# CHAPTER – 1
# INTRODUCTION

## Introduction

Biodiversity forms the backbone of human sustenance. They are important for the human existence and have profound ethical and aesthetic implications. Biodiversity is part and parcel of our daily life and livelihood. It forms the major resources upon which community, nation and future generation depend. The gene, species and ecosystem represent a library of options for adapting to local and global changes. Human have been using biological resource in different aspects of daily life in the form of food, shelter, transportation etc. from time immemorial. It also has indirect benefit such as hydrological cycle, regulation of climate, floods, diseases, wastes, and water quality; cultural services like recreation, aesthetic value and spiritual fulfillment; supporting services such as soil formation, photosynthesis, and nutrient recycling. But the indiscriminate use of biological resources over a period of time has inflicted great damage to the environment and its resilience is taken for granted. Accelerated rate of loss of species, wild populations and natural habitats are causing growing concern regarding the survival of human society itself. Today, as Heywood has pointed, we are facing global biodiversity crisis. Prediction on the future trends on the global environment and their consequences has brought the environmental issues to top priority. There is an increasing realisation that biological resources are of fundamental importance to human society and that our influence on these systems is increasing exponentially (Heywood and Baste, 1995). The scientific studies are supported by social concept on the issue of biodiversity for their conservation and sustainable use.

Forest is one of the most important components of life support system that play an important role in maintaining environmental balance. Utilization of forest resources beyond their productive potential has resulted in their quantitative and qualitative depletion. The environmental malice produced by the technological society has changed or restricted the course of natural evolution process. "*We are directly under the influence of changes in the biosphere, which are generated by our own activities*" (Hargrove, 1994). The continuing loss of world's forests is leading to massive environmental disruption, including a historically unprecedented rate of species extinction and endangering the survival of mankind.

As the so called 'modern technology' advances, so does our ability to change our surrounding on the surface of earth. Today, the problems are extensive and occurring more rapidly than ever before. The ramifications of these changes have become more significant with the increase in world population, resulting in the decline of available per capita land. Environment is loosing its resilience where the intensity of human intervention is high. Planners and resource managers need a reliable mechanism to assess these consequences by detecting, monitoring and analysing land use/ land cover changes. However, land cover changes are related to land use changes, which, in turn, are associated with demographic and economic changes.

## 1.1 Biodiversity

The most prevalent usage of the term 'biodiversity' is as a synonym for the 'variety of life'. The term '*Biodiversity*' was first coined by Walter G. Rosen in 1986 at "National Forum on BioDiversity" held under the auspices of the US National Academy of Sciences and the Smithsonian Institute (Sarkar and Margules, 2002) and since has been a matter of discussion in almost all fora. They often emphasize the multiple dimension and levels at which this variety, diversity or heterogeneity can be observed (Williams *et al.,* 1994; Gaston, 1996) (Fig. 1.2). Scientific communities and social scientists have tried to define biodiversity to explain the essences of the terminology. Thus: '*Biological diversity refers to the variety and variability among living organisms and the ecological complexes in which they occur. Diversity can be defined as the number of different items and their relative frequency. For biological diversity, these items are organised at many levels, ranging from complete ecosystems to the chemical structures that are the molecular basis of heredity. Thus, the term encompasses different ecosystems, species, genes, and their relative abundance.*' [OTA, 1987]

'*Biodiversity is the variety of the world's organisms, including their genetic diversity and the assemblages they form. It is the blanket term for the natural biological wealth that undergirds human life and well-being. The breadth of the concept reflects the interrelatedness of genes, species and ecosystems*' [Reid and Miller, 1989].

"... *Biological diversity" encompasses all species of plants, animals and micro-organisms and the ecosystems and ecological processes of which they are parts. It is an umbrella term for the degree of nature's variety, including both the number and frequency of ecosystems, species, or genes in a given assemblage.*' [McNeely *et al.*, 1990]

'*Biodiversity is the total variety of life on earth. It includes all genes, species and ecosystems and the ecological processes of which they are part.*' [ICBP, 1992]

'*Biological diversity (=Biodiversity). Full range of variety and variability within and among living organisms, their associations and habitat-oriented ecological complexes. The term encompasses ecosystem, species, and landscape as well as intra-specific (genetic) levels of diversity.*' [Fiedler and Jain, 1992]

'*[Biodiversity] The variety of organisms considered at all levels, from genetic variants belonging to the same species through arrays of species to arrays of genera, families, and still higher taxonomic levels; includes the variety of ecosystems, which comprise both the communities of organisms within particular habitats and the physical conditions under which they live.*' [Wilson, 1992]

'*"Biological diversity" means the variability among living organisms from all sources including, inter alia terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems'* (Johnson, 1993).

Thus biodiversity refers to the quality, range or extent of differences between the biological entities in a given set. It signifies diversity of all life forms, which is characteristic of nature. This covers the total range of variation in and variability among systems and organisms, at regional, landscape, ecosystem and habitat level and at the organisational level down to species, populations and individuals and at populations and genes (Fig. 1.1). It also covers complex set of structural and functional relationships within and between these different levels of organisation. These different levels of diversity describe hierarchy from gene to ecosystem level through intermediary levels as mentioned above (Heywood and Baste, 1995; Ricklefs and Miller, 2000).

Biodiversity has been recognised into three components as genetic diversity, species diversity and ecosystem diversity (McAllister, 1991; Solbrig, 1991; Stuart and Adams, 1991; Groombridge, 1992; Heywood, 1994; Norse, 1994). These three organisational levels closely form hierarchically related level of biodiversity and action at any one level will impact on the other levels of hierarchies (Heywood and Baste, 1995). *Genetic diversity* refers to variation within and between populations of species. *Species diversity* is related to numbers and relative abundance of species and its higher taxa within a community. Species is generally regarded as the most natural unit around which to consider whole diversity. As species is the most prominent to focus on evolutionary mechanism; origin and extinction of species are the principal agent in governing biological diversity (Bora and Kumar, 2003; Duelli and Obrist, 2003). Diversity of higher taxa such as genera and family provides clues about the distinctiveness of various lineage of an organism (Ricklefs and Miller, 2000). *Ecological diversity* refers to the number of species in a given area, the ecological role these species play by interacting within and between the systems. It also covers the diversity of ecosystem in landscapes, of landscape in biomes and so forth. Noss (1990) distinguishes three interdependent sets of attributes of biodiversity viz., compositional levels (the identity and variety of elements), structural levels (the physical organization or pattern of elements) and functional levels (ecological and evolutionary processes).

Taxonomy serves as reference point in the study of biodiversity. Species is regarded as the fundamental unit of classification and most commonly used currency when referring to biodiversity. Thus, it provides a measure of the variety of life and captures a number of other facets of that variety (Gaston, 1996). Species as a measure provides a way of understanding how biodiversity changes over time and space, the drivers responsible for and consequences of such change for ecosystem services etc. (Sarukhán and Whyte, 2005). Species as basic unit and its higher hierarchy, serves as an effective quantifiable unit. They occur in wide array of ecological groupings as a distinct entity.

Because of the multidimensionality of biodiversity, a variety of surrogate measures are used. A diversity index such as species richness is one metric that addresses the problem of measuring biodiversity (Ricklefs and Miller, 2000; Sarkar, 2002; Sarkar and Margules, 2002). In recent years, distinct plant functional groups (habit types), species or other taxonbased measures of biodiversity provided valuable insight into the role of biodiversity. Comparisons of similarity/ dissimilarity of species composition between different habitats are increasingly gaining popularity in understanding the vegetation. Ecological and economic indicators are often used in monitoring and assessing biodiversity (Heywood and Watson, 1995).

Diversity at species level as well as in Ecosystem level comprises of three components viz. *alpha diversity* ($\alpha$), *beta diversity* ($\beta$) and *gamma diversity* ($\gamma$). Comparison of species diversity between different habitats/ ecosystems can give valuable insight into the ecological diversity and processes operating within a landscape.

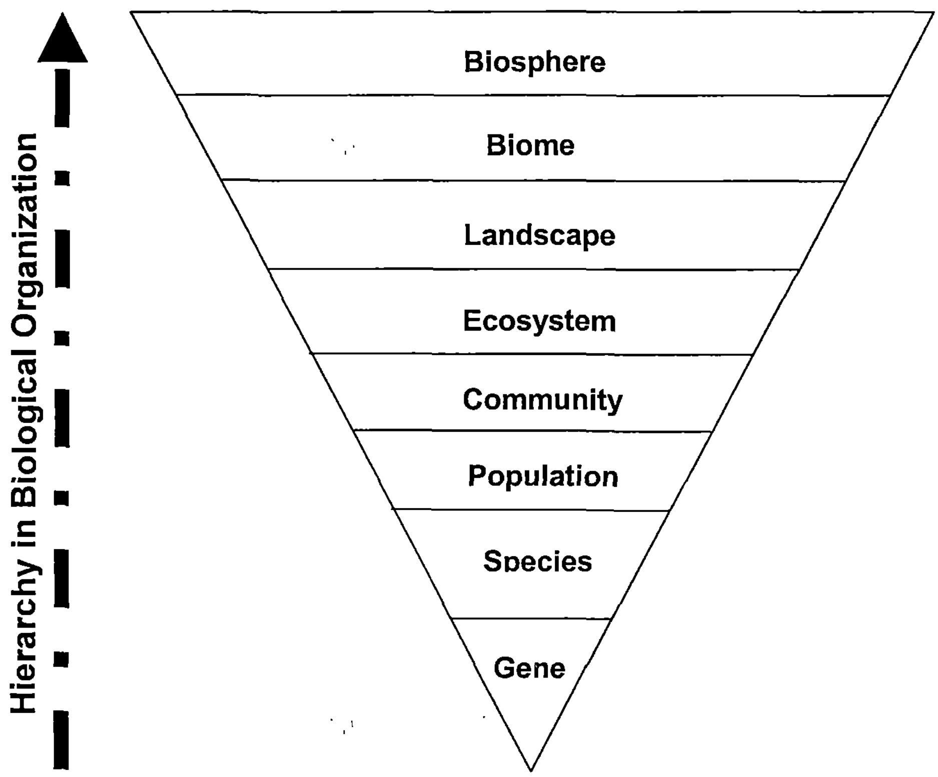


Fig. 1.1 Hierarchy in Biological Organisation (Source: IIRS, 2003).

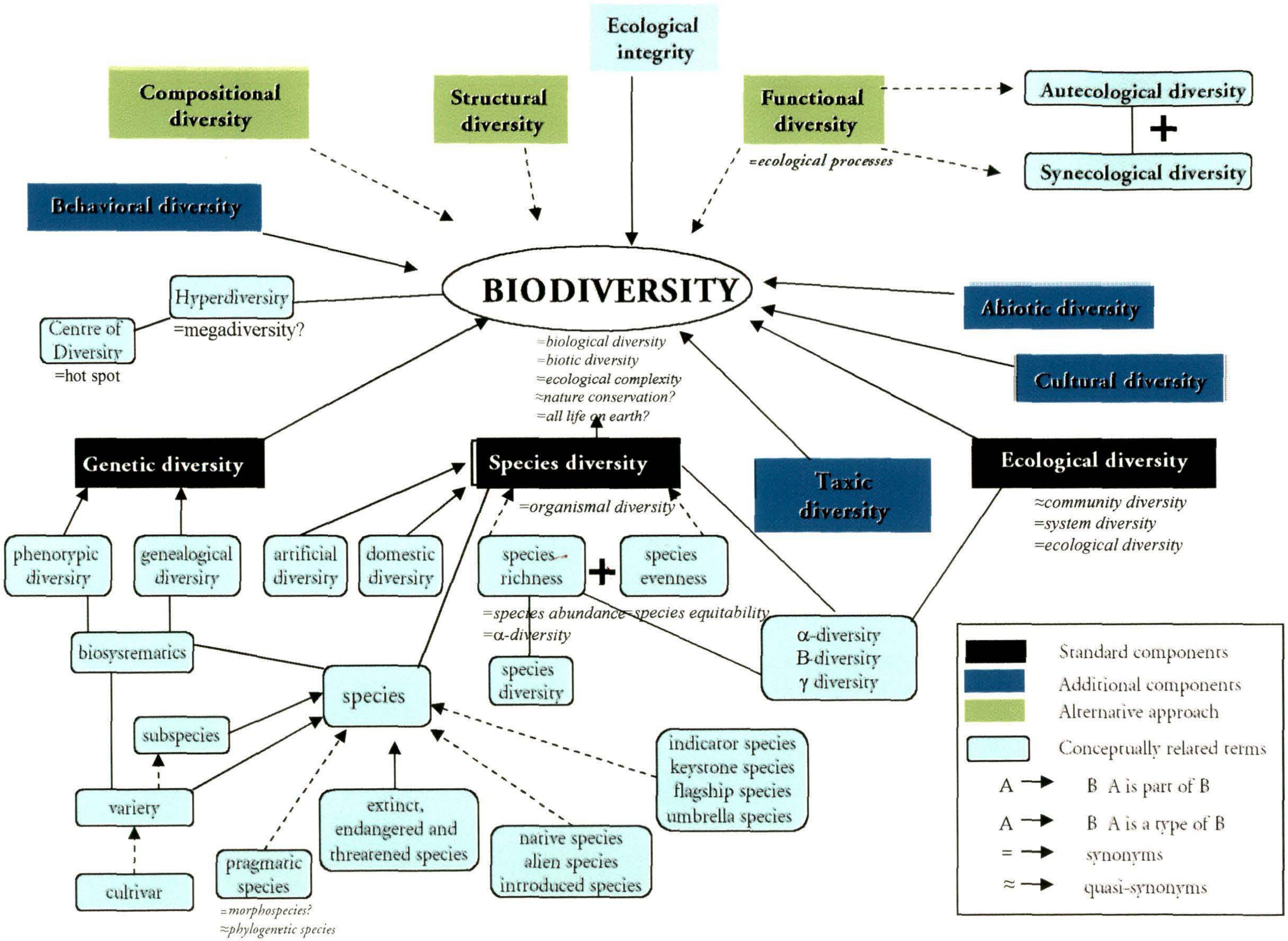


Fig 1.2 Domain tree of biodiversity (Source: Duelli & Obrist, 2003).

## 1.2 Threats to the biodiversity

The unprecedented rate in the increase of human population, which has crossed 5 billion mark world-wide is the major concern for the survival of biodiversity. Increase of human population and the extraction of natural resources are directly proportional. Vegetable products and land area are the resources under major demand. So, at every moment more and more pressures are being exerted to meet these demands to maintain the ever-growing population. As a consequence, large areas of forests are getting wiped out and many in the line to meet the same fate. The proximate causes of biodiversity loss and species extinction are thereby related to the loss of habitat and degradation affecting 91 per cent of all the threatened plants assessed globally. Habitat destruction is a pervasive threat affecting biodiversity rich areas and is causing extinctions in innumerable areas round the world. Accelerating anthropogenic change in climatic factors will magnify the effects of habitat destruction and fragmentation. Invasive alien species are a significant threat affecting 15 per cent of all threatened plants. They are adversely affecting the ecosystem in a massive way that has devastating impact on biodiversity. Direct exploitation of species for food, fodder, fuel, medicine, etc is a major threat to biodiversity world wide. The underlying causes of biodiversity loss, however, are poverty, macro-economic policies, international trade factors, policy failures, poor environmental law and its weak enforcement, unsustainable developmental projects and lack of local control over resources (Wood *et al.*, 2000). Population pressures and concomitant increases in the collection of firewood and fodder, and grazing in forests by local communities too take their toll on the forests, and consequently its biodiversity.

Mc Neely (1990) recognizes 12 countries that contribute 70 per cent of the world's flora as the mega-diversity countries (Groombridge, 1992), (Table 1.1). Myers (1988) brought in the concept of 'hotspot' based on the total endemics and the rate of natural habitat loss. Initially, 13 hotspots were recognized world wide. The figure was revised to add 12 more regions totaling 25 (Myers *et al.*, 2000). The International Union for Conservation of Nature and Natural Resources (IUCN) added 9 more regions to the already existing list. Now there are 34 Hotspots recognized world-wide (CI, 2005).

Hotspots are concentrations of unique biodiversity. They support a variety of threatened species and ecosystems and each deserves conservation attention. Hotspots have lost at least 70% of their original native vegetation. Humans heavily impact these areas, and most of them continue to suffer ongoing threats to the remaining parts of habitat. Hotspots can be evaluated in terms of their unique biodiversity, the amount of habitat lost and protected, and the number of endemic species in a given region. All of these factors are important in deciding where to allocate conservation resources.

IUCN in recent years has significantly modified the concept and included a precondition that the hotspots must hold at least 1500 endemic plant species and have lost 70 per cent of its original habitat extent. The updated analysis of Conservation International reveals the existence of 34 biodiversity hotspots (Fig. 1.3). These hotspots are estimated to have lost 86 per cent of the habitat and the intact remnant of the hotspot now only covers 2.3 per cent of the earth's land surface (CI, 2005). These hotspots hold astounding level of species endemism with an estimated 150,000 endemic plant species that accounts to 50 per cent of the world's total. Such high level of endemism represents evolutionary potential, ecological diversity and the range of options for future human use.

Table 1.1 Flowering Plant mega-diversity countries of World (Groombridge, 1992).

| **Sl. No.** | **Countries** | **Number of Flowering Plant species** |
|---|---|---|
| 1 | Brazil | 55,000 |
| 2 | Columbia | 35,000 |
| 3 | China | 30,000 |
| 4 | Mexico | 25,000 |
| 5 | South Africa | 23,000 |
| 6 | Soviet Union (former) | 22,000 |
| 7 | Indonesia | 20,000 |
| 8 | Venezuela | 20,000 |
| 9 | United States of America | 18,000 |
| 10 | Equador | 18,000 |
| 11 | India | 17,500 |
| 12 | Australia | 15,000 |

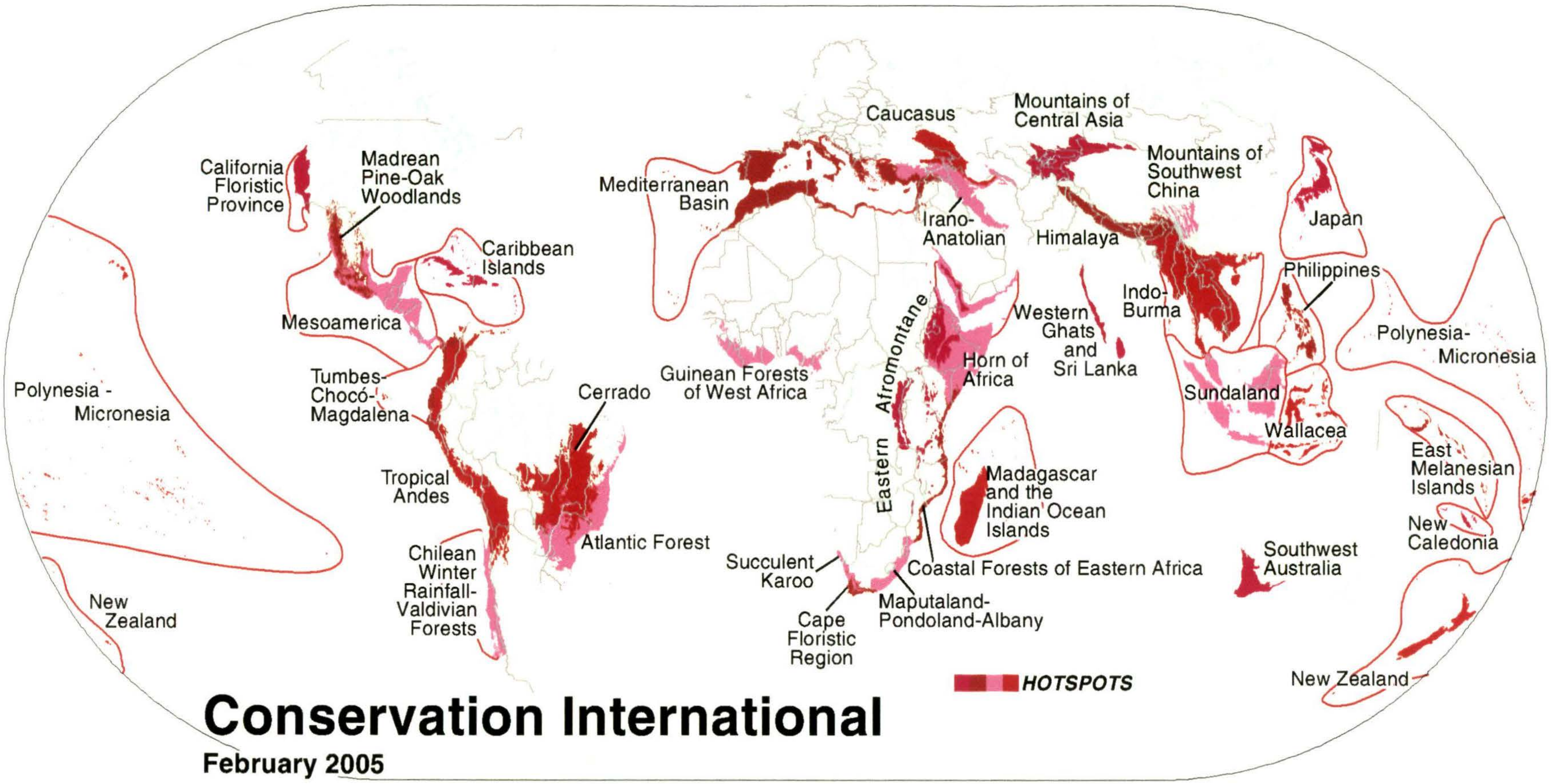


**Fig. 1.3 Map showing 34 Hotspots of Biodiversity of the world (Source: Conservation International, revised Feb. 2005)**

## 1.3 Plant diversity in India

India is extremely rich in biological diversity. Such richness is endowed to the vast variation in physiographic conditions. Different ecological habitats ranging from tropical rainforests, tropical deciduous forests, sub-tropical, temperate forests, alpine, mangrove to xerophytic vegetation to costal wetland has placed India in the league of mega-diversity countries of the world. India is reckoned for its three hotspots for biodiversity conservation out of the 34 recognised world wide viz. Himalayan, Western Ghats, and Indo-Burma (Fig. 1.3). In the revised classification of Conservation International (updated Feb, 2005), the Himalayan region including the Eastern Himalayas, which were part of the previous Indo-Burma hotspot have been created; and they are included amongst the top ten hotspots. (CI, 2005). Besides these, Nayar (1996) has recognized over 40 sites in different phyto-geographic zones of India to be known for their high endemism and genetic diversity.

About 1.7 million species have been described to date of the estimated 5 – 50 million of the world's biota (Groombridge and Jenkins, 2000). About seven per cent of the world's total land area is home to half of the world's species. India contributes significantly to this latitudinal biodiversity trend. Biogeographically, India represents two major realms – Palaeoarctic and Indo-Malayan and three biomes; the tropical humid forests, tropical dry/deciduous forests and hot desert and semi-desert areas (Udvardy, 1975). The distinctiveness of its flora in different geographical regions has led to the recognition of 10 phyto-geographic regions including the Trans-Himalayan, the Himalayan, the Indian desert, the semi-arid zone(s), the Western Ghats, the Deccan Peninsula, the Gangetic Plain, North-East India, and the islands and coasts (Rodgers and Panwar, 1988). India is one of the 12 centres of origin of cultivated plants (Vavilov, 1951).

Extreme climatic and altitudinal variations with much diversified ecological zones have contributed in the development of rich biological wealth in India. The floras and faunas from all ecological zones represent a unique blend of biodiversity. The Indian flora is influenced by its geographical history and various foreign elements from near and far off countries show their presence. All these factors have contributed to enriching the phyto-diversity. Sir J.D. Hooker (1904) a renowned taxonomist, also noted the richness of Indian flora in his book entitled "*A sketch of the Flora of British India*".

India with only 2.4% of the global geographic area harbours about 11% of the world biota. More than 45,000 plant species have been estimated to be present in India and the flowering plants alone at 17,500 species (Goombridge, 1992; Singh and Chowdhery, 2002). About 33% of the country's recorded flora are endemic to the country and are concentrated mainly in the North-East, Western Ghats, North-West Himalaya and the Andaman and Nicobar islands. The Indian flora has as many as ca 6,000 endemic species. Eastern Himalaya and North-East region alone with about 2,500 endemic species, Western Ghats and peninsular India with about 2,600 endemic species, North-Western Himalaya with 800 endemic species and Andaman and Nicobar Island with 200 endemic species are the areas where endemism is maximum (Chatterjee, 1939, 1962; Nayar, 1980). Besides, these different phyto-graphic zones India have over 40 sites having high endemism and genetic diversity (Nayar, 1996, Singh and Chowdhery, 2002). The country has an impressive record in agro-biodiversity with 167 crop species and their wild relatives. India is considered to be the centre of origin of 30,000 – 50,000 varieties of crop plants and ranks seventh in terms of contribution to world agriculture.

## 1.4 The Eastern Himalaya and its natural wealth

The Eastern Himalaya is well known for its rich biodiversity and is considered to be a treasure house of myriad of plant species. Phyto-geographic region encompassing the Eastern Himalaya comprise Eastern Nepal in the west to Arunachal Pradesh in the east passing through Darjiling, Sikkim and Bhutan, covering 850 km stretch (Gansser, 1964). The Himalayan landmass with congenial climate and extremely variable habitat has been the driving force for development of extremely rich vegetation. Pristine forest existed in undisturbed condition until the advent of settlers in this region. The region still has intact virgin forest at many places and contributes highest forest cover in India (FSI, 2003). Myers (1988) and Wilson (1992) have estimated the occurrence of about 9000 species of vascular plant from this region of which at least 39% are endemic. According to Rao and Murti (1990) this region exhibits the richest flora in the Indian phytochorion (Indian sub-continent). The Indian phytochorion is rich in relict species content (Sharma, 2000).

Nayar (1996) recognised Eastern Himalaya as one of the 3 mega-centres of endemic plant species, which harbours maximum number of endemics. Out of 5725 endemic species found in India, Eastern Himalayan region alone accounts 1808 endemic species. The snow capped Himalayan range in the north and great Gangatic plain in the south acted as geographic barriers for their migration to other parts. These species developed and evolved within their geographical distribution.

Takhtajan (1969) regarded Eastern Himalaya along with Western Burma and Yunan as the 'Cradle of Angiosperm' and is regarded as one of the important centres of speciation. Eastern Himalayas have been the meeting ground for diverse flora of the region since its origin (Shrestha, 1982; Das 1986, 1995, 2004). With great altitudinal variation and extremely wet condition, major vegetation types find its representation from tropical to temperate and alpine forests. Some of the plant taxa show a conspicuously rich representation with high degree of endemism for the region. Orchids, Rhododendrons, bamboos, *Impatiens* spp and *Hedychium* show high preponderance. Out of the ca 1200 species of orchids known from India 650 species are reported from the Eastern Himalaya, 70 out of 82 species of Rhododendron, 34 species of 60 species of Hedychium in the world and 58 species of 100 known species of bamboo in India are found in the Eastern Himalayan region. Eastern Himalayas, particularly Arunachal Pradesh has been, one of the regions with high speciation producing neoendemics. Singh and Panigrahi (2005) reported 48 new taxa of pteridophytes from a small area of Tirap and Cheenglang districts of Arunachal Pradesh and which is an indicator of the speciation and evolution of flora.

Recent years have witnessed the destruction of natural vegetation and dramatic environment changes, which would be disastrous to the existence of all living organisms. It is a well established fact that the Himalaya is the most severely degraded region of the world. The weak and unstable geology along with monsoonal type of pre humid climate and undulating terrain with diversified landforms are some of the natural processes helping soil degradation in Northeastern states. This has been aggravated due to population explosion of the region.

## 1.5 Plant diversity in the Darjiling Himalaya

The total geographic area of Darjiling district is 3149 $km^2$ of which 2196 $km^2$ (69.74%) is under forest cover (FSI 2001). The district is covering not only some area of plains but 2228.13 $km^2$ areas of hills covering an altitudinal range of 180 m to 3660 m. Extreme variability in altitude, physical condition, highly complex terrain and other abiotic factors have resulted in a wide array of micro-climatic variations in the habitat throughout the hills. Such heterogeneity of habitat has supported the development of wide diversity of vegetational communities not only along altitudinal gradient but also within same climatic zones (Bhujel, 1996; Bhujel and Das, 2002; Rai, 2001; Samanta and Das, 1998). The climatic variation and heterogeneity of habitat created conducive environment for development and evolution of species. Also, the process of speciation is still continuing in this part of the Himalayas (Das, 2004). The Darjiling Himalaya is a part of palaeo-arctic flora and Tibetan highland and wet evergreen flora of South-east Asia and shows a good assemblage of plant species and occupies significant place for evolution of its flora and for speciation. Das (2004) has reported 2137 species of flowering plants from Darjiling Himalaya. 21.26% of these are local and regional endemics. Flora of Darjiling also shows a significant number of exotic species, which were introduced and later naturalised in the wild. They together constitute 5.33% of the Darjiling flora (Das, 2002).

But the biological resources of Darjiling Himalaya are facing threats due to almost uncontrolled increase in anthropogenic activities leading to rapid habitat destruction and excessive fragmentation, spread of invasive exotic species etc. (Das, 1995, 2004).

### 1.5.1 Development of flora

After the rise of the Himalayas form the bottom of ancient sea Tethys through numerous upheavals in the Cretaceous resulted in land formation and river system. These geomorphic features have been the basis of ecology and biogeography of the whole Indian Region (Ahmedulla, 2000). During various period of upliftment, deposition of molassic sediments on the southern side of Himalayas prepared the ground for development of Himalayan flora. New climatic regime and the mountainous chain provided conducive environment for the evolution of flora and fauna, their migration through corridors afforded by the mountain chains and adaptive radiation of species in new ecological niche. Conducive climate and varying ecological niche provided ideal home for extension and expansion of other floristic belts and evolution of Himalayan taxa from the migrant floristic component (Sharma, 2000; Ahmedulla, 2000).

The Himalayan orogeny created conditions favourable for migration of temperate species from mainland Asia to this region (Lakhanpal, 1988). In the lower reaches of the

Himalayas warm and humid climate with high precipitation prevailed. Numerous tropical to semi-evergreen taxa from Southeast Asia migrated and developed (Awasthi, 1992; Sharma, 2000). Palynological evidence from various places of Himalayan region indicated sub-tropical to temperate vegetation in the upper region of the newly formed mountain ranges, which had later developed a cooler climate (Sharma, 2000; Sharma and Chauhan, 1988; Lukose, 1969; Nandi, 1975; Singh and Saxena, 1981). High degree of precipitation supported by the topography of the Himalayan mountain range provided a just condition for the development and evolution of East Himalayan flora.

The region has since been invaded by different groups of plants from numerous far and near localities, which have successfully established. The basic flora of the Eastern Himalayan region is an admixture of taxa arrived there from various countries. The great floristic diversity is largely attributed to its geographical and climatic factors that have helped not only the local flora to evolve but also plants species from surrounding places like China, Malaysia, Africa, Europe etc. to migrate and successfully and established in the region (Bhujel, 1996; Bhujel and Das, 2002; Das, 1995, 2002, 2004). A wide spectrum of climatic and ecological conditions within the region has supported the plants of diverse floristic affinities to survive, flourish and to take part in the process of local speciation.

### 1.5.2 Arrival of species

Endemic elements of a region throw light on the biogeography of an area that includes centres of speciation, areas of extinction, variance and adaptive evolution of the flora and fauna etc. The rise of the Himalayas on the northern frontier from the floor of the once existing Tethys Sea created the virgin land for the development of vegetation during Cretaceous. At the beginning, when Himalayas was just a hilly island, surrounded by Tethys water, it is difficult to imagine that there were numerous species growing in its juvenile vegetation. However, this situation was ideal for the creation of endemic elements and later on when Himalayas formed a high wall in the Northern frontier of the country that then created a situation, which has helped to develop a very high proportion of endemics for the entire Indian subcontinent (Ahmedullah, 2000).

However, the first vegetation on that island-like Himalayas might have been formed from the spores, seeds and propagules arrived there through air and water currents. These modes were not quite suitable and speedy for the migration of most of the land plants. So, the actual process of migration/ mass migration might have started when the Himalayas gradually developed land connection with existing land mass on its north and south, i.e. with Chinese and Indian land masses respectively. After this connection was established, long distance migration through land was initiated connecting two far away rich vegetations on east and west. So, plants from far away places like Australia, New Zealand, Tasmania, Malayan Archipelago, Myanmar etc on east and places in Europe, specially around Caspian Lake now travelled through the Himalayas arrived and settled in different corners, acclimatised, mixed and evolved new elements. Not only from east and west, plants from the southern Indian plains and from northern Sino-Japanese area also entered there gradually. So, subsequently, all these elements together formed the basic Himalayan vegetation.

### 1.5.3 Migration, Mixing and Evolution

India with its land connection on three sides, North, West and East have a good number of plants from the neighbouring countries those have migrated into the area and were established successfully. The distribution of high altitude Himalayan flora are described by Rau (1974) as one of migration of floras, survival of relicts, that evolved by intermixing of different flora and acclimatisation of species from the lower elevation. Genera like *Cyclosorus*, *Pseudocyclosorus*, *Pronepphrium*, *Trigonospora* and *Microlepia* have shown more vigour in Wet Evergreen Forest enjoying high rainfall, high temperatures and high humidity almost throughout the year (Singh and Panigrahi, 2005). Hundreds of taxa as far as from Africa, Sri Lanka, Australia and even Surinam, have their home in North-East India (Singh and Panigrahi, 2005).

With the gradual increase of the Himalayas, differentiation into the climatic zones was formed at various altitudes. Then, it was possible for species of different climatic zones to travel through their desired climatic belt. So, tropical plants migrated through the lowest warm belt and alpine species through the uppermost belt.

At the same time, the Himalayan range is effectively isolated from the northern Asia by the Tibetan plateau to the north and warmer alluvial plains to the south. Consequently the temperate and alpine vegetation of the Himalaya failed to migrate either to north or south.

This has caused the isolation of different species in one belt after their arrival. Now, plants arriving from widely isolated vegetation formed a mixed flora were, it was possible for different elements to exchange their genes and such mixing and exchanges had led to the evolution of numerous local species of plants. After the evolution of a species, that may also try to migrate in eastern or western direction though its own climatic belt or may also try for a vertical migration. However, there is every possibility that the species will remain there as an endemic plant at least for a considerable period.

Bhujel and Das (2002) and Das (2004) presented lists of endemic plants of Darjiling Hills in which, it is evident that the proportion of endemic species are more in upper tiers of vegetation where there is lesser chances of effective migration. And, all these modified and new elements rendered uniqueness to the flora of Darjiling Himalaya.