

## ABSTRACT

Manas Biosphere Reserve (MBR), located in Northeast India has been facing excessive biotic pressure since 1988 due to continuous political imbalance in the region. The human impact on forests, especially in the eastern buffer of MBR has resulted in severe environmental degradation and ecological problems like severe human elephant conflict and water scarcity during the lean period. Restoration of natural forests of the region is very much essential to manage these problems. Therefore, there is an urgent need to study the human impacts on forests of the region so that necessary action plan may be taken for their regeneration/restoration. This study was carried out to assess human impact on the forest community structure and soil quality in the eastern buffer of MBR.

The study is based on the identification and assessment of disturbed forest areas in four reserved forests (Daodhora, Batabari, Subankhata and Dihira (proposed)) covering the eastern buffer of MBR by using remote sensing and Geographic Information System followed by field verification and necessary field work. After identification of disturbed and undisturbed forest areas, proper sampling design was formulated and field works were made to collect ecological data and soil samples. Standard methods were used for identification of plant species and ecological data analysis. Soil samples were analysed by using standard procedures for different soil parameters.

It was found that amongst the 98.35 sq km of the study site, an area of 13.29 sq km and 5.65 sq km forests have been encroached for agricultural activities and human habitation respectively. Different landuses like mixed moist evergreen forest and semievergreen forest (0.32 - 8.86 sq km), mixed deciduous forest (0.08 - 15.32 sq km), scrub forest (0.50 - 12.07 sq km), grassland (0.60 - 3.50 sq km), wetland/river (0.14 -

2.43 sq km), agricultural land (0.34 - 8.41 sq km) and human habitation (0.29 - 2.62 sq km) were identified with diverse vegetation in different areas. Anthropogenic disturbance in different forests have resulted in the decrease of canopy cover from 50-75% to 5-20% and canopy heights from 5-12 meters to 2-7meters. It also significantly changed the tree (undergrowth vegetation) diversity from 2.84 (2.96) in undisturbed area to 2.13 (1.99) in the disturbed area. The phenology of the tree (25 species) and underground vegetation (15 species) indicated that most of the species onset flower during spring and rainy season though some also prefer the winter season. The contiguous four reserve forests showed above 60% similarity in tree vegetation and variation was related to influence of abiotic and biotic factors.

The average nitrogen (N) and organic matter (OM) contents in soil are found to be significantly low in disturbed scrub land, grassland, human habitation area and agricultural sites (N = 0.007%, OM = 0.13%) compared to undisturbed evergreen and semievergreen forests including mixed deciduous (N = 0.45%, OM = 1.57%). The microhabitat level study in different forests confirmed higher percentage of sand (34.5-78.6) with low to moderate clay and silt particles in disturbed forests depending upon the level of human disturbance and landuse variation. Highest sandy particles are observed in the highly disturbed Subonkhata RF.

The anthropogenic disturbance in forest community structure converted the natural tree association *Lagerstroemia parviflora-Linnea grandis-Dillenia pentagyna* to *Lagerstroemia parviflora-Dillenia pentagyna-Bridellia retusa* in Daodhora. In Batabari the *Lagerstroemia parviflora-Linnea grandis-Dillenia pentagyna-Sterculia villosa* association has been changed to *Bomabx ceiba-Dillenia pentagyna-Bridellia retusa-Callicarpa arborea* type indicating gradual shifting of non timber type of forest community in due course of time. In Subonkhata RF vast encroachment (47.13%) resulted major fragmentation in the continuity of the MBR in the eastern buffer zone.

The undisturbed forest community comprising of *Bombax ceiba* - *Lagerstroemia parviflora* - *Dillenia pentagyna* - *Linnea grandis* changed to *Linnea grandis* - *Lagerstroemia parviflora* - *Bridellia retusa* type in due course of time. Dihira proposed reserve forest has some potential for upgrading to reserve forest. The major tree association is comprised of *Lagerstroemia parviflora*, *Dillenia pentagyna*, *Callicarpa arboria*, *Linnea grandis* and *Bombax ceiba* in the undisturbed sites.

Due to logging pressure trees like *Alstonia scholaris*, *Albizia procera*, *Albizia lebeck*, *Bischofia javanica*, *Dillenia indica*, *Gmelina arborea*, *Lagerstroemia speciosa*, *Pterospermum acerifolium*, *Bauhinia variagata*, *Careya arboea*, *Duabanga grandiflora*, *Pterospermum acerifolium*, *Terminalia bellirica*, *Holarrhena antidysenterica* and *Oroxylum indicum* were completely eliminated due to demand of timber, fuel wood and medicine in different sites. The undisturbed ground vegetation dominated by *Clerodendrum viscosum*, *Litsea salicifolia*, *Leea asiatica*, *Chromolaena odorata*, *Adhoda vasica*, *Ageratum conyzoides*, *Dryopteris paleacea*, *Costus speciosus* *Calamus sp.* has been gradually replaced by *Leea asiatica*, *Clerodendrum viscosum* and problematic weed *Chromolaena odorata*.

With support of networks of 80 years old human made channels from river Pagladia and protection by local NGO and villagers (dong bund committees), an area of 6.69 sq km of the encroached land in Subonkhata RF were naturally regenerated within six years. It is significant that regenerating forest with canopy height of 1-2.5 meters are mainly dominated by *Linnea grandis*, *Lagerstroemia parviflora*, *Bridellia retusa* and moderate species like *Bombax ceiba*, *Dillenia pentagyna*, *Duabanga grandiflora*, *Toona ciliata*. The undergrowth vegetation also improved significantly in restored area. There was significant increase of vegetation cover (from 5 to 45 %), species number (from 3 to 20) and vegetation height (from 0.5 to 5 feet). Other parameters like nitrogen (from 0.0045% to 0.0058 %) phosphorus (from 0.426 kg/acre to 1.34 kg/acre), potassium

(from 33.12 kg/acre to 57.06 kg/acre), organic matter (from 0.15% to 0.48%), clay (from 11.58 to 18.54 %) and silt (from 14.57 to 23.46 %) contents in soil have also been found to increase in four different restored and disturbed stands. The riparian area in Subonkhata RF has more potential of natural restoration and helped improvement soil nutrients.

The study reflects that human impact of forest community in the eastern buffer of Manas biosphere reserve has caused environmental degradation including forest loss; but some positive initiative has resulted due to forest restoration and would help in future management of the Manas biosphere reserve.

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