Chapter - II

REVIEW OF LITERATURE

The human impact on forest community and its resources is a cause of concern in different parts of the world. 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). Unfortunately, very few studies on the impacts of human pressure on the forest characteristics were conducted in the buffer zones of Manas Biosphere Reserve that included under the hotspot Himalayas amongst the 34 biodiversity hotspots around the world. It contains the elements of Indo-Malayan, Indo-Chinese, Sino-Malayasian and east Asiatic floras as well as several Gondwana relicts (Rawat and Wikramanayake, 2001). The diverse forests types of the biosphere reserve harbour some of the globally threatened and endangered species like Royal Bengal tiger, Asian elephant, Indian Gaur and arboreal species like capped langur. It is unfortunate that due to political unrest and insurgent activities in and around the biosphere reserve since late nineties, it lost some of its biodiversity attributes. There was no earlier data base to assess the extent of damage in terms of plant community structure and habitat nature (Bezbarua, 2007). Till 2011, the UNESCO continued the status of Manas world heritage site as 'in danger' since 1992. It may be mentioned that the core of the reserve covering an area of 391 sq. km. and attached to buffer forests was declared as Manas World Heritage site in the year 1985 for its unique rich biodiversity and cultural value. As per the direction of the UNESCO and different stakeholders at government and suggestion of conservation organizations, importance was given on core zone regarding evaluation of biodiversity and its conservation. Despite continuing anthropogenic activity in the buffer area of Manas, very little field study has been done for evaluation of the human impacts on the

plant biodiversity and ecosystem services particularly at plant community level (Bezbarua, 2007).

There are several good reasons for studying the phenology of plant species to find out the restoration ecology, survival success, the efficiency of many weed control stage and crop (Bezbarua, 2007). The switch over from vegetative to reproductive growth on the onset of flowering can be influenced by temperature, light, moisture, soil nutrient and genotype. Franklin and Bach (2006) made assessment of intraspecific phenological synchrony in zoochorous trees from the monsoon forests of northern Australia. Flowering calendar of the angiospermic flora of Darjeeling Hill was studied by Das and Chanda (1987). Baruah (1998) studied phenology of the plant species of Kaziranga National Park, while Bezbarua (2007) recorded the phenology of selected plants from core zone.

The forest community diversity plays an important role in the conservation of the biodiversity of Manas Biosphere Reserve located in the foothills of eastern Himalayas in Indo-Bhutan border. Species diversity is considered to be one of the key parameters characterizing ecosystems and a key component of ecosystem functions (Hutchinson, 1959; Schulze and Mooney, 1994; Larsson, 2001; Loreau et al., 2002; Scherer-Lorenzen et al., 2005). Schmidt (2005) discussed the reasons of differences in higher plant species diversity of forest community. The forest has controlled the different environmental attributes including regulating the speeds of the turbulent water as well as diversify the distribution of the water availability. Baruah et al. (2004) found that factor like annual flood had played a crucial role in diversity, distribution and composition of wetland vegetation of Kaziranga National Park. The complex forest ecosystem has been created due to succession of the Bhabor zone in the foothills and riparian grasslands in due course of the time. Despite having diverse forest types in

Manas, it is an urgent to know the status of the forest ecosystem to manage the forest depended fauna and their habitat (Bezbarua, 2007).

Natural forest cover has been shrinking in different parts of the world due to tremendous anthropogenic pressure. According to United Nations' Food and Agriculture Organization (FAO), the world has been losing 7.3 million hectors of forest per year. From 4077 million hectors of forest cover in 1990, global forest cover was reduced to 3952 million hectors in 2005 (FAO, 2006). Although a slight increase of total forest cover (0.65%) was observed in between 2001 and 2003, India lost 26,245 sq. km. of its dense forest during the same period (FSI, 2003). Since 1989, the forests of Manas biosphere reserve was also severely degraded by tremendous logging pressure during the political instability. Several close canopy forests has been converted to open forest even to degraded land in last 20-25 years. The opening of the forest by natural or biotic disturbance would result in change in plant community dynamics at top layer as well as undergrowth. Forest dynamics in relation to logging pressure in south eastern Manitoba, Canada was studied by Kemball (2005). Canopy opening by thinning of forestry would favour increase of undergrowth (Ratnayake, 2005). Dwarf bamboo produced dense undergrowth in forests, especially at open sites (Toyooka et al., 1981; Noguchi and Yoshida, 2005). The canopy opening by illegal or legal exploitation of forests would result increase in light intensity which subsequently change the demography of the undergrowth community.

Light intensity is acknowledged as being one of the most important environmental factors (Lieffers and Stadt, 1994). Under storey vegetation are suitable indicators for site conditions, human impact and forest dynamics and therefore an useful and easy tool to measure and evaluate biodiversity in order to characterize sustainable or ecosystem-based forest management (Schmidt, 2005). During logging operation, selective tree species have been targeted for timber and fuel wood. In

absence of better timber yielding trees due to continuous logging, smugglers had preferred second best timber for exploitation (Bezbarua, 2007). Most of the timber or non timbers yielding plants also have been used as fuel wood. Thus, the tree diversity and community have been changed as less important plants would play a significant role in the forest ecosystem dynamics. The disturbance is one of the major factors, which determines plant communities in natural ecosystems and status of soil nutrients (Armesto and Pickett, 1985). Change in species composition is one of the major causes for determination of status and release of nutrients in soil, as chemical composition of soil is largely governed by nature of vegetation (Mishra and Laloo, 2006).

The openness of forest due to human influence also changes the microclimate like soil properties, temperature and moisture content of the area. The relation between soil and vegetation has been an important aspect for natural ecosystem. Braun-Blanquet (1934) has pointed out the close relationship between the natural evolution of the vegetation and the development of the soil (Sharma et al., 2010a). Recently works on phytosociology and soil-vegetation interrelationship in the different forest types of Garhwal Himalayan region was done by Sharma et al. (2009a, 2009b, 2010a, 2010b, 2010c) and Gairola (2010). Sundarpandian and Swamy (2004) investigated the soil organic matter dynamics and carbon balance in disturbed tropical forest ecosystem in Western Ghats. Nitrogen in soil can change the spatial and temporal dynamics of vegetation (Knap et al., 1999). Forest strata changed significantly in Namdopha national park due to forest exploitation (Nath et al., 2004). The plant species influences the rate of nutrients cycle within an ecosystem through litter-quality feedbacks (Wedin and Tilman 1996, Evans et al., 2001). The pattern of forest plant diversity is very much depended on the variation of altitude that linked diverse soil organic matter and NPK availability (Tomer and Tripathi, 2004). Impact of human activities on plant diversity and soil properties in Nokrek biosphere reserve, Meghalaya was well documented by

Prabhu et al. (2004). The gradient of temperature and moisture in combination with different soil conditions and altitudinal changes results in a mosaic of different vegetation types (Hilbig, 1995). The post disturbance light environment impacted the shade tolerate vegetation composition (Kemball et al., 2005). 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 mortality (Sankaran et al., 2004). In open forest the level of NPK is responsible for spread of weed species *Argemone maxicana* (Ramakrisnan, 1991). Natural vegetation of the Indian subcontinent has been subjected to dramatic alteration through human interference (Saxena, 1991).

Himalayan forests play an important role in tempering the inclemency of the climate, in cooling and purifying the atmosphere, in protecting the soil, in holding the hill slopes in position and in buffering up huge reserves of soil nutrients (Sharma et al., 2010). There have been different efforts for restoration and regeneration of degraded forest in the region. But the rate of success is very limited and evident where local communities took the lead. The natural regeneration of tree species have been evaluated in sub-tropical broad leaved forest in Shillong (Barik et al., 1992, 1996), tropical wet evergreen forest of Arunachal Pradesh (Bhuyan et al., 2001), the forest of Kumayun Himalayas (Saxena and Singh, 1984) and degraded Sal forests in north-eastern U.P. (Pandey and Shukla, 2001). Chaubey and Sharma (2013) made a systemic attempt to understand dynamism of natural regeneration of *Shorea robusta* and suggested management inputs to encourage its regeneration, particularly in the state of Madhya Pradesh. Natural regeneration of Sal (*Shorea robusta*) in the dry deciduous forest was studied by Nag and Gupta (2014) in west Bengal.

Successful regeneration of tree species is considered as a function of three major components – (i) ability to initiate new seedlings, (ii) ability of seedlings and saplings to

survive, and (iii) ability of seedlings and saplings to grow (Good and Good, 1972). Measurement of these parameters provides an insight into the regeneration of species in a forest community (Bargali et al., 2013). Several authors have predicted regeneration status of tree species based on the age and diameter structure of their population (Khan et al., 1987; Bhuyan et al., 2003). Scattered information is available in literature on the status of *Shorea robusta* regeneration in relation to soil pH (Gupta, 1953), accumulation of leaf litter in moist forests (Champion and Seth, 1968), damage by wild animals (Sirkar, 1954), effect of grazing closure (Chaubey and Jamaluddin, 1989), shrubby growth and ground flora richness (Khan and Gupta, 1960), and the effect of standing crop (Chaubey and Sharma, 2013). Srivastava (1963) studied phyto-sociological studies of *Shorea robusta* forests in Uttar Pradesh, India with special reference to regeneration. Dabral et al. (1980) studied micro-climatic variations in naturally regenerating *Shorea robusta* forest in West Dehradun. Seedling establishment of tree species in a forest community is also determined by the tree fall gap size (Whitmore, 1978; Broksaw, 1985; Welden et al., 1991; Barik et al., 1992), herbivory (Kobe, 1999), low light (Kobe, 1999), low nutrient levels (Holl, 2002), deer browsing (Boerner and Brinkman, 1996). Decreased rainfall, grazing and trampling by cattle have adverse effect on the seedling population (Saxena and Singh, 1984; Yadav, 2001).

Regeneration of forest trees in different level of disturbance in different sites of forests also significantly contributed in the forests diversity, dynamics and function. Forest dynamics in relation to regeneration of tree species was observed by different workers. European forests provide the driving force for forest dynamics and regeneration through structural change, the initiation of succession and creation of habitat diversity (Pickett and White 1985; Quine et al., 1999). Scarification has greatly enhanced the germination and survival of tree species relative to control areas or treatments without scarification (Mäkitalo, 1999; Karlsson and Orlander, 2000; Wurtz

and Zasada, 2001; Béland et al., 2003), suggesting that it is an effective practice for regeneration and restoration of degraded forests. It is inferred that surface soil compaction by machinery increases ground hardness (Buckley et al., 2003) and results in decreased growth, probably by inhibition of root extension (Miyoshi, 1978). The intensity of scarification may also have a strong negative effect by removing many dispersed and buried seeds in the site (Hayashida and Koyama, 1990).

Assam is one of the largest states in North East India and is the gateway to other hilly states in the region. The diversity of topography, valleys and unique climate provide world's most endangered flora to find their home in this landscape. This rich flora in the forest has been the centre of attraction for various botanists since early 19th century which began with the famous Assam tea delegation comprising N. Wallich, W. Griffith and J. Mc Clelland (1823). Robinson (1841) provided the floristic account of the region. Flora of Assam (Kanjilal, 1934-40) was the beginning of botanical studies by Indian botanist (Haridason, 2003). A number of botanists contributed to the understanding the flora of the state (Rao and Rabha, 1966; Kar and Panigrahi, 1963; Kataki and Panigrahi, 1964; Jain and Hajra, 1975; Rao, 1974). 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 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 from the literature of some workers (Biswas et al., 1991; Baruah, 1992; Hajra and Jain, 1996; Baishya, 1998; Hajra and Baishya, 2002, Baruah et al., 2003, Bezbarua, 2007). The tribal people of fringe villages mainly depend on the medicinal plants of Manas biosphere reserve (Phukan et al., 2003). In Indo-Bhutan border also there are some

local efforts where different tribal communities have come forward to restore degraded forests of Manas biosphere reserve through community based NGOs (Bezbarua et al. 2005, Bezbarua, 2008).

The current literature reveals that very little studies on human impact on forest community structure in eastern buffer of Manas biosphere reserve have been done till present period. Therefore, the present study will provide a database on the influence of anthropogenic pressure on the status forest and its surrounding environmental condition of the reserve. The evaluation of forest ecology in relation to abiotic and biotic factors needs to be explored in Manas Biosphere Reserve which is the home of many endangered flora and fauna. Besides the database obtained in this present study will be a tool for different research workers, evaluation teams of different organizations as well as other stakeholders and will help in designing a practical management plan for Manas biosphere reserve.

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