CHAPTER I

GENERAL INTRODUCTION

PROTECTED AREA NETWORK

The biological diversity is defined as the variety of life forms, the ecological roles they perform and the genetic diversity they contain (Wilcox, 1984). India has a vast ecologically diverse condition supporting wide biological and physical components. The increasing biotic and abiotic pressure is resulting to the loss of habitats and existence of the biodiversity. This has made the concerned authorities to think for the conservation of natural resources. As a result the Wildlife (Protection) Act 1972 (amended in 1983, 1986 and 1991) provides for the protection of wild plants and animals to regulate hunting, trade and collection of specific forest products and thus realizing the importance of the protection, a plan “Protected Areas Network” came in existence. Broadly the Protected areas (PAs) are those areas of land or sea dedicated to the protection and maintenance of biological diversity and of natural and associated cultural resources and well managed through legal or others effective means (IUCN, 1994a). The main objectives of the Protected areas are to conserve plant and animal diversity along with the conservation of their natural habitats; to protect the genetic diversity within the species to sustain their evolutionary processes; to facilitates multidisciplinary research and monitoring, education and training for economic well-being of the local people and to ensure local people participation in the conservation of ecosystems and/or rejuvenation of the disturbed ecosystems. The concept of protected areas is solely the basis for proper natural resources management and the regeneration within a specified area where human interference is restricted.

The north-east India (Biogeographic Zone, 09) comprises of eight states viz., Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura
has two main biotic provinces, viz. Brahmaputra Valley (9A) and North-East Hills (9B), having a number of protected areas. The region lies between 22° N to 29.4° N latitude and 88° E to 97.4° E longitude covered by humid tropic shows the richest vegetation, both in number as well as density of species and exhibit maximum diversity. About 17% of the country’s total forest cover is met within the northeastern region. Out of about 156800 Km² of the area of northeastern region, 121944 km is embraced by dense forests. About 50% of the total number of species of vascular plants of India represents from this region. The region shares the maximum number of endemic species and other such species reported either from other parts of India or from neighboring countries like Tibet, China, Myanmar, Malaysia, etc. (Rao and Murty, 1990). The region is the primary centre of origin of angiosperm i.e. the cradle of flowering plants (Takhtajan, 1969) and moreover, the N. E. region is considered as the home of many wild relatives of cultivated crop plants (Kumar et al., 2003). Due to the high endemism, floristic richness and threats by environmental destruction, this region included in the list of so far identified 25 ‘Hotspots’ in the world (Myers et al., 2000). Recently, the existing 25-hotspots of the world have been updated to 34-hotspots with the list of 9 new hotspots in the great range of the Himalayas and the island nation of Japan (Holsinger, 2005).

To conserve nature and natural resources of this region PAs are playing a vital role. At present, North-East Region represents 4 Biosphere Reserves, 11 National Parks and 48 Wildlife Sanctuaries (Singh & Singh, 2002). Though, many tropical forests of the region are under great anthropogenic pressures and require management to maintain the overall biodiversity, productivity and sustainability (Kumar et al., 2006).

For the conservation strategies of plant biodiversity, the taxonomic studies on plant genetic resources in the smaller areas like Biosphere Reserves, National Parks, Wildlife Sanctuaries, Reserve forests and Districts are more valuable, because of their potentiality for the monitoring of populations, ecological process and the habitats. The documentation and
proper assessment of the diversity is needed in the respective areas for the conservation of biodiversity and maintaining natural ecosystems. Besides, for utilization of the forest resources on scientific ways, it is essential to know the economic as well as medicinal plant genetic resources of the areas taxonomically. Moreover, the local flora will be helpful for the revisionary work of state, regional and national flora of our country as well as forest officials for management of forest working plans.

Meghalaya is a part of Northeastern States lies between 24° 58’ N to 26° 07’N latitudes and 89° 48’E to 92° 51’ E longitudes, spread over an area of about 22,429 sq km, comprising of seven districts, viz., Jaintia Hills, Ri-Bhoi, East Khasi Hills, West Khasi Hills, East Garo Hills, West Garo Hills and South Garo Hills district and has an estimated forest cover of about 9496.4 sq km (Sarma, 2003). Its varied topography and high annual precipitation makes the state one of the richest biodiversity belt of the region. In the matter of establishment of protected areas Meghalaya is enriched with one biosphere reserve, viz. Nokrek Biosphere Reserve; one national park viz. Balpakram National Park and three Wildlife Sanctuaries viz. Nongkhyillem, Siju and Baghmara. So far the floristic study of all the Meghalaya districts and/or PAs is quite fragmentary in the point of view of biodiversity conservation strategy, though several botanical expedition where undertaken to various parts of the state, starting from Buchanan Hamilton (1820-1824) till to the recent works to be mentioned as Bor (1942), Raju (1964), Hajra (1974), Rao & Sanpru (1980), Balakrishnan (1981-83), Joseph (1982), Kumar et al. (1982), Baishya & Rao (1982), Rao & Haridasan (1982), Kumar & Rao (1983), Chauhan (1983), Haridasan & Rao (1984), Katakki (1986), Pandey et al. (2005), Kumar et al. (2006), Phukan & Sinha (2010), Sharma & Borthakur (2010), etc. and even after the publication of “Forest Flora of Meghalaya” (Haridasan and Rao, 1985-1987), which deals with about 1150 species of dicots (shrub and tree species) only, excluding monocots and herbaceous dicots except those which are of forestry
importance. However, some resourceful districts as well as forests (PAs, Sacred grooves and others) are yet to be explored thoroughly for the assessment of floristic components and plant genetic resources of potentially economic values as well as for the documentation of Rare, Endangered and Threaten plant species and the reasons to their threat for creating awareness amongst the people as a whole to take necessary measures for conservation of our seriously disturbed ecosystem and environment.

The South Garo Hills district is one of the highest forest coverage (64.11%) districts of Meghalaya, witness a dominant tropical climatic condition with high rainfall and humidity which supports the luxuriant growth of vegetation consisting of evergreen, semi-evergreen & deciduous forests (Sarma, 2003). This area is a part of Indo-Myanmar realm, has a wide range of Flora and Fauna with a mixture diversity of Asiatic and Indian Peninsular elements (Anonymous, 2002). The district has biologically significances due to having one national park viz. Balpakram and two wildlife sanctuaries viz. Siju and Baghmara. So far floristic study of South Garo Hills District in general and the Protected Areas in particular is concerned, a few sporadic works have been done by Rao & Sanpru (1980), Kumar et al. (1982), Kumar & Rao (1983), Haridasan & Rao (1984), Kumar et al. (2006), Sharma & Borthakur (2010), etc. Kumar and Rao (1983) studied on the flora of Balphakram Wildlife Sanctuary when its area was 220sq Kms. Later on, the Balphakram Wildlife Sanctuary was upgraded as Balphakram National Park vide Govt. Notification no.103/84/354 dated 15th February, 1986 by acquiring private Akhing land and at present the park is spread over an area of 352.002 Sq Km covering most part of Rongara Development Block of South Garo Hills District, Meghalaya. Further 142.055sq kms of Akhing lands are under acquisition, proceeding for which fund has been placed with the District Collector, South Garo Hills, Baghmara. Once this is completed the total area of the park will come to 494.055sq kms.
Hence, revised study is needed to assess the plant biodiversity of Balphakram National Park. Besides, no attempt has been made till date to assess the flora of Siju Wildlife Sanctuary as well as Baghmara Wildlife Sanctuary.

A large portion of the natural vegetation of this district including PAs have been suffering from deforestation for the traditional agricultural practices called *Jhum* cultivation, large scale indiscriminate extraction of timber, mining of coal, limestone, etc. and other developmental activities. Thus at present the existing flora of the district requires conservation and proper management. Some urgent measures are needed for identification and mapping of wild RET plant species and documentation of ethno-botanical as well as ethno-medicinal plant species for their conservation and sustainable utilization.

Keeping the above facts in mind, Siju Wildlife Sanctuary, South Garo Hills District of Meghalaya has been selected for survey and documentation of the Angiospermic flora with reference to the conservational strategies, taxonomic and economic utilization.

**CHOICE & IMPORTANCE OF THE STUDY AREA**

1. On 8\(^{th}\) May’ 1906, the study area was declared as ‘Reserve Forest’ by the then Lieutenant-Governor of East Bengal and Assam vide Notification No. 3920 F, and amended by Governor in council vide notification No. 2323 dated 26\(^{th}\) July 1932.

2. On 30\(^{th}\) March 1979, with an area of 5.18 sq. kms declared as ‘Wildlife Sanctuary’ vid Govt. notification No. MFG. 66/4.

3. Despite its small area, Siju WLS recorded 46 elephants and 3 tigers during the survey in 2001-02.

4. Siju WLS has been identified as elephant concentration zone by William A. C. and A. T. C. Johnsing in their report “A status survey of elephants (*Elephas maximus*), their habits and assessment of elephant-human conflict in Garo Hills, Meghalaya (WII Deradun-1996).
5. Thus Siju WLS, though of a small area, has a greater potential for Conservation of flora and fauna.

6. No comprehensive work has been done so far on the flora of the Siju WLS.

AIM AND OBJECTIVES OF THE STUDY

Considering the importance of Siju Wildlife Sanctuary, the present study is intended to carry out botanical exploration, inventorization and documentation of Angiospermic Flora with reference to taxonomic and economic utilization of the area.

The work is also proposed, to study the rare, endangered, threatened and endemic plant species available within the Sanctuary; to study the plant resources utilized by the local communities inhabit in the area and the anthropogenic factors causing depletion of the plant genetic resources in and around the Sanctuary.

STUDY AREA

Location and area

Siju Wildlife Sanctuary comes under South Garo Hills District which is situated in the south-west corner of Meghalaya and bounded by international border with Bangladesh in the South, West Garo Hills district in the West, East Garo Hills district in the north and West Khasi Hills district in the east (Anonymous 1996/ Map). The Sanctuary is situated in Siju, 40 Kms from Baghmara the district head quarter, 160 kms from Tura the head quarter of West Garo Hills district and 475 kms from Shillong via Tura and Baghmara. It lies between 25°25'N to 25°27'N latitudes and 90°30'E to 90°45'E longitude and spreads over an area of about 5.2 sq. kms.
Physiography and Drainage

Siju Wildlife Sanctuary is a flat plateau along the Simsang River ascending up into steep slopes with scattered pockets of limestone crevices. Altitude varies from 90-200 m above sea level. The southern and western boundary consists of rocky cliffs. In some parts the limestone formations are very beautiful and are enthralling creations of nature. River Simsang, the mightiest of the rivers in Garo Hills, makes its winding course bordering this Sanctuary. Perennial streams like Rongjak Stream, Narambak stream, Dabat stream are found inside the sanctuary area and are westward bounded till they meet the river Simsang. A smaller lake called Goerapatthal Lake is situated at the middle of this hilly sanctuary.
Geology and Soil

The entire part of the SWLS is characterized by deep red clayey soil with light covering of humus. Quartzite and limestone pebbles are found with the soil. There are few caves situated in and around SWLS like Matchakol cave, Siju-Bobakkol cave, exhibit limestone formations and give greater details about the changes in soil profile of the area over a period of time in the past.

Climate

The type of vegetation meet within an area depends on the climate, soil and biotic factors. Temperature, rainfall and relative humidity govern the climate. SWLS exhibits warm and high humid with dry cold season. The temperature ranges between 37°C and 6°C. Frost generally occur during the winter months of December and January. The weather of the sanctuary can be grouped in to three seasons viz. Rainy season (May to October), Dry season (March to April) and Winter season (November to February). During the onset of monsoon (May –June) there are always strong winds.

VEGETATION

The present study reveals that the vegetation of Siju Wildlife Sanctuary consists of the following forest types-

1. Tropical Semi-evergreen forest.
2. Tropical moist and dry deciduous forest.
3. Riparian forest.

Tropical Semi-evergreen forest

This type of forest occupies the western part of the sanctuary at some height on the eastern bank of Simsung River. The trees exhibit distinct zonation with dense herbaceous
undergrowth, especially during the rainy season. Some species like *Dillenia pentagyna*, *D. indica*, *Careya arborea*, which are deciduous in nature, are also found in this type of forest.

The top canopy composed of *Tetrameles nudiflora*, *D. pentagyna*, *D. indica*, *Toona ciliata*, *Dysoxylum binectariferum*, *Sapindus baccatum*, *Pterospermum acerifolium*, etc. While the second layer composed of *Carrallia bracheata*, *Saraca asoka*, *Pterospermum lancifolium*, *Streblus illicifolius*, *Ficus hirta*, *Ficus semicordata*, *Micromelum integerimum*, *Aphania rubra*, *Symplocos pyrifolia*, etc.

The shrub layer is composed of *Ardisia paniculata*, *Randia griffithii*, *Leea indica*, *Goniothalamus sesquipedalis*, *Licuala peltata*, *Munronia piñata*, *Phlogacanthus thyrsiflorus*, *Draceana spicata*, *Wallichia densiflora*, etc. along with perennial herbs like *Homalomena aromatica*, *Globba spathulata*, *Ariopsis potanthera*, *Costus speciosus*, *Alpinia malaccensis*, *Pollia subumbellata*, *Begonia spp.*, *Disporum contoniense*, *Floscopa scandens*, etc.

Amongst the climbers *Tetrastigma thomsonianum*, *Thunbergia grandiflora*, *Cayratia trifolia*, *Hodgsonia macrocarpa*, *Parabaena sagittata*, etc. are dominant. (Fig. 01)

**Tropical moist and dry deciduous forest**

This type of forest is characterized by seasonal shedding of leaves and profuse flowering. In Siju WLS the dominant species of this type of forest is *Shorea robusta* (Sal) which forms the pure belts. The common associate species are *Lagerstroemia parviflora*, *L. speciosa*, *Duabanga grandiflora*, *Macaranga denticulata*, *Ficus racemosa*, *F. hispida*, *Schima wallichii*, *Toona ciliata*, *Hibiscus macrophylla*, etc.

The forest under growth is composed of *Phlogacanthus thyrsiflorus*, *Glycosmis pentaphylla*, *Clerodendrum viscosum*, *Croton caudatus*, *Costus speciosus*, *Curcuma angustifolia*, *Solanum spp.*, *Curculigo orchioides*, *Urena lbata*, etc. The common climbers
met in the forest are *Smilax prolifera, Dioscorea bulbifera, D. pentaphylla, D. hipida.* etc. (Fig. 2).

**Riparian forest**

This type of forest occurs in the semi evergreen zones in the study site along the river bank of Simsang. The characteristic elements of this type of forest is *Dillenia indica, Duabanga grandiflora, Pterospermum acerifolium, Ficus semicordata, F. racemosa, Trewia nudiflora, Streblus asper, Toona ciliata, Trema orientalis,* etc.

The under growths consists of *Salix psilostigma, Rubus ellipticus, Crotolaria alata, Polygonum hidropiper, Heliotricum indicum, Phyllanthus roeperianus, Synedrella nodiflora, Cleome speciosa, Chenopodium ambrosiodes, Cyperus cyperoides,* etc. (Fig. 03).

**Grassland**

The grassland of the study site is not complex type. The rolling grass land can be seen in some patches along the Simsung River. The dominant grass and sedge species are *Saccharum spontaneum, Thysanolaena maxima, Imperata cylinderica, Cyperus diffusus, C. cyperoides, Cynodon dactylon,* *Elusine indica,* etc. Some dicot species like *Solanum torvum, S.indicum, S. khasianum, Urena lobata, Heliptropium indicum, Ipomea cymosa, Torenia diffusa, Ageratum conyzoides,* etc. and ground orchids like *Eulophia graminea* are also found in the grass lands. (Fig. 04).
Fig. 01. Tropical Semi-evergreen forest

Fig. 02. Tropical moist and dry deciduous forest
Fig. 03. Riparian forest

Fig. 04. Grassland