Thematic Report on Mountain Ecosystems

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Please provide summary information on the process by which this report has been prepared, including information on the types of stakeholders who have been actively involved in its preparation and on material which was used as a basis for the report

The Ministry of Environment and Forests is implementing the National Biodiversity Strategy and Action Plan Project (NBSAP) for last two and a half years for developing action plans at microlevel for conservation of sustainable use of biological diversity in the country. NBSAP is India's biggest ever development and planning exercise in scale and participation. The NBSAP project entered its final stage and will be completed by December 2002. Under the NBSAP project, 74 action plans are being prepared for : (i) 14 themes relating to biodiversity at the national level; (ii) for all states and union territories; (iii) for 10 inter state eco-regions, and (iv) 17 sub-state local sites.

Under the NBSAP action plans for the ecoregions namely Western Himalayas, North East Himalayas, Western Ghats, Eastern Ghats and Aravalis exclusively deal with the mountain ranges of the country. Action plans are prepared using a highly participatory approach involving all stakeholders. Apart from seeking inputs from experts and learned individuals, brainstorming sessions, discussions and public meetings were also organized for preparing the action plan. The present report is based upon the strategies and action plans prepared for the eco regions of Western Ghats, Eastern Ghats, Aravallis, Himalayas and North East Himalayas.

The other sources used for preparing the draft report include Planning Commission especially draft approach paper to the Tenth Five Year Plan, Annual Report for 2001 and the Report of the Working Group on Hill Areas Development Programme and Western Ghats developed programme for the Tenth Five Year Plan and Chapter 12 of the Agenda 21 : An Assessment prepared in connection with the WSSD.

Mountain Ecosystems

1. What is the relative priority your country accords to the conservation and sustainable use of biological diversity in mountain ecosystems?							
a) High	✓	b) Medium		c) Low			
2. How does your country assess the resources available for conservation and sustainable use of biological diversity in mountain ecosystems, both domestic and international?							
a) Good		b) Adequate	✓	c) Limiting		d) Severely limiting	

3. Has your country requested financial assistance from GEF for funding the activities for conservation and sustainable use of biological diversity in mountain ecosystems?	
a) no	✓
b) yes, please provide details	

Assessment, Identification and Monitoring

4. Has your country undertaken any assessment of direct and underlying causes of degradation and loss of biological diversity of mountain ecosystems?	
a) no (please specify the reasons)	
b) yes, please specify major threats and their relative importance, as well as gaps	✓ (See box)
c) If yes, please specify the measures your country has taken to control the causes of loss of mountain biodiversity	
5. Has your country identified taxonomic needs for conservation and sustainable use of biological diversity of mountain ecosystems?	
a) no, (please specify the reasons)	
b) yes, please specify	✓
6. Has your country made any assessment of the vulnerability or fragility of the mountains in your country?	
a) no, please specify the reasons	
b) yes, please specify the results and observed impacts on mountain biodiversity	✓
7. Has your country made any assessment important for conservation of biological diversity of mountain ecosystems at the genetic, species and ecosystem levels? (You may wish to use the Annex I of the Convention for categories of biodiversity important for conservation)	
a) no, please specify the reasons	
b) yes, some assessments or monitoring undertaken (please specify)	✓
c) yes, comprehensive assessments or monitoring programmes undertaken (please specify where results can be found, and opportunities and obstacles, if any)	

Regulatory and Information System and Action Plan

8. Has your country developed regulations, policies and programs for conservation and sustainable use of biological diversity in mountain ecosystems?	
a) no	
b) yes, please specify sectors	✓
9. Has your country applied the ecosystem approach (adopted at COP 5) in the conservation and sustainable use of biological diversity in mountain ecosystems?	
a) no	
b) yes, please provide some cases or examples	✓
10. Does your national biodiversity strategy and action plan cover mountain biological diversity?	
a) no, please specify why	
b) yes, please give some information on the strategy and plan, in particular on mountain biodiversity	✓
11. Has your country disseminated the relevant information concerning management practices, plans and programmes for conservation and sustainable use of components of biological diversity in mountain ecosystems?	
a) no	
b) yes, please provide details where information can be retrieved concerning management practices, plans and programmes	✓

Cooperation

12. Has your country undertaken any collaboration with other Parties for conservation and sustainable use of biological diversity in mountain ecosystems at the regional level or within a range of mountains?	
a) no	
b) yes, please specify the objectives of this collaboration and achievements	✓
13. Has your country signed or ratified any regional or international treaty concerning mountains?	
a) no	✓
b) yes, please specify which treaty and provide as much as possible a report on the progress in the implementation of the treaties, including any major constraints in the implementation of the treaties	

Relevant thematic areas and cross-cutting issues

14. Has your country taken account of mountain ecosystems while implementing thematic programmes of work on agricultural; inland waters; forest; and dry and sub-humid lands biological diversity?	
a) no	
b) yes – but in only one or two thematic programmes of work	✓
c) yes, included in all programmes of work	
d) if yes, please specify details	
15. Has your country taken any measures to ensure that the tourism in mountains is sustainable?	
a) no , please specify why	
b) yes, but in early stages of development (please specify the reasons)	✓
c) in advanced stages of development (please specify the reasons)	
d) relatively comprehensive measures being implemented (please specify the reasons)	
16. Has your country taken any measures to protect the traditional knowledge, innovations and practices of indigenous and local communities for conservation and sustainable use of biological diversity in mountain ecosystems?	
a) no	
b) not relevant	
c) yes, but in early stages of policy or programme development	✓
d) yes, in advanced stages of development	
e) some programmes being implemented	
f) comprehensive programmes being implemented	
17. Has your country developed any programmes for the protection of natural and cultural heritages in the mountains?	
a) no	
b) yes, please provide some information in the programmes	✓
18. Has your country established protected areas in mountains?	
a) no	
b) yes, please specify the percentage of mountains under protected areas out of total mountain areas in your country	✓
19. Has your country undertaken any activities to celebrate the International Year of Mountains and Eco-tourism?	
a) no	
b) yes, please specify	✓

MOUNTAINS – INDIA'S THEMATIC REPORT

1. INTRODUCTION

India is one of the 12 mega biodiversity countries of the world. By virtue of supporting and sustaining rich biological, ethnic and landscape diversity, it manifests biodiversity at all levels and spatial scales. It represents an example of conglomeration of diverse bioclimates influenced by neighbouring areas (particularly Mediterranean), the unique location, peninsular land mass, Gangetic plains and the crown of complex chain of mountain systems – the Himalaya.

The major mountain ranges in India are the Himalaya and the Western Ghats. The Himalaya stretches to about 3,000 km. in length and varies between 220-300 km. in width. The Indian Himalayan region is spread over the states of Jammu & Kashmir, Himachal Pradesh, Sikkim, Arunachal Pradesh, Nagaland, Manipur, Mizoram, Tripura, Meghalaya, and a part of Assam, along with eight districts of Uttar Pradesh and one district of West Bengal. Biogeographically, the Indian Himalayan region falls under Boreal Zone which has two sub-zones, viz. Sino-Siberian and Sino-Himalayan. The area can be divided into four distinct zones longitudinally (i) the Siwalik (900 – 1500 m), (ii) the outer Himalaya (1500 – 3500 m), (iii) the middle or lesser Himalaya (3600 – 4600 m), and (iv) the Greater Himalaya (above 4,600 m). This complex mountain system consists of narrow and deep valleys, glaciers and fertile terrain.

Five climatic zones can be delineated in the Himalayan region based on geographic and physiographic factors. These are : the warm Tropical, warm Sub-Tropical, cool Temperate, Alpine and Arctic. While these are only broad zonations, there are many local variations in the climate due to precipitation, temperature, wind patterns, humidity etc. The type and nature of soils also vary vastly in the Himalayan region from deep alluvial to the thin and bare soils of the high mountains. The nature of the soil depends upon the rocks, the prevailing climatic conditions, topography and vegetation.

The Himalaya is a reservoir of over 5,000 glaciers with permanent ice and snow from which rivers like the Indus, the Ganges and the Brahmaputra emanate.

Himalaya is endowed with richness and representativeness in biodiversity. North-eastern Himalayan region is one of the 25 hotspots of the world. Concurrent with changes in topography altitude, precipitation, temperature, geological formations, soil conditions and resultant diversity of bioclimates, this region is rich in forestry, horticulture, agriculture and fauna.

The Western Ghats forms a nearly unbroken relief parallel to the Western Coast of Indian Peninsula for almost 1600 km with a latitudinal range of more than 10 degree. The Western Ghats also are among the 25 biodiversity hot spots globally identified.

They extend from the mount of the river Tapti (21^oN) to the South of India (about 8^oN), the only gap in the chain being Palghat Gap. Based on the topography and geology the Western Ghats can be divided into three major regions:

North Western Ghats (Surat to Goa) : This region consists of the most homogeneous part of the Ghats, hugging the coast for almost 600 km. It corresponds to the western edge of the vast plateau formed by the basaltic outpourings of the Deccan trap. Its elevation is generally between 700 to 1000 m and with some peaks like Kalusbai (1646 m) and Mahabaleshwar (1438 m).

Central Western Ghats (Goa to Nilgiris) : The basaltic outpourings cease to the north of Goa. However, towards the south, the Ghats consists of complex pre-Cambrian rocks. In the central Western Ghats, the rocks are predominantly of Dharwar system (among the olded in India) and Peninsular Gneiss. The elevation generally range between 600 m to 1000 m upto $13^o30'N$ (except Kodachadri : 1343m). From Kudremuch (1892 m) and upto Wynad, the edge of the plateau is very often higher than 1000 m and with several peaks ranging between 1713 and 2339 m. Towards $11^o30'$ N, the Western Ghats rise abruptly in the Nilgiris horst which is made of Charnokites rock. The Nilgiri Mountains constitute an elevated plateau attaining a maximum height of 2637 m at Dodda Betta.

Southern Western Ghats (South of the Palghat Gap) : This region is mostly formed of Charnokites rocks. The Ghats which are interrupted by a gap (Palghat Gap) of about 30 km wide reappear abruptly as the Anamalai-Palani block whose high plateau attain a height of 2695m in the Anaimudi peak, the highest point in South India. They end almost at the southern tip of India, about 20 km before Kanniyakumari. This last part, which is very rugged, culminates at 1869m in the Agastyamalai peak.

The climate of the Western Ghats shows rainfall gradients and a temperature gradient. The western slopes of the Ghats are subject to direct influence of rain-bearing winds of the south-west monsoon. They receive 2000 to 7500mm of rainfall. These totals decay rapid to<800 mm towards the east within a distance of 7 to 60 km. The second, north-south gradient is determined by the time of arrival and withdrawal of the monsoon. The temperature gradient is mostly related to increase in altitude. However, it is not uniform throughout the Ghats because of variability in the relief from south to north. In general, the mean temperature of the coldest month varies from 23^oC at sea level to 12^oC at 2300m.

2. BIODIVERSITY RICHNESS

A.ECOSYSTEM DIVERSITY

(a) Himalayas

Considering wide structural and functional differences, the natural terrestrial ecosystems of the region can broadly be divided into two categories: (i) Grasslands, and (ii) Woodlands.

Grassland Ecosystems : The true (natural) grasslands in the Himalaya are represented by alpine meadows. These systems are widely distributed between tree line and snow line habitas from extremely dry trans/ north west Himalaya to humid east Himalaya. In view of the variations in structure / composition of biodiversity elements in response to climatic conditions two types of alpine grassland ecosystems are discernible in the Himalaya. These are Alpine Arid Pastures and Alpine Moist Pastures.

Woodland Ecosystems : In view of difference in structure and composition, two broad woodland categories are recognized in the Himalaya (i) the forests, and (ii) the scrubs. Under both the categories various sub-categories, in different parts of the Himalaya, are recognizable. The Himalayan woodlands can be grouped into following 5 broad zones: (i) tropical / sub tropical forests; (ii) warm temperature; (iii) temperate; (iv) sub-alpine / cool temperate; (v) alpine. The terminology largely follows the one used for northern temperate types.

(b) Western Ghats

In the Western Ghats, based on the ecological factors and floristic composition, four major forests and 23 floristic types have been distinguished. These types are closely correlated with the temperature and rainfall regimes. Wet evergreen, dry evergreen, moist deciduous and dry deciduous forests are clearly distinguished by the mean annual rainfall, whereas low, medium and high elevation wet evergreen types are distinguished by the decrease in minimum temperature with increasing altitude. In addition to forests, high altitude grasslands are another unique ecosystem in the Western Ghats.

B. SPECIES DIVERSITY

a. Himalayas

Floral Diversity :

The floristic studies in the Himalaya, dating back to the last quarter of the eighteenth century, have so far revealed over 18,500 taxa, belonging to various groups of plants. The Himalayan region with only 18% of India's land area, houses 81.4% of the country's stock of gymnosperms, 47% of angiosperms, 59.5% of lichens, 58.7% of pteridophytes, 43.9% of bryophytes and 53.07% of fungi found in India. These figures are approximate, because much of the Eastern Himalaya is yet unexplored. Currently recorded taxa from Sikkim and Arunachal Pradesh in the Eastern Himalaya number approximately 5500 and 5000 respectively, while the Western Himalaya, which is comparatively better explored, is known to harbour about 5000 taxa.

Orchidaceae with over 750 genera represents the largest angiosperm family in the Himalaya. However, the relative composition of this family differs in Western and Eastern flanks. In the Eastern Himalaya, the Orchid family is the largest, with 60% species, whereas in the Western Himalaya, Asteraceae with 540 species is the largest family follwed by Poaceae with 439 species and Fabaceae with 362 species. Carex with more than a 100 species and infraspecific categories, is the largest genus in the Himalaya. *Rhododendron* with 96 species and infra-specific categories, and *Astragalus* with 90 species, are the largest genera in the Eastern and Western Himalaya, respectively.

One of the 18 monotypic orchid genera of India, 13 are found in the Himalayan region. Some other plants with pronounced diversity in the Eastern Himalaya include the *Hedychium* (Zingiberaceae) with 18 species out of 35 Indian species, and numerous species of bamboos. The Eastern Himalaya is a cradle of numerous primitive angiosperms, such as *Manglietia* and *Euptelea* belonging to family Magnoliaceae and *Tetracentron* belonging to family Tetracentraceae. The most primitive among vascular plants, *Psilotum nudum*, occurs in Kullu, Garhwal and Kumaun regins. *Christollea himalayensis*, recorded from Mt. Camet (6300 amsl), is the flowering plant occurring at the highest altitude. *Arceuthobium minutissimum*, the small angiosperm, grows on Himalayan conifers. Apart from these botanical curios, the Himalayan region has a rich diversity of medicinal and aromatic plants.

Faunal diversity

The insects occupy a dominating position among the fauna elements recorded in the Himalaya both in terms of diversity and adaptiveness. The insect fauna of eastern part exhibits significant influence of Indo-Chinese and Indo-Malayan elements. Extreme adaptability has been recorded in members of the genus *Capnia* (Stoneflies) in the Mt. Everest massif (at 5000 m), grasshoppers of the genes *Hynonomus* (at 4880 m) and the Collembolan insects (*Hypogastrura, Isotoma and Proisotoma* species) at ca. 6800m.

Besides insects, rich species diversity is noted in other invertebrate groups viz. Annelids, Spiders, Molluscs etc. The vertebrate faunal elements in the Himalaya provide a high degree of diversity at species level. Of the 372 mammalian species recorded in the country so far, as many as 241 species are recorded in the Himalaya; and of the 1,228 bird species as many as 528 species and subspecies occur in the region. Likewise 149 species of reptiles, 74 species of amphibians and 218 species of fishes have been documented from the Himalaya which amount to 35%, 36% and 17% of known species in the country respectively.

Endangered Species

Of the total 622 endangered plants listed so far in the Red Data Books, 137 occur in the Himalayan region. Of the 137 species, 71 species are from the Eastern Himalaya, 56 species from the Western Himalaya, and ten species are common to both these regions. In addition to the listed threatened taxa, literature and herbaria surveys suggest that about 450 plant species of the region are endangered. *Panax pseudo-ginseng, Calamus inermis, Phoenix rupicola, Dioscorea deltoidea, Coptis teeta, Picrorhija Kurrca*, etc. and a large number of orchids are some such examples.

As many as 29 mammalian species listed under Schedule 1 of the Indian Wildlife Protection Act occur in the Himalaya. These include Slow Loris, Hoolock Gibbon, Brown Bear, Asiatic Black Bear, Spotted Linsang, Binturong, Marbled Cat, Goldern Cat, Himalayan Lynx, Clouded Leopard, Snow Leopard, Kiang, Pygmy Hog, Must Deer, Tibetan Gazelle, Tibetan Antelope, Hangul, Rhinoceros, Wild Buffalo, Takin, Himalayan Tahr, Ibex, Serow Markhor, Urial, Yak, Nyan and Hispid Hare.

The endangered avian species include Himalayan Bearded Baza, Tibetan Snowcock, Mountain Quail, Tibetan Blook Pheasant, Western Tragopan, Satyr's Tragopan, Blyth's Tragopan, Temmincks Tragopan, Himalayan Monal Pheasant, Elwee's Eared Pheasant, Cheoe Pheasant, Koklass Pheasant, Black necked Crane, Rufous neckled Hornbill etc. Most of the endangered avian species are recorded from Central or North West Himalaya.

The endangered reptilian species include such widely distributed forms as Indian Rock Python, and the only endangered amphibian in the region is Himalayan Newt in Darjeeling Himalaya.

The status of hill stream fishes of the Himalaya has not been studied in recent times. With large number of interventions in the Himalayan rivers, it is thought that many typical upstream fishes have been adversely affected, especially the ones who depend on seasonal migration for breeding.

Endemism

About 40% of the Himalayan flora are endemic to the region, particularly to the eastern flank. *Nepenthes khasiana* is endemic to Shillong plateau, and represent the northernmost limit of the family *Nepenthaceae.* The primitive family *Magnoliaceae* has most of its members in Assam and Eastern Himalays. Two genera of the family *Berberidoceae* and six species of *Impatiens*, a genus of the family *Balsaminaeae,* occur in Shillong plateau and Eastern Himalaya. 135 species of the family *Orchidaceae*, 13 species of the family *Zingiberaceae* and seven species of the family *Areaceae* are also endemic to North Eastern Himalaya. In the case of Gymnosperms, one species of the family *Cycadaceae* and two species of the family *Gentiaceae* are endemic. The richness of floral endemism is further witnessed in the 350 species of Pteridophyta. Of the 675 wild edible plant species reported from Indian Himalaya, 39 are endemic and about 93 are near endemic.

In the case of fauna, several intertebrates are endemic to the Himalayan region. 15 of the earthworm species are endemic to North West Himalaya. Endemic vertebrate fauna include Snow Leopard, Slow Loris, Hoolock Gibbon, Tibetan Wolf, Tibetan Sand Fox, Himalayan Brown Bear, Red Panda, Spotted Linsang, Himalayan Lynx, Tibetan Wild Ass, Kashmir Stag and Himalayan Must deer etc.

Among the avian species, Himalayan Bearded Vulture, Mountain Quail and 10 species of Pheasants are endemic to the region. The number of species of Reptiles, Amphibia and freshwater fishes endemic to Himalaya are 29, 35 and 35 respectively.

Diversity in Wild Relatives of Cultivated Plants

The Himalaya is one of the Vavilov's world centers of origin of cultivated plants. Of 320 species of wild relatives and related taxa occurring in India, approximately 60% occur in the Himalaya, with more species richness in the Western Himalaya and north-eastern region, than in the Eastern Himalaya. Out of 167 species of plants which have originated and diversified in eight sub-centres of India, the Western Himalaya has contributed 125 species in such genera as *Pyrus, Perunus, Sorbus, Rubus, Ribes, Hordeum, Elmus, Eremopyrum, Avena, Aegilops, Allium* etc. The Eastern Himalaya has been the source of species of the genera *Pyrus, Prunus, Sorbus, Rubus, Ribes* and

Hordeum. The North Eastern region has contributed species of genera *Citrus, Musa, Mangifera, Docynia, Cucumis, Mamordia, Piper, Curcuma, Saccharum, Oryza* etc.

(b) Western Ghats

Floral diversity

Four thousand species of flowering plants are known from the Western Ghats. The gymnosperm flora is represented by *Cycas circinalis* (Cycadales), *Decussocarpus wallichianus* (Coniferales) and *Gnetum ula* and *G. contractum* (Gnetales). Amongst the lower plants around 150 species of pteridophytes, 200 species of bryophates, 200-300 species of algae and 800 species of lichens are known. There are 600 species of fungi known from the Western Ghats.

Fifty-six genera of flowering plants are considered endemic to the Western Ghats (Nayar, 1982), The validity of endemism at generic and higher taxonomic levels is however subject to systematic revisions.

Although the exact number keeps varying with the author and time, what is of interest is that nearly 38% of all species of flowering plants in the Western Ghats are endemic. Further it is to be noted that 63% of India's evergreen woody plants are endemic to the Western Ghats. Nearly 650 species of plants in the Western Ghats are trees.

The Nilgiri mountains are considered as the most importance centre of speciation of flowering plants in the Western Ghats . 82 species are endemic to these hills. High levels of montane endemism is also seen in the Palni Hills (18 species) and Anaimalai hills (13 species) (Nair and Daniel, 1986). These mountains are also unique in having a mosaic of montane forests and savannas often referred to as the 'shola-grassland' complex.

It has been observed that the endemic species in general predominate those south Indian flowering plants listed as endangered in the Red Data Books. Besides geographical restrictedness, other inherent factors that render species of flowering plants vulnerable to extinction are specialized altitude, vegetation type, habitat and microhabitat preferences of individual species. Thus amongst 17 species of south Indian flowering plants listed in the Red Data Books, 41.5% are from the evergreen forests and 10% are from grasslands. 24.5% are restricted to altitudes above 1800 m ASL. 10% grow in rock crevices filled with humus, 9.4% are found in stream banks and 7.6% are epiphytic.

Faunal diversity

Scientific research on the invertebrates of the Western Ghats has largely been restricted to a few groups of organisms. As with any other tropical region, the Western Ghats' invertebrate diversity is best known by the butterflies. Amongst other insects, ants of the Western Ghats are better studied for their habitats and ecology.

Butterflies in the Western Ghats belong to five families, 166 genera and 300 species. Of these, 37 species are endemic. The 330 species of butterflies depend on over 1000 species plants for feeding and breeding. Diversity of butterflies in the Western Ghats is thus related not only to adult feeding habitats, but also larval food plants.

There are around 218 species of primary and secondary freshwater fishes in the Western Ghats. 53% of all fish species (116 species in 51 genera) in the Western Ghats are endemic.

One hundred and twenty one species of amphibians are known from the Western Ghats. Of these, 94 species are endemic. The 121 species fall under 24 genera, six families and two orders. The family ranidae (true frogs) has the largest number of species (49) amounting to 42% of the amphibian fauna of the Western Ghats. The next largest family is rhacophoridae (treefrogs) with 30 species (25% of the amphibian fauna).

157 species of reptiles including a species of crocodile *Crocodylus palustris* is known from the Western Ghats, majority being snakes. 97 species, representing 36 genera (2 genera of turtles / tortoises, 14 lizard genera and 20 genera of snakes) of all reptiles in the Western Ghats are endemic. Endemism is highest amongst snakes, especially with the family Uropeltidae alone contributing 33 species. Amongst lizards, dwarf geckoes (Cnemaspis spp) and skinks (*Ristella, Lygosoma, Mabuya and Scincella*) have the maximum number of endemic species. There are 508 species of birds, represented by nearly 600 forms of resident and migratory birds. Amongst the 508 species, 144 (28%) are aquatic birds including those which are found in the coastal habitats. A total of 324 species (64%) are resident. These are predominantly land birds. Nineteen species have been considered endemic to the Western Ghats.

One hundred and twenty species of mammals are known from the Western Ghats. Fourteen species are endemic. The mammalian fauna of the Western Ghats is dominated by insectivores (11 species), bats (41 species), and rodents (27 species including the porcupine).

Domesticated biodiversity in the Western Ghats has been documented by various agencies including National Bureau of Plant Genetic Resources, National Bureau of Animal Genetic Resources and the many ICAR institutions and agricultural universities. Greatest diversity of cultivars is known in rich (Oryaza sativa). Sannakki known only in the remote hills of Uttara Kannad is a localized

fragrant rice.. Landraces are also common amongst millets (*Setaria italica, Echinocloa spp, Panicum spp, Elusine coracana*), pulses (*Cajanaus, Lablab, Dolichos, Cicer, etc.*) oilseeds (*Cocus nucifera, Calophyllum inophyllum, Ricinus communis, Arachis hypogea*), tubers (*Dioscorea spp, Ipomea batatus, Amorphophallus spp, Colacasia spp, Manihot esculenta, Maranta* spp), vegetables (gourds, greens, Solanum torvum etc), bananas, species (especially *Piper spp, Capsicum annum, Zinziber officinalis, Curcuma spp. Myristica franrans, Elettaria cardamomi, Syzigium aromaticum, Cinnamomum spp*), a variety of horticultural crops.

Amongst domesticated animals, cattle, buffaloes, goats, sheep, pigs, dogs, cats, rabbits, chicken, geese, ducks, turkeys, guineafowl and pigeons have been maintained and bred in selected pockets of the Western Ghats. Amongst goats breeds endemic to the Western Ghats ecoregion include *Marwari* (Kerala), *Chigu* and *Beetal* (both from Mahrashtra). Sheep breeds native to the ecoregion are *Mandya* (Karnataka), *Coimbatore, Nilgiri* and *Vembur* (all from Tamilnadu). Hill cattle are locally preserved in Uttara Kannada (*Malnad Gidda*), Kerala (Vechuri) and in Tamilnadu (*Malaimaddu*).

3. STATEMENT OF PROBLEMS AFFECTING BIODIVERSITY

a. Himalayas

The factors threatening the species and ecosystem diversity in Himalayas are more or less similar to those operating elsewhere such as habitat fragmentation, poaching and trade in wild flora and fauna, introduction of exotics etc. A summary of threats to biodiversity, forests and other ecosystems in the Western Himalaya is as follows:

Threats / causes	Time frame (approximate)	Major consequences	Current status
Commercial logging, (more destructive during railway expansion, wars, extraction system)	More than a century, until 1986	Over-exploitation of sal, deodar, disruption of sal regeneration	No more in practice because of the ban of "green" tree cutting
Firewood, fodder and ground litter collection from forest	Right from beginning, still going on	Lopping of oaks, adverse effect on tree regeneration, soil deterioration and disruption within fragments; women drudgery increased	In practice, shortage of broadleaved species leaf litter being felt; no proper silvicultural practices yet introduced.
Free grating in forests	Right from the beginning	Damage to tree seedlings and saplings, particularly oaks; regeneration of *Q. semecarpifolia* threatened in many areas	In practice, some change in animal composition, e.g. more goats, reduction in transhumance
Frequent but mild burning	Right from the beginning	Damage to oaks and other broadleaved species, promotion of chir pine and some grasses	In practice, getting more extensive; people's cooperation in fire fighting weakened

Charcoal making	Until 1986	Overexploitation of oaks, forest fragmentation, women drudgery increased	No more in practice, because of ban on “green” tree cutting
Shifting cultivation	Right from the beginning, but replaced by sedentary agriculture long ago	Conversion of primary forests into secondary forests, expansion of fire-resistant species, loss of soil carbon and fertility, fragmentation, spread of weeds.	No more a problem.
Spread of invasive species	Extensive during last half century e.g. *Lantana camara, Eupatorium, Parthenium*	Loss of biodiversity, failture of tree species to regenerate, and rapid carbon loss due to shallow rooting and carbon deposition	Spread continues, has led to a cool but persistent fire regime
Hunting	Common until 1970s	Populations of almost all large mammals depleted from most areas	Prohibited
Poaching	Grew particularly during last two decades	All charismatic mammals affected	Poachers getting organized and becoming uncontrollable; partly because of the apathy of people, particularly in matters even remotely connected with the SFDs.

Commercial collection of medicinal, and aromatic plants (MAP), lichens etc.	Much of the activities gave occurred during last two-three decades	Populations of several species threatened	Illegal network getting stronger and uncontrollable; there is a lack of awareness and community involvement
Fragmentation of habitat	For a century or so	Large wild animals threatened; loss of interior species and domination of edge species, including exotics and light demanding hemi-parasites	Vegetation becoming highly fragmented.
Road construction	A major activity during last 3-4 decades	Fragmentation of habitat, accelerated landslides, increase in illegal activities including poaching, tree cutting and collection of MAP	Technology remains crude
Water pollution, eutrophication and degradation of aquatic ecosystems	For the last 4-5 decades	Loss of fishes, non-palatable species increased, reduced recreational values and drinking water supply and health hazards	Very serious problem warranting immediate restoration work in case of lakes
Promotion of high yielding varieties of crops by state, universities and other institutions	Last three decades or so	Depletion of crop diversity, increase in the use if pesticides and chemical fertilizers	Growing, but the “save seeds movement” by village-level organizations in UA is a notable beginning to revive biodiversity.

Orchards particularly of apple in HP	For last 3-4 decades	Clear-cutting of trees for plantation and to meet demand of fruit cases, use of pesticides, damage to pollinating insects, improvement in economy	Well established in HP; seen as a model of economic growth for also in the new state of UA; but doubts also being raised.
Global warming	Being perceived for a decade or so	Receding glaciers, warmer winters, untimely flowing in apple, etc. are perceived as consequences	Likely to be a major issue in immediate future; not attempt yet made to address this threat.
Eutrophication and pollution of lakes, particularly of Kashmir and Nainital	Last 3-4 decades	Decline in the health of aquatic ecosystems, quality fishes, recreational value of lake and water resources.	Lakes still in degraded stages; major restoration work needed.

Certain crucial factors affecting biodiversity in the north eastern Himalayas are as follows:

Land tenure issues, dichotomy in Forest Administration, effective management of private and community forests; smuggling of timber across international border; shifting cultivation; inter-state border dispute; insurgency etc.

b. <u>Western Ghats</u>

Root causes for the present loss of biodiversity in the Western Ghats are anthropogenic and manifold. Human impacts on biodiversity have been direct as that due to collection, harvest and poaching and indirectly through habitat destruction. Direct extraction of biodiversity, live or dead, has led to decimation of population leading to various forms of quantitative losses.

A variety of plants of economic importance and animals such as elephants, tigers, larger herbivores, birds and reptiles have locally disappeared due to this reason. Poaching of vertebrates for the pet trade, as trophies and for animal

products such as skin, bones, tusks, claws, horns, feathers, etc. continue to take a heavy toll of biodiversity in the Western Ghats.

Indirectly, diversity of plants has suffered extensively from pressures of exotic plants and domesticated animals. Other human induced loss of plant diversity is affected by alternate land use including monocultures, cultivation, dams, mining etc. Animal biodiversity in the Western Ghats has similarly suffered due to pressures from domesticated plants and animals and the human induced population rise of secondary and invasive species of animals.

Indirect loss of biodiversity is affected through quantitative and qualitative reduction of habitats. Habitat shrinkage and fragmentation restricts the range and area of occupancy of most species. For most species in the Western Ghats, with the exception of the urban adapted species, the available habitats are not adequate in extent. Such restriction leads to a greater rate of human-animal conflicts.

Chief norms of qualitative loss of habitats include change of flow, depth and turbidity in aquatic habitats, opening of canopy (often due to selected logging), dense undergrowth choking regenerating plants, loss of old and mature trees offering roosting and breeding sites to hole nesting birds and mammals, loss of trees bearing fleshy fruits etc. The net result of qualitative changes in habitats has led to ‘empty habitats’ through the Western Ghats. Such habitats are apparently ‘excellent’ as might be inferred from maps and satellite images. They are however devoid of the species of plants and animals that once inhabited them.

Whether it is fire or the use of inorganic pesticides or invasive species, indirect and widespread loss of biodiversity in the Western Ghats is due to depletion of habitat. The depletion can be quantitative, qualitative or both. Good examples of quantitative loss of habitats in the Western Ghats can be seen in the shoal-grassland complexes, torrential streams and waterfalls, freshwater (*Myristica*) swamps, and lowland rain forests.

The factors that lead to qualitative and quantitative loss of biodiversity in the Western Ghats are many. The following have been identified as those of immediate concern (in the order of decreasing importance):

1. Grazing pressure
2. Demand for fuelwood
3. Demand for small timber
4. Fire, especially when recurrent
5. Demand for green manure
6. Encroachment
7. Demand for non-timber forest produce
8. Poaching and smuggling
9. Development projects
10. Land use practices

11. Pesticides
12. Soil erosion and water logging
13. Increase in population density
14. Pilgrimage
15. Mining and quarrying

4. CONSERVATION EFFORTS

A number of programmes are currently being implemented for conservation and sustainable utilization of biodiversity in the Himalay and Western Ghats. These include survey and inventorisation, in-situ conservation through protected area network, and ex-situ conservation. In addition, the Government also supports biodiversity-related research in these areas. A brief account of these efforts is given below.

(a) Himalayas

The Botanical Survey of India through its Northern Circle Office at Dehradun, Sikkim Himalayan Circle in Gangtok and Arunachal Field Station in Itanagar, is engaged in botanical exploration, inventorisation and documentation of the plant diversity of Himalaya. About 6000 species of flowering plants have been inventorised so far from the region and two publication namely 'Flora of Sikkim Vol. I Monocotyledons', and 'Flora of Arunachal Pradesh Vol. I Dicotyledons', have been brought out.

The faunal survey of Himalays is being carried out by the Zoological Survey of India through its Northern Regional Station at Dehradun and Arunachal Pradesh Regional Station in Itanagar. State Faunas of Sikkim, Meghalaya, Tripura and Mizoram and Fauna of Nanda Devi and Namdapha Biosphere Reserves have been published by ZSI.

In Western Himalayas a total of 12 National Parks and 53 Wildlife Sanctuaries have been set up under the Wildlife (Protection) Act 1972. In the State of Jammu & Kashmir there are four National Parks and 15 Wildlife Sanctuaries covering an area of 14872.22 km^2, which constitutes 7.27% of the geographical area. Dachigam National Park is of special significance because of Project Hangul, which was established in 1970. Wular Lake, situated in Baramula district, covering an area of 8,900 ha. is one of the important wetlands of international importance and has been designated as Ramsar Site.

The proected area network in Himachal Pradesh comprises 2 National Park and 32 Wildlife Sanctuaries covering total area of 7202.25 km^2. The total protected area constitutes 12.94% of the geographic area of the state. Snow Leopard and Monal are important faunal species abounding the protected area. Lake Renuka, a wetland of national importance, with an area of 670 ha. is situated in Sirmaur district. Great Himalayan National Park is of particular ecological significance.

The oldest protected area of the region is Corbett National Park in Uttaranchal that was established way back in pre-indepdence era in 1936. In Uttaranchal only 6474.5 sq.km. is under Protected Area accounting for 12.11% of the geographical area. Nandadevi Peak has been designated as a Biosphere Reserve which is included in the Global Network of Biosphere Reserves.

In the North Eastern Himalayas, 13 National Parks and 42 Wildlife Sanctuaries have been constituted. In addition 5 biosphere reserves have also been designated which include Nokrek in Meghalaya, Manas and Dibru Saikowa in Assam, Dehang Dibang in Arunachal Pradesh and Kanchanjunga in Sikkim. The total area under the Protected Area Network in the region is 14,989.75 sq. km. which constitutes about 5.71% of the total geographical area of the region. The Tura Range in Garo Hills of Meghalaya is a gene sanctuary for preserving the rich native diversity of wild *Citrus* and *Musa* species. Sanctuaries for rhododendrons and orchids have been established in Sikkim.

The Kaziranga and Manas National Parks in Assam and Nandadevi National Park in Uttaranchal have been recognized as old heritage sites. These sites represent moist alpine and montane forests.

In order to understand ecosystem functioning and to scientifically manage protected areas, a number of research projects are being supported in the region. GB Pant Institute of Himalayan Environment and Development of the Ministry of Environment and Forests undertakes action oriented research for development of technologies and demonstration packages towards sustainable development of Himalayan regions suited to local specificities.

The Ministry of Environment & Forests issued a Notification under the Environment (Protection) Act 1986 for 'Protection and Improvement of Quality of Environment in the Himalayas'. The Notification deals the activities relate to location planning in urban areas, rain-water harvesting and guidelines for construction of hill roads. The Planning Commission enunciated a National Policy for the Integrated Development of the Himalayas. A special programme known as Hill Areas Development Programme is being implemented since 1974 with eco-regeneration and eco-preservation as the primary objectives. The programme also emphasizes on preservation of biodiversity and rejuvenation of hill ecology.

(b) Western Ghats

The phytodiversity of Western Ghats is explored, identified and documented by the Southern and Western Circles of BSI located at Coimbatore and Pune, respectively. This documentation has been published in the form of District and State Floras such as Flora of Karnataka : Analysis (Vol.I), Flora of Tamilnadu : Analysis (Vol. 1-3), Flora of Maharashtra : Monocotyledons (Vol. I), Flora of Goa (two volumes), Flora of Kerala (Grasses), Flora of Cannanore, Flora of Thiruvananthapuram, Flora of Palaghat, Flora of Nasik and Flora of Mahabaleshwar.

Faunal surveys of Western Ghats are being conducted by ZSI through its Regional Stations in Pune, Chennai and Kozhikode. A document on faunal diversity of Nilgiri Biosphere Reserve has been published.

The system of Protected Areas in the Western Ghats includes the Nilgiri Biosphere Reserve, the first and largest Biosphere Reserve in India, 13 National Parks and 45 Wildlife Sanctuaries. The largest National Park is Bandipur with an area of 874 sq. km. and the largest Wildlife Sanctuary is in the Anaimalai Hills having an area of 841.49 sq.km. The 58 Protected Areas together cover an area of 14,140.36 sq.km. This amounts to 8.8% of the Western Ghats. Of these, Bandipur, Periyar and Kalakad-Mundanthurai are Project Tiger Reserves. Some of the Protected Areas in Karnataka, Tamilnadu and Kerala have also been designated as Project Elephant Reserves.

Further to managing the system of Protected Areas and initiatives such as afforestation, eco-development and Joint Forest Management, the State Departments of Forests have mooted programmes that specifically address conservation of endangered vertebrates.

The Western Ghats biodiversity network was launched in 1994 with the participation of school and college teachers and NGOs. This network systematically collected data on distribution and ecology of 1500 species of flowering plants and 212 species of birds. The combined effort of the network resulted in developing people's biodiversity register which are tools that help achieving conservation, sustainable use and equitable sharing of the benefits, the three coals of the Convention on Biological Diversity.

Several non-government organizations such as Kerala Shastra Sahatya Parishad, the M.S.Swaminathan Foundation, the Foundation for Revitalisation of Local Health Traditions (FRLHT) are also actually involved in the conservation of biodiversity in the Western Ghats by involving local communities. Other notable NGOs involved in scientific research / activism related to the conservation of biodiversity in the region include Bombay Natural History Society, Ashoka Trust for Research in Ecology and Environment, Kalpavriksh, Juhu Outreach Organisation etc.

The Ministry of Environment and Forests support the Centre for Ecological Sciences (CES), Bangalore and the Tropical Botanic Garden and Research Institute (TBGRI), Thiruvananthapuram. The CES conducts research in frontline areas of basic and applied ecology and ecology-related extension programmes of Western Ghats. The thrust areas of activities of TBGRI are conservation and sustainable utilization of tropical plant diversity, with emphasis on medicinal plants.

5. NATIONAL BIODIVERSITY STRATEGY AND ACTION PLAN (NBSAP) PROJECT

The Ministry of Environment and Forests is implementing the National Biodiversity Strategy and Action Plan Project (NBSAP) for last two and a half years for developing action plans at microlevel for conservation of sustainable use of biological diversity in the country. NBSAP is India's biggest ever development and planning exercise in scale and participation. The NBSAP project entered its final stage and will be completed by December 2002. Under the NBSAP project, 74 action plans are being prepared for : (i) 14 themes relating to biodiversity at the national level; (ii) for all states and union territories; (iii) for 10 inter state eco-regions, and (iv) 17 sub-state local sites. The expected outcome of the NBSAP is an implementable and a realistic and practicable action plan, which can be easily translated into a number of projects at the ground level in priority areas to ensure conservation and sustainable use of biodiversity thereby securing ecological and livelihood security.

Under the NBSAP action plans for the ecoregions namely Western Himalayas, North East Himalayas, Western Ghats, Eastern Ghats and Aravalis exclusively deal with the mountain ranges of the country. Action plans are prepared using a highly participatory approach involving all stakeholders. Apart from seeking inputs from experts and learned individuals, brainstorming sessions, discussions and public meetings were also organized for preparing the action plan. The action plans describe the detailed biodiversity profiles of these regions, the factors affecting the biodiversity and the gap anlaysis and prescribe strategies and actions required for conservation and sustainable use of the biological diversity.

6. ECO-TOURISM INITIATIVE

Sikkim, a unique biodiversity rich area in India, is situated at the foothills of Khangchendzonga, the third highest mountain in the world. Located amidst the magnificence of the mountain peaks, lush valleys, hills and fast flowing rivers, Sikkim is a dream holiday destination. Tourism is rapidly increasing here, with approximately 100,000 domestic and 8,000 international tourists visiting the state every year. Tourism has also become an important economic activity for the local people. But the increase in the tourist traffic has also brought along problems to the area's biodiversity due to road construction, over collection of forest product and fuelwood collection.

To correct the negative effects of tourism and to provide benefits to the local community, the Sikkim Biodiversity and Ecotourism Project was launched in 1995. The project with a time period of four years aimed to support the development of viable enterprises which could provide sustained economic incentives and support for the local communities. The project was multi-stakeholders in the true sense. The project collaborators wee in the G.B. Pant Institute of Himalayan Environment and Development (GNPIHED), Uttaranchal. The Mountain Institute (TMI), Nepal, Travel Agents Association of Sikkim

(TAAS), and local organizations and communities. The government of Sikkim played a key role at various stages of project implementation. The focus of the project activity was the Khangchendzonga National Park and the communities residing in areas surrounding the protected areas of west Sikkim.

In the second year itself, the project took major strides in training for income generation, capacity building for conservation, biological monitoring and promoting policy dialogue, in conservation and ecotourism development. Training was conducted by the project partners and project staff for over 200 lodge owners, naturalists and trekking guides, trek cooks, vegetable growers and porters. Also, as a result of the project the Khangchendzonga Conservation Committee (KCC) was formed at Yuksam.

For the first time, the project provided a platform to capacity build local and state level organizations, and form linkages between tourism development and conservation. The Sikkim Biodiversity and Ecotourism Project has shown that collaborative and participatory frameworks, and partnership between public and private sectors, as well as local communities, can produce results that contribute to conserving globally significant biodiversity assets.

7. INTERNATIONAL YEAR OF MOUNTAINS

India celebrated International Year of Mountains by organizing workshops in various mountain provinces for discussing the critical issues as well as for creating awareness about the sustainable development of mountains.