Chapter 2

REVIEW OF LITERATURE

Analysis of the work done all over the world on survey among aboriginal societies and scrutiny of ethnobotanical literature has brought about the record of several hundred wild edible plants, which not only satisfy hunger of the people but have been proved nutritious too. It has been noticed that several tribal communities, who still live in undisturbed forest area possesses the traditional food habit. This probably emphasizes on nutritional status of wild edible plants, consumed by tribals as regular food or supplementary food.

Since the time immemorial, useful plants has been handled by human societies for medicinal and food purposes. Throughout history, wild edible plants have sustained human populations in each of the inhabited continents. Human consumption of wild edible has been documented from antiquity into the Common Era. Dietary use of wild fruits, nuts, seeds and leaves appear in numerous records from ancient Egypt (Darby et al., 1977), Greece (Athenaeus, 1927-1942), Rome (Apicius, 1958), India (Caraka, 1981), China (Simoons, 1991) and the Medieval era (Arano, 1976). Today, most human plant food is based on rather limited number of crops, but it is clear that in many parts of the world the use of wild plants is not negligible (Prescott-Allen, 1990; Scherrer et al. 2005; Bussmann et al. 2006; Bussman and Sharon, 2006; Kunwar et al., 2006; Cavendar, 2006; Pieroni et al., 2007)

A few world compilations on useful wild and cultivated plants has been done: (Tanaka, 1976; Upholf, 1986; Clute, 1943 and other regional work of this kind (Burkill, 1935 for Malaya; Povlov, 1942 for USSR; Edlins, 1951 for UK; Dalzell, 1937 for Tropical West Africa; Saunders, 1934 for USA and Canada) list such wild edible types. Besides, many compilations on country-wise basis exclusively for wild edible have also been published: for UK (Cameron, 1917). Hill, 1939; Medsger, 1943; Fernald and Kensy, 1943; Porsild, 1937; Harrington and Matsumura, 1967 (USA and Canada); for USSR
Many wild edible plants are great source of proteins and minerals, like seeds of certain indigenous species rich in protein are more or less equal to that of almonds (M.Oommachan and S.K. Masih, 1988). It was observed that during adverse conditions when food is not available due to drought, flood or other calamities, the tribes go for consuming wild edibles. The nutritional composition of a large number of plants used in emergency by various tribes in different parts of the world has been evaluated: (T. Kundaji and M.V.R. Rao, 1954; J. Barrau, 1959; W.H. Mai, B.Sahani, B.N. Majundar and M.D. Kehar, 1960; N. Rajaram and K. Janardranan, 1991; V. Vadivel and K. Janardhan, 2000; C.T. Lockeett, C.C. Calvert and L.E. Grivetti, 2000; B.M. Ogle, H.T.A. Dao, G. Mulokozi and L. Hambraeus, 2001; S. Rehman, M.P. Sharma and Sahai Suman, 2006). Sometimes the nutritional value of wild plants is higher than several known common vegetables and the fruits (Nordeide et al., 1996; Orech et al., 2007).

Millions of the people in many developing countries do not have enough food to meet their daily requirements and a further more people are deficient in one or more micronutrients (FAO, 2004) and same is truth about India, the country with second largest human population on this planet. In India most rural communities depend on the wild resources including wild edible plants to meet their food needs in periods of food crisis, as well as for additional food supplements. The diversity in wild plants species offers variety in family diet and contributes to household food security. Various publications provide detailed knowledge about the utilization of wild edible plants as food in specific location around the world. Studies conducted in Africa by Zemed (1997) showed that wild plants are essentials components of many African diets especially in period of seasonal food shortage. A study conducted by Wilson (1990) in Zimbabwe revealed that some poor household rely on wild fruits for their livelihood.

Pastor and Gustavo (2007) in their study conducted on wild edible found that 57 wild edible plants species are consumed, in 118 different ways as a source of food by the Chorote people of Argentina. Francesca and Francesca (2007) described the importance of 188 wild food plant species used popularly in the Sicily.
Javier et al. (2006) compiled and evaluated the ethnobotanical data available on the wild edible plants traditionally used for human consumption in Spain. A total of 419 wild plants species belonging to 67 families were discussed with respect to the part used, localisation, methods of consumption and harvesting time. This study showed that the reported wild edibles are the essential components of many Spanish diets especially during various traditional events and fairs. Victoria et al. (2006) described the cultural, practical and economic value of wild plants by applying a quantitative technique in the Bolivian Amazon and concluded that the wild plants play an important role in the daily life of local inhabitants.

An increasing interest in wild edible plants, even in modern societies, has led to many local ethnobotanical studies in Spain (Turner, 1975; Pieroni, 1999; Crowe, 2001; Bonet and Valles, 2002; Pieroni et al., 2002; Tardio, Pascual and Morales, 2002; Ogoye-Ndegwa and Aagaard-Hansen, 2003; Van den Eyden, 2003; Cerne, 1992; Ertug, 2004; Ogle et al., 2004). This topic is relevant at the moment, as biodiversity conservation and its links with nutrition and human health is the subject of a recent cross-cutting initiative by the Convention on Biological Diversity (CBD, 2005). In the recent studies (Heinrich et al., 2005) state that although only three crops provide around 50% of human energy intake, some 10,000 species are used, or have been used, for food.

A study conducted by Athena et al. (2006) on Paphos and Larnaca country side of Cyprus revealed that inhabitants of these areas subsisted primarily on pastoralism and agriculture and therefore preserves the traditional knowledge on wild edible plants. Ana and Mariana (2004) studied the pattern use and knowledge of wild edible plants in distinct ecological environments, from North western Patagonia and found that knowledge and consumption of wild edible plant follow a pattern according to ecological conditions of the gathering environments, as well as the cultural heritage of the Paineo people.

International Institute for Environment and Development (1995) noted in its report that many wild edibles are nutritionally rich and can supplement nutritional requirements, especially vitamins and micronutrients. Mandu et al (1999) found that nutritional analysis of some wild food plants demonstrates that in many cases the nutritional quality of wild plants is comparable and in some case even superior to domesticated varieties.
Tshwenyane and Mojeremane, 2004 have found the indigenous wild fruits trees of Botswana although mostly undomesticated play an important roles in people life especially for those who living in rural areas of Botswana and in addition to their roles as sources of food most of them are important sources of traditional beverages, oil, carbohydrates and proteins (FAO, 1982; Maghembe et al., 1994; Saka et al., 1994).

According to Etkin (1994) a problem often arises with species classified in the intergrading catagories, many wild species can occasionally be cultivated, and some cultivated plants that are not completely domesticated sometimes grow as feral species. Furthermore, following Harlan (1975), a range of morphological differentiation may be observed in the plant themselves ‘from form identical to wild races to fully domesticated races’. Thus, in many cases, it is almost impossible to distinguish wild forms of a certain species from cultivated ones. For all these reasons, some authors prefer to the terms ‘noncrop food' (Bonet and Valles, 2002) and ‘noncultivated' (Pieroni et al., 2005) plants to the more common term ‘wild’ food plants.

Wild sources of food, in general, remain particularly important for the poor and landless, and are especially important during times of famine or conflict when normal food supply mechanisms are disrupted and local or displaced have limited access to other kind of food. However, even under normal conditions, wild plants have played important role in complementing staple foods to provide balanced diets, which has been highlighted in recent studies (Dufor and Wilson (1994).

Many articles on the uses of wild edible plants have appeared since the first comprehensive publications dealing with this aspect and also on other economic plants (Watt, 1971- Repr. Ed.), but the main sources of such information remain scattered in various regional/floristic works (Duthie, 1960; Cooke, 1958; Gamble, 1957; Kanjilal et al., 1934-40; Prain, 1963; Haines, 1961; Santapau, 1958; Collect, 1971) dealing with the flora of India. Though attempts to synthesize information on economic plants of India have been made recently followed by a compilation of useful plants of India (Sunderaraj and Balasubramanyam, 1959; Maheshwari and Singh, 1965; Ambasta, 1986).

The Indian Himalayan Region (IHR) comprises of five biogeographic provinces i.e., Trans, North West, West, Central and East Himalaya and covers approximately an
area of 591 thousand Km square (Rodgers and Panwar, 1998). It has a large altitudinal range (300m - 8000m, amsl) and supports a unique flora and fauna. About 18,440 species of plants (23.3% species endemic), 1748 species of medicinal plants and 675 species of wild edibles have been reported from the IHR (Samant and Dhar, 1997).

At least 167 species of important agri-horticulture crops and about 320 species of their wild relatives belonging to 116 genera and 48 families are known to have been originated only in Himalayas (Arora and Nayar, 1994). Singh and Arora, 1978 identified about 1,000 species of wild edible plants of India. According to (Nayar, 1996) about 33% of Indian flowering plants or 5725 species and 147 genera are regarded as endemic to India, largely occurring in the three geographical divisions that in Himalayan, Peninsular and Andaman and Nicobar Island. Of the 5725 endemic species, 3471 species (20%) are found only in Indian Himalayan region.


Aghar Murugkar and Pal (2004) studied the nutritive value of wild edible fruits, berries, nuts, roots and spices consumed by the Khasi tribes of India. They concluded that the wild plants eaten by Khasi tribe are good source of nutrients and considering their low cost and easy availability, need to be popularized and recommended for commercial exploitation. Maikhuri (1991) studied the nutritional value of some lesser known wild food plants and their role in tribal nutrition. Sundriyal and Sundriyal, 2000, studied that wild edible plants form an important constituent of traditional diets in the Himalayas. In the Sikkim Himalaya a total of 190 species has been screened as edible species, out of which nearly 47 species come to the market.
Parvathi and Kumar (2002) studied the chemical composition and utilisation of the wild edible vegetable Athalakkai (*Momordica tuberosa*). Anjula *et al* (2007) discussed the collection of 373 species of wild relatives of crop plants representing 120 genera and 48 families under a special plant biodiversity project during 1999-2005 from India. The study revealed many aspects of the collected plants including distribution, life form, economic types, threats, concerns and future potentialities.

A study conducted by Debarata (2002) on the wild food plants of Midnapore; West Bengal showed that 31 wild edible plants species are frequently consumed during the flood and droughts. S.N. Patole and A.K. Jain (2002) enumerated nearly 45 plant species consumed by tribals and other rural people residing in Pachmarhi Bioshere Reserve of Madhya Pradesh.

Significant work in the field of ethnobotany has been done in past 3-4 decades in the Himalayan state of Jammu and Kashmir by many workers including Abrol and Chopra (1962), Gupta *et al* (1982), Kachroo and Nahvi (1976), Kiran *et al* (1999) and kaul *et al* (1987). Some botanical explorations and publications have emphasized on the diversity and value of wild edible plants (Vartak, 1959; Billore, 1969; Datar and Vartak, 1975; Kumbhojkar and Vartak, 1988; Jain, 1995; Arora *et al*., 1996; Maikhuri *et al*., 2000; Natrajan and Paulsen 2000; Kala, 2007; Bhattacharjee, 2008; khyade *et al*., 2003. The notable published work is by Patel (1968), Dhore and Joshi (1988), Bhoganonkar & Devarkar (1999) and Devarkar (2001) on floristics and ethnobotany of Melghat area. Their works make few passing references to mention whether the species is edible or otherwise used.

The rich diversity in edible flora since distant past has been used by the natives all over the Himalayas. Documented information on wild edible plants of India (Singh and Arora, 1978), points out that over 250 such species occur in the western Himalayas and over 300 species in eastern Himalayas which includes roots and tubers (37 species), green leaf types vegetables (121 species), edible flower buds (20species), edible fruits (258species). Of about 214 endangered species occurring in Himalayan ranges nearly 37 are exploited, being medicinal herbs of commercial value and need priority action for conservation (Arora and Nayar, 1984; Arora, 1987).
According to Kala, Dhyani and Sajwan (2006) over 200 species of Himalayan medicinal plants are consumed raw, roasted, boiled, fried, cooked, or they are used in the form of oil, spices, jam or pickles. The indigenous communities use some medicinal plant species as a source of fodder, timber as well as in many ethnobotanical purposes. Approximately 81 species of Himalayan wild edibles, 171 are used for the treatment of diseases.

Sundriyal and Sundriyal (2001) described the wild edible plants of Sikkim Himalaya. Again Sundriyal and Sundriyal (2004) studied the dietary use of wild edible plant resources in the Sikkim Himalaya and conclude that wild edible plants are greatly valued through the Himalayan region and serve as an important source of food for indigenous communities. Rakesh et al. (2004) found that wild edible are playing an important role in the rural development in the central Himalayan mountains of India. The study also concludes that many wild fruits are richer in nutritional composition than cultivated fruits of the region.

2.1 Floristic Studies: In context to Garhwal Himalayas

Garhwal Himalayas is geographical portion of newly born state of Uttarakhand. It is much known for its religiosity, pilgrimage and spiritual centres, fascinating folk culture and awe-inspiring mountainscape, as for its rich and diverse vegetation and wildlife from ancient times as mentioned in Skand Purana. In fact, wide diversity in meteorological, geological and ecological patterns has specially bestowed the region with unique and yet enormously diverse vegetational wealth aptly represented by sub-tropical to almost arctic type of flora. Further, the abrupt rise and fall in altitude coupled with specific local topography and micro-climatic conditions within different physiographic zones has led to the origin of some distinct plant associations (Rawat et al., 2001).

The Western Himalaya is one of the well researched ecoregions in the country with potential to build up further research opportunities. The baseline information exists on various parameters of environment, floral and faunal diversity. The forest ecosystems of this region are best documented in the country. Research on this aspect has proved that the temperate forests of this region have tropical characteristics with predominance of evergreens having one year leaf span. This uniqueness is of significant regional and global
importance. The region has a well recorded history of participatory management of natural resources. This is an added advantage, which would be useful for formulation of effective conservation plans (Zobel and Singh 1997).

Thus it can be argued that the Western Himalaya signifies one of the most important conservation areas in the country. In terms of overall diversity this region is as important as the Eastern Himalaya and hence should be designated as important hotspot of biodiversity in the country. The Western Himalaya has been explored and studied in terms of floristic, ecology, ethnobotany and more recently a few localities have been taken up for detailed forest cover mapping using Remote Sensing (RS) techniques and Geographical Information Systems (GIS) by several authors. A brief review of the existing literature on the above themes in Garhwal Himalaya is given below.

The history of floristic surveys in the region dates back to 1796 when Thomas Hardwicke (first European visitor in the region) entered the Garhwal Himalaya via Kotdwar on a political mission to the king of Garhwal at Srinagar. During his visit to Garhwal, he collected a large number of plants from Alaknanda Valley (Burkill, 1965). Hooker’s Flora of British India in seven volumes (1872-1897) included most of the plants collected by T. Hardwicke and others known from the area. However, the major interest on the plant collection started with Sir Richard Strachey and J.E. Winterbottom, two army officers who passed through hills of Kumaun and Garhwal to Tibet in 1846-1849. These two surveyors have made best collections in the Himalayan region of the state as well as in Tibet and adjoining parts of Garhwal. J.F. Duthie (1906) revised and supplemented Strachey and Winterbottom’s original catalogue, which is now known as Catalogue of the plants of Kumaun and of the adjacent portion of Garhwal and Tibet based in the collection made by Strachey and Winterbottom during the years 1846-1849. This valuable publication influenced other workers to write accounts of the plant wealth of other regions in the state. Among the important works on plant taxonomy of the region, Osmaston’s (1927) Forest Flora for Kumaon is notable, which includes the flora of adjoining portions of Garhwal and gives an account of the woody flora and described 816 species under 94 families.

Quite comprehensive information on the Garhwal flora has been included in Flora Indica by Hooker and Thomson (1855) and Flora of British India by Hooker (1872-1897).
Schlich and Brandis (1878-1881), while working at Forest School Dehradun (later Forest Research Institute) gave a new impetus to the botanical exploration in the North-West Himalaya including Garhwal. Some other early botanical exploration in the region was carried out by Keshwanand, 1897.


Many works have emphasized on the diversity and traditional uses of wild plants from Garhwal Himalayas (Gaur, 1977; Gaur and Semwal, 1983; Negi, 1988; Negi and Gaur, 1991, 1994; Samant and Dhar, 1997; Maikhuri et al., 2000; Kala, 2007; Dhyan et al., 2007). Rawat et al. (1994) reported some common wild fruits of Garhwal Himalayas, Saka et al. (1992) also conducted similar type of study. According to Arya (2003) about

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Diversity, Endemism and Economic Potential of Wild Edible Plants in Chopta-Mandal Forest and Vicinity of Garhwal Himalayas in Uttarakhand
202 economically important species (26 shrubs, 176 herbs including 3 pteridophytes) belonging to 51 genera and 128 species has been recorded from the alpine meadows in Garhwal Himalayas, in which about 66 species are used as wild edibles.

Rao (1994) reported that Garhwal Himalayas is extremely rich in plant life and abounds in genetic diversity of medicinal plants, timber plants, wild relative of crop plants and other economic forest product species, in addition also a potential source of nitrogen fixing legumes, essential oil yielding species and temperate crude drug plants. According to him Garhwal Himalayas has more than 3500 species of flowering plants most of which are in forest or alpine meadows.

After emergence of interdisciplinary science of Ethnobotany, which deals with the direct relationship of plants with man, the study of traditional knowledge on forest products evolved as new dimensions of forest world. Ethnobotanical studies in this region (Garhwal) have received attention of some workers; Gaur (1999) on Pauri Garhwal; Bist et al. (1988) on Arakot valley; Badoni (1990) on Pinswari community of Garhwal; Paliwal and Badoni (1990, 1998) on the hill tribes of Uttarkashi district; Bist and Badoni (1990) mention the role of family Araceae in folk life within Garhwal Himalaya; Gaur and Nautiyal (1993) and Negi and Gaur (1994) on fiber yielding species and wild edible plants of Garhwal Himalayas.

Badoni and Badoni (2001) have reported that there is urgency to be fast and in fact, stead fast in action with winning strategies to take care of plant genetic resources of the region to avert the meaning of ‘Himalayan blunder’ to the ‘blunder done about Himalaya’ in its newer sense. All this can only be achieved through interdisciplinary ‘thinking’ and ‘action’ in a most integrated way as achieving such Himalayan goal is too big a task for any individual discipline or institution. They concluded that the study of traditional knowledge and uses associated with the plants would be vitally important alongside exploitation of their morphological and physiological aspects and their correlation with the ecosystem.

Khoshoo (1992) reported that increasing human population, increasing demand of forest products for various domestic and commercial purposes in addition to the invasion by ubiquitous weeds and other natural calamities have tremendously affected the plant
diversity of the Garhwal Himalayas. Deterioration of natural habitats, exploitation of economic plants coupled with other developmental factors is further creating great stresses to biotic forms (Gaur et al., 1993). It has also been noticed that though economic plants (forest products) receive prime concern on account of their over exploitation, the other species facing difficulties in perpetuation due to ecological and phenological events are usually ignored when the rare and threatened taxa are listed, often leading to the unnoticed loss of species from the area.

Pande et al. (2001) have carried out studies on the plant diversity and vegetation analysis in moist temperate Himalayan forest. They have taken Chopta as one of their study sites. Naithani et al. (2009) have conducted systematic studies on the vascular plants of Mandal forest.

An extensive floristic survey has been conducted by (Rai, Adhikari and Rawat, 2011) in Kedarnath Wildlife Sanctuary. During the survey a total of 433 plant species belonging to 234 genera under 71 families were recorded along the sub-alpine and alpine region (2800-3680m amsl) of which there are 349 herbs, 42 shrubs, 18 grasses, 13 trees, 5 sedges and 6 climbers respectively. Among dicotyledonous families Asteraceae was the largest family represented by 42 species followed by Rosaceae (30 species), Ranunculaceae (25 species), Polygonaceae (24 species), Scrophulariaceae (17 species) and Apiaceae (17 species), whereas Orchidaceae (29 species), Poaceae (19 species) and Liliaceae (13 species) were the major families among the monocotyledons.

Bhat et al. (2013) conducted the study on ecological status and traditional knowledge of medicinal plants in Kedarnath Wildlife Sanctuary of Garhwal Himalaya.

### 2.2 Who use wild edible plants and why?

Wild edible plants (WEP) have been an important component for the survival of communities living in forested areas. It is as old as human existence. According to a report of the International Expert Consultation on forest products in Indonesia (FAO, 1995), about 80% of the population in the developing world depend on forest products for health and nutrition. In many countries wild edible plants are important export goods or products, but the national market is often more important. The total value of WEP on a per hectare
basis may be relatively minimal, but the percent of total consumption and income that comes from them may be quite high (Godoy et al., 2002).

The WEP are mostly used as a complement to the products gained from the agricultural practises. They can be very important in filling agricultural seasonal fluctuations, working as a safety net for food security. The products can provide a buffer in case of emergency or depression but also give a possibility to improve the household economy and security (Alcorn, 1990; FAO, 1995; Arnold and Ruiz Perez, 1995; Ros-Tonen, 2000; Arnold, 2001).

Poor household in particular depend on these WEP for their survival and in time of crisis, often because they have more access to the forest than other resources and that these activities do not demand any skills or capital threshold (FAO/NWFP7, 1995; Ros-Tonen, 2000). According to Arnold and Ruiz Perez (1995), the dependence of WEP is associated to cultural isolation, poor technology and economy and also poor access to markets. Household that are bit better off may use the products to complement and improve the household economy (Ogle, 1995). Wild plants are directly important for livelihood. They can also find some extra personal income by selling some products (FAO/NWFP7, 1995; Arnold, 2001).

Arnold (2001) argues that forest products are used because the people do not have any alternative, helping them cope with poverty but usually providing little opportunity to escape from poverty. It has been argued that where the poor do have high levels of reliance on forest product activities; this is likely to mean that they are facing persistent poverty (Arnold, 2001). The marketing of WEP from natural forest cannot solely be expected to improve the livelihoods of local people (Rosen-Tonen, 2000).

WEP are essential for many households’ nutrition in urban areas. The nutritional content was put together by FAO- the Food and Nutrition Division, 1994 in table:
Table 2.1 WEP (wild edible plants) and their nutritional contents.

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<tr>
<th>Type of Forest Food</th>
<th>Nutrient</th>
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<tbody>
<tr>
<td>1. Fruits and berries</td>
<td>Carbohydrates (fructose and soluble sugars), vitamins (especially C),</td>
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<tr>
<td></td>
<td>minerals (calcium, magnesium, potassium); some provide protein, fat</td>
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<td></td>
<td>or starch.</td>
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<tr>
<td>2. Nuts</td>
<td>Oils and carbohydrates</td>
</tr>
<tr>
<td>3. Young leaves, herbaceous plants</td>
<td>Vitamins (beta-carotene, C), calcium, iron</td>
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Source: FAO, 1995

The valuation of forest benefits, especially to the local population, is important to answer what benefits communities need to give up if biological resources to be conserved. In this context, it is also important to know that what factors determine the dependence on forest. Chopra, (1994) examined the role of WEP for the district MP, India. She discussed the user valuation of different WEP and evaluated the efficiency of marketing channels. The study shows that 40% of the household income was derived from collection and sale of various WEP.

There are few studies, which attempted examining the factors determining community dependence on forest (Gunatilake, 1998 and Hedge and Enters, 2000). They found that income from non-forestry activities emerge as the most significant variable that reduces forest dependence. The degree of dependence on the forest by local people/communities differs depending on their socio-economic status and legal right to collect forest products (Nambiar et al., 1985). Studies show that the dependence on WEP decline with higher income and a higher education level (Cavendish, 2001; Gavin, 2002).

When the household economy improves, the families prefer to buy what they perceive as better ‘quality’ substitutes rather than collecting products from the forest. The size of the family and the age of the family members also affect the intensity of forest product use. Families with older members also use the forest more, as the old traditions of forest products are still practiced and are not forgotten. A family consisting of many members uses more forest products because there are many people available and time can
be spent in the forest at the same time as other family members work on the fields (Gavin, 2002).

In recent years, some scientific research has suggested that WEP could be an important key to the management of forest resources in a sustainable way. The products can be sustainably harvested without causing damage to the ecosystem and are therefore seen as environmentally friendly (FAO, 1995; Arnold and Ruiz Perez, 1995).

Kristensen et al. (2004) discuss the meaning of sustainable use; sustainable use means the use of biological resources in way and at a rate that it does not lead to long term decline of biodiversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations. When addressing WEP, extraction, harvest and exploitation are used as synonyms.

Forest management for WEP can improve socioeconomic situation of the local people as they can collect and sell products on the market and like this gain some income instead of practicing intense agricultural activities. In this way, they may help to maintain the forests intact for future generations. A concept formed for these ideas is ‘conservation through commercialization’ (Arnold and Ruiz Perez, 2001). Agenda 21, approved by the UN conference on Environment and Development (1992) has recognised the role of WEP in sustainable forest management (FAO, 1995). The sustainable extraction of forest products in combination with minor agricultural activities could prevent further deforestation and misuse of forests and at the same time improve the livelihood and standards of the people.

2.3 Assessment of Anthropogenic Pressures on Natural Vegetation

Anthropogenic pressures affect (directly and indirectly) the land use, structure and composition of the atmosphere and the climate, which directly affect biodiversity. Quercus forests represent the climax evergreen vegetation between 1,000-2800m in Western and Central Himalaya (Troup 1921, Champion and Seth 1968a, b). But in the middle elevations i.e., 1,000 to 2,200m, the increasing over exploitation has pushed these forests to the verge of extinction in many localities (Singh 1981). Anthropogenic activities in the forms of commercial harvesting, over exploitation of oak forests for fodder, fuel and uncontrolled grazing have been cited as the most important reasons for forest degradation (Singh and
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Singh 1992). Increased resource dependency on surrounding forests has affected the status of highly preferred species (Awasthi et al. 2003) and its repeated lopping and poor regeneration not only checks the growth of the trees but also affects the available biomass and favors the growth of thorny and unpalatable species (Upeti et al. 1985). Concentration of human settlements closer to oak forests, lopping and felling, and occasional fire spreading from pine forests have reduced the area under oak forests (Champion and Seth 1968). The replacement of oak by pine has become a common and ever increasing phenomenon (Singh et al. 1984). However, a small quantity of fuel is also obtained from the trees growing in agroforestry systems, but these sources are also continuously being degraded (Shah 1982, Khoshoo 1987). Continual biomass extraction i.e., fuel and fodder is considered a major reason for depletion of oak forests (Singh 1998). Few studies reveal that grazing is essential to maintain species diversity (Naithani et al. 1992, Negi et al. 1993) mainly in Himalayan region. Some other studies (Joss et al. 1986, Ram et al. 1989) have shown that intermediate level of grazing maintain species diversity.

The state forest departments have been preparing working plans for various Forest Divisions in India, based on the detailed inventory of growing stock and species composition. For Kedarnath WLS (KWLS) Negi (1982) prepared a working plan based on a detailed vegetation map using aerial photographs taken in September 1977 and field surveys conducted in 1980. A preliminary community based study on the Banj oak (Quercus leucotrichophora) forests of the region studied by Rawat et al. (1999) and revealed that the old growth forests had low shrub diversity when compared to disturbed forests. But the status of other major phytoresources, anthropogenic pressure and understory vegetation has not been studied. Bisht (2005) conducted ecological studies on some important medicinal herbs and their multiplication through rhizome as well as seed.

Perusal of literature reveals that floristic studies have been given more importance in Garhwal Himalaya. Ecology of vegetation particularly the structure and composition of forests is negligible in the Kedarnath WLS. Studies on the structure and composition of forests are not only essential for the proper conservation and management but also form an important resource base for the local people. The sustainability of watersheds, livelihood of the villagers and the status of native flora and fauna depends on the structure, composition and productivity of these forests. Therefore, the present study was undertaken...
to study the structure and composition of these highly fragile but ecologically diverse forests, which have faced several phases of exploitation since the past few decades.

In spite of over 35 years of its existence there are still major research gaps in the Kedarnath WLS. Broad areas where information is still lacking include structure and composition of vegetation, status of major phytoresources, anthropogenic pressure assessment and landscape characterization at large scales.

**Objectives of the Study**

• Survey and collection of wild edible plants consumed regularly; also those used in times of scarcity and sold in the market for livelihood.

• Documentation of knowledge, frequency of use and availability status of wild edible plants and their market potential.

• Dependency of local people on the wild edible plants for economic potential.