The Proposed Work

The present work was proposed to trace the impacts of plantation forests on plant diversity of Terai-Duars belt of West Bengal. Terai-Duars belt of West Bengal is a part of the Terai Arch Landscape in Northern India which extends over a large area eastward from the Yamuna River across Himachal Pradesh, Haryana, Uttaranchal, Uttar Pradesh, Bihar, West Bengal, Bangladesh, Bhutan and Assam and east to the Brahmaputra River. The entire belt is lying at foot of the Himalayas and is contiguous with the IUCN recognized Himalaya Biodiversity Hotspot. The marshy tract of dense vegetation shares innumerable important floral elements with the *Himalayan hotspot* and are extremely rich in biodiversity (Das, 1995, 1996, 2004). In drawing attention of biologists, environmentalists and plant explorer the Terai-Duars belt stands second to the Darjeeling Himalaya which in turn is an important segment of *Eastern Himalaya Hotspot*. Thus the area is important enough to the botanist, environmentalist and foresters and the peoples who are involved with forests and plantations from the view point of biodiversity especially, the phyto-diversity. Conducive and variable environments in this belt harbours a widely diverse flora and fauna and favours their evolution, migration from adjoining areas through corridors, and adaptive radiation of species in new ecological niche (Ahmedulla, 2000; Rai, 2006).

2.1. IMPORTANCE OF THE PRESENT WORK

Before the establishment of human settlement almost the entire tract was wrapped with dense forests. But rapid development of hilly Darjeeling town after the historical visit of Capt. Lloyd and Mr. Grant in 1827, introduction of Tea cultivation in Terai and Duars region and it rapid expansion started eliminating the dense vegetation (Ghosh, 2006; Ghosh & Das, 2007). Not only that the Dhupi [*Cryptomeria japonica* (Thunb. *ex* L.f.) D. Don] plantation in Darjeeling for supplying wood for tea packing boxes, indirectly affected the vegetation of Terai.

A large number of tribal people from different region were brought to the Terai-Duars region to supply with the Tea worker and labours in other developmental activities. Population of this region started increasing in a very high rate, dense and virgin forest were cleared for housing and farming land, building materials and fuel woods. In one side pressure from rapidly growing population and their needs and on the other hand construction of roads, rails and expansion of tea gardens began to fragment the vegetation and posed threats to the phytodiversity of this area (Das, 2004; Rai, 2006).

In Terai region, at Siliguri on the bank of river Mahananda, a giant sawmill was established for shaping up large Sal trees into railways sleepers and that had encouraged slaughtering of millions of Sal and other trees and ultimately wiping out of large extents of greenery.

In 1862 and 1874 tea plantation was spread out in Terai and Duars respectively, which was first initiated in 1835 in Lebong. Vigorously growing tea gardens started replacing characteristic forests, grassland, herbs land, scrubs and other types of landform that apparently appeared to be valueless (Ghosh *et al.* 2004). In addition to this in 6th (1965-66 to 1974-75) and 7th (1975-76 to 1984-85) working plan of Forest Department converted vast extents of natural vegetation in Duars into teak plantation for eradication of herbs and shrubs (Das, 2004). To face the demands for fuel woods of tea gardens and wood based industries a huge area was also converted into wet mixed type of forest by planting different types of trees in mixed (Sarkar, 2014).

With the rapid decline of forest cover in Terai and Duars region, mainly with the Governmental initiatives, plantations of some selected species have been raised over wide areas in different times. Majority of these plantations are monocultural or with few species only. Most of the species used for plantation are commercially viable, tree in habit, many exotics, and form dense and continuous canopy within three to five years. None of these features, in fact, is in favour of the reclamation of natural vegetation and thereby do not support the conservation activities.

Thus along with the multiple factors posing threats simultaneously to this unique vegetation and forests of this area, different types of plantations of both native and non-native species, and mono-cultural or mixed, supposed to have some effects on phyto-diversity and environments of Terai-Duars region. One the other hand in question of influence of plantation in biodiversity, the whole universe is segregated into two groups- one in favour of plantation and the other against it. Plantations are being addressed as “Biological Dessert” and some large environmental organizations are running an anti-plantation campaign, like the Rainforest Action Network and Greenpeace.

At the same times there is no any of the systematic study to understand the effects and/or performances of such artificial vegetation, apart from the economic gains and floristic aspects (Gamble, 1875, 1878; Prain, 1903; Burkill, 1916; Cowan & Cowan, 1929; Cowan, 1929a; & Biswas, 1956, 1966) in the conservation of biodiversity. However, Shebbeare (1961) worked on ‘Taungyan’ plantation in Nothern Bengal and Ghosh (2006) studied some aspects of tea plantation in North Bengal. Recently Sarkar *et al.* (2010a,b), Sarkar & Das (2010) and Sarkar (2011) explored the ethnobotanical aspects of Duars whereas Saha *et al.* (2013) has estimated the medicinal plants of this area.

On the other hand it is important to understand that the study area is situated at the foot of "Himalaya Hotspot" recognized by IUCN and very rich in biodiversity. No data is available regarding the similarities and differences in the vegetation structure and the role playing by plantation in the conservation of area's biodiversity.

Thus the present study is important enough to gather some information on plantations and natural vegetations of Terai-Duars belt, their comparative accounts and the actual impacts of plantation forests on the natural vegetation and the phyto-diversity as well as its role in conservation of biodiversity of the study area.

2.2. DIFFERENT ASPECTS OF THE WORK

The present study attempts to determine the influences and/or impacts of different type of plantation forests on plant diversity of the Terai-Duars belt of West Bengal which is represented by the natural vegetation of this area. This will be performed by comparing different type of plantation forests like mono-cultural plantation, mixed plantation, plantation of exotic species and that of native ones, with natural vegetation located at the same ecological zone. Here natural vegetation will be treated as standard land use pattern of this area. They will be compared on the basis of following aspect:

1. Vegetation structure and Phytosociology
2. Different diversity indices
3. Soil parameters
4. Above ground herbaceous biomass
5. NTFPs and Medicinal Plants
6. Traditional knowledge and ethnobotany
7. RET elements
8. Aggressive exotic weeds
9. Allelopathy

2.3. OBJECTIVES OF THE PRESENT WORK

Present dissertation aims to detect the impacts of plantation forests on natural vegetation that represents the existing phyto-diversity of this area along with the attempt to understand some others aspects of plantation and natural vegetation. The objectives of the study are outlined as follows:

- Determination of impact of plantation forests on natural vegetation
- Determination of vegetation structure, species richness, diversity pattern etc. of plantation and natural vegetation

- Recognition of Rare, Endemic and Threatened plants
- To analyze the changes in soil characteristics in plantation and compare with natural vegetation
- To invent and record the NTFP potential and ethnobotanical importance
- Survey and recording of ethnobotanical knowledge of the tribal people living in and adjoining area
- Determination of impact of aggressive exotic plant species over the local flora and vegetation
- Determination of allelopathic effects of plantation species on some important elements

Along with the above mentioned objectives regeneration status of trees, determination of soil seed bank, occurrences of exotic weeds and their impacts and detection of effect of plantation on above ground herbaceous biomass productivity will be measured.

It is expected that the properly collected and processed data will provide us further data on natural vegetation and on plantation forest for first time. It will help us to understand the impacts of plantation on plant diversity of this area along with the followings:

- The vegetation structure and species composition of the plantation as well as the natural forests will be clearly understood
- Further data on Non Timber Forest Produces (NTFPs) from both the natural vegetation and plantations will be recorded.
- Traditional Knowledge system related to natural forests and plantation if any will be revealed and ethnobotanically important plants of this area will be recoded.
- Occurrences of any Rare Endemic and Threatened plants in plantation and natural vegetation will be traced and their population structure will be known.
- Impacts of plantation on soil parameter, if any, could be identified
- Occurrences of important medicinal plants, their uses and status will be recorded

Not only that the study will help to understand the allelopathic effects (if any) of trees used in plantation on some important and selected plants, occurrences of exotic elements and their impacts, a comparative account of the above ground herbaceous

biomass production of natural forest and the plantation forests. All these parameters together will make our understanding of the impacts of plantation on biodiversity clear.

After acquiring all these information it will be easier to frame a proper strategy for conservation practice, redesigning the plantation, selection of species for plantation and improvement of habitat for RET plants.