Chapter 2

HISTORICAL REVIEW

2. Historical Review

2.1 Floristic Study of Sikkim

The land locked state of India, the Sikkim encompasses the physiographic or geologic terrains, viz. the Tibetan Himalayan Zone, Higher Himalaya and Lower Himalaya etc. This terrain is greatly surging and is represented by drainage of well–marked, amalgamated and highly complex peculiarities in its development. It is included within the Biogeographic Zone of The Eastern Himalaya (Rodgers and Panwas, 1988; Rao, 1994).

Sikkim itself is gifted with abundant natural resources that can be grouped into biotic or abiotic, both of which can be renewable. The resources include ores and minerals (coal, dolomite/limestone, marble, base metals, quartz/quartzite, talc) but the large areas of this state still remains unexplored. Of course, their exhaustible nature calls for judicious as well as rational uses and conservation (Tashi, 1998). Biotic resources include agriculture crops, fodder and forests. The entire Himalayan region is endowed with natural flora and fauna, and is a natural paradise for nature lovers, conservationists, botanists, zoologists and environmentalists. It is documented that the diversity in the litho–techno land form units of Sikkim Himalaya is greater than any other sub–basins of the physiographic or geologic terrains within the Eastern Himalaya and that are being noted for its climate, geological and tectonic domains (Mukhopadhyay, 1978).

The upper part of the Tista basin represents Sikkim; the landscape owes much to the drainage network of the river Tista and all the major rivers are flowing towards the south. The higher elevation is noted in its north–western part and remains snow covered almost throughout the year. A typical glaciated topography represents the region which is further characterized by cirques, arctes, glacial troughs and morainic deposits (Choudhury, 1998).

The prime sources of water in the state of Sikkim are the snow covers and glaciers. Around 21% of the North Sikkim district is covered by ice and glaciers where 6% is accumulation zone, 9% is ablation area and 7% of the area is ice covered with moraines and this information has been chronicled by Jeyaram *et al*. (1998) using remote sensing techniques.

Due to the uniqueness in the geographical locations, relief and altitude Sikkim has its own climatic peculiarities. The most important single factor that determines rainfall at a place is the altitude of the place and it is nearly 58–76% of annual totals received during south–west monsoon followed by 16–30% in premonsoon season. The annual rainfall of Tista valley shows a steady increase from about 200 cm in the extreme outward (Bandopadhyay and Singh, 1998).

The economy of Sikkim is mainly based on agricultural and animal husbandry. The diversified agricultural products are mainly due to the climatologically variable scenarios. Apart

from these, some other occupational disciplines have also been encountered, viz., forest and vegetation formation, urban and industrial planning, aviation, navigation and tourism etc. With the advancement of rapid industrialization excessive diminution of fuel wood, timbers, fodders etc. on one hand and on the other, large scale use of chemical pesticides for greater production in agriculture, haphazard devastation of forest has undoubtedly brought in its rouse the problem of large scale environmental pollution as well as disproportion of ecological status.

Sikkim Himalaya is known to have 6 broad vegetation types i) tropical mixed deciduous to semi–evergreen forest, ii) subtropical broad–leaved hill forest, iii) temperate forest, iv) temperate to subalpine forest, v) subalpine forest and vi) alpine moorland forest (Rao and Panigrahi, 1961; Champion and Seth, 1968; Mani, 1974; Sahni, 1979, 1981; Mehra *et al*., 1985; Sudhakar *et al*., 1998; Singh and Singh, 2002).

Srivastava (1996) had considered the phytogeographical regions of Sikkim broadly into three distinct zones viz. tropical, temperate and alpine depending on the elevation and characteristics of the vegetation. The vegetation is again classified into low hill forest as of tropical to suptropical type upto 900 m; middle hill forests as subtropical forest type from 750–1500 m; upper hill forest as warm or wet temperate type from 1500–2700 m; Rhododendron–conifer zone as cold temperate or subalpine zone of 2700–3600 m; then the alpine scrub and grasslands from 3600–4300 m and above. Depending upon the altitude the forests vary from tropical types to alpine vegetation, each again having many subtypes (Rao, 1994).

The Eastern Himalaya including Sikkim is considered to be one of the major features of world relief with the tallest peaks, deep river gorges and rare flora (Rao, 1994). The vegetation is very rich and diverse abounding in spetacular flora of some of the tallest trees in India; tree ferns, orchids, *Primula*, *Hedychium*, *Rhododendron*, Rosaceous, Asteraceous members and blue poppies. The mountain slopes are covered by a variety of colourfull *Rhododendron* along with the habitat of many botanical curiosities and botanical varities. The lower ridges of this region are considered to be the sanctuaries of ancient flora, as evident by the presence of several primitive flowering plants. Takhtajan (1969) treats this region as the “Cradle of flowering Plants”. Sikkim is more evenly humid than the other regions of the Himalayas. The high humidity is conductive for the tree growth and therefore the timber line or the upper limit of the tree vegetation in this sector goes up to 4000 m as compared to 3800 m in the western Himalaya. Floristically this region also acts as a gateway for migration of flora from the adjacent countries like China, Japan, Nepal and Bhutan.

A variety of floristic elements have migrated from several near and far–off lands. Sino–Japanese elements viz. species of *Quercus, Schima* etc. are quite common in this region. The elements of Western China are *Aletris pauciflora, Anemone rupicola, A. vitifolia* and others. The European and Mediterranean elements are represented by the species of *Allium, Anemone, Artemisia, Gentiana, Ranunculus, Swertia* etc. American elements in Sikkim flora are exhibited generally by weeds of agricultural lands, open forest edges and waste places e.g. *Eupatorium adenophorum, E. odoratum, Bidens pilosa, B. biternata*, etc. (Srivastava, 1996).

The available knowledge of the vegetational types of Sikkim is mainly by workers like Griffith (1847), Hooker (1854, 1872–1897), Gammie (1894), Smith and Cave (1911), and recently by Rao (1964), Mehra and Bir (1964), Hara (1965, 1966, 1971), Sahni (1969, 1979), Srivastava (1993a, 1993b, 1996), Singh and Chauhan (1997, 1998). These above works have tried to present the vegetational types, essentially the floristic components.

Forests constitutes the major portion of the earth's renewable natural resources and they play a major role in maintaining and improving the ecological balance and also provide wide range of forest produce. But the forests are now suffering a serious net back during the last two decades due to tremendous pressure arising out of ever increasing demand for fuel wood, fodder and timber coupled with diversion of forest lands to non–forest uses in the name of developmental process. So, it is essential to implement the effective measure to control further onslaught by acquiring authentic and real time data base on existing forest stocks (Srivastava, 1996).

2.2 Floristic Study of Zemu and Lhonak Valley

It contains unique geomorphic features with some of the lofty pictureques and beautiful peaks of mights ranging from 5825 m to over 8598 m asl., glaciers, world high altitude lakes and is with one of the highest ecosystems. It covers varying eco-clines from temperate to arctic areas (1220-8598 m) and several major North-South and West-South trans-boundary watersheds. It is of a high religious significance. Mountains, lakes rocks and caves are sacred to the local people and are worshipped by them.

The floristic composition is very rich and also diverse, so it needs attention for conservation of this wealth. The richness and the diverse species composition rather species concentration are very high. The diversity and richness are corresponding to the altitude and climatic condition, as well as forest types. The floristic composition or the vegetational changes are distinct in the temperate evergreen forest to subalpine and alpine forest and finally the alpine scrub forest (Gut Lepcha, 1998).

The floristic pattern of Sikkim Himalaya including Zemu and Lhonak valley is much discussed by Hooker (1854, 1872–1897), Smith and Cave (1911), Hara (1965, 1966, 1971),

Srivastava (1993a, 1993b, 1996), Singh and Chauhan (1997, 1998), Maity (2005), Lucksom (2007). However, Floristic accounts of Zemu and Lhonak valley in particular are quite limited. Extensive study on the vegetation and flora of Zemu and Lhonak valley had been carried out by two famous botanists W. W. Smith and G. H. Cave from 1904 to 1911, about 105 years back (Smith and Cave, 1911). The floristic account of north Sikkim, in general, including this region had been provided by Hara (1965, 1966, 1971). Since then very few fragmentary works have been accomplished by Lucksom (2005), Nautiyal *et al*. (2009), Maity (2005), Maity and Maiti (2007, 2009). In recent years few new species/taxa have been described from this region (Lucksom, 2005). Several species have also been rediscovered in India after a long gap from this valley (Nautiyal *et al*., 2009). Report on endemic and threatened plants of Sikkim was provided by Maiti (2000), Maity (2005), Maity and Maiti (2009). However, the floristic diversity, status of endemic and threatened species of Zemu and Lhonak valley has not yet been thoroughly evaluated. Simultaneously, anthropogenic factors including national security purpose activities of the Indian Army increased day by day. As a result several species are known to be extinct in these valleys in recent years (Maiti, 2000; Nautiyal *et al*., 2009; Maity and Maiti, 2009). On the other hand few species has rediscovered in India after more than a century. *Pseudoyoungia simulatrix* (Babc.) D. Maity and Maiti was rediscovered from Lhonak valley after 105 years in the country (Dey and Maity, 2015b). Maity and Dey (2015) had rediscovered the population of both *Diplarche multiflora* Hook.*f*.&Thomson and *D. pauciflora* Hook.*f*.&Thomson of the family Ericaceae after more or less 100 years in India. Similarly in Lachen valley (Part of Zemu valley) the populations of *Youngia atripappa* (Babc.) Kilian (Asteraceae) were identified by Dey and Maity (2016a) and this is the rediscovery of this species after 105 years in the country.

Diversity, distribution and conservation aspects of some important species growing in this region have been discussed by Sharma and Pandit (2012). Loss of biodiversity due to soil erosion and land-slides were also reported by many workers (Maity *et al.*, 2007; Maity and Maiti, 2009a; Lepcha *et al.*, 2012; Pradhan *et al.*, 2012; Srivastava, 2012). A comprehensive survey of Zemu and Lhonak valley for the preparation of a Flora was thus undertaken to elucidate the rich floristic diversity of the region.