Chapter 1

GENERAL INTRODUCTION

1.1 Introduction

The great variety of life on earth has provided for man’s needs over thousands of years. This diversity of living creatures forms a support system which has been used by each civilization for its growth and development. Those that used this “bounty of nature” carefully and sustainably survived. Those that overused or misused it disintegrated. Plants provide food and other life-supporting commodities and are very important for survival of human beings and other organisms; besides, they protect our environment and maintain nature. The evidence of man’s dependency on plants for survival can be demonstrated by palaeo-ethnobotanical findings from prehistoric archaeological sites (Renfrew, 1963; Smith, 1987).

Tropical forests are major reservoir of plant diversity, as they harbour about 50% of the total plant species identified so far, with 12% area of the Earth (Whitmore, 1998). The forest inhabit a large number of trees, shrubs, herbs, climbers, epiphytes, wealth of non-timber forest products (NTFP) including medicinal and aromatic plants (MAP), and wild edible plants with high diversity are widely distributed in mountain forests and are valuable source of food and medicines for domestic and commercial purposes.

Although rural people utilized wild plants for their livelihood, the scientists have recently realized importance of such plants in rural economy. Since late 1980s studies on use of wild edible plants in tropical forests have been taken up vigorously (M.Plotkin and L. Famolare, 1992). The easy access to the resources and proximity to widely dispersed rural markets are key factors enabling people to generate income for NTFP (A.Wickramasinghe, Ruiz Perez and J.M.Blockhus, 1996). Income from NTFP seldom appears to account for a large share of a household’s total income, but it often is important in bridging seasonal or other cash flow gaps. In the area having high plant diversity, income from NTFP can be the main source of household income for rural communities. There has been a revival of interest in medicinal and wild food plants during the last few
decades among the ethnobotanists which is associated with an increasing desire for natural rather than synthetic medicine and wild or organically grown foods.

Wild fruits are an important source of food for mankind before the dawn of civilization and the domestication of the present day fruits. Cavemen in the forests also dependent on these fruits and passed on valuable information on the utility and choice of wild species of fruits from generation to generation. These wild fruits have played a very vital role in supplementing the diet of the people. Recently the use of wild fruit as a food has decreased due to improvement and hybridization in commercially cultivated fruit plants. On the other hand increase in urbanization and gradual explorations of forest and wasteland has led to the threat of the extinction of wild species. Few people in rural areas still use them extensively as a supplement to their basic food requirement. Some are preserved for use during periods of scarcity. They are sometimes sold in the urban market. Although, the popularity of these wild forms of fruits has declined it is essential to consider that special attention should be paid to them in order to maintain and improve this important source of food supply.

Science has attempted to classify and categorize the variability in nature for over a century. This has led to an understanding of its organization into communities of plants and animals. This information has helped in utilizing the earth’s biological wealth for the benefit of humanity and has been integral to the process of ‘development’. This includes better health care, better crops and the use of these life forms as raw material for industrial growth which has led to a higher standard of living for the developed world. However this has also produced the modern consumerist society, which has had a negative effect on the diversity of biological resources upon which it is based. The diversity of life on earth is so great that if we use it sustainably we can go on developing new products from biodiversity for many generations. This can only happen if we manage biodiversity as a precious resource and prevent the extinction of species.

The indigenous communities have played a vital role in the development and management of the environment through their traditional knowledge and practice. They use abundant plant biodiversity as fodder, fuel, food, medicine etc. without disturbing the local ecosystem. This knowledge system can be broadly classified into whole range folk traditions on the one hand and a codified classified traditional system on the other.
folk systems are ecosystem specific, very diverse, and very rich. Animism and naturalism are part of the cultural life and belief of the tribals of India. The faith of these indigenous people in nature creations has greatly helped in the preservation and protection of many natural ecosystems in India such as sacred groves (Gadgil and Vartak, 1976).

India has over 70 million tribals belonging to over 550 communities inhabiting in 5000 villages located in and around forest region of the country. These ethic groups live in different geographic locations. The group have in their possession enormous traditional knowledge on the utilization aspect and curative properties of medicinal plant resources. The documentation of traditional knowledge related to biodiversity began long ago as Greek, Egyptian, Indian and Native American scholars recorded folkways of classifying and using plants and animals. Indigenous communities have generally preserved their tradition art, culture and agriculture.

Existence of life is the most striking feature of the planet earth and the most important feature of life is its diversity (Tilman 2000). Diversity of life or biodiversity is defined as ‘variety and variability within and among living organisms and ecological complexes in which they occur. It encompasses ecosystem or community diversity, species diversity and genetic diversity. Biodiversity provides basic raw material for human survival including food, fibre, medicine, fuel and various other commodities (Singh 2002). Diversity at all organizational levels, ranging from genetic diversity within a population to the diversity of ecosystems at larger landscapes, contributes ultimately to global biodiversity. Species diversity has functional consequences, because the number and kind of species present at any place, determine the ecosystem processes (Srivastava and Vellend 2005). The biotic and abiotic factors play an important role in shaping the patterns of diversity and distribution among various living organisms.

Diversity is abundant at global level. 1.7 million Species of plants, animals and microorganisms have been classified, named and described. It is estimated that the world contains 5-10 million species and many of these have hundreds or even thousands of genetic types. Biological diversity is not based on a single mechanism of the ecosystem. It is based on the condition under which different mechanisms such as predation, competition, dispersal or evolutionary history work together. These mechanisms are possibly the most important in regulating the diversity particularly a group of organism. It
is important to identify the condition (i.e. spatial and temporal scale, evolutionary and geological history disturbance regime and resources availability) under which specific mechanisms are likely to leave the greatest influence on the diversity of specific sub-sets of organisms.

McNeely et al (1990) estimated that 70% of the world’s total flowering plant occurs in 12 countries (Mega biodiversity countries) and these have been called biodiversity existing in only 2.4% land area of the world (Khosoo, 1996). The country has 6,500 spp of algae, 14,500 spp of fungi, 2,021 spp of algae, 845 of liverworts, 1,980 of mosses, 1,200 of pteridophytes, 48 spp of gymnosperms and 17,500 of angiosperms (Sharma. et.al, 1997). In all, more than 53,000 plant spp and 1, 50,000 spp of other living organisms are known in India. The Himalayas has maximum degree of Endemism of sub-continent. Chatterjee (1940) has estimated 3,165 endemics for the entire Himalayas and it is certain that the eastern Himalayas have stronger endemism than the western Himalayas.

Diversity of life can be measured in several ways, viz., the number of species per unit area (species diversity), the number of groups (taxonomic diversity), the number of distinct body plans (morphological diversity), the number of feeding strategies (trophic diversity) and the number of genotypes (genetic diversity). While a number of useful indices have been developed to quantify species diversity (Ludwig and Reynolds 1988), species richness and evenness are probably the most frequently used measures of the species diversity of a region. Species diversity is also described in terms of the evolutionary relatedness of the species present in an area.

1.2 Himalayan Biodiversity

The Himalayas are endowed with rich diversity of flora and fauna. Phytogeographically and biogeographically northwest and central Himalayas are a distinct entity. Restricted distribution of various floristic components has resulted into evolution of several intraspecific variabilities thus enriching the genetic diversity. NW Himalayas is one of three mega centre of endemism in India with nearly 30% endemic flora.

Floristically Indian Himalayas is endowed with rich biodiversity and genetic resources. Out of nearly 18,000 flowering plant species occurring in Indian floristic region nearly 4, 000 species are endemic to Himalayas. An appreciable proportion of the floristic
components are used by inhabiting indigenous communities for variety of value added products such as food, fodder, dyes, fibre, gum, resins, rattan, bamboos, medicinal herbs etc. The study reveals that out of 1,000 species largely consumed as food plants in India, 400 species are found in Himalayan and N.E. region. The forest flora of Himalayas provides not only life support system to various indigenous communities in different ways but also maintains ecological security.

Indian region has over 1, 30,000 species of plants and animals which have been scientifically documented. The country has been referred to as one of the top mega diversity region of the globe. The richness of the biodiversity of the region is largely due to the occurrence of rich diversity of species, genetic and ecological variabilities in different biogeographically and bioclimatically defined zones. There are 16 different major forest groups, each of which is sub divided into as many as 250 sub types. Key areas of significance with as many as 681 protected areas (166 National parks and 515 wildlife Sanctuaries) spread over nearly 1, 50, 000 sq km. are at the reservoir of biodiversity and genetic resources.

The Himalayan region covers approximately 18% of India’s land surface and spread over an area of approximately 2,10,626 km$^2$. It is treated as a distinct biogeographic region and at a global scale it has been recognized as an important biodiversity hotspot. Within India, it is spread across (partially or fully) twelve states viz., Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, Arunachal Pradesh, Nagaland, Manipur, Mizorum, Tripura, Meghalaya, Assam and West Bengal (Singh 2006). Hooker (1906) divided the Indian Himalaya in to two floristic zones viz., Eastern and Western Himalaya. Rodgers & Panwar (1988) have divided Himalaya into six provinces viz., Ladakh Mountain, Tibetan plateau, North-West Himalaya, Western Himalaya, Central Himalaya and the Eastern Himalaya. The Western Himalaya comprises eastern part of Himachal Pradesh and Uttarakhand between rivers Sutlej and Sharada respectively. Also, in terms of biogeography, Rodgers and Panwar (1988) have treated North-Eastern hill states (Nagaland, Manipur, Mizoram, Tripura, Meghalaya) under different zone i.e., North-East India.

The Himalayan region harbours immense biological diversity as it encompasses tropical, subtropical, temperate, sub-alpine and alpine habitats. It is located at the
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confluence of two realms viz., Palaeartic and Oriental, and has a tremendous variation in
topography and climate. As a result, it exhibits a great deal of intermingling of floral and
faunal elements from the adjoining regions. It is home of over 8,000 species of flowering
plants and nearly 10,000 species of lower plants (Singh & Hajra 1996; Samant et al.
1998b). The largest families of flowering plants in the region are Orchidaceae (750
species), Asteraceae (734 species), Poaceae (520 species) and Fabaceae (507 species). The
Eastern Himalaya is also a center of diversity for several widely distributed plant taxa,
such as Rhododendron, Primula and Pedicularis (Sahni 1979).

About 29% (4000 species), which constitute about half of the higher plant species
listed from the Himalaya, are reported to be endemic (Jain and Sastry 1980). Brassicaceae
(87 species), Caryophyllaceae (57 species), Rubiaceae (170 species), Asteraceae (102
species), Acanthaceae (188 species), Euphorbiaceae (119 species) and Asclepiadaceae (73
species) are some of the important families constituting most of the endemic flora of the
Himalaya (Chatterjee 1940). However, no single family is endemic and generic endemism
is negligible. Nearly thirty species from Uttarakhand Himalaya have been listed under
various threat categories in the Indian Red Data Book (Nayar and Sastry 1987, 1988 and
1990) of which, 24 species are from high altitude (alpine) region. Recently Rawat et al.
(2001) listed 45 more rare and threatened species (excluding Red Data Book) which need
special attention for conservation.

The Himalayan region not only supports rich floral diversity but also known for
faunal, aesthetic, geo-hydrological and culture values and their crucial role in conservation
and sustainable development of the region. Most of the information available for this
region pertains to larger vertebrates, especially large mammals and birds that are easily
observed. Smaller mammals, reptiles, amphibians and fishes have been under sampled,
while the insects have been largely ignored, with the exception of a few studies of the
Himalayan Lepidoptera (e.g. Haribal 1992).

The human population of the Indian Himalaya is 2,018,000 which is 2.37% of the
total population of India (Premi, 1991). The majority of them live in the villages and
belong to diverse cultures and communities. Among the tribes Gaddi (Trans/Northwest
Himalaya), Bhotias, Rajees, Tharus, Buxus, Jaunsarees (West Himalaya), Bhutias, Lepchas
(Central Himalaya) and Chakma, Nagas: subtribes- Singpho, Tangsa, Hillmiri, Adis, Nishi,
Apatani, Monpas, Mijis, Akas, Knowas, Bongnis, Sulungs, Mishmis, Noctes, Wanchoes etc. (East Himalaya) are well known. The rich diversity of useful plants of Indian Himalaya has been used by different communities as food/edible, medicine, fodder, fuel, timber, and agriculture tools, religious and other purposes for a long time.

1.3 Value of Biodiversity

Environmental services from species and ecosystems are essential at global, regional and local levels. Production of oxygen, reducing carbon dioxide, maintaining the water cycle, protecting soil is important services. The world now acknowledges that the loss of biodiversity contributes to global climatic changes. Forests are the main mechanism for the conversion of carbon dioxide into carbon and oxygen. The loss of forest cover, coupled with the increasing release of carbon dioxide and other gases through industrialization contributes to the ‘greenhouse effect’. Global warming is melting ice caps, resulting in a rise in the sea level which will submerge the low lying areas in the world. It is causing major atmospheric changes, leading to increased temperatures, serious droughts in some areas and unexpected floods in other areas.

Biological diversity is also essential for preserving ecological processes, such as fixing and recycling of nutrients, soil formation, circulation and cleansing of air and water, global life support (plants absorb CO2, give out O2). Food, clothing, housing, energy, medicines, are all resources that are directly or indirectly linked to the biological variety present in the biosphere.

This is most obvious in the tribal communities who gather resources from the forest or fisher folk who catch fish in marine or freshwater ecosystems. For others, such as agricultural communities, biodiversity is used to grow their crops to suit the environment. Urban communities generally use the greatest amount of goods and services, which are all indirectly drawn from natural ecosystems. It has become obvious that the preservation of biological resources is essential for the well-being and the long-term survival of mankind. This diversity of living organisms which is present in the wilderness, as well as in our crops and livestock, plays a major role in human ‘development’. The preservation of ‘biodiversity’ is therefore integral to any strategy that aims at improving the quality of human life.
1.4 Consumptive use value:

The biodiversity held in the ecosystem provides forest dwellers with all their daily needs, food, building material, fodder, medicines and a variety of other products. They know the qualities and different uses of wood from different species of trees, and collect a large number of local fruits, roots and plant material that they use as food, construction material or medicines.

The Biodiversity of an area influences every aspect of the lives of people who inhabit it. Their living space and their livelihoods depend on the type of ecosystem. Even people living in urban areas are dependent on the ecological services provided by the wilderness in the PAs. We frequently don’t see this in everyday life as it is not necessarily overt. It is linked with every service that nature provides us. The quality of water we drink and use, the air we breathe, the soil on which our food grows are all influenced by a wide variety of living organisms both plants and animals and the ecosystem of which each species is linked with in nature. While it is well known that plant life removes carbon dioxide and releases the oxygen we breathe, it is less obvious that fungi, small soil invertebrates and even microbes are essential for plants to grow.

That a natural forest maintains the water in the river after the monsoon, or that the absence of ants could destroy life on earth, are to be appreciated to understand how we are completely dependent on the living ‘web of life’ on earth. The wilderness is an outcome of a long evolutionary process that has created an unimaginably large diversity of living species, their genetic differences and the various ecosystems on earth in which all living creatures live. This includes mankind as well. Think about this and we cannot but want to protect out earth’s unique biodiversity. We are highly dependent on these living resources.

1.5 Productive use value:

The biotechnologist uses bio rich areas to ‘prospect’ and search for potential genetic properties in plants or animals that can be used to develop better varieties of crops that are used in farming and plantation programs or to develop better livestock. To the pharmacist, biological diversity is the raw material from which new drugs can be identified from plant or animal products. To industrialists, biodiversity is a rich store-house from which to develop new products. For the agricultural scientist the biodiversity in the wild
relatives of crop plants is the basis for developing better crops. Genetic diversity enables scientists and farmers to develop better crops and domestic animals through careful breeding. Originally this was done by selecting or pollinating crops artificially to get a more productive or disease resistant strain. Today this is increasingly being done by genetic engineering, selecting genes from one plant and introducing them into another. New crop varieties (cultivars) are being developed using the genetic material found in wild relatives of crop plants through biotechnology.

Even today, species of plants and animals are being constantly discovered in the wild. Thus these wild species are the building blocks for the betterment of human life and their loss is a great economic loss to mankind. Among the known species, only a tiny fraction has been investigated for their value in terms of food, or their medicinal or industrial potential. Preservation of biodiversity has now become essential for industrial growth and economic development.

1.6 Threats to the Himalayan Biodiversity:

The Himalaya is the home of many unique and diverse human groups, living in the river valleys and mountain slopes which differ from each other in terms of language, culture, tradition, religion and patterns of resource use. They have been subsisting on the Himalayan natural resources for thousands of years. However, with better access to global market and demands of socio-economic development, local people’s dependence on natural resources has increased in recent years. Despite their apparent remoteness and inaccessibility, the Himalaya has not been spared from human-induced biodiversity loss. Access has encouraged immigration into mountain areas from outside in some regions, such as Arunachal Pradesh and in some areas of Uttarakhand and Nepal, people have migrated from the mountain to the terai-bhabar regions.

Compared to several bio geographic regions in the country, the conservation status in the mountain region has remained relatively better till recently owing to low human population and inaccessibility. Traditionally, the local communities have simple life-style which had helped in conservation of nature and natural resources. However, with the increase in human population the area is facing problems of degradation, fragmentation and loss of wildlife habitats. Besides, changes in the socio-economic conditions, demands of development and dwindling biomass resources have led to conflicts during recent times.
1.7 Mountain Protected Areas and Their Significance:

Convention on Biological Diversity (CBD) advocates the importance of promoting in situ conservation. As a result, international commitment to establish and strengthen protected areas (PAs) has received considerable attention from all the nations who were signatories to the convention. Therefore, the representative PAs and conservation sites are expected to possess maximum representation of biological diversity (in situ) within a biogeographical region (Margules et al. 1988). Hence, their adequate maintenance and monitoring has become important. India has also responded positively in this context. The network of legally designated PAs and other conservation sites in India comprise 613 units covering over 9.7% of the total geographical area (National Wildlife Data Base Cell 2008).

Protected areas have a mixed history of management in the Himalaya. One of the first PAs in the region is Corbett National Park, which was established way back in 1935. Most other PAs were established within past three to four decades. Today there are 88 PAs in the Indian Himalayan region including 17 National parks and 71 Wildlife Sanctuaries which cover 9.7% of the geographical area of the region. The establishment of several PAs in recent years in Himalaya as well as other parts of the country (Rodgers & Panwar 1988) raises hopes for the conservation of representative ecosystems and biota. However, a large number of PAs are suffering from lack of final notification and boundary verification. This has adversely affected the rational allocation of available resources. As a result, values for a few PAs are often over-emphasized while other PAs with relatively higher biodiversity remain unnoticed (Rawal and Dhar 2001). Secondly, the mountain’s PAs have a peculiar situation of resource distribution along an altitudinal gradient and high dependence of local people on the forest resources. Most of the PA boundaries are drawn based on the administrative convenience rather than ecological consideration. Several mountain animals e.g., Himalayan tahr (Hemitragus jemhalicus), Asiatic balck bear (Selenarctos thibetanus) and serow (Nemorhedus sumatraensis) descend to the lower altitudes during winter months and there are no adequate buffer zones between PAs and the villagers. Therefore, many PAs in the region are facing severe conservation problems arising due to human-wildlife conflicts and over-exploitation of resources.

Steady increase in human population, over exploitation of natural resources, extensive clearing of forests and grasslands for cultivation, widespread logging and
grazing have been responsible for the loss of diversity in the region. In the temperate and alpine forests, habitat loss is severe, with over 70% of the natural vegetation reported to have lost (Singh 1991). All the gentle and accessible meadows in the alpine and sub-alpine region have undergone extensive habitat degradation due to overgrazing, trampling and commercial harvest for medicinal and aromatic plants.

The state of Uttarakhand has twelve protected areas, six National Parks and six Wildlife Sanctuaries, initially identified for conservation of certain threatened species of mammals, these PAs are now playing greater role in the conservation of overall biodiversity. In addition, some of the Reserved Forests in less populated areas do give legal protection to the natural vegetation and fauna of the region. Several workers have stressed the need for the conservation of threatened flora in the region. Several seminars, symposia and conferences held from time to time also have been focusing on this subject. However, except for the declaration of a few PAs nothing has been achieved in terms of plant conservation and giving local people’s support in formation of joint conservation plans and sustainable harvest of non-timber forest produce (NTFP), medicinal plants, hill bamboos, grasses and other resources. These age old practices have been influencing the abundance of plant species in some way or other. Some of the practices such as over exploitation of phytoresources and ill-planned developmental activities have resulted in habitat fragmentation and depletion in the population of some important species.

1.8 Use of wild edible by local people in Uttarakhand

People living in the rural areas of the Himalayas utilize a variety of biological resources for livelihoods. Animal husbandry and marginal agriculture are the major source of their economy (C.P. Kala, 1998, 2005). Besides, they have distributed their production risks across the various subsistence activities such as pastoralism, handicraft, collection and sale of wild edibles and medicinal plants because of irregular agricultural practices and low agricultural yields (N.A. Farooquee and K.G. Saxena, 1996). In order to check the over-exploitation of useful plant species, they worship many ethnobotanical important species and their immediate environment. The geographical isolation has preserved the indigenous practises and knowledge of the Himalayan people related to their immediate environment, agricultural systems and use of forest resources (C.P. Kala, 2005). Since cultivated and wild edibles are integrated into the culture of local people, these edible
species reflect the history of such people, their traditional and the ecological and social systems (V. Reyes-Garcia et al., 2005; A.H. Ladio and M. Lozada, 2003).

The indigenous agricultural system in the Himalaya sustains a great diversity of crops and cultivars; of these many species are little known to the lowland societies (P.S. Ramakrishnan and K.G. Saxena, 1996). Shifting cultivation in the eastern Himalaya (locally known as jhum) and sedentary cultivation in the western Himalaya such as baranaja are the two major agricultural practices of traditional mixed cropping systems in the Indian Himalaya.

Within Uttarakhand state of Indian Himalaya, more than 100 varieties of paddy and 170 varieties of kidney beans along with many varieties of wheat, barley and pulses are known to cultivate in the baranaja system of agricultural practice (V. Zardhari, 2000). Of 675 wild edibles known in the Indian Himalaya, more than 340 wild edibles have been reported exclusively in Uttarakhand state (S.S. Samant, U. Dhar and R.S. Rawal, 2001). Despite such a rich diversity of wild edible and agricultural crops, meager information exits on the indigenous use patterns and socio economic status of these valuable resources (Arora and Pandey, 1996 and Bhatt, 2001). Historically, the wild edibles and indigenous crops have constituted a sustainable source for subsistence in most indigenous communities. However, at present the use of these plant species has reduced considerably resulting in the improvised diets of local people (V. Reyes-Garcia et al., 2005; A.H. Ladio and M. Lozada, 2003).

Although, the Himalaya sustains a great diversity of valuable natural resources, the local people may have preferences over the use and importance of both crops and wild edibles. The aspect is of utmost significance and interest on account of the local people’s knowledge and preferences over plant use. Unfortunately, no study exists on this important aspect of ethnobiology in Uttarakhand hills of Indian Himalaya. The preferred plant species, especially the wild edibles and indigenous crops, if documented properly, might be developed as a vital source of income generation as well as nutritional requirements.

The Garhwal Himalayas region is the land of many beautiful holy places, valleys and hills. Most of the people of the Garhwal live in the villages. The area forms the middle and outer part of the Himalaya, which is rich in natural resources. The forest resources play an important role in the livelihood of the local communities. The rich diversity of the area
is utilized by the local inhabitants in various forms as medicine, food, fodder, fuel, timber, agricultural implements, etc. Among these, wild edible plants play an important role in food supplement during scarcity for local inhabitants. Because of small land holdings and subsistence agriculture, the local people collect many wild plants for food.