, percentage of forest cover changes. Here it is mentioned that the rate of forest cover changes is high in 1973 because during the Liberation War in 1971 the Indo-Bangladesh border was opened facilitating the neighboring Indians to enter and destroy forest in order to collect fuel wood and timber. High population pressure is existing forestland both for settlement and cultivation. The rate of forest cover changes also high in 1999 (13.58%), it is because, increasing growth population in and around existing forest land for settlement and cultivation enhanced destruction for forest.

In 1989 the percentage of forest cover changes is 2.93.It is low because to plant up the aforesaid degraded Sal forest area with participation of the local poor the participatory social forestry programs were introduced during 1987-88. Forest cover change is the lowest in 2007, which percentage is 1.55%. But in 2013 the percentage of forest coverage change (3.13%) is higher than the percentage of forest coverage change of 2007.

Table-4.19: Total Forest Coverage of Madhupur Upazila at a Glance:

Range	Beat	Total Forest land(Acre)	Encroach Forest land(Acre)	Natural Forest (Acre)	Social Forest (Acre)	Fallow land (Acre)
Madhupur	Charaljani Mohismara	3835.23 2050.30	2403.27 1956.25	-	-	-
Total Range		5885.53	4359.52	953.59	489.50	82.92
Dokhola	Dokhola Sadar Chanpur	10442.52 7354.99	6682.95 3261.11	-	-	-
Total Range		17797.51	9944.06	5908.23	1568.10	377.12
Aronkhula	Aronkhula Sadar	6805.8	2251.16	3319.33	694.96	540.35
Total Range		6805.8	2251.16	3319.33	694.96	540.35
National Park Sadar	Beribaid Lohoria National park Gachhabari	6497.87 3160.08 3854.63 1563.76	2005.00 1250.00 800.00 307.20	3401.49 1435.18 2468.07 749.94	511.28 220.00 358.68 335.00	-
Total Range		15076.34	4362.20	8054.68	1424.96	1234.50
Total Madhupur Upazila		45565.18	20916.94	18235.83	4177.52	2234.89

Source: Divisional Forest Department, Tangail.

-Data is not available.

Here, 1Ha = 2.47 Acre

5.1. Introduction:

Forest is the part and parcel of the natural environment. The role of forest is very significant in maintaining the ecological balance of nature. These days, forest resources of Bangladesh are at a stake with multifaceted problems due to increased demand for fuel and timber, crop production, industry, urbanization and infrastructure development. In addition, global climate change impacts further add to the problem. Bangladesh is extremely vulnerable to the adverse impact of climate change because of its geographical position and huge population size.

5.2. Forest Depletion: Response to Global Development

The nature of forest depletion is a warning of economic and social development in the global world. In this context the response of biodiversity and economic imbalance reduce the growth of development. With the world growing at a pace hard to match, the increasing need for space is turning out to be an area of concern. With desperate need for land for agricultural, industrial and most importantly urban needs to contain cities and their growing population, a direct action that we have come to recognize as depletion of forest occurs. Depletion of Forest in simple term means the felling and clearing of forest cover or tree plantations in order to accommodate agricultural, industrial or urban use. It involves permanent end of forest cover to make that land available for residential, commercial or industrial purpose (Source: http://www.conserve-energyfuture.com /causes-effects-solutions-of-deforestation.php).

Over the last century the forest cover around the globe has been greatly compared with economic and social development, leaving the green cover down to an all time low of about 30 per cent. According to the United Nations Food and Agriculture Organization (FAO), an estimated 18 million acres (7.3 million hectares) of forest are lost each year.

Depletion of forest can also be seen as removal of forests leading to several imbalances ecologically and environmentally. What make deforestation alarming are the immediate and long term effects it is bound to inflict if continued at the current pace. Some predictions state that the rain forests of the world will be destroyed completely if deforestation continues at its current pace (Source: http://www.conserve-energy-future.com/causes-effects-solutions-of-deforestation.ph.).

Depletion of forest occurs due to several reasons, to get an overview we could include the need of money, both in terms of profitability as well as providing for one's family in most scenarios, along with lack of or no forest laws, need for land space for housing etc among a long list of other uses. Mainly blamed on agricultural or pastoral use, farmers fell trees for increasing space for cultivation and/or as fodder land for grazing and surviving live stock. The whole concept of 'slash and burn' agriculture is used to indicate this same process where farmers employ the above chain of actions for their purposes (Source:http://www.conserve-energy-future.com/causes-effects-solutions-of-deforestation.php).

5.3. Process of Depletion of Forest:

In order to examine and understand the process of depletion of forest in Madhupur Upazila, it is necessary to have a clear understanding of the historical background as well as the causes of depletion of forest in the study area. Map-4.2, Map-4.3, Map-4.4, Map-4.5, Map-4.6, Map-4.7, and Map-4.8 represents the trend of depletion of forest of the Madhupur Upazilla in 1967, 1973, 1989s, 1999, 2003, 2007 and 2013 respectively (See Page No. 72-78).

5.4. Causes, Impacts and Consequences of Forest Depletion:

The multilateral development banks (MDBs), the Forest Department and other authorities generally blame growing population, wide-spread poverty, migration of landless people in the forest areas, shifting cultivation and inappropriate exploitation of forest resources for depletion and degradation of forests. Grazing, illegal felling, fuel wood collection, uncontrolled and wasteful commercial exploitation are also shown to be causes of depletion of forest resources. In case of Bangladesh the population increase is said to be one major cause of depletion of forest (Source: Gain Philip, 1998). Depletion of forest or Deforestation involves the cutting down, burning, and damaging of forests. Deforestation can be defined as the change of forest with depletion of tree crown cover more than 90% (http://www.conserve-energy-future.com/causes-effects-solutions-of-deforestation.php# sthash.dgcR12s1.dpuf.).

5.4.1. Causes of Depletion of Forest:

According to Gain Philip (1998), Population pressure is one of the causes for depletion of forest in Asian countries. Agricultural activities are one of the major factors affecting

depletion of forest. Due to overgrowing demand for food products, huge amount of tress are fell down to grow crops and for cattle grazing. Apart from this, wood based industries like paper, match-sticks, furniture etc also need a substantial amount of wood supply. Wood is used as fuel both directly and indirectly, therefore trees are chopped for supplies. Firewood and charcoal are examples of wood being used as fuel. Some of these industries thrive on illegal wood cutting and felling of trees.

Further in order to gain access to these forests, the construction of roads are undertaken; here again trees are chopped to create roads. Overpopulation too directly affects forest covers, as with the expansion of cities more land is needed to establish housing and settlements. Therefore forest land is reclaimed.

Some of the other factors that leads to depletion of forest are also part natural and part anthropogenic like Desertification of land. It occurs due to land abuse making it unfit for growth of trees. Many industries release their wastes like petrochemicals into rivers which results in soil erosion and make it unfit to grow plants and trees (Source: http://earthuntouched.com/wiped-forests/).

Another example would be forest blazes; Hundreds of trees are lost each year due to forest fires in various portions of the world. This happens due to extreme warm summers and milder winters. Fires, whether caused by man or nature results in huge loss of forest cover (Source: http://www.conserve-energy-future.com/causes-effects-solutions-of-deforestation.php).

Tabe-5.1: Causes of depletion of forest:

Causes	Frequency
Anarchical situation during the Liberation War in 1971	12
Over population	48
Gain in arable land	5
Increase in human habitation	10
Increase in demand for timber and fuel wood	25
Total	100

Source: Questionnaire Survey, 2013-2014.

Table -5.1 presents the causes of Depletion of forest of the study area. It is obvious from the table-5.1 that almost all respondents of the study area said that over population was mainly responsible for the depletion of forest which percentage was 48. Increase in

demand for timber and fuel wood influenced the rate of Madhupur forest to a large extent. It is to be noted that want of arable land or increase in human habitation has not been regarded by the respondents as the main or major cause of depletion of forest.

Figure-5.1: Causes of Depletion of Forest.

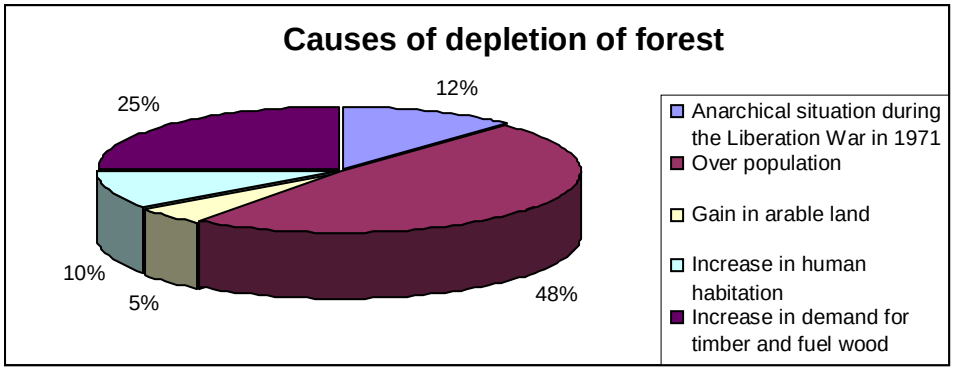


Table-5.2: Persons of Responsible for Depletion of Forest:

Person of Responsibility	Frequency
Landless men migrating from India after 1971	30
The Adibasis	20
Local Bangalis	25
Local Influential people	10
Dishonest staff of the forest department	10
Others	5
Total	100

Source: Questionnaire Survey, 2013-2014.

Table-5.2 shows the persons responsible for depletion of forest of the study area. It is evident from the table-5.2 that almost all the respondents of the study area accused the landless migrants from Indian to be responsible for depletion of Sal forest during 1971. The Indo-Bangladesh border was open during the liberation War. Availing themselves of this golden opportunity, collection of timber was carried on and the forest was destroyed, within a very short time.

It also reveals Indians Muslims have migrated to a large extent to these study area because of communal riots occurring there from time-to-time on and after 1947. They have, then, destroyed the forest for habitation and arable land. Hindu Zaminders who left the country after 1947 have also destroyed the forest to some extent. Apprehending

acquisition of the forests by the Government, the Zaminders anxiously allowed felling of trees for fast and easy flow of cash within a short time.

Moreover, the local Bangalis have also destroyed (and still do) the forest (table-5.2). But the Adibasis have caused little harm to the forest although they collect many substances required in their daily life from the forest.

Adibasi is the man of nature. That's why they know how to preserve the forest though they collected different essential materials from forest. On the other hand the Bangalis depend on agriculture that is why they transform forest land to agriculture land and houses.

5.4.2. Impact of Depletion of Forest on Environment:

One of the key environmental issues throughout the world is depletion of forest. Depletion of forest is caused by the growing demand for forest products and the conversion of forest to agriculture as the human population continues to expand. In 1750 cropland and pastureland occupied 6-7% of the global land surface; by 1990 cropland and pastureland occupied 35-39% of the global land surface. It is estimated that the world is currently losing over 9 million hectares per year which is an area the size of Portugal (Source: http://www.motherearthnews.com/nature-and-environment/the-effect-of-deforestation-on-the-climate-andenvironment.aspx#axzz 39vcySG1H).

Depletion of forest is not only affects the climate by increasing the atmospheric level of carbon dioxide but also affects the environment by inhibiting water recycling, triggering severe flooding, aquifer depletion, soil degradation and the extinction of plant and animal species (Source: Hilderman, R. [2010, Dec. 27] on his article "The effect of deforestation on the climate and environment").

Trees remove carbon dioxide from the atmosphere through photosynthesis. Cutting down forests will cause a decline in photosynthetic activity which results in the atmosphere retaining higher levels of carbon dioxide. Forests also store an enormous amount of organic carbon which is released into the atmosphere as carbon dioxide when forests are cleared by burning. Clearly, deforestation contributes to global warming and ocean acidification (www.motherearthnews.com).

Water recycling is the movement of rain from the forest to land masses further inland. When rain falls on forests the water is intercepted by the forest canopy. Some of this intercepted water is returned to the atmosphere by evaporation and transpiration while the rest is returned to the ocean as river runoff. In a healthy forest about three fourth of the intercepted water is returned to the atmosphere as moisture laden air masses which move inland, cool and are converted to rain. Land cleared by deforestation returns only about one fourth of the rain water to the atmosphere. This air mass has less moisture and delivers less rain further inland. Deforestation inhibits water recycling and converts inland forest to dry land and potential waste land (Source: http: //www.motherearthnews. com/nature-and-environment/the-effect-of-deforestation-on-the-climate.aspx).

Severe flooding is a result of deforestation because removal of the forest leaves little vegetative cover to hold heavy rains. The inability of land void of forest to hold heavy rain water will also trigger mudslides like the ones that have occurred in recent years in California, China and other parts of the world. Severe flooding and mudslides are extremely costly because they devastate homes and communities (Source: http://www. motherearthnews.com).

The excess water from land cleared of forest becomes runoff water and enters the ocean instead of seeping downward into the soil to recharge aquifers. Aquifer depletion is already becoming a serious problem in certain areas of the planet and as the human population continues to grow so will the demand for fresh water (Source: http://www. motherearthnews.com).

Depletion of forest also results in soil degradation. According to Hilderman, R. [2010, Dec. 27] on his article "The effect of deforestation on the climate and environment", forests store nutrients that are required for all plant life. In the tropics almost all nutrients are stored in the vegetation because tropical soil has little organic matter and almost no nutrient storage capacity. If tropical forests are cleared for cropland, the land will yield crops for only a few years and when the nutrients are depleted they become waste land.

Today depletion of forest or deforestation, especially, in the tropics, decimates plant and animal life. Tropical rainforest contain about 7% of land surface but over half of the plant and animal species on the planet. If tropical rainforest deforestation continues at the current rate, it is estimated that by the first part of the 21st century about half of the remaining rainforest will be lost along with about 5 to 10% of all the species on the

planet (Source: http: //www.motherearthnews. com/nature-and-environment/the-effect-of-deforestation-on-the-climate.aspx).

Global warming is not just about temperature. Global warming directly affects humans because everything about our life is tied to the climate such as food production, water supplies, health and well being, etc. (Source: http://www.motherearthnews.com/nature-and-environment/the-effect-of-deforestation-on-the-climate-andenvironment.aspx#axzz 39 vcySG1H).

Table-5.3: Impact on the Environment:

Impacts	Frequency
Decreasing soil fertility	22
High land under-go erosion	13
Decreasing rainfall	15
Extinction of biodiversity	23
Decreasing underground water	10
Increasing temperature	15
Others	2
Total	100

Source: Questionnaire Survey, 2013-2014.

Table-5.3 reveals the impact on the environment of depletion of forest. It is obvious from table-5.3 that almost all the respondents of the study area agreed in this regard that the biodiversity of the region is at stake because of these adverse effects and most of the medicinal plants are already extinct. In order to say their statements, a checklist has been made through the determination of the rate of all the extinct and near-to-extinct flora and fauna of the study area.Table-5.3 also demonstrates some respondents have expressed their concern in this regard that the temperature is raising, rainfall is becoming inadequate, and the availability of underground water is also decreasing. And these are final impact on agriculture. Besides, many respondents have said that the fertility of soil gets reduced as a consequence of depletion of forest and the yield of crops also decreases.

Figure-5.2: Impact of Depletion of Forest on the Environment.

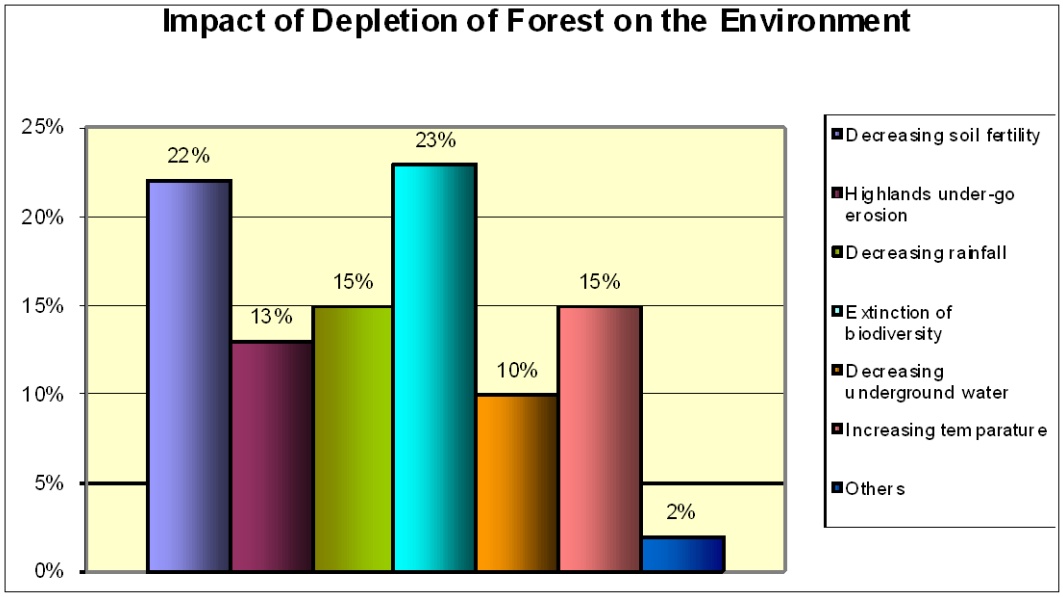


Table-5.4: Environmental Changes due to depletion of forest:

Changes	Frequency
Poorer habitat for wildlife	16
Decrease O_2	22
Increase CO_2 to the atmosphere	20
Green house Effect increase	18
Soil erosion	10
Increase temperature	8
Rainfall decrease	6
Total	100

Source: Questionnaire Survey, 2013-2014.

Table-5.4 represents the changes due to depletion of forest. It is obvious from table-5.4 that almost all the respondents of the study area agreed in this regard that the Oxygen decreases from the atmosphere because of changing of the climate on the study area. Trees play a major role in controlling global warming. The trees utilize the green house gases, restoring the balance in the atmosphere. With constant deforestation the ratio of green house gases in the atmosphere has increased, adding to our global warming woes. Also due to the shade of trees the soil remains moist. With the clearance of tree cover, the soil is directly exposed to the sun, making it dry. As the soil is eroded, it accelerates siltation in dams, rivers, and the coastal zone. The increased sedimentation harms downstream fisheries. When it rains, trees absorb and store large amount of water with

the help of their roots. When they are cut down, the flow of water is disrupted and leads to floods in some areas and droughts in other.

Table-5.4 also demonstrates some Respondents have expressed their concern in this regard that the temperature is rising, rainfall is becoming inadequate, and the green house effect creates global warming. And these are final impact on poorer habitat for wildlife.

Table-5.5: Impact on Agriculture:

Impacts	Frequency
Decreasing soil fertility	22
High lands under-go erosion	11
Production cost increases	12
Decreasing rainfall	15
Decreasing underground water	10
Increasing temperature	13
Crop production decreased due to lack of humus	17
Total	100

Source: Questionnaire Survey, 2013-2014.

Table-5.5 reveals the impact of depletion of forests on the Agriculture. It is obvious from table-5.5 that almost all the respondents of the study area agreed in this regard that the fertility of soil of the region is at stake because of these adverse effects. It is also demonstrates some respondents have expressed their concern in this regard that the temperature is raising, rainfall is becoming inadequate, and the availability of underground water is also decreasing. Besides, many respondents have said that the fertility of soil gets reduced as a consequence of depletion of forest and the yield of crops also decreases.

5.5. Causes of Biodiversity Loss of the Forest:

The most important direct cause of biodiversity loss include logging, conversion of forested lands for agriculture, settlement and cattle-raising, urbanization, mining and oil exploitation, acid rain and fire. However, there has been a tendency of highlighting small-scale migratory farmers or “poverty” as the major cause of forest loss. Such farmers tend to settle along roads through the forest, to clear a patch of land and to use it for growing subsistence or cash crops. In tropical forests, such practices tend to lead to rapid soil degradation as most soils are too poor to sustain agriculture. Consequently, the farmer is forced to clear another patch of forest after a few years. The degraded agricultural land is often used for a few years more for cattle raising. This is a death

sentence for the soil, as cattle remove the last scarce traces of fertility. The result is an entirely degraded piece of land which will be unable to recover its original biomass for many years. It is a major mistake to think that such unsustainable agricultural practices only take place in tropical countries (Source: wrm.org.uy/oldsite/deforestation/ indirect.htm).

According to the satellite studies, Bangladesh's forest cover has been reduced from 24% in 1947 to only 6-8 % in 1989. Increased population has contributed to the depletion of forest to a certain degree though it is not the prime cause. Other contributing factors include urbanization, increasing demand for forest products for commercial purposes, poverty and conversion of forest land into cropland. The worst victims of depletion of forest have been the poor and ethnic communities and also the animals. So it is the prime concern of the government and the public how to protect the remnants of the natural forest and afforest the degraded 32, 70,000 acres of land (Source: Joshi P.C. and Joshi Namita, 2011).

5.5.1. The Underlying Causes of Biodiversity Loss of Madhupur Sal Forest:

- Agriculture and Cattle raising
- Unclear Land Tenure
- Population pressure
- Shift from Garo to Bangali Settlers
- Water logging
- Soil erosion
- The forces behind unsustainable agriculture

5.5.2. Effect of Depletion of Forest on Biodiversity:

Human beings and forest are closely related with each other from very beginning of human history. Forests play an important role in maintaining sound environment, wildlife, biodiversity in the national economy. In Bangladesh forests are very unevenly distributed. Traditional Sal forest has now become a history. These particular types of forests cover are situated in the central region of Bangladesh, which has familiarly known as traditional Madhupur Forest. These types of forest cover situated in the region of Bangladesh. So the forest has been the subject to encroachment and over exploitation.

With this forest disappeared rare wildlife and biodiversity have also reduced quite rapidly. Many species of wildlife are going to be extinct. Such as deer, monkey, bear, wolf, rabbit fox, hog and various species of birds-shalik, doel, mayna, owl, etc.

The forest land of the study area has changed into other uses such as cultivation, settlement, roads and highways, Government and Non-Government offices, Hat-Bazars, expansion of urban area, environment and economic activities in the study area according to the respondents. Many families who depended on agricultural activities have gone out from this area to establish secondary and tertiary economic activities. Today, forestry has been consistently under pressure in the study area for conversion of agricultural purposes. Forestland of such area is going to be depleting day by day. It is very alarming for agro-based economy of Bangladesh. It will also affect primarily in such area, widely our nation and country. So we need to find remedies to these deforestation activities.

Depletion of forest also affects the climate in more than one ways. Trees release water vapor in the air, which is compromised on with the lack of trees. Trees also provide the required shade that keeps the soil moist. This leads to the imbalance in the atmospheric temperature further making conditions for the ecology difficult. Flora and fauna across the world are accustomed to their habitat. These haphazard clearances of forests have forced several of these animals to shift from their native environment. Due to this several species are finding it difficult to survive or adapt to new habitats (Source: http://www.conserve-energy-future.com/causes-effects-solutions-of-deforestation.php).

Due to massive felling down of trees, various species of animals are lost. They lose their habitat and forced to move to new location. Some of them are even pushed to extinction. Our world has lost so many species of plants and animals in last couple of decades.

5.5.3 Impact of Depletion of Forest on Biodiversity:

Estimates of total number of species present on earth today range over more than order of magnitude, from low around 3 million to a high of 30 million or possibly much more. At the same time we have a little idea of the rate at which species are currently becoming extinct. The systematic naming and recording of species begin relatively recently, with Linneaus' work in 1758 recognizing some 9000 species (May, 2002). Recent studies

indicates that about 1.4 million living species of organisms exsit in this world. Approximately 750,000 are insects, 41,000 are vertebrates and 250,000are plants. The remainder consists of a complex array of invertebrates, fungi, algae and micro organisms. Many taxonomists agree that this picture is still very incomplete except in a few well-studied groups such as the vertebrates and flowering plants. If insects, the most species rich of all major groups¸ are included, the absolutely number is likely to exceed 5 million. Thus remarkable we do not know the exact number of species on the earth. According to May (2002) the total number of species that have been named and recorded emphasizes the uncertainties caused by the synonyms. The IUCN survey estimates that around 13,000 new species are currently named each year, but current rates of resolving synonymies reduces this number to around 10,000 distinct new species added yearly to be known total (Joshi, P.C. & Joshi, Namita, 2011).

The Biodiversity of the forest is at a risk due to depletion of forest. Depletion of forest has been the cause of a truly massive number of species extinctions in modern times and historical times. Even when the originally deforested area is over time reforested, it always lacks the large biodiversity of its previous state. With the disappearance of the original forest, many species go extinct, and many that don't lose a great deal of their genetic diversity and variation. This has significant implications for the medical and agricultural industries. Many potential medicines, and disease and pest resistant varieties of agricultural plants, have been lost as a result of deforestation. Modern agriculture is almost entirely dependent on a very limited number of crop plants that are becoming increasingly lacking in genetic diversity, and susceptible to disease, pests, and climatic changes. With the loss of many related wild species, much genetic diversity is lost that could address potential future disease outbreaks and climatic changes.

It's currently estimated that the world is losing around 137 plants, animal and insect species every day as a result of rainforest deforestation. That's roughly 50,000 species going extinct every year (Source: Wikipedia).

Loss of biodiversity is also an urgent issue for Bangladesh that needs to be addressed. Massive depletion of forest in the Madhupur Forest and monoculture of crop plantation, partly funded by the Asian Development Bank (ADB), in place of natural Sal forest have devastated the prime habitat of the rare Golden Lumpur monkey and other animals. Conservative estimates of the existing biodiversity is ten million species, but if estimates

for insects are correct then it could be around 30 million species, we have till now enlisted about 1.4 million species.

It includes among others about 98% birds, 95% reptiles and amphibians, 90% fish and about 85% higher plants known to exist on this Earth (http://www.yourarticlelibrary.com/uncategorized/biodiversity-at-global-national-and-local-levels-explained-with-diagram/28262/).

Flora:

It is evident from table-5.7 that trees, shrubs, herbs and climbers species have been regarded as the flora of this region under this checklist. With the exception of Sal, shishu, eucalyptus and acacia, almost every other species is threatened to some extent. The Respondents have not been able to give important information as regards shrubs, herbs or climbers. But since these types of plants are somehow depending on larger trees, these will soon to be extinct with the destruction of forest. The economic uses of these plants given in the checklist are likely to show how important these plants are in our daily life and how far they can be helpful for our life.

Fauna:

From table-5.8, it is obvious that the conditions of the fauna are much worse than the flora of the study area. Amphibians, reptilians, birds and mammals have been taken into consideration in this checklist. Among amphibian, 'gecho bang' has become completely extinct. Among reptilian, 'ajagar' (a kind of python) is now extinct and 'gecho shap' and 'roktochosha' (a kind of lizard) are on the verge of extinction. But 'cobra' and 'kalo mete dhora shap' (a kind of snake) are still not under any considerable threat. Various species of birds are still on of danger. But 'bon morog' are scarcely found now-a-days. Many species of mammalian vertebrates are now completely extinct. But porcupine, rabbit, mongoose, fox, etc. are still not under considerable threat.

It can easily be said from table-5.7 and 5.8 that the biodiversity of the study area is facing considerable threat as a consequence of deforestation. The only way to keep this biodiversity safe and sound is to preserve the natural forest and also to undertake large scheme projects of afforestation and reforestation so that the natural habitat of the still-existing flora and fauna is saved.

Table-5.7: A Comprehensive Checklist of Flora in Madhupur Forest

(Peoples Opinion):

Local name	Scientific name	Economic use	EX%	Threatened			No%	DD%
				CR%	EN %	VU%		
Tree								
Acacia	*Nf*	T	-	-	-	-	100	-
Amloki	*Phyllanthus embelica*	Fr+M	9	65	22	4	-	-
Amra	*Spondias Pinnata (L.f.) Kurz*	Fr	2	12	24	41	4	17
Babla	*Acacia Arabica*	D+M	8	12	21	19	38	2
Bel	*Aegle mar melos (L.)Correa*	Fr+M+T	-	52	15	25	8	-
Bohera	*Terminalia belerica Roxb.*	D+Fr+M+T	42	24	14	6	-	14
Boroi/kul	*Zizyphshus Mauritiana Lank*	D+Fr+M+T	-	-	23	42	28	7
Chalta	*Dilenia indica*	Fr+M	10	45	26	4	-	15
Champak	*Michelia champaca*	T	63	21	3	4	-	0
Chhatim	*Alstonia scholaris*	T	38	26	13	7	-	16
Dumur	*L.Ficus hispida L.f.*	Fi+Fr+M	-	12	26	14	36	12
Eucaliptus	*Nf*	D+T	-	-	-	-	100	-
Goyam	*Psidium guajara*	Fr+M+T	26	18	23	2	-	31
Hijal	*Barringtonia acutangula*	T	40	22	11	1	-	26
Horitoki	*Terminalia chebula*	Fr+M+T	15	34	9	5	-	37
Jhoribot	*Ficus Bengalensis*	T+M+Fi	-	2	8	25	52	13
Kadam	*Anthocipholus chinenris*	T	-	5	39	21	5	30
Kalojam	*Syzygium cumini (L) Skeel.*	Fr+M+T	-	-	12	32	24	32
Kanthal	*Artocarpus integrifolia*	Fr+T	-	-	-	63	25	12
Kumbha	*Carea arborea*	M+T	12	30	28	10	2	18
Mahua	*Madhuca indica Gmel.*	T+Fr+M	15	27	31	-11	15	1
Mahogoni	*Swietenia mahogoni*	T	30	24	18	3	15	10
Nim	*Azadirachta indica A. Juss*	M+T	2	22	28	17	14	17
Palash	*Butea frondosa*	T	15	28	31	16	-	10

Local name	Scientific name	Economic use	EX%	Threatened			No%	DD%
				CR%	EN %	VU%		
Panbot	*Ficus religiosa L.*	Fi+M+T	-	12	24	32	10	22
Peepul	*Ficus religiosa*	T	28	16	14	10	-	32
Sal	*Shorea robusta*	Fr+M+T	-	1	3	18	78	-
Shorea	*Streblus asper*	T+M	39	15	6	6	2	32
Shimul	*Bombax malabaricum*	T+M+Fi	10	14	33	11	5	27
Shirish	*Albizia lebbek (L.) Benth*	M+T	39	31	16	7	-	7
Sisso	*Dalbergia sisso*	T	-	-	-	2	90	8
Singhra	*Nyctanthes arbortristis L.*	M	24	13	15	2	5	41
Sonalu	*Cassia fistula*	T+M	22	17	24	6	-	31
Tal	*Borassus flabellifer L.*	Fi+M+T	-	-	3	25	64	8
Tetul	*Tamarindus indica*	Fr+M+T	-	6	12	18	24	40
Thenga jam	*Syzygium operculatum*	Fr+M	-	4	22	12	30	32
Tut	*Morus indica L.*	M	-	-	11	35	22	32
Shrub								
Benuchi	*Flacourtiaindica (Burm.f.) M.*	-	12	24	20	4	-	40
Bish katali	*Polygonum hydropiper L.*	M	-	22	12	25	11	30
Bonboroi	*Zizyphus oehoplea (L.) Mill.*	D+Fr	-	2	20	16	35	27
Bon jam	*Ardisia solanacea (poir)R.*	M+T	-	3	23	25	36	13
Bon okra	*Urena Lobata L.*	Fi+M	25	12	4	-	2	57
Bonopanimarich	*Polygonum orientale*	M	-	-	5	26	36	33
Choto kamini	*Murraya keonigii (L.) Spreng*	M	-	11	32	20	12	25
Datmajar	*Glycosmis pentaphylla (Retz)*	M	-	5	15	18	41	21
Dhulkalmi	*Iponmoea Fistulosa Mart.exc.*	M	-	-	-	12	65	23
Ganga tulsi	*Hyptis suaveslens poit.*	M	14	25	28	15	-	18
Jarul	*Lagerstroemia flosreginae*	T	26	20	11	5	-	38
Lalkanta/Natai	*Caesalpiniabonduc (L.)Roxb.*	M	-	12	10	42	6	30

Local name	Scientific name	Economic use	EX%	Threatened			No%	DD%
				CR%	EN %	VU%		
Madipata	*Flemingia bracteata (Roxb) W*	M	-	12	14	5	16	47
Monkanta	*Xeromphis spinosa (Thumb)K*	M	-	-	10	21	18	51
Salpani	*Desmodium gangeticum (L) D.*	M	17	16	22	15	2	28
Herb								
Danda kolos	*Leucas aspera (wild.) Link*	M	-	15	18	21	15	31
Gimashak	*Hydrocotyle sibtorpioides L.*	V	-	-	5	24	47	24
Haicha	*Alternanthera sessilis (L) R.B*	V+M	-	2	28	24	32	14
Jhalai	*Biophytum sensitivum (L.) AP*	M	16	16	8	14	2	44
Kachuri	*Curcuma zedoaria Rosc.*	M	3	8	14	21	26	28
Katamorich	*Amaranthus spinous L.*	M	-	-	-	20	64	16
Kur	*Saussurea lappa cl*	M	12	7	24	5	3	49
Lajjaboti	*Mimosa pudica L.*	M	-	-	-	-	100	-
Luchipata	*Peporamia pellucida kunth.*	M	-	-	5	10	68	17
Mechitra	*Emilia sonchifolia D.C.*	M	2	4	12	22	42	18
Panimorich	*Polygonum hydropiper L.*	M	-	-	20	15	25	40
Pindi	*Rungia pectinata (L.) Nees.*	M	20	25	18	6	5	26
Sillata	*Vernonia patula (Dry.) Merr.*	M	14	25	36	12	-	13
Talamoli	*Curculigo orchioides Gaertu*	M	16	25	14	31	-	14
Thankuni	*Centalla asiatica (L.) Urban*	M	-	-	12	38	22	28
Climber								
Bonalu/Paglaalu	*Dioscorea bulbifera L.*	M+V	-	-	21	25	33	21
Goalialata	*Spatholobus roxburghii Benth*	Fi+M	-	4	22	16	25	33
Gulancha	*Tinospora cordifolia (Willd.)*	V+M	-	-	22	36	28	14
Kalilata	*Ichnocarpus frutes*	F+M	4	12	29	34	13	8
Kochikata	*Accacia Pinnata*	M	-	12	20	23	10	35
Kumarilata	*Smylax roxburghiana wall.*	M	-	-	25	22	31	22

Local name	Scientific name	Economic use	EX%	Threatened			No%	DD%
				CR%	EN %	VU%		
Palashlata	*Spatholobus roxburghii*	M	1	9	18	21	30	21
Pepul/pipla	*Piper Longum L.*	M	22	28	12	8	12	18
Satamuli	*Asparagus racemosus L.*	M	-	25	32	18	15	10
Swarnalata	*Cuscuta reflexa Roxb.*	M	-	-	-	-	100	-
Taralata	*Mikania cordata (Burm.f.) R.*	M	-	-	12	21	54	13

Source: Questionnaire Survey and Direct Observation, 2003.

N.B. D = Dye Plant, Fi = Fiber plant, Fr = Fruit plant, M = Medicinal plant, T = Timber Plant, V = Vegetation.

EX= Extinct, CR= Critically Endangered, EN= Endangered, VU = Vulnerable, NO = Not Threatened, DD = Data Deficient

(See: Appendix-D)

Table-5.8: A Comprehensive Checklist of Fauna in Madhupur Forest (Peoples Opinion):

Local name	Scientific name	EX%	Threatened			LR%	No%	DD%
			CR%	EN %	VU%			
Amphibians								
Cheena Bang	*Mycrohyla ornate*	12	20	25	22	22	10	11
Gecho Bang	*Rana toiupeehensis*	25	26	8	-	-	-	5
Pana Bang	*Rana alticola*	-	5	21	20	20	33	21
Reptilians								
Ajagar	*Pythomolurus*	-	-	-	-	-	-	-
Daraj	*Coluber mucosus*	-	15	21	26	26	10	28
Gecho Shap	*Denrelaphis pictus*	25	5	2	-	-	-	-
Gokhra Shap	*Naja kaothia*	-	-	22	33	33	36	9
Gui shap	*Varanus bengalensis*	16	31	33	10	10	36-	10
Kalkeotey	*Bungarus caeruleus*	-	-	8	21	12	7	52
Kalomete Dhora shap	*Xenochrophis cerasogast.*	-	-	5	8	26	42	19
Roktochosha	*Calotes rouxii*	32	5		-	-	2	9
Sutanoli shap	*Ahaetulla nasutus*	2	20	15	32	32	41	3
Tiktiki	*Hemidactylus bowringii*	-	6	16	6	6	88	6
Aves/Birds								
Baga bok	*Grasachius melanolophus*	12	18	9	25	25	5	16
Bhutum Pencha	*Ketupa zeylonesis*	15	32	42	2	2	-	9
Bon morog	*Gallus gallus*	22	8	2	-	-	-	28
Bou-khoth-kao	*Cuculas micropterus*	-	21	36	32	32	4	7
Gang chil	*Sterna acuticauda*	9	17	26	32	32	5	11
Kaththorka	*Dendrocopos hyperythrus*	-	2	16	38	38	22	22
Kokil	*Phaenicophaeous leschen*	-	5	12	26	26	20	37
Laxmi Penncha	*Tyto alba*	1	3	18	45	45	16	17
Maachranga	*Alcedo Hercules*	-	8	25	36	36	12	19
Maina	*Gracula religiosa*	-	20	30	24	24	9	17
Papiya	*Clamator jacobinus*	-	15	21	32	32	3	29
Shatbhaira	*Pellorneum albiventure*	2	5	18	26	26	35	14

Local name	Scientific name	EX%	Threatened			LR%	No%	DD%
			CR%	EN %	VU%			
Suichora	*Merops orientalis*	6	14	12	26	26	5	37
Tia	*Psittacula krameri*	-	6	32	41	41	10	11
Titir	*Francolinus pondicerianu*	-	12	23	36	36	14	15
Mammals/Mammalians								
Bagdash	*Viverra zibetha*	26	36	12	-	-	-	14
Banor	*Macaca mulatta*	30	26	2	-	-	-	17
Bon Biral	*Felis chaus*	39	21	5	3	-	-	17
Bonno Mohish	*Bubalus bubalis*	-	-	-	-	-	-	6
Bonno Shukor	*Sus scrofa*	68	26	-	-	-	-	6
Boro benji	*Herpestes edwardsi*	-	10	16	24	32	2	16
Gaur	*Bos gaurus*	100	-	-	-	-	-	-
Gecho Bang	*Neofelis*	65	25	-	-	-	-	10
Khargosh	*Lepus nigricollis*	-	16	28	34	10	-	12
Khatash	*Viverricula indica*	48	25	11	3	-	-	13
Khenshail	*Vulpes bengalensis*	-	-	5	16	27	34	18
Mecho Bagh	*Prionaillurus viverrinus*	32	39	6	4	1	-	18
Mecho Biral	*Felis niverrina*	52	26	11	7	-	-	4
Nekre	*Canis lupus*	26	35	21	6	5	-	7
Nilgai	*Boselaphus tragotracamelus*	100	-	-	-	-	-	-
Shojaru	*Hystrix indica*	-	-	6	13	21	45	15

Source: Questionnaire Survey and Direct Observation, 2008.

N.B. EX = Extinct, CR = Critically Endangered, EN = Endangered, VU = Vulnerable,

LR = Lower Risk, NO = Not Threatened, DD = Data Deficient.

(See: Appendix-D)

5.6. Present Condition of Deforested Land:

Table-5.6: Present Condition of Depleted Land:

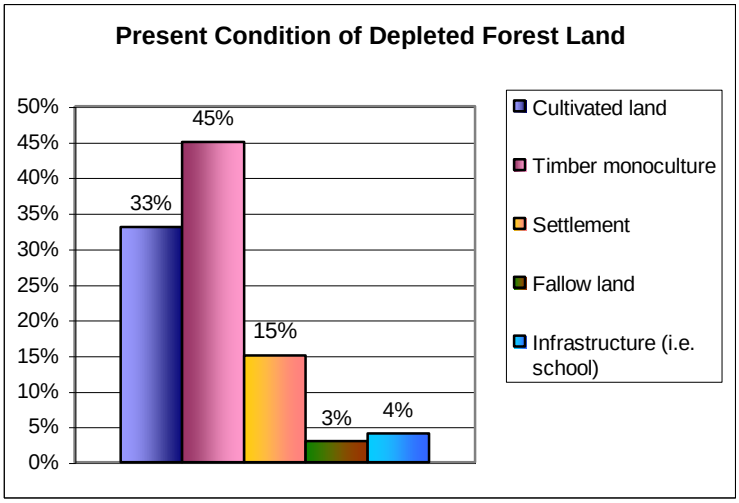
Item	Frequency
Cultivated land	33
Timber monoculture	45
Settlement	15
Fallow land	3
Infrastructure (i.e. school)	4
Total	100

Source: Questionnaire Survey, 2013-2014.

It is evident from table-5.6 that, according to the Respondents of the study area, the depleted forest lands are being used for agricultural purposes. Besides, according to 45% of the respondents of the study area, the natural forest, after being destroyed, is used for timber monoculture (mainly eucalyptus and acacia). These trees are actually not suitable for this region, kinds of trees with the hope of getting timber in a very short time. This sort of monoculture is playing an important role in reducing the fertility of soil, and is also limiting the availability of underground water. Moreover, according to many, a large portion of the depleted land remains fallow. And such fallow lands are ultimately settled by landless in-migrants.

Therefore, many Respondents have agreed in this regard that afforestation and reforestation projects should be undertaken besides stopping timber monoculture.

Figure-5.3: Present Condition of Depleted Forest Land.



5.7. Solutions to Depletion of Forest:

Around the world, forests are being logged for timber and paper pulp and cleared to grow mono-crops like palm oil and soy while they are deteriorating from the impacts of global warming. Deforestation is a major driver of global warming, responsible for up to 20 percent of global greenhouse gas emissions–more than all the cars, trucks, planes, boats and trains in the world combined (http://www.conserve-energy-future.com/causes-effects-solutions-of-deforestation.php).

Depletion of forest does not just threaten our climate; it threatens the livelihoods of 1.6 billion people that rely on forests for food and economic activity. Forests also serve as habitats to rare and undiscovered animal and plant species and play a key role in providing water and preventing flooding and erosion (Source: http://www.greenpeace. org/usa/en/campaigns/forests/solutions-todeforestation/conserve-energyfuture.com).

Ending depletion of forest and protecting forests will not only preserve biodiversity and defend the rights of forest communities; it is also one of the quickest and cost effective ways of curbing global warming. According to Greenpeace Org., the best solutions to depletion of forest are as follows:

1. C**urb the felling of trees**, **by employing a series of rules and laws to govern it**. Depletion of forest or Deforestation in the current scenario may have reduced however it would be too early to assume.

2. Clear cutting of forests must be banned. This will curb total depletion of the forest cover. It is a practical solution and is very feasible.

3. Land skinned of its tree cover for urban settlements should be urged to plant trees in the vicinity and replace the cut trees. Also the **cutting must be replaced by planting young trees to replace the older ones that were cut**. Trees are being planted under several initiatives every year, but they still don't match the numbers of the ones we've already lost.

5.8: Discussion:

To assess the causes and process of depletion of forest and its impact on the environment was attempted in this study. The people are using forest land intensively for different purposes in the country. The area of forest use in different purposes has changed over the last few decades. During the tenure of this research study a number of causes of depletion of forest were identified.

It was recommended that the Hindu Zaminders, who were leaving Bangladesh to make their way to India and the migratory Muslims from India during the Partition in 1947, were responsible for depletion of forests. Although it is true to a large extent, it is not likely to be absolutely true.

Through this study, it was found that overpopulation was the cause of depletion of forest. This was largely responsible for the vast devastation of Sal forests and it is proved to be true again. During the Liberation War in 1971, the Indians were largely responsible for the depletion of forests is proved to be true also. It was considered that the rate of depletion of forest is higher in the Bangali settled areas than Adibasi settled areas.

Indiscriminate cutting, logging, encroachment, felling of wood and clearing of forest cover, leaf-litter collection and removal, grazing, picnic gathering, dwelling, intentional fire, over exploitation or up-rooting of economically important specific species etc. are the main biotic factors which are influenced directly by man's activities. Availability of different economic plants in the Madhupur Sal Forest is one of the main cause for frequent encroachment in the study area.

There are many problems is trying to conserve the Madhupur Sal Forest. There are about 28 furniture shops in the project area from Kakraid, Pirojpur, Jalchatra, Pochis Mile to Sholakuri. Many of them have no valid license for trading is timber. They usually receive sawed timber from sawmills and trade locally. It is alleged that they sometimes receive illegally felled timber from thieves and get sawed and sell it and thus help in the illegal felling of timber. There are about 05 sawmills in the project area from Charaljani, Brittibari to Pirojpur. Also there are a number of temporary sawmills found in the forest area. All these sawmills are to some extent involved in illegal tree felling. That's why Sal forest decreases day by day. On the other hand, there are about 03 brickfields in the

forest area from Charaljani. Most of these brick-fields use forest woods as fuel. Therefore, these brick-fields are also responsible for forest destruction.

There are about 33 timber traders in a limited area from Kakaid, Pirojpur, Jalchatra, Pochish Mile to Sholakuri who are involved with timber trading. Many of them have no valid license for the trading of timber. They usually receive sawed timber from sawmills and trade locally. It is alleged that they sometimes receive illegally felled timber from thieves and get sawed and sell it and thus help in the illegal felling of timber. A number of fuel wood traders have been identified who have indirect stakes in the Madhupur Forest, collecting fuel-wood from the local direct collectors. There are about 22 fuel-wood traders at Chorljani to Sholakuri Bazaar. Several trucks of fuel wood are transported everyday from this area and majority of which come from clear felling. Substantial fuel-wood is also sold locally by the traders. The traders procure fuel-wood from the individual collectors, stack them and also sell it to the local consumers, while the others transport it by trucks, van, rickshaw, pickup, etc. The marketing opportunities have increased during the recent times at the local level. The fuel-wood is traded at the rate of Tk. 200 -300 taka per van which contain about 2 mounds.

The Madhupur Sal Forest is a unique example how of the government let the foresters steal trees, clear the forest to grow wood plants and let people grab forestland violating the rights of the forest inhabitants. Many trees have been cut down in the last 20 years. People also cut down trees for making agriculture land. The major causes for the decline in forest in order of magnitude are as follows: clear felling and illegal timber felling, FD's plantation strategies, fuel-wood collection, collection of house building materials, hunting, bamboo and cane collection, etc.

Forests provide a total of 11 different types of resource extracted from the forest. Of them, timber (includes both legal and illegal extraction), fuel-wood, coppices dead leafs are extracted on a large scale, bamboo and building materials on a medium scale, wildlife, fruits, vegetables, sun grass etc. on a minor scale, while honey, cane, medicinal plants on a negligible scale . The main purposes for resource extraction include meeting household needs, selling for added income/and or to support and supplement livelihood. Timber felling, fuel-wood and bamboo collection, collection of house building materials, hunting etc. all are posing threats to the forest and its biodiversity through bringing qualitative and quantitative changes in the habitat and the wildlife they support.

Moreover, local poor people, forest villagers and unemployed laborer are the major categories of resource user.

Abiotic causes mainly comprise heavy canopy gaps and direct sunlight penetration, occasional flood, erosion and drought. Ultimately, in coming future, all these causes create a severe consequence to Madhupur Sal forest ecosystem which is really alarming for their existence of Sal.

Presently, the most common and serious interference in Madhupur Sal forests include collection of fallen dry leaves and cutting of herbaceous and shrubby plants and even small coppice of Sal trees by local people for fuel consumption resulting in rapid reduction of species diversity including Sal tree itself. In Madhupur forest for the rapid loss of Sal trees some specific causes are also responsible. As for example, a number of brick fields have been illegally established inside as well as very near to Madhupur forest where, Sal trees, Sal coppices and other small trees exist. At Madhupur the rate of illegal wood cutting and stealing of timber is higher. In dry season Sal dwellers and other farmers burn the forest floor every year as the ashes are washed away by subsequent rain water and deposited in 'Baid'areas where paddy cultivation have been practiced. But due to continuous leaf-litter collection and regular burning of forest floor organic matter and other nutritional elements cannot be deposited and recycled in forest soils. Thus the potentiality and productivity of Sal forest ecosystem is degrading day by day resulting in the depletion of Sal forest regeneration as well.

Besides these, Sal forest areas and thereby the forest resources have been decreasing day by day due to illegal new settlements in forest areas and conservation of this important forest ecosystem are accelerating the rate of degradation.

6.1: Summary:

The main aim of the study is to find out the process of depletion of forest and its impact on the environment. This necessarily meant that the causes of depletion of forest should be identified so that the depletion process of the forest can be made clear. It is also needed to point out whether depletion of forest has its clear-cut impact on the environment, particularly on the characteristics of the soil, biodiversity of the region, micro-climatic changes, etc. The initial original information collected for the study is primarily based on questionnaire survey and In-depth Interview. The questionnaire comprising 44 queries and In-depth Interview comprising 20 queries in question or statement form and design pre-tested to accommodate both open and fixed responses. Direct observation, field samplings, laboratory and mathematical analysis are also adopted to identify the environmental degradations. The study is also utilized considerable data gathered from the secondary sources. These are mostly official documents and records, journals and books, etc, as a matter of fact a through search is made in libraries of govt., semi –govt., universities, etc.

Sal forests are the only 'Tropical Moist Deciduous Forest' of Bangladesh. The scattered small patches of Sal forests, found in the Madhupur Tract are now on the verge of extinction. For this reason, the present study attempts to focus on the region of Madhupur Upazila in Tangail District. It has chosen some mauzas from this Upazilla. They are: Aronkhula, Dokhola, Beribaid, Pirgachha and Rasulpur. Once, the Madhupur Upazilla was fully covered with forest. At present little forest coverage exists there. The major findings of the study are as follows:

1. Like other regions of Bangladesh, my study area is also undergoing deforestation. But the causes and process of deforestation in the area are somewhat different from other parts of Bangladesh. Although the Hindu Zaminders caused some harm to the Sal forest during the partition in 1947; the forest faced vast devastation during the Liberation War in 1971. The Indo-Bangladesh border was opened at that time and the Sal forest was destroyed to extent by people through collecting fuel woods and timbers. About half of the Sal forest of this region had been deforested during this short span of time.

2. Although the rate of depletion of forest differ region wise, depletion of forest continues even after 1971. According to Forest Department there exists no forest cover at the present time in Madhupur Upazilla, although some 38.82 acres of forest land with 15.79 acres of reserve forest exists here. The Bangalis especially those who have migrated from India because of the occurrence of communal riots from time to time have destroyed forest mainly for residential and agricultural purpose. On the other hand, depletion of forest occurs to a very little extent in that part of this Upazilla which is dominated by the Adibasis. The Adibasis are, in fact, men of nature who know how to derive benefits from the forest without destroying it.

3. It can also be observed that there exists a small piece of public land within a large forest cover which undergoes cultivation. In this way, depletion of forest is being encouraged. Again, when owners of public cultivated lands lying by forest land cultivate their lands, they usually cultivate also a very little portion of forest land even an entire plot is used as arable land. But people who are engaged in preserving this forest can equally be accused, with the local Bangalis, of destroying the forest cover. But most culpable is the forest conservation law which is completely unable to prevent people from destroying forest.

4. The Sal forests are considered one of the richest ecosystems as regards forest diversity in Bangladesh. However, the level of diversity is generally unknown to the scientific community, politicians, and local people and is, therefore, not well documented at all. The forests are facing a severe threat by anthropogenic disturbances caused by humans who directly or indirectly depend on forest resources for their welfare. Since the value of these forests is currently not recognized, the increasing human population is likely to threaten their very existence. Even in the low disturbed site, 75% of the species have become rare or very rare in Madhupur Sal forests. So the Madhupur National Park warrants more attention in order to conserve their species richness.

5. Depletion of forest always exerts some negative impacts on environment. The soil characteristics of an area usually depend upon the existence or non-existence of forest in that area. The quantity of silt and clay is considerable and the amount

of sand is low in reserve forest. On the other hand, the quantity of sand is found to be high in the deforested fallow land and the quantity of silt and clay being low. Moreover, the soil of deforested fallow land becomes more acidic than the reserve forest. Because of using various kinds of fertilizers to increase the yield of crops, the quantity of organic carbon, nitrogen, phosphorus and potassium is found to be very high in cultivated lands, which is also the case with naturally reserve forest where leaves fallen from trees and undergrowth pants after their death become decomposed, increase thereby the amount of organic matter, nitrogen, phosphorus, potassium etc. in the soil. But the quantity of these elements is very low in timber monoculture and deforested fallow land.

6. Depletion of forest also exerts negative impact on local environment. When large trees are cut down, clumbers, herbs and shrubs dependent on the trees have no other way than to wither. Many medicinal plants are disappearing in this way. Following deforestation the forest becomes less dense and the activities of man increases in the forest, as a consequence of which many animals once found in this forest in considerable numbers, have almost disappeared from the forest.

7. Changes in the micro-climate because of depletion of forest can also be observed. The variation of diurnal temperature is small in the forested area. On the other hand, the variation of diurnal temperature is large in the deforested area.

8. Sal forest is a natural entity where ‘Sal’ is the major tree. It grows and provides habitat for other species. The region was full of a varity of flora and fauna in the past. But at present they have decreased drastically.

6.2. Possibilities of Madhupur Sal Forest:

Madhupur Sal Forest is satisfied with various natural resources. There is fertile land suitable climate, condition, easy transportation system and so many other facilities. So there have a great probability to benefit from this forest. The land of Madhupur Forest is very fertile for agriculture land. It is full of various types of natural recourses such as wood, food, honey, wax and so on. If we take necessary step to preserve this forest we can be benefited from this forest.

6.3: Recommendation:

To sum up the findings the following steps can be taken as important for the preservation and management of the Sal forest of Madhupur Upazilla:

1. According to 1950's land acquire law, the areas that are recorded, as forest should not be transferred to private sector.

2. According to 1950's law the registered forestland should be free from all kinds of legislative problem.

3. Changes in land record law are very necessary, because the people who acquired forestland by treachery should be reclaimed.

4. Stopping the transferring of 'Khas' land to private sector and afforestation and reforestation program in those 'Khas' land.

5. Resolving the problem of ownership between Forest Department and Land Department for the management of some specific forests.

6. Agro-forestry scheme should be checked by Forest Department and can be banned in specific sector.

7. Combining the scattered forest plots by afforestation program, providing land to the landowner in the other areas.

8. Bangalis have rapidly destroyed forest. On the other hand Adibasis are known to preserve the forest and also collect their necessary goods mainly fuel. So Adibasi can be settled down near all categories of forestland except reserve forest.

9. The surrounding people of the Madhupur National Park or people living inside are not fully aware of the importance of the conservation measure regarding the Sal forests. Besides the land resources, people living in and around the Sal forests heavily rely upon the forest products. In this context forest management efforts need to consider community-based forestry programmers involving local people in forest

management activities. It was found that moderately disturbed forest sites could be restored as natural ecosystem if human disturbances are minimized.

10. Conservation management practices should therefore be focused on such site. The continuing destruction of regeneration should be stopped otherwise many rare species even in the low disturbed forest site will be extinct.

11. Gap filling with rare species in the low disturbed forest area will reduce the threat of being extinct. Additionally afforestation practices on bare lands could help the early succession species *Shorea robusta* to recover within a short period of time through its strong regeneration potentiality.

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Appendix-A

Figure-1: Reserved Forest of Madhupur Tract.

Figure-2: Conduct In-depth Interview with Forest Official.

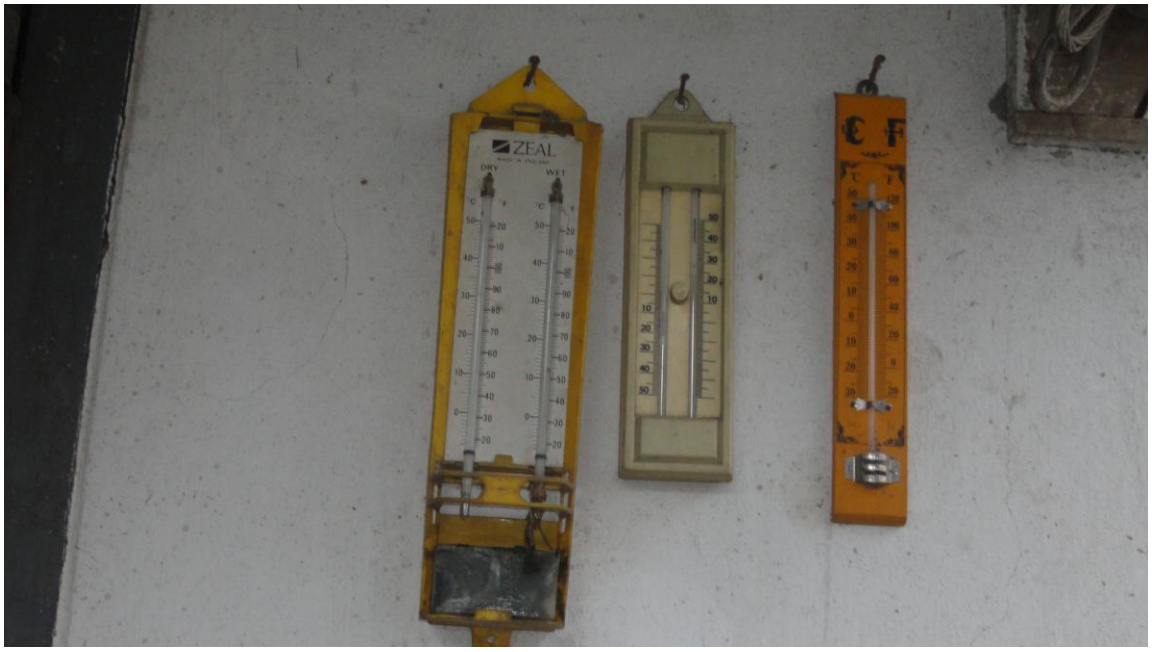

Figure-3: Measurement Machine of Temperature and Humidity at Madhupur Krishi Office.

Figure-3: Measurement Machine of Rainfall at Madhupur Krishi Office.

Figure-5: Pineapple intercropping at Arankhola.

Figure-6: Banana Intercropping in Agro Forestry Plot, Dokhola.

Figure7: Cultivation of Pineapple at Madhupur Forest.

Figure-8: Deer Breeding Centre at Madhupur Sal forest.

Figure-9: Degraded Forest Land beside Rubber Plantation, Arankhola.

Figure-10: Red Soil of Madhupur Tract

Figure-11: Degraded Forest in the Sal belt at Madhupur.

Figure-12: Cutting trees are heaped in the Madhupur Forest Beet office.

Figure-13: Cattle grazing on an agricultural field in the Madhupur Reserve Forest.

Figure-14: Banana cultivation in the Garo village Gaira has dramatically changed its traditional landscapes.

Figure-15**:** Different Relief of Madhupur Tract.

Figure-16: Hanuman Langur in Madhupur Forest which are critically endangered today due to severe depletion of forest.

Appendix-B

Questionnaire Survey for M.Phill Thesis
Department of Geography and Environment
University of Dhaka

Subject: Impact of Depletion of Forest on Environment: A case study of Madhupur Pleistocene Terrace Area in the district of Tangail.

(All information gathered from this survey will be used for research only)

Respondent ID Number…….

A.SOCIO – ECONOMIC PROFILE OF THE RESPONDENTS :

1. Name of the Interviewee……..

2. ☐ Male ☐ Female

3. ☐ Bangali ☐ Adibasi ☐

4. ☐ Muslim ☐ Hindu ☐ ☐ Christian ☐ Others

5. Age…….years

6. Educational Status

☐ Illiterate ☐ primary ☐ Secondary

☐ S .S.C. ☐ H.S.C. ☐ Graduate and Higher

☐ Others

7. Occupation

☐ Cultivator ☐ Laborer ☐ Service-holder

☐ Businessman ☐ House-wife ☐ Others

8. Number of family Members

☐ Less than 5 ☐ 5-6 ☐ 7-6

☐ 9-10 ☐ More than 10

9. Do you live here permanently? ☐ Yes ☐ No

9.1. If you are a permanent resident of this place -
How long have you been living here?

☐ Hereditarily ☐ n the British period

☐ From the Pakistani period ☐ After 1971

9.2. If you are not a permanent resident of this place-

Since how long are you here?

☐ Since 1 year ☐ 2-5 years

☐ 6-10 years ☐ 10 years

10. If your four father have not lived here, where did you migrate from……

11. If you are a migrant here what is the cause of the migration?

☐ Migrated from India during the partition in 1947

☐ Migrated from India during the Indo-Pak war in 1965

☐ Migrated from India after the independence in 1971

☐ Due landless condition

☐ Natural catastrophes (i.e. food, river bank erosion)

☐ In search of livelihood development

☐ For security reasons

☐ Other causes

12. How have you come here?

☐ Own decision

☐ Through the assistance of relatives

☐ Through the rehabilitation program of the government

☐ Others

13. What is the source of ownership of your land?

☐ Inheritance ☐ Exchange ☐ Purchase

☐ By force ☐ Obtained from the Govt.

☐ Others

14. How far is the forest from your household?

☐ Within 1 mile

☐ Within 2-3 miles

☐ Within 4-5 miles

15. How many members are involved in family economic activities?

Male	Female

16. What is your average Family Income per month?

Farming	Non-farming	Total

17. Do you know about Participatory / community / Social Forestry?

Yes	No

18. If yes, from whom did you learn?

Forest Dept.	NGO	Local people	Media	Social / political / Leaders	Others

19. What factor (s) influenced your decision to join the programme:

Hope of permanent tenure on land	No risk of losing the land	Input assistance & protection of FD	Group patronage	Economic benefit	Severance of Forest / cases	Others specify

20. Who motivated you to join the Participatory/Community/Social Forestry Programme?

Self	FD	NGO	Govt.	LG	NGO	Others

21. How do you think the present Participatory/Community/Social Forestry improved?

1	Expanding participation eligibility
2	Extending Tenure of agreement
3	Changing share percentage
4	Changing the present individual partnership into groups
5	Changing Termination procedure
6	Changing liability burdens
7	Extending Assistance
8	Extending Training & Motivation Programme
9	Increasing size of land allocation
10	Distance factor minimization
11	Possession factor

22. Do you think group participation would be more effective and sustainable than individual agreements?

Yes	No

If yes, who

1	FD
2	NGO
3	Social bodies
4	Social Leader
5	Political Leader
6	L.G.
7	Participants themselves

23. Do the participants practice intercrops (subsistence crops) in their plots of PSF plantations?

Yes	No

If yes, please show how much they are benefited:

From sale of crops …….Taka

From Hhs' food consumption (nutrition)…....Taka

24. In your opinion how do the economic benefits of the PSF practices help the Participants' households?

1	Increases households' economic solvency
2	Enables households' to buy assets (e .g. arable lands, auto-rickshaw etc.)
3	Enables to send children to schools avoiding child labors
4	Others

25. Do you take loan?

If yes, from what sources

Grameen Bank	Other Bank	Co-operative	Village money lender	Friends relatives	Others

26. Is there any conflict over Farmlands between the participants?

Participants & part.	Participants & FD	Part. & Outside	Part. & Non-Participants	Part. & Tribal

27. How are the conflicts resolved?

Unsettled	Traditional Mechanism (Non-formal)	Court litigation	Intervention Of FD	Intervention Of L.G	Other Govt. agency	NGO

28. Do you ever have conflict with FD?

Land ownership	Usufructuary rights	Forest produce

29. Have you / your family members ever been charged or chased for a forest offence by FD? :

Yes	No

B: CAUSES AND PROCESS OF DEPLETION OF FOREST:

30. What is the source of your weekly fuel?

- ☐ Wood
- ☐ Jute plant
- ☐ Straw
- ☐ Others ____

31. What are the causes of depletion of forests of your area in your own opinion?

- ☐ Anarchical situation during the Liberation War in 1971
- ☐ Over-population
- ☐ Gain in arable land
- ☐ Increase in human habitation
- ☐ Increase in demand for timber and fuel wood
- ☐ Others ____

32. According to you who are responsible for depletion of forest?

- ☐ The Landless people migrating from India after 1947,'65 and '71
- ☐ The Adibasis
- ☐ The local Bangalis
- ☐ The local influential people
- ☐ The dishonest staff of the forest department
- ☐ Others

33. Are you now better aware of the need to create and enhance forest resources than before?

Yes	No

C. IMPACT ON THE ENVIRONMENT OF DEPLETION OF FOREST RELATED QUESTIONNAIRE :

34. According to you what are the impacts of depletion of forest?

……..…….
……
…….

35. What plants were found before here in this forest?

(1)…… (2)…… (3)…….
(4)……..... (5)…… (6)…….
(7)…… (8)…… (9)…….

36. Which plants have become extinct?

(1)……..... (2)……. (3)……
(4)…… (5)…… (6)……...
(7)…… (8)…… (9)……

37. What wild animals were found in the past here in this forest?

(1)…… (2)…… (3)……
(4)…… (5)…… (6)……
(7)…… (8)…… (9)……

38. Which wild animals have become extinct?

(1)…… (2)…… (3)……
(4)…….. (5)…… (6)……
(7)…….. (7)…… (9)……

49. How the deforested lands are now being used?

☐ Cultivated land ☐ Settlement

☐ Fallow land ☐ Other infrastructure (i.e. school, bazaar, etc.)

☐ Others ☐

40. If the deforested lands remain fallow do you think that it can be reforested?

☐ Yes ☐ No

41. How the Afforestation and Reforestation are possible in your opinion?

☐ Through the activities of government

☐ Through the activities of NGO

☐ Through the activities of local people

☐ Others ☐

42. According to you what are the Environmental Changes that have occurred due to depletion of forest?

……
……
……
……
……
……

43. According to you what are the impacts on agriculture for depletion of forest?

- ☐ The fertility of soil degraded as a consequence of which the yield of crops decreases
- ☐ High lands under-go erosion and lowlands are filled with rising the temperature
- ☐ Production cost is increase
- ☐ Rainfall is inadequate
- ☐ The available of underground water is decreased
- ☐ The extinction of natural biodiversity
- ☐ Production of Crops are decreased because of lack of humus
- ☐ Others impacts ☐

44. Would you like to give your own opinion as regards the process and its impact of deforestation?

……
……
……
……
……

(Signature of interviewer)

[Thank you for your kind co-operation]

Appendix-C

In-depth Interview of Forest Expert for M.Phill Thesis
Dept. of Geography and Environment
University of Dhaka

Subject: Impact of Depletion of Forest on Environment: A case study of Madhupur Pleistocene Terrace Area in the district of Tangail.

(All information gathered from this survey will be used for research only)

Respondent ID Number…….

A.SOCIO-ECONOMIC PROFILE OF THE RESPONDENTS :

1. Name of the Interviewee……..

2. ☐ Male ☐ Female

3. ☐ Muslim ☐ Hindu ☐ Christian ☐ Others

4. Age…….years

5. Educational Status :

☐ Illiterate ☐ Literate ☐ primary
☐ Secondary ☐ S .S.C. ☐ H.S.C.
☐ Graduate and Higher ☐ Others

6. Occupation :

☐ Cultivator ☐ Laborer ☐ Service
☐ Businessman ☐ House-wife ☐ Others

B: CAUSES AND PROCESS OF DEPLETION OF FOREST:

7. What are the causes of depletion of forests of your area in your own opinion?

☐ Anarchical situation during the Liberation War in 1971
☐ Over-population
☐ Gain in arable land
☐ Increase in human habitation
☐ Increase in demand for timber and fuel wood
☐ Others ☐

8. According to you who are responsible for depletion of forest?

- ☐ The landless men who had migrated from India after 1947,'65 and '71
- ☐ The Adibasis
- ☐ The local Bangalis
- ☐ The local influential people
- ☐ The dishonest staff of the forest department
- ☐ Others

9. What are the main reasons for forest land encroachment?

FD	Law	Land Record	Traditional dispute	Open access	Elites	Law Enforcing agencies	Forestry Traders

C. IMPACT ON THE ENVIRONMENT OF DEPLETION OF FOREST RELATED QUESTIONNAIRE :

10. According to you what are the impacts of depletion of forest?

……
……
……
……
……

11. What plants were found before here in this forest?

(1)…… (2)…… (3)…….
(4)……..... (5)…… (6)…….
(7)……. (8)…… (9)…….

12. Which plants have become extinct?

(1)……..... (2)…… (3)……
(4)……. (5)…… (6)……...
(7)……. (8)…… (9)……

13. What wild animals were found before here in this forest?

(1)…… (2)…… (3)……
(4)…… (5)…… (6)……
(7)…… (8)…… (9)……

14. Which wild animals have become extinct?

(1)…… (2)…… (3)……
(4)…… (5)…… (6)……
(7)…… (8)…… (9)……

15. How the deforested lands are now being used?

☐ Cultivated land ☐ Settlement
☐ Fallow land ☐ other infrastructure (i.e. school, bazaar, etc.)
☐ Others ☐

16. If the deforested lands remain fallow do you think that it can be reforested?

☐ Yes ☐ No

17. How the afforestation and reforestation are possible in your opinion?

☐ Through the activities of government
☐ Through the activities of NGO
☐ Through the activities of local people
☐ Co-ordination between Gov. NGO & local People
☐ Others ☐

18. According to you what are the Environmental Changes occur for depleting of forest?

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19. According to you what are the impacts on agriculture for depletion of forest?

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20. Would you like to give your own opinion as regards the causes and its impact of deforestation and how to solve it?

……
……
……
……
……

(Signature of interviewer)

[Thank you for your kind co-operation]

Appendix-D

Bangladesh National Categories:

The National Categories of Threatened Animals are based on the Global Threatened Categories of IUCN. Bangladesh National Criteria were developed on the basis of qualitative data due to the lack of Quantitative ones.

The definitions of these categories are:

I. **Extinct (EX):** A taxon is Extinct when there is no reasonable doubt that the last individual died.

II. **Critically Endangered (CR):** A taxon is Critically Endangered when it is facing a very and extremely high risk of extinction in the wild in Bangladesh in the immediate future.

III. **Endangered (EN):** A taxon is Endangered when it is not Critically Endangered or Endangered but is facing a very high risk of extinction in the wild in Bangladesh in the near future.

IV. **Vulnerable (VU):** A taxon is vulnerable when it is not Critically Endangered but is facing a high risk of extinction in the wild in Bangladesh in the medium-term future.

V. **Not Threatened (NO):** A taxon is not Threatened when it is out of the above-mentioned categories, i.e. which has no apparent threat of extinction in Bangladesh.

VI. **Data Deficient (DD):** A taxon is Data Defincient when there it is out of the four above-mentioned categories, i.e. apparent threat of extinction in Bangladesh.

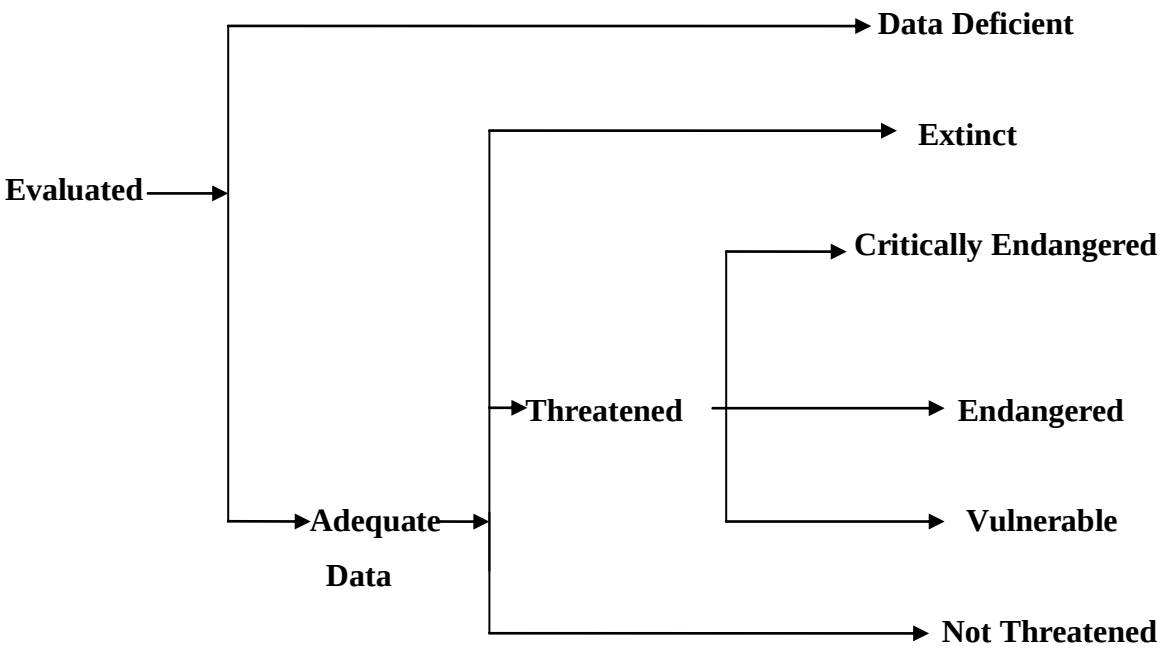

Figure: 1- Structure of the Bangladesh National Categories.