

# Chapter – I

## INTRODUCTION

### 1.1 Introduction

Forests are biologically diverse natural systems, representing some of the richest biological areas on the earth. They offer a variety of habitats for plants, animals and microorganisms. Forests play an important role in environment, land and economic sustainability. They constitute the most valuable resource for mankind's existence. According to Bhagawan Gautam Buddha - "Forest is a peculiar organism of unlimited kindness and benevolence that make no demand for its sustenance and extends protection to all beings, offering shade even to the axe-man who destroys it." Forests, the "Green Lungs" of the earth, function as reservoirs of energy and nutrients while enrich soil by providing the much needed organic matter and enhance its water holding capacity. Being one of the vital components of the environment, forests provide man with food, fodder, medicine, fiber, timber etc. and a wide range of non-wood products along with shade and protection. Forest is natural habitat for biodiversity and repository of genetic wealth. Carbon sequestration can be achieved effectively through forest conservation. If one compares global warming to a fever of the planet, then forest does not only function as a potential remedy, but their destruction also contributes to further illness (Schone and Netto, 2005). Deforestation and forest degradation contribute 24% of all anthropogenic carbon emissions and 18% of all greenhouse gas emissions combined (IPCC, 2000).

India that represents one of the twelve-mega biodiversity regions identified in the world is rich in all aspects of diverse forest communities at species and genetic levels due to its varied climatic conditions and geographical features. In India, about

47,000 species of plants and 89,451 species of animals have been reported and a lot more are still waiting to be discovered and known to world (Singh and Choudhury, 2002). A major portion of these flora and fauna are found in the forest community of the country. Based on the floristic richness, which supports diverse endangered and endemic fauna, the North East India falls under two biodiversity hotspots – Himalaya and Indo-Burma, among the 34 hotspots of the world (Conservation International, 2005). The zone contains elements of Indo-Malayan, Indo-Chinese, Sino-Malaysian and east Asiatic floras as well as several Bondwoman relicts (Rawat et al., 2001).

### **1.1.1 Human Pressure on Forests**

Forests are under increasing pressure from a range of factors including agricultural expansion, industrialization, large scale timber extraction, climate change and urbanization (Geist and Lambin, 2002). Anthropogenic pressure can cause uncontrolled influences that bring changes in floral and faunal diversity, habitat, landscape, soil properties and it may also leads to considerable alterations in the environmental conditions (Gupta and Yadav, 2005).

The gravity of depletion of forest and its biodiversity has received worldwide attention and earth summit held in Rio de Janeiro in June 1992 was the outcome of this consideration (Singh and Choudhury, 2002). Apart from loss of biodiversity, the continuous loss of forest cover poses a serious problem of increasing global warming and climate change. The various consequences of deforestation includes loss of biodiversity (Myers et al., 2000), loss of an important sink for atmospheric carbon dioxide (Houghton, 1999), impacts on local and regional climate (Shukla et al., 1990) and negative effects on the livelihoods of people in tropical forests (Bishop, 1993).

The opening of forest areas also effected the edaphic environment and microclimate of the area resulting loss of ecosystem services. Edaphic factors like soil temperature, soil moisture content and light conditions under the plant canopy affect

the germination and establishment success of plants (Evans and Young, 1970, 1972). The plant species influences the rate of nutrients cycle within an ecosystem through litter-quality feedbacks (Wedin and Tilman, 1996). Nitrogen in soil can change the spatial and temporal dynamics of vegetation (Knap et al., 1999). In open forest the level of NPK is responsible for spread of weed species *Argemone maxicana* (Ramakrisnan, 1991). Disturbances and environmental variability do ultimately create niche opportunities by modifying resource availability or supply rates. It is their proximate density independent effects on tree germination, establishment and/or mortality (Sankaran et al., 2004). The establishment and survival of the different species also resulted in creation of vegetational zones. Further, the gradient of temperature and moisture in combination with different soil conditions and altitudinal changes result in a mosaic of different vegetation types (Hilbig, 1995).

According to United Nation's Food and Agriculture Organization (FAO), world has been losing 7.3 million hectars of forests per year. A comparison between 1990 and 2005 revealed that the global forest cover having 4077 million hectars of areas in 1990 was reduced to 3952 million hectars in 2005 (FAO, 2006). In between 2001 and 2003, India lost 26,245 sq. km. of its dense forests (State Forest Report, 2003).

### **1.1.2 Human impact on forest community structure**

Human impact on forest structure is now a global issue and its effects possess a great threat to biodiversity as well as humankind. The term human impact can be described as the result of different anthropogenic activities or disturbances related to resource exploitation from the environment or ecosystem. Disturbances often act quickly and with great effect, sometimes resulting in the removal of large amounts of biomass. The devastating effects of human impact on the environment, such as – forest clearing can be considered as major disturbances. Disturbing forces may have profound immediate effects on the ecosystems and can greatly alter the natural forest

community structure. Because of these and the impacts on species population, these effects can continue for an extended period of time. On the other hand, the forest floor is often littered with dead material. This decaying matter and abundant sunlight promote the abundance of newly growth vegetation in the gap areas caused by human impacts. Generally, in case of human induced forest fires, a portion of the nutrients previously held in plant biomass is returned quickly to the soil as biomass burns. On the other hand, flush floods in disturbed forests can result washing out of soil nutrients and affect the growing vegetation. However, some species are particularly suited for exploiting recently disturbed sites by using the remaining soil nutrients. Vegetation with the potential for rapid growth can quickly take advantage of the lack of competition. It has been reported that in Northeastern United States, shade intolerant trees like – pine, cherry quickly filled in the forest gaps created by fire, wind or human disturbance. They are highly tolerant of standing water and frequently dominate floodplains where other species are periodically wiped out. Bezbarua (2007) also reported that forest opening plays a crucial role in replacement of shade tolerant plant community to sun loving species. In Indian context also, dramatic alteration of natural forest vegetation due to human interference was reported by Saxena (1991). It has been observed that forest strata in Namdapha national park of Northeast India have changed significantly due to forest exploitation (Nath et al., 2004).

### **1.1.3 Biosphere Reserves**

In contrast to various categories of protected areas established to conserve forest resources under various protection acts, the biosphere reserve programme was launched by UNESCO under its Man and Biosphere programme in 1973-74 with the primary objective to identify the representative ecosystems which are still in pristine condition and to strengthen their conservation efforts. Biosphere reserves are protected areas of representative of natural ecosystem under various worlds' biogeographical

provinces which have been internationally recognized for their value in the conservation and in providing scientific knowledge skills and human value to support sustainable development.

Man is an integral part of biosphere reserve and its conservation is based on the intrinsic realization of the harmony between man and nature. Biosphere reserves are designed to deal with one of the most important problems of reconciling conservation of biodiversity, the quest for the economical social development and maintenance of associated cultural values (Rai, 2000). According to Singh and Choudhury (2002), they also represent means for maintaining the gene pools of species of plants, animals and microorganisms in totality by setting aside the representative areas of wide ranging natural ecosystem throughout the world for their conservation and research. Generally, biosphere reserve has two major components – core and buffer zone. While core zone is totally remain as undisturbed, buffer zone have several pattern of human interference for overall management of the total area.

#### **1.1.4 Manas Biosphere Reserve and Vegetation of the Study Area**

In India, the first biosphere reserve was set in the year 1986. The adjacent areas of western Assam at the foothills of Bhutan Himalayas in Indo-Bhutan border flanked by Sonkosh river in the west and Dhansiri river at the east was declared as Manas Biosphere Reserve on the 14<sup>th</sup> of March, 1989 considering its unique landscape biodiversity and cultural value. It is the first biosphere reserve in Assam, second in northeast India and sixth amongst total eighteen biosphere reserve in India.

The vegetation pattern in the study region is observed to be diverse depending the variation of climatological parameters as well as the topographic effects. Champion and Seth (1968) described the general vegetation pattern of India and accorging to his classification, the following types of vegetation are observed in the study region.

(a) *Northern Secondary Moist Mixed Deciduous Forests (3C/C32s1)*

- (b) Evergreen Forests (1B/C1 and 2B/C1)
- (c) Low Alluvium Savannah Woodland (31S1)
- (d) Eastern Wet Alluvial Grassland (Tarai formation)
- (e) Riparian Fringing Forest (4E/RS1)
- (f) Khair Sisso Forests (5/1s2)
- (g) Secondary Bamboo Brakes (2/2s1)
- (h) Cane Brakes (1/E1)

## **1.2 Statement of the Problem**

The mystic Manas biosphere reserve, which serves as habitats of so many endangered and endemic flora and fauna, has been facing excessive biotic pressure due to continuous political imbalance started in the region since 1988. The biosphere reserve is also known as a tiger reserve, elephant reserve and important bird area. The eastern part of the buffer serves as the part of the elephant corridor or traditional migration routes of elephants between Buxa tiger reserve in west Bengal to the protected areas of Aruanchal Pradesh covering the Indo-Bhutan bhabor terai ecosystem. Unfortunately, during the last 18 years, there has been severe destruction of forest resources in the eastern buffer of the biosphere reserve in the form of heavy tree felling and collection of firewood, thatch and grasses, medicinal plants and poaching of wildlife by the forest mafias availing the unstable political situation.

While study on floristic and ecology of different plant community as well as wildlife habitat have been going on or partially completed in the core and the western buffer of the biosphere reserve, the eastern buffer remains untouched due to continuous insurgency problem and law and order situation. The earliest floristic study of Manas Biosphere Reserve was carried out by Kanjilal (1934-1940). Jain and Hajra (1975) recorded 401 species of plants comprising angiosperms and pteridophytes from the core areas of the reserve. Further addition to the list of plants was made by Kataki

and Barua (1989) from the core area of the Manas biosphere reserve. Floristic and ecological studies in disturbed and undisturbed forest community of western buffer and core zone of the biosphere reserve were also reported by some workers (Biswas et.al., 1991; Baruah, 1992; Hajra and Jain, 1996; Baishya, 1998; Hajra and Baishya, 2002; Baruah et al., 2003; Bezbarua, 2007).

Periphery of the biosphere reserve is mainly inhabited by tribal people. The tribal people of fringe villages mainly depend on the medicinal plants of Manas Biosphere Reserve (Phukan et al., 2003). A few short surveys on capped langur distribution (Bezbarua, 2008) was carried out in the eastern buffer. There is also significant encroachment in the eastern buffer resulting fragmentation of forests (Bezbarua, 2008). The environmental degradation and fragmentation of forest caused significant habitat loss of endangered Asian elephant, royal Bengal tiger and its prey including capped langur. The forest destruction in the area showed two immediate environmental hazards – (i) severe human elephant conflict resulting death and injury of elephants and human beings as well as crop and household damage and (ii) deterioration of the exiting water crisis in the region. Even 80 years old traditional water distribution system run by local villagers have been badly affected and people have to increase their volunteer service and money to get water. It may be mentioned that the local villagers from 70 villages traditionally have been practiced volunteer service in sharing water of river Pagladia by temporary blocking and opening of different natural and human made drainage system since 1930. The villagers complained that overexploitation of forest might be the reason of decreasing water level in recent years. This is evident from the drying of government installed several deep tube-wells within a short period of time. It is feared that important biodiversity attributes in the forest would be destroyed before being explored and evaluated.

Recently a local NGO of the area has taken lead role since 2006 in protecting the existing forest and wildlife where presence of forest department is rare. They also helped in converting the hardcore poachers to conservation volunteers to patrol the forest day and night also driving away the wild elephants from human habitation. Therefore, there is a gradual restoration of forest in some pockets and if focused well, it will be an important beginning to mitigate environmental hazard of the area.

Considering the above discussion, it has been felt that the eastern buffer zone of Manas was untouched despite continuous forest exploitation resulting severe environmental hazard. Therefore, there is an urgent need to evaluate the impact of human intervention in forest community and its environment in the eastern buffer zone of the reserve forest as priority. The database will certainly help the forest department and other stakeholders to conserve environment and the forest community, particularly designing future management plan of the biosphere reserve to mitigate the human elephant conflict, improving water management and biodiversity conservation.

### **1.3 Aims and Objectives**

The overall aim of the study is to evaluate the status of the forest community structure of the eastern buffer of Manas Biosphere Reserve. The detail objectives are given as follows –

1. To characterize the different forest communities present in the eastern buffer of Manas Biosphere Reserve.
2. To investigate the forest community distribution in relation to soil properties.
3. To identify the change in forest community structure due to anthropogenic activities.
4. To evaluate the effectiveness of potential forest restoration programmes initiated by local NGOs and tribal communities.

## **1.4 Working Hypothesis**

The following working hypotheses are proposed here.

1. Due to the overexploitation, the forest cover has been shrunk resulting in the openness of in the forest areas. The openness of the forests affects the edaphic environment and microclimate of the area resulting in the loss of ecosystem services as well as the loss of biodiversity.
2. The change of soil properties is related to different land use and forest density in different topographical (altitude) variations.
3. Significant change of canopy cover as well as species diversity occurs due to anthropogenic disturbances and forest degradation.
4. Local people's participation and initiatives of NGOs in conservation can help in restoration of forests and restrict environmental degradation.

## **1.5 Methodology**

At the very beginning, a base map of the entire study area was prepared by using remote sensing data and topo maps of Survey of India. On the basis of it, field survey was made for spot verification with handheld GPS. Based on the field survey, a working plan covering all significant features of different study sites was prepared for data collection on forest community structure, different level of human disturbance on forests, soil sample collection and data related with forest restoration work initiated by local communities and NGO workers. Details about the methodology containing preparation of base maps, ecological data collection and identification of species, soil sample collection and soil nutrient analysis, etc. are presented in Chapter III.

## **1.6 Significance of the Study**

Human impact on forest community is now a global issue and its effects possess a great threat to biodiversity as well as mankind. The continuous loss of forest cover in the form of agricultural area expansion, industrialization, large scale timber extraction, urbanization, overexploitation of non-timber forest products by the local people possess a serious problem of biodiversity loss, increasing global warming and climate change. Floristic and ecological studies of forest community of western buffer and core zone have been going on or partially completed while the eastern part of Manas Biosphere Reserve was remained untouched despite continuous forest exploitation resulting severe environmental hazard. Therefore, there is an urgent need to evaluate the impact of human intervention in forest community and its environment in eastern buffer zone as priority. The database will certainly help the forest department of the state government and other stakeholders to prepare necessary action plan or management plan of the biosphere reserve for the conservation of environment and forest community leading to mitigate the human elephant conflict, improving water management of the area and biodiversity conservation.

## **1.7 Organization of the Thesis**

The subject matter of the thesis is divided into eight chapters. The first chapter deals with the introduction covering different aspects of the topic of the subject starting from definition to related matters on human impacts on the forest community structure. It also shortly describes the area of the study, statement of the problem, working hypothesis, aims and objectives, methodology and significance of the study. Chapter-II covers the literature review related to human

impacts on forests and its effects on forest community structure including effects on soil properties and related microclimate environment. Chapter-III deals with the methodology applied in details and materials for the study as well as a description of the study site. Forest community structure in the study area is dealt in Chapter-IV. Chapter-V gave an account of effects of forest degradation in soil properties in different sites. Chapter-VI discusses the impact of anthropogenic pressure on forest community structure. Chapter-VII deals with the initiative steps of the local people for forest restoration by conserving the forest area. Lastly summary and conclusion are dealt in Chapter-VIII. In the end of the thesis, the references are included.

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