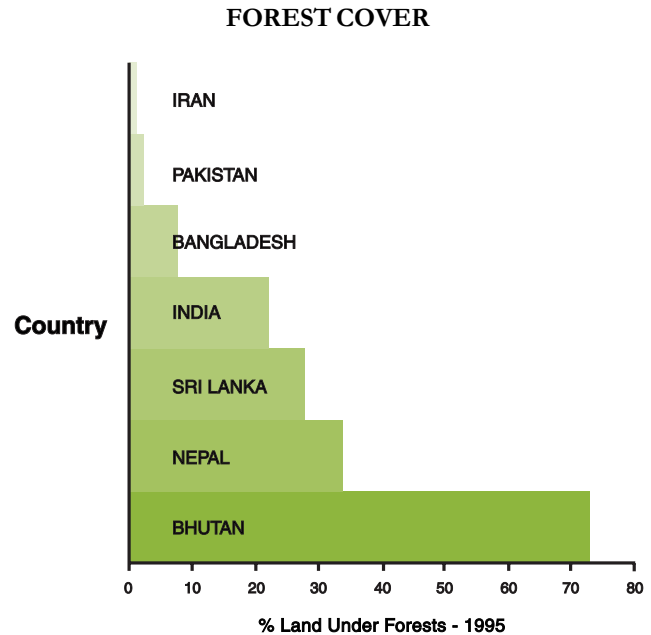


5.0 Biodiversity

South Asia* is home to spectacular natural beauty and biological wealth. The region's geographical expanse and topography include several diverse ecosystems which harbour a rich variety of faunal and floral species – the Sunderbans, the largest contiguous mangrove swamp in the world, in India and Bangladesh; magnificent coral reefs and atolls in the Lakshadweep-Maldives chain of islands; the Thar desert and arid areas in north-west India and southern Pakistan; high altitude cold deserts in the upper Himalayas and Deosai plains in Kashmir; two rich biodiversity hotspots in the eastern Himalayas (Nepal, north-eastern India, and Bhutan) and the Western and Eastern Ghats of India and Sri Lanka; and the dense and virtually untouched virgin forests of Bhutan and Sinharaja, the ancient forest in Sri Lanka.

The diversity in the latitude, altitude, climate, topography and rainfall patterns plays an important role in determining the vegetation of the area. The monsoon rainfall pattern, unique to the region, principally distinguishes the forests into evergreen (which receive 2,500 mm rainfall per annum), deciduous (1,000-2,000 mm), dry forests and scrubland (500-1,000 mm), and desert and semi-desert (less than 500 mm). Forests cover an area of approximately 7,71,37,000 ha (Source: WRI, 2000) of the total land area (4,122,97,000 ha) of the region - i.e. 18.6 per cent of the land area of South Asia is under forests, which accounts for approximately 2.93 per cent of the world's forest cover.



Data not available for Maldives

Source : World Development Indicators, 2000

These forests and ecosystems are home to nearly 42,288 species of higher flowering plants and 6,472 species of fauna (mammals, birds, reptiles, amphibians and freshwater fishes). Of these, 9,257 species of vascular plants and 824 species of animals are endemic to the region. Thus, occupying an area of 44,49,060 sq. km.



approximately - i.e., only 3.2 per cent of the world's land area - South Asia accounts for nearly 15.6 per cent of the global floral and 12 per cent of the faunal diversity.

Right : *Sal Shorea robusta* forest in the low lying terai belt of the India/Nepal border. This forest is interspersed with tall wet grassland which is under pressure from drainage for agriculture. The wet grasslands are home to the threatened swamp francolin *Francolinus gularis* (bird all).

* Does not reflect data of Iran

Table 33: Forest Types in South Asia

Forest Types	Location	Dominant species
Tropical wet evergreen and semi-evergreen forests >3,000 mm	Assam Hills and Western Ghats of India , south-western Sri Lanka	Multi-storied emergents; epiphytes are abundant. Herbs poorly developed. Species numbers are high.
Tropical Deciduous (monsoon) forest	Peninsular India	Trees include <i>Tectona grandis</i> (teak), <i>Shorea robusta</i> (Sal), <i>terminalia chebula</i> and <i>Acacia catechu</i> .
Thorn forest < 750 mm	North-west of the peninsula and western ghats (India)	Thorn forest grades into xerophytic bushland and desert vegetation.
Tropical dry evergreen forest	Madras (India) to Point Calimere	The canopy is closed and low (1-13 m), with an understorey of spiny shrubs.
Montane subtropical and temperate forests	Nilgiri hills, Anamalai hills and Palni hills of South India Sikkim Assam and Meghalaya; Nepal, Bhutan	Species of <i>Fraxinus</i> and <i>Shorea robusta</i> in favourable sites; climbers and epiphytes are also common.
Subtropical moist pine forest	Khasia Hills and mountains of Assam (India) and southern slopes of Himalayas (900-1,800 m)	
Subtropical dry evergreen forest	Kashmir(salt range), Himalayan foothills and scattered patches in Baluchistan (Pakistan) (100-1,525 m)	Low scrub, with dwarf palm <i>Nannorrhops dritchieana</i> together with <i>Acacia modesta</i> and <i>Olea cuspidata</i> .
Northern wet temperate forest >2,000 mm	East of longitude 88degree E occurs east of longitude 88° E, between 1,800-2,900 m	Dominated by <i>Quercus</i> , <i>Castanopsis</i> and <i>Laurus</i> with dwarf bamboo undergrowth.
Himalayan moist temperate forest (1,000-2,500 mm)	Himalayas (150-2,500 mm)	Mixed broadleaved evergreen and coniferous forest with rhododendron, oak, laurel and bamboo undergrowth.
Alpine forest and scrub	Himalayas (2,895-3,660 m)	Above tree-line, >4,000 m, vegetation changes to open <i>Rhododendron</i> scrub and alpine pasture. Wet areas are rich in herb flora - <i>Primula</i> and <i>Pedicularis</i> . Chasmophytes and cushion plants, such as <i>Chionocharis bookeri</i> , occur on rocks.
Tidal forests and mangroves	Sundarbans and the coast of Taninthayi	Sand-dunes are often fringed with, and stabilized by, <i>Casuarina spp.</i>

Grasslands or rangelands in South Asia - India in particular - comprise of the tropical savannah, savannah, woodland and dry forest. Grassland diversity includes semi-arid pastures in the Deccan peninsula, humid semi-waterlogged grasslands in the terai in Nepal and India, rolling shola grasslands in the Western Ghats and high altitude alpine pastures in the Himalayas. Indian grasslands harbour an estimated 1,256 species belonging to 245 genera. The great Indian bustard, the lesser florican and the lesser Indian rhinoceros are the key avifauna characteristic of Indian grasslands. Grasslands

of the region have great economic value, besides being the providers of food, fodder and habitat for a large number of insects, reptiles, amphibians and birds.

The desert ecosystem in South Asia includes sandy deserts (the Thar desert) in India (2,78,330 sq. km.) and Pakistan; salt deserts in the Rann of Kutch in India (9,000 sq. km.); and the high altitude cold deserts (1,09,990 sq. km.) in Jammu and Kashmir and Himachal Pradesh in India and the alpine reaches of Bhutan. The arid zones in the western parts of India and Pakistan



Source : 1998 UNDP Ecological Co-operation for Biodiversity

are home to several faunal species including the desert fox, desert cat, Houbara bustard, chinkara and the great Indian bustard in the Thar desert, and the Asian lesser flamingo, the rare Asiatic wild ass, and crow pheasant in the salt desert. The cold deserts in the eastern Himalayas exhibit high endemism and richness, particularly in the diversity of wild sheep and goat species. The dominant fauna here include the elusive snow leopard, yak, urial, bharal (blue sheep), ibex, Himalayan musk deer, the keong (Tibetan wild ass), snow pigeon, upland pipit and the Tibetan snow finch.

million people are dependent on fishing for their livelihood. Of the annual estimated harvest of fish (6,75,000 tonnes) and crustaceans and frogs (7,25,000 tonnes) in Bangladesh, 81 per cent comes from wetlands and rivers while the remaining is from marine sources. In India, the Chilka Lake fisheries in Orissa alone account for more than 700 tonnes of fish per year and are a source of livelihood for people in the coastal region.

Table 34: Wetlands in S.Asia

Countries	No. of sites	Area (km ²)
Bangladesh	12	67,700
Bhutan	5	85
India	137	54,700
Nepal	17	456
Pakistan	48	8,580
Sri Lanka	41	2,740

Source : Scott D.A. and Poole C.M. 1989. *A status overview of Asian wetlands no. 53, Asian Wetland Bureau, Kuala Lumpur, Malaysia*

Wetlands cover approximately 1,34,261 sq. km. in South Asia, and include floodplains, marshes, estuaries, lagoons, tidal mudflats, reservoirs, rice paddies, saline expanses, freshwater marshes and swamps. In Bangladesh, wetlands cover almost 50 per cent of the total land surface, and are an important source of income and livelihood for several thousands of its people. In Sri Lanka, wetlands account for 15 per cent of the land area.

Wetlands also support specialised biodiversity such as medicinal plant species (for example, *Ghechu aponogeton*, *Makhana Euryale ferox*, *Polygonum spp.*, etc.) and several commercial fishes. In Bangladesh alone, more than five

Wetlands are also particularly significant as the wintering grounds of several species of waterfowl and migratory birds. Some of the important wetland fauna include the Indian one-horned rhinoceros, marsh crocodile, estuarine crocodile, gharial, the Gangetic dolphin, swamp deer, Manipur brow-antlered deer, Asian lesser flamingo, white-winged wood duck, Andaman grey teal, lesser and greater adjutant stork, bar-headed goose, etc.



Rich and endemic biodiversity of the Himalayas – left to right Bharal (blue sheep), snow pigeon, Himalayan Monal Pheasant and the rare Himalayan Blue Poppy

Source: 1998 Biodiversity Action Plan for Bhutan, Ministry of Agriculture, Royal Government of Bhutan, libray.thinkquest.org; <http://www.britannicaindia.com/eb/spotlights/animal/ani04.htm>



Magnificent mangroves at Sunderbans

The central Indian ocean marine region includes four South Asian countries - Bangladesh, India, Maldives and Sri Lanka. It comprises of three distinct areas - the Arabian Sea, Bay of Bengal and a large area of the Indian Ocean to the south of India and Sri Lanka. Within the region, India and Sri Lanka (to a lesser extent) are representative of almost all the marine ecosystems - mangroves, coral reefs, sea grass, and estuarine and coastal wetlands. Bangladesh is primarily dominated by estuarine and mangrove ecosystems, while Maldives is made up entirely of coral reefs and atolls.

The Sunderbans, with a total extent of dense tidal forest extending nearly 6,050 sq. km. shared between India (2,000 sq. km.) and Bangladesh (4,050 sq. km.), has the unique distinction of being one of the world's largest contiguous stretches of mangrove forests. Of the 22 countries that hold the world's principal mangroves, Bangladesh and India rank 12th and 14th respectively (Hotdrings and Saenger, 1987). Figures for total area covered by mangroves in the region are extremely variable, but in the northern Bay of Bengal, the Sunderbans and the Ganges delta are estimated to support over 5,00,000 hectares. Besides Sunderbans, important mangrove areas in India are found in the Cauvery and Godavari deltas, Bhitarkanika and the Gulf of Kutch (52,500 hectares) and Andaman and Nicobar islands (1,15,200 hectares); much of the forests in the Andaman and Nicobar are still relatively pristine.



In Sri Lanka, mangroves are found on the north-west coast in the Puttalam Lagoon and the Dutch and Portugal Bay areas.

Maldives has a few small stands, with very low diversity (Pernetta, 1993d). Plant diversity in Indian mangroves is extensive with 45 recorded mangrove species. Sri Lanka has 28 species, Bangladesh has 27, and Maldives about five (Pernetta, 1993a).

Large sea grass beds are present in southern India in the Palk Bay, Gulf of Mannar and the Andaman and Nicobar islands; the estuaries and embankments of Sri Lanka also hold sea grass beds. In Sri Lanka, sea grass covers an area far in excess of that covered by mangroves and coral reefs. Coral reefs, one of the most productive ecosystems, are extensive in the Maldives. The mainland coast of India has two widely separated areas containing reefs – the Gulf of Kutch in the north-west, Palk Bay, Gulf of Mannar (*fringing reefs*), and the Andaman and Nicobar islands. A few coral reefs are also found in Sri Lanka, mainly along the shores. The coastal and marine biodiversity includes about 174 algal species in Sri Lanka, 285 in Maldives and 624 in India (Pernetta, 1993e). Over 1,200 species of reef fishes are found in the Indian Ocean around Maldives (UNEP/IUCN 1988). The Sunderbans are an important staging and wintering area for gulls and terns, and the islets of Adam's Bridge, off Sri Lanka, and several atoll islands in Lakshadweep (Pitti and Baliapani) and in Maldives have seabird colonies.

The coasts of India, Sri Lanka, Maldives and Bangladesh (St Martin's Island) are visited by five of the seven most highly endangered marine turtle species in the world. These are the loggerhead turtle (*Caretta caretta*), green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), Olive Ridley turtle (*Lepidochelys olivacea*) and the leatherback turtle (*Dermochelys coriacea*). Marine mammals found in the region include the humpback dolphin (*Sousa chinensis*) and the spotted dolphin (*Stenella attenuata*). The dugong, which is a threatened species in the region, is found in small numbers in the Gulf of Kutch and Andamans and Nicobar islands (Ritchie's Archipelago and North Reef).



Olive Ridley, Green and Hawksbill Turtle – Visitors to the coasts of south asia

South Asia is equally rich in agrobiodiversity and livestock diversity, and has made significant contributions to the rest of the world's supplies of timber, food and medicinal plants, fruits, spices, fibres, oils and dyes over thousands of years. Within the region, India is considered to be one of the world's eight centres of crop plant origin and diversity, as demonstrated by the Russian scientist N.I. Vavilov. The Indian National Bureau of Plant Genetic Resources estimates that at least 166 food/crop species and 320 wild relatives of crops have originated in this region. Some of these include rice, turmeric, ginger, pepper, banana, cardamom, jackfruit, sugarcane, bamboo, taro, indigo, sunhemp, amaranthus, mango and gooseberries.

The Himalayas, a centre of origin of cultivated plants, contain nearly 320 species of wild relatives and related taxa that occur in India. The species richness is concentrated mostly in the western Himalayas and the north-eastern region.

India, Pakistan and Bangladesh account for most of the mangoes produced in the world; India alone accounts for nearly 1,000 mango cultivars. Peninsular India and Andaman and Nicobar islands account for nearly 21 genera and around 91 species of palms. Coconut and arecanut (*Areca catechu*) are cultivated extensively in India and are the major sources of economy for the Lakshadweep islands. Palms are widely used in building, thatching, bag making, fans etc. and the fibres are used for industrial purposes. Nearly 80 per cent of Palmyra palm fibre is exported to Japan and the West.

In Pakistan, the Valley of Kashmir and associated mountains constitute one of the most floristically rich areas. A large number of alpine and sub-alpine species are endemic to the area. Of these, nearly 40 endemics including *Aconitum kashmiricum*, *Saussurea sacra*, *Primula minutissima* and *Megacarpaea bifida* are highly endangered (Dhara Kachroo 1983 a,b).

India also has one of the world's largest diversity of domesticated animals, with about 26 breeds of cattle, 40 breeds of sheep, 20 of goats, eight of camels, six



From Left top: Seabuckthorn, Brahmakamal—Saussurea obvallata, a medicinal plant found in the Himalayan region.

Source: Amruth; 1998 UNDP Ecological Co-operation for Biodiversity Conservation in the Himalayas ; 1998 Biodiversity Action Plan for Bhutan, Ministry of Agriculture, Royal Government of Bhutan,

of horses, and 18 of poultry, apart from the yak, the mithun, and several species and breeds of birds including geese, ducks, pigeons, and doves (CSIR, 1970; Mohapatra and Panda, 1981; Khanna, 1993; Sabai, 1993).

Finally, within the region, three areas – the Western Ghats in India and Sri Lanka and the Eastern Himalayas (India-Bhutan-Nepal) - have been identified as three of the '18 biodiversity hotspots' (Myers, 1988), areas with high species diversity and high levels of endemism and

Regions in South Asia Identified as Centres of Plant Diversity and Endemism

- Nanda Devi (Kumaon-Garhwal Himalayas, India)
- Northern Sikkim and Eastern Nepal (India, Nepal)
- Namdapha (India)
- Agastyamalai Hills (India)
- Nilgiri Hills (India)
- Nallamalai Hills (India)
- Knuckles (Sri Lanka)
- Kashmir Himalayas (India and Pakistan)
- Peak Wilderness and Horton Plains (Sri Lanka)
- Sinharaja (Sri Lanka)
- Andaman and Nicobar islands (India)
- Sunderbans (Bangladesh, India)

Source: Centre of Plant Diversity, IUCN, 1995

where the species are subject to exceptional levels of threat in the world (see box). Additionally, India is also designated as one of the 12 megadiversity countries (McNeely, 1990; Mittermeier, 1998; Mittermeier and Werner, 1990). These 12 countries alone are estimated to hold up to 70 per cent of the world's species diversity.

5.1 Undervalued and Threatened Biological Wealth

South Asia's enormous diversity and richness of ecosystems has been grossly undervalued. What is known and documented today is estimated to be only a small fraction of the actual (and as yet undiscovered) biodiversity reserves that exist. Moreover, the little that is known today is under severe threat, mainly from

anthropogenic pressures for meeting the subsistence needs of the people and from keeping pace with the rapid commercial development sweeping the entire region.

The pressures have, over the years, led to drastic changes in prime biodiversity habitats, resulting in severe habitat loss and degradation in some cases. This has been aggravated by increasing unemployment, poverty, changing lifestyles, lack of awareness and political will, loss of traditional values and vested interests of commercial exploiters – all of which have led to rapid escalation in the plunder of our natural wealth. The untapped, undervalued, fragile biological wealth of the region thus is faced with high risk of extinction in the near future.

Global Biodiversity Hotspots

The Eastern Himalayas, including parts of Nepal, India and Bhutan; the Western Ghats in India (mountain ranges running along west coast of India upto the southern tip); and the Western Ghats in Sri Lanka have the distinction of being designated as three of the 18 biodiversity hotspots in the world.

The mountains of the Western Ghats of south-western India and the highlands of south-western Sri Lanka are separated by 400 km of water, but they are strikingly similar in their geology, climatic patterns and evolutionary history. Representing one of the eight bio-geographical zones of the Indian subcontinent, they are some of the oldest hills on earth and exhibit assemblages of pristine flora and fauna. Two main centres of diversity, the Agastyamalai hills and Silent Valley in the Indian Western Ghats, are home to nearly one-third of all the flowering plants found in India. Of this, nearly 40 per cent is endemic.

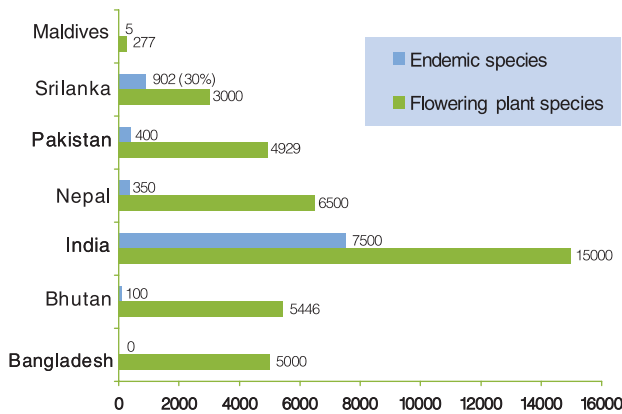
The faunal diversity of the region includes 146 species of amphibians, (116 or 80 per cent are endemic); 259 of reptiles (161 or 62 per cent endemic); 528 of birds (7.5 per cent endemic); and 140 of mammals (38 or 27 per cent endemic). Total number of terrestrial vertebrate species stands at 1,073 (355 or 33 per cent endemic), and of vascular plant species at 4,780 (2,180 or 45 per cent endemic). The fauna includes the tiger, leopard, sloth bear, barking deer, mouse deer, Nilgiri langur, lion-tailed macaque, Nilgiri tahr, spotted deer, giant squirrel, etc. The Indian portion of the Western Ghats is also home to 250 species of orchids, of which 100 are endemic, and 150 species of grasses. The Western Ghats act as the gene bank of mycorrhizal fungi (13,000 species) as well.

The Eastern Ghats too display a rich floral diversity, with about 2,000 species of flowering plants (angiosperms), few gymnosperms such as *Cycas* and *Gnetum Scandens*, and 30 species of ferns. The floral diversity in this region is threatened, though some rare plants and trees still survive. Among these are *Andrographis beddomei*, *Andrographis nallamalayana*, *Dicliptera beddomei*, *Brachystelma glabrum*, *Brachystelma volubile*, *Boswellia ovalifoliolata*, *Chrysopogon velutinus*, *Pimpinella tirupatiensis* and *Cycas beddomei*. (Rajamani R., 1998, Conservation of Eastern Ghats – I).

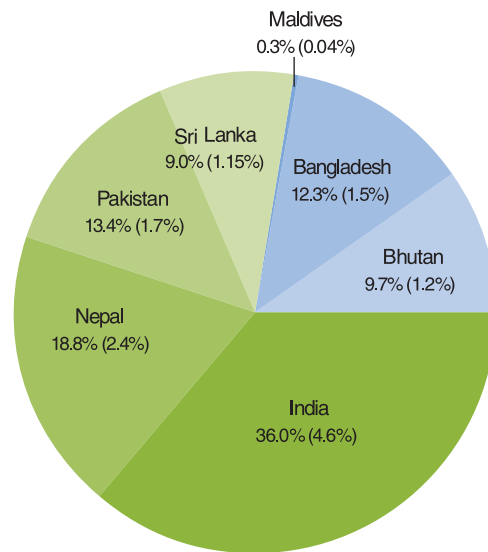
Approximately 18 million people are dependent on resources from the forests in the Western Ghats in Sri Lanka. These forests hold more than 4,700 species of plants, 46 per cent of which are found only in this region. High demand for tree species with commercial value, along with rapid development, has put this hotspot under critical threat of biodiversity loss. Species such as the Indian tiger and the Asian elephant, whose numbers have dwindled due to poaching and loss of habitat, have become important international 'flagships' for tropical forest conservation.

The Eastern Himalayas comprise of tracts of the Darjeeling hills, Sikkim and Arunachal Pradesh in India and eastern Bhutan. Subtropical forests cover the land up to 2,000 m; beyond it lie the temperate mixed forests, mainly comprising of fir, juniper and rhododendron. The eastern Himalayas are home to a large number of endemic fauna including the slow loris, one-horned rhinoceros, golden langur, tiger, Indian civet, red panda, clouded leopard and golden cat. Birds include the snow pigeon, snow cock, white-winged wood duck, pheasants, bar-headed geese and the black-necked crane. The region is particularly rich in endemic plant species. The Indian part of the eastern Himalayas accounts for about 5,800 plant species of which about 2,000 — i.e. 36 per cent — are endemic. In India, Sikkim alone accounts for 4,250 plant species of which 2,550 — i.e. 60 per cent — are endemic. Of the 12,000 plant species found in Nepal and Bhutan, 1,300 are endemic to the eastern Himalayan region.

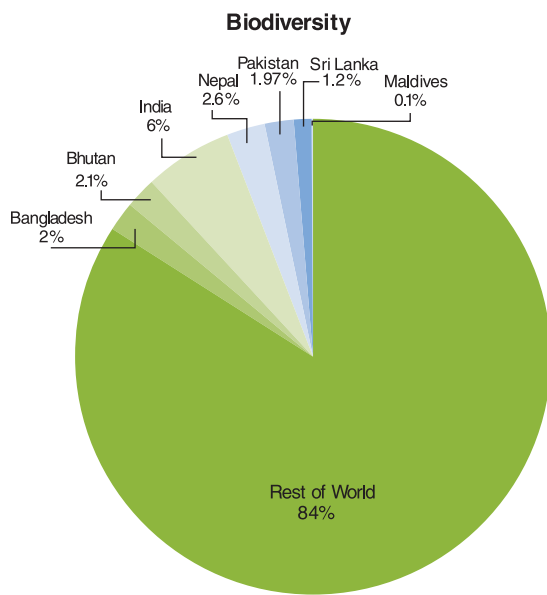
Floristic Richness and Endemism in South Asia



Faunal Diversity in South Asia



South Asia's Contribution to Global Floral Biodiversity



World Total of flora - 2,70,000
South Asia Total - 40,152 (14.8%)

The valuable services provided by the various ecosystems – the mangroves in mitigating the impact of tropical cyclones (a common occurrence in the Bay of Bengal); the wetlands in flood control, water purification and groundwater recharge; livestock biodiversity and agrobiodiversity in providing livelihood, food and shelter; and the marine and forest ecosystems as a major source of food and protein, shelter and livelihoods - have been grossly underrated and taken for granted.

Given these facts, the pressure on the region's biodiversity has been seen to be mainly arising from two major threats – subsistence and commercial. The various factors contributing to these threats and their resultant impacts have been analysed in the following sections.

Source: IUCN 1997, Red Data Book of Threatened Plants, World Resources 2000-2001

5.2 Subsistence Threats

Table 35: Faunal Diversity in South Asia

	Mammals	Birds	Reptiles	Amphibian	Fishes
Bangladesh	109	295	119	19	260
Bhutan	99	448	19	24	44
India	316	926	137	209	748
Nepal	281	611	100	43	185
Pakistan	151	375	172	17	156
Sri Lanka	88	250	144	39	65
Maldives	0	23	0	0	0
South Asia	1,044	2,928	691	351	1,458
World	4,629	9,672	6,900	4,522	25,000

Increasing population in almost all countries within the region, particularly India, Sri Lanka, Pakistan, Bangladesh and Nepal, and the resulting increase in demand for food, shelter, energy and fuel and fodder to meet their basic subsistence needs have put tremendous pressure on the different natural ecosystems that exist within the region. Traditional sustainable practices have been altered, giving way to a new culture of 'fast returns' in the form of monocultures with serious consequences in the future.

Source :

1. IUCN Red Data Book of Animals 1996
2. WCMC Database, 1998 World Resources 200-2001

Agriculture and Forests

Agriculture is the main source of livelihood for a majority of the region's rural population. In the last 10 years, the per capita land availability in the region has reduced by 18.4 per cent and now remains a meagre 0.16 ha. The reduction is attributed to the rapid increase in population and consequent fragmentation of the land.

Similarly, per capita cereal availability has also reduced by 9.4 per cent in the last 10 years. The present per capita cereal availability is only 0.16 kg, thus making it very important to ensure food security in the region at any cost. Agricultural productivity in the region is not adequate to produce sufficiently for the increasing population. The average agricultural yield at present is 2.1 tonnes/ha (excluding Maldives) after an increase of 8.1 per cent in the last 10 years. The increase is attributed to increased use of fertilisers (69 kg/ha, which is a 40 per cent increase in the last 10 years in the region, excluding Maldives) and inclusion of more area from forests into the agriculture sector. This situation has, in its turn, taken its toll by depleting and threatening the remaining biodiversity of the region.

Forests play a vital role in the economy of developing countries. A large segment of South Asia's population depends on forests for its housing, fuelwood and fodder needs. The demand for forest products and services is increasing with the growth in population and economy, even as the forest cover in the region deteriorates. A disproportionate withdrawal of forest

produce as compared to a forest's carrying capacity leads to this deterioration. Between 1990 and 1995, five countries in the region have experienced a reduction in their forest cover; the exception has been India where forest cover has increased by 36,000 ha. This increase can be attributed to an increase in commercial plantation and wasteland reclamation activities.

Plantations:

In order to cater to the increasing demand for fuelwood, fodder and timber, the area under commercial plantations has increased in five countries of the region (Bangladesh, Bhutan, India, Nepal and Pakistan) between 1990 and 1995. Forestry has been accepted as a farming practice, but has not spread in the region at the desired pace because the rotation cycle of forestry plantations takes time to give returns. It, therefore, has become limited to the bigger farmers. The slow-growing indigenous tree species have not been preferred in the commercial plantations, resulting in the introduction of fast-growing exotic tree species, which in turn has changed the composition of the local vegetation to some extent.

Plantation forestry has resulted in large-scale monocultures of teak, sal, eucalyptus, Mexican pine, etc. The yield and income data collected from different countries have influenced the developing countries to adopt these species. This has been complemented by the indiscriminate plantation of eucalyptus, even on very dry sites where other species can perform better.

Table 36: Extent of Cropland (000 ha)

	Bangladesh	Bhutan	India	Nepal	Pakistan	Srilanka
1987	9248	130	169770	2968	20920	1895
1997	8241	160	169850	2968	21600	1888
Increase	1007**	30*	80*	Nil	680*	7**

Source: World Resource 2000-2001

* indicates increase ** indicates reduction

Table 37: Change in Forest Cover (000ha)

	Bangladesh	Bhutan	India	Nepal	Pakistan	Srilanka
1990	1054	2803	64969	5096	2023	1897
1995	1010	2756	65005	4822	1748	1796
Change	44**	47**	36*	274**	275**	101**

Source: World Resource 2000-2001

* indicates increase in forest cover ** indicates reduction in forest cover

Table 38: Plantations (000ha)

	Bangladesh	Bhutan	India	Nepal	Pakistan	Sri lanka
1990	235	4	13230	56	168	139
1995	443	12	20252	140	840	138
Increase	208*	8*	7022*	84*	672*	1**

Source: World Resource 2000-2001

* indicate increase ** indicate reduction

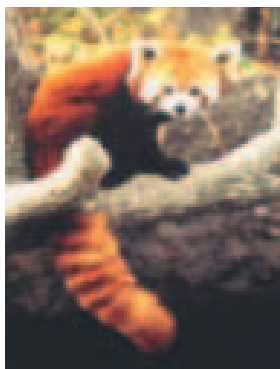
Shifting cultivation:

Commonly practised by the hill tribes of India, Nepal, Pakistan and Sri Lanka, shifting cultivation is considered to be a major cause of deforestation. It is difficult to estimate the exact extent of shifting cultivation in the region due to the dispersed and unorganised nature of the activity, however it is estimated that it is practised over an area of 63.57 million hectares by about 22.7 million people in Bangladesh, India and Sri Lanka (*State of Environment in Asia and Pacific, 1990*).

In India alone, shifting cultivation is reported to be practised on 4.37 million hectares, and in Bangladesh about 8,00,000 people depend on shifting cultivation in the northern and eastern hills, where land degradation rates are quite high (SAARC, 1992). According to the Forest Survey of India, an important cause of habitat destruction in the eastern Himalayan states of Sikkim and Arunachal Pradesh is slash-and-burn/shifting cultivation practised in nearly 70 per cent of the land area, which has resulted in the loss of nearly 57 per cent of forests in the area. However, it is not the practice itself that is faulty; the growing population pressure has led to a shortening of the fallow cycle, thus not allowing sufficient time for forest resources to regenerate, which has resulted in this practice becoming unsustainable.

Livestock grazing:

Forest grazing is also a major factor in the deforestation process. In the region's drier parts, forest grazing is traditional and endemic to agricultural lifestyles. This problem is acute in large parts of India, which suffers from a lack of adequate grazing lands and a mammoth livestock population. Forests, therefore, are the only places where livestock can find any vegetation. Occupying a little over 2.4 per cent of the global land area and 16 per cent of the human population, India accounts for nearly 20 per cent of the world's livestock population. The nation's 12 million hectares of permanent pastures are grossly inadequate for the needs of its 1,896 million heads of cattle. This large livestock population has put tremendous pressure on land, particularly the grasslands.



Red Panda – Threatened and endangered due to habitat loss, deforestation and poaching
Source: www.animal.info.org

Not only are rangelands damaged by grazing practices, but forests also suffer livestock pressure as branches are cut for fodder

or entire stands are levelled to make way for pastures. In Nepal, lopping is a prevalent practice, with nearly 40 per cent of the buffalo feed and 25 per cent of cattle feed is made of logs and leaves, thus putting tremendous pressure on the forests.

Besides overgrazing by livestock, conversion to croplands is also a major threat to natural grassland ecosystems and results in decreasing vegetation and exposes the soil to water and wind erosion. In addition, livestock trampling compacts the soil, reducing its capacity to retain moisture. This is estimated to affect 280 million hectares in the region (33 per cent of the total degraded land).

Propagation of monocultures:

Being a primarily agrarian region, agriculture practised over several thousands of years has led to the building up of a complex gene pool of thousands of crop plants adapted to local conditions. The traditional practice of planting several different varieties of crops in different seasons in an area, was intended to minimise risks from crop failure. However, the past years have witnessed the introduction of monocultures of fast- and high-yield crop varieties and livestock to increase productivity.



A view of mono culture, destroying habitat
Source: *Bangladesh: State of the Environment 2001*

Introduction of monocultures has resulted in genetic erosion of domesticated species of plants, animals and fishes. Thousands of varieties of rice, millets, oilseeds, vegetables and legumes have been lost and several breeds of domesticated animals and birds are threatened. The number of threatened breeds include three breeds of cattle, seven of sheep, five of goats, five of camels, four of horses and all breeds of poultry.

It is estimated that until recently, for the past 50 years, Indian farmers were growing nearly 30,000 varieties of rice. However, *Maheshwari (1986)* predicts that by

Humans vs Animals

An emerging impact of the increasing pressure of loss of prime wildlife habitats due to subsistence threats is increasing instances of human-animal conflict. One such conflict which is increasingly becoming common in India is between man and one of his closest wild associates, the elephant. Elephants play a crucial role in maintaining forest biodiversity and their presence is indicative of the “richness of biodiversity” and the “good state of forests, water regions and soil conditions” of the area. A habitat preferred and inhabited by elephants is also considered good for other species such as the sambhar, cheetal, panther and tiger.

The conversion of forests to croplands following drastic changes in agriculture and forest policies, and the propagation of monocultures has led to a severe loss of elephant habitat across the country. This has forced the gentle beasts to come out of the dwindling forests in search for food and raid the nearby agricultural fields – thus laying the foundation for these conflicts.

Studies conducted by the Wildlife Institute of India reveal severe scarcity of elephant habitats in several states. Conversion of natural forests to commercial timber or other monoculture plantations has drastically reduced these habitats. Between 1976-96, nearly one-third of the elephants’ habitat was replaced by eucalyptus and other quick-growing species. Similarly, the conversion of sal forests to teak plantations has also adversely affected elephant habitats.

In the north-eastern state of Arunachal Pradesh (India), the elephant’s habitat is shrinking due to the construction of roads, development activities, and increasing human settlements in the foothills and valleys. The adjacent states of Meghalaya, Nagaland and Tripura are reported to have already lost nearly 25-40 per cent of their forests, a major cause of which is the practice of slash-and-burn agriculture. Faulty policies and agricultural practices have put two species that had lived in harmony, into serious confrontation.

A similar scenario afflicts the rare Indian rhinoceros. The need for increased land by a growing human population has posed a serious threat to its habitats – and its survival. Several protected areas that have rhino populations have reached their carrying capacity, thus leading to increased conflicts between man and rhinos who reportedly raid rice fields outside the parks.

the year 2000 this is expected to reduce to 50 varieties and according to a recent estimate by *Ryan (1992)*, by 2005, India is expected to produce 75 per cent of its rice from just 10 varieties. This is expected to drastically reduce the genetic diversity of staple food crops, posing serious consequences not only for the future plant breeding programmes, but also for meeting the food requirements of the burgeoning population.

Fuelwood and fodder extraction:

In India, nearly 90 per cent of cooking fuel is biomass-based (fuelwood, cowdung and crop waste). The average annual requirement of cooking fuel in the country is 130 million tonnes, and more than 80 per cent of the fuelwood is collected from the countryside. Increased fuelwood needs have been resulting in increased deforestation to the extent that some sacred groves, which were left untouched for several years, have been damaged or cut down (*Gadgil & Vartak 1975, 1976*). In Nepal, nearly 90 per cent of all the energy consumed is still in the form of traditional fuel (WRI, UNEP, UNDP, WB, 1995). Biomass fuel comprises 73 per cent of the total energy consumed in Bangladesh.

These subsistence threats have, over the years, led to deforestation and loss of prime habitats of biodiversity. Loss of tree cover has led to erosion, landslides, silting of rivers and dams and floods downstream, resulting in economic losses. This has put to threat the existence of several species. Introduction of fast-growing monocultures has resulted in genetic erosion and loss of germplasm for evolution.

5.3 Commercial Threats

The past decade in South Asia has been witness to rapid commercial developments with diversification in urbanisation and industrialisation. There has been an unprecedented spurt in development activities with very little regard for the environment and biological wealth. The increasing demand for and commercial value of the region’s biological wealth in markets outside the region has led to increased illegal poaching and trade in biodiversity.

Urbanisation and Industrialisation

In 1980, the rate of deforestation in South Asia was about 1.7 million ha/annum. The rate of deforestation is analysed by comparing absolute figures of deforestation with the population figures. The current

annual rate of deforestation in South Asia is about 3m²/person. This is due to high populations, limited forest resources, construction of irrigation and hydroelectric projects, mining activities, land settlement programmes and road construction.

The annual demand for industrial wood in the region is about 28 million cubic metre (mm³) against a production capacity of 12 mm³. This naturally has serious consequences for the forests in the region. The countries experiencing the fastest deforestation in the region are Bangladesh and Pakistan. Bangladesh, one of the most densely populated areas in the world, has recorded 94 per cent loss of original wildlife habitat. In Sri Lanka, during 1956, the total area under forests was about 44 per cent of the total land area; in 1983, it came down to 26.6 per cent and in 1992, the forest cover stood at 20.2 per cent. Deforestation resulting from construction of irrigation and hydroelectric projects is also a major problem, especially in Sri Lanka and India. Almost 2.4 million sq. km. have been lost to deforestation in India.

Mining:

In Sri Lanka, mining for precious gemstones poses serious threats to Peak Wilderness and Horton Plains (*Hoffmann, 1988*). A sizeable area of natural forests near Peak Wilderness is reportedly extensively damaged by soil erosion as a result of mining for precious stones. There is also extensive mining for monazite, ilmenite, rutile, garnet and zircon along the Tamil Nadu coast in India. It is estimated that there are some 2,000 million tonnes of pure calcareous sand available in the lagoons of Lakshadweep which could be suitable for a number of industrial purposes (*Qasim and Sankaranarayan, 1970*).

Marine pollution:

This is a problem common to the region resulting in degradation of coastal areas and resources. The main route of marine transport of oil from the Gulf is across the Arabian Sea, where it passes the southern tip of Sri Lanka across southern Bay of Bengal, through the Malacca Strait to the Far East and Japan. The sea lane in the southern coast of Sri Lanka carries an annual volume of over 5,000 tankers in ballast or loaded conditions. Dondra Head in the southern tip of Sri Lanka serves as a focal point for ocean transport before ships change course for onward passage.

This shipping of oil, coupled with increasing emphasis on offshore oil exploration in many countries of the region, makes the northern Indian Ocean vulnerable to oil pollution. In addition, effluents from land-based sources (such as refineries) and harbour activities also



A victim of oil slick

Source: Hindu Survey of the Environment, 1993

add to the pollution. Internal movements of fuel and its decentralised storage for supplying the fishing fleet pose a potential risk of future oil spills and accidents. In the port of Chittagong in Bangladesh, for instance, nearly 1,000 ships and over 40 oil tankers are handled annually, while the port of Mongla services nearly 500 ships. The estimate of crude oil spillage in Chittagong is about 6,000 tonnes annually, while crude oil residue and waste water effluents from the refineries amount to about 50,000 tonnes per year (*Khan, 1993*).

Industrial effluents and sediments:

In recent years, industrial effluent discharges have become a major source of land and water pollution in the region. Effluent discharge from the textile dyeing and printing industries into the ephemeral streams have contaminated the surface and groundwater downstream. Use of such toxic water for irrigation has also degraded the land. It has been reported that beach tar along the west coast of India is now a severe problem, with total deposits of up to 1,000 tonnes per year (*GESAMP, 1991*). Considerable damage has been noted on some of the Indian atolls and coral reefs of the Andaman and Nicobar islands. In Pakistan, mortality among flora in the harbour of Karachi and the tainting of commercial edible shellfish have also been reported. The presence of toxic heavy metals such as mercury, cadmium and lead, has also been detected in the seas and coastal waters of the region.

The amount of sediment in the coastal areas of the South Asian region is high, mainly due to soil erosion. Annually, about 1.6 billion tonnes of sediments reach the Indian Ocean from rivers flowing from the Indian subcontinent. The total annual sediment load of the river system of Bangladesh alone amounts to about 2.5 billion tonnes, of which the Brahmaputra carries 1.7 billion tonnes and the Ganga, 0.8 billion tonnes (*UNEP, 1987*).

Tourism:

Increased tourism continues to be a source of pressure on coastal resources. In fact, coastal tourism is recognised as the most rapidly growing sector of tourism world-wide. In Sri Lanka, between 1970 and 1990, tourism grew by nearly 300 per cent and is expected to increase by another 50 per cent by the end of the century. Sri Lanka's coastal resources are expected to come under increasing threat from this economic sector. Marine-based tourism is on a dramatic rise in the Maldives as well. It contributes to more than 19 per cent of the country's GDP and nearly 30 per cent of the government revenues (*Government of Maldives, 1998*). It poses a serious threat of environmental degradation, particularly through construction of hotels, beach clubs and marinas which involves infilling and dredging.

Visitor pressures pose a threat to some fragile areas in the Horton Plains in Sri Lanka - especially to a number of rare grassland species. The number of visitors to Adam's Peak has increased dramatically over the last four-five decades. Pressure from tourism has led to degradation of forests, changes in density and composition of species, and a loss of rare plants.

In Sikkim (north-east India), a biodiversity hotspot, unplanned domestic tourism is adversely affecting the biodiversity of the region. Tourists invade ecologically fragile areas such as alpine grasslands, trample and uproot plants, leaving a trail of destruction behind them. Hotels and lodges in the state consume about 40 kg/day of oak, mahua and rhododendron bushes for firewood. In several areas in Sikkim, felling of fir trees for construction of hotels and lodges has resulted in accelerated erosion. The growth of trek tourism has resulted in the use of pack animals like yak, which consume nearly 30 kg of fodder - which puts further strain on the forests.

Unsustainable Fishing Practices

Increasing population pressures and rising demands for fish and other marine resources have resulted in the introduction of modern fishing methods and technologies, which have completely transformed the industry in the region. Marine catches in South Asia have recorded a constant increase indicating that the maximum exploitation levels have not yet been reached. However, the increased mechanisation and destructive techniques of fishing pose a serious concern and threat to the marine biodiversity of the region.

In the Maldives, while there is no evidence that exploitation of the tuna fisheries is exceeding the sustainable yields, the potential for this to happen in the future is great. Tuna fishing is carried out by traditional motorised dhonis which are dolphin-friendly. The catch in all sectors of the fin fisheries have increased, but there is no indication yet that the maximum sustainable yield has been reached. There are, however, some indications of local over-exploitation of reef fishes in Malé atoll, and populations of giant clams, sea cucumbers and lobsters have reportedly declined due to intensive fishing.

In Sri Lanka, the use of motorised crafts with insulated fish hold facilities for increased catches is reported to have resulted in threat to some species of dolphins. Fishing by local and foreign trawlers using bottom-set nets and long drift nets is reported to have had adverse effects on the marine biodiversity (*Biodiversity Conservation in Sri Lanka, Framework for Action, Ministry of Forestry and Environment, 1998*). Traditional fishing using non-motorised crafts (dugout canoes and catamarans) and techniques such as angling, fill netting (natural fibre nets) and beach seining have received a setback due to depletion of shore fish resources and competition from mechanised crafts.

Besides fish, lobster resources in Sri Lanka's southern coast have depleted due to indiscriminate harvesting of gravid females and juveniles. There is extensive collection and harvesting of lobsters and crabs (in 1998, it was 164 and 486 metric tonnes respectively) inspite of a ban on their collection. The export trade in ornamental fish ranks next to that of prawns and lobsters in terms of value and levels of collection for sale and export. Nearly 200-300 species of fish and invertebrates are being exported by Sri Lanka for the aquarium trade.

Seven of the 20 edible species of sea cucumbers (*Holothuria*) found in the Indian Ocean are present in Sri Lankan waters. Till recently, traditional harvesting was limited to the estuarine environment; but to meet the increasing demand, sea cucumbers are being harvested unsustainably in large numbers. Export figures have recorded a decline from 272 metric tonnes in 1997 to 203 metric tonnes in 1998 (*Joseph, 1993; Brown, 1997*). Sea cucumber (*beche-ce-mer*) catches are entirely exported to Singapore and Hong Kong. The decline is attributed to the declining population in the region.

Coral destruction:

Most coral reefs in the region are under increasing threat and have been degraded due to causes such as coral mining, fishing with explosives, sedimentation, pollution, removal of reef organisms, anchoring, harbour construction and removal of coral for curio trade. However, the latest threat to these reefs is reported to be from the increasing temperatures of the oceans (see box).



Coral Reefs under threat

Coral mining is a major concern in the Maldives where, due to severe shortage of construction material, there is no option but to resort to coral mining; coral rock constitutes the main building material. It is estimated that nearly 94,000 cu. m. of rock was mined in Maldives

between 1975-1985. Recent estimates are between 2,00,000 and 1,00,000 cu. m. of coral rock annually (*Rajasuriya, Arjan and White, Alan: Status of Coral Reefs of the World, 1998*).

Tourism is a major source of income for the Maldivian economy. It also incorporates extensive reef-related activity; tourist resorts in the area have expanded from two in 1972 to 74 today. Besides this, corals also face natural threats which include the large populations of the Crown-of-thorns starfish, which causes considerable damage to reefs around Sri Lanka, Maldives and India. (*D. Bruin, 1972; Rajasuriya and Rathnapriya, 1994*). In Sri Lanka, however, most known reefs - particularly the readily accessible near-shore reefs - have been degraded due to human-induced damage (*Ekratne, 1990b, 1997c*).

Aquaculture:

Mangroves and associated lagoons and estuaries which are productive ecosystems, function as nurseries for several species. Loss of coastal habitats includes substantial loss of mangrove forests in South Asia, particularly for making way for the construction of shrimp ponds and for paddy rice cultivation, with negative impacts on commercial fisheries that rely on species using the mangroves as nursery areas. Fish and shellfish have suffered due to reduced water quality, clearance of mangroves for prawn farming and shrimp ponds and also the wide use of chemicals in prawn and shrimp farming. Prawn farming has cleared

Table 39: Threats to South Asian reefs

	Erosion/ Pond clearance	Construction	Pollution	Over collection	Recreational use	Fishing Activities
Bangladesh			Sewage* industrial *	shells, corals	tourism	Dynamiting
India agriculture	Deforestation, mining	Coral & sand industry* Sewage	Oil,	Trochus particularly in Andaman & Nicobar Island	Tourism*	Dynamiting
Maldives	infilling, dredging, coral mining	Hotels, airport, Shipping, Sewage	Industrial* corals	Shells, fish, Divers* Collection for aquaria	Anchor damage dynamiting	Spearfishing
Sri Lanka		Coral mining	Coconut soaking	Fish, corals, shells, reef fishes to meet demands of tourism	Tourism collection for aquaria spear fishing.	Anchor, damage dynamiting,

Source: UNEP/IUCN (1988). Coral Reefs of the world Vol. 2. Indian Ocean, Red Sea & Government.

* Potential threat . The 1998 Coral bleaching event mainly attributed to increase in ocean temperatures has seriously affected the reefs of this region with nearly 60.80 per cent losses reported.

ecologically sensitive mangrove areas (359.5 ha) that were incompatible with shrimp farming, which boomed in 1983-1992 (Jayasinghe, 1995).

Identical problems because of shrimp culture have occurred in Bangladesh, India, and Sri Lanka. One example of this destructive sequence of events is the Chakaria Sunderbans in eastern Bangladesh, which has been almost completely cleared for aquaculture (ESCAP, 1995a).

There are also reports of reduced water quality, salinisation of paddy yields and reduced rice yields (50 per cent) due to tiger prawn farming activities in the area – mostly the results of land-fill and reclamation activities for housing and infrastructure.

Consumerism and Increasing Market Demand

In the past few years, the region has witnessed rapid escalation in incidents of poaching, trading and smuggling of wild flora and fauna due to increased demand and commercial value of wildlife and their parts. This demand is largely from other parts of the world. Loss of traditional values, lack of knowledge



Wetlands of Bangladesh

Source: Bangladesh Centre for Advanced Studies

and awareness, and poverty and unemployment have led to mercenaries and middlemen exploiting people for their services in this lucrative and insensitive trade.

Illegal trade in fauna and flora:

South Asia - and India in particular - has been the focus of international attention due to the drastic fall in the

Sunderbans: Threatened Home of a Threatened Species

Sunderban, meaning the 'beautiful forests', derives its name from the predominant tree - *Heritiera fomes*, locally called the 'Sundari' tree. It is one of the world's largest contiguous patches of mangrove forest, extending up to 10,000 sq. km., of which 4,262 sq. km. lies in southern West Bengal (India) and the remaining greater part extends into Bangladesh. It is representative of the Indo-Pacific type of mangrove flora in the subcontinent, and the only mangrove habitat in the world with a tiger population.

The Sunderbans exhibit three distinct ecological zones and hold about 25 species of forest flora of which the Sundari, Gewa (*Excoecaria agallocha*), Goran (*Ceriops decandra*) and Keora (*Sonneratia apatala*) are predominant.

These mangroves support a wide range of mammals, birds, amphibians, reptiles and crustaceans. Some famous residents of Sunderbans include the Royal Bengal tiger, estuarine crocodile, spotted deer, Indian wild boar, fishing cat, monitor lizard and nearly 300 species of birds. The aquatic fauna includes more than 250 species of fish, prawns and crabs. Several endangered turtles (*Lepidochelys olivacea*), terrapins (*Trionyx gangeticus*, *Batagur baska*, etc) and the Gangetic dolphin (*Platanista gangetica*) are found here. Crustaceans, found in abundance, account for nearly 40,000 tonnes of fiddler crabs, 1,00,000 tonnes of mud crabs, and large quantities of shrimps, prawns and lobsters.

The biological richness of this region has been a source of employment and livelihood for nearly 5,00,000 people living in its vicinity. These forests have been under some kind of management for commercial exploitation of resources. However, over the years the increasing population and its increasing dependence on this ecosystem have led to its unsustainable exploitation. The Sundari trees have suffered a nearly 45 per cent reduction. Sundari trees are harvested mainly for timber while Gewa is used as pulpwood in newsprint mills and as matchwood, and Goran is felled for fuelwood. Most of the key species have recorded a decrease in numbers over the last 20 years.

The unsustainable exploitation has caused considerable stress on this fragile ecosystem resulting in nearly four major species - the Javan rhinoceros, wild buffalo, swamp deer and the hog deer - becoming extinct. The famous threatened resident, the Royal Bengal tiger, is also increasingly getting rarer along with the estuarine crocodile and deer. It is feared that this continued exploitation would not only affect the ecology of the ecosystem in the near future, but also have severe adverse impacts on its economic viability as a source of livelihood.



Wildlife : tiger

Source: Bhutan: State of the Environment 2001

population of the Bengal Tiger (*Panthera tigris tigris*) as a consequence of indiscriminate poaching and killing for meeting the increasing market demand for tiger parts in Oriental medicine.

Besides the tiger, the illegal trade in faunal products include some of the most endangered species - the rhinoceros, musk deer, bear, elephant, the falcon and other birds such as parakeets. Trade in wildlife and its parts in the region is reported to be next only in volume to the trade in narcotics and illegal arms.

Falcons are smuggled to West Asia from India and Pakistan. In Pakistan, lizards and snakes are killed for their skins and crocodile hunting is a popular sport and recreational activity (*Government of Pakistan, 1994: Pakistan Conservation Strategy*). Rhino horns are used extensively for ornamental items such as handles for daggers etc. in Nepal, and tigers and leopards are killed for their skins and bones.

Medicinal plants, over-exploitation and biopiracy: The South Asian countries hold immense reserves of medicinal plants and trade in medicinal plants is widespread. It is estimated that this trade, between developed and developing nations, would touch an all time high of US \$500 billion by the end of 2,000 and the value of germplasm from developing countries to the pharmaceutical industry would be around US \$47,000 million by the turn of this century.

At least 90 per cent of the plant species used in the industry are collected from the wild. A 1997 World Bank report says that revenue earned by India from the export of crude herbal drugs in 1994-95 was \$53.2

million (Rs. 197 crore). Medicinal plants-related trade in India is worth Rs. 550 crore; Rs. 900 crore worth of herbal medicines are produced annually in India. Over 7,000 licensed manufacturers supply 55,000 pharmacies and 14,000 herbal dispensaries with plant-based products. Nearly 300 million Indians still use medicinal plants and herbs for primary health care. Around one million village healers treat local communities in various parts of India. While Ayurveda, Siddha and Unani together use at least 1,200 medicinal plants, tribals as well as rural communities use over 6,000 medicinal plants for treating a variety of ailments. In the Indian subcontinent, approximately 1,000 species are used in food and forage, and about 7,000 species in indigenous folk medicine. In India, nearly 800 native plants are used (*Kaul et al, 1990*).

Several species of plants are threatened with extinction due to commercial over-exploitation in India and Nepal. Some of these are *Coptis teeta*, *Rheum nobile* and *Rheum emodi*, and several species of orchids, etc. Commercial export of medicinal plants and their products in Nepal has resulted in a dramatic rise in Nepal's foreign earnings.

Tibet's Medicinal Resources

According to Dr. Tenzin Choedak, senior personal physician to His Holiness the Dalai Lama, there are over 2,000 medicinal plants in Tibet. These plants have an immense potential to cure various dreaded and common ailments. For example, *Taxus wallichiana*, a tree found in the forests of Tibet, is the source of the allopathic drug taxol, which is regarded as one of the most effective remedies for cancer. The Tibetan plateau is rich in such medicinal plants, which are widely used in allopathic, homeopathic, Tibetan and Chinese medicines. Some of these are *Gastrodia elata*, *Angelica sinensis*, *Coptis tectoides*, *Picrorhiza scrophulariiflora*, *Rheum officinalis*, *Magnolia officinalis*, *Terminalia chebula*, and *Liolyophora phalloides*.

The richness of the plateau has been exploited and damaged by unregulated extraction of its resources. For example, in the six years from 1987 to 1992, in the region of Amdo Golok in eastern Tibet alone, medicinal plants worth several hundred tonnes had been extracted. Among those taken out were *Rheum palmatum* (chumtsa) - 1,017.5 tonnes; *Fritillaria sp.* (abhika) - over 30 tonnes; *Cordyceps sinensis* (Yartsa gunbu) 9,105 kg; and the *Gentiana robusta* (Kiche) - 36 tonnes. In 30 years, 6,105 tonnes of chumtsa, 180 tonnes of abhika, 54.9 tonnes of Yartsa gunbu, and 28.5 tonnes of deer antlers have been extracted.

Source: www.tibet.com/Eco/Green97/biodiversity.html

An aspect of the whole issue is that the over-exploitation is not only leading to economic loss, but also to biodiversity loss. This is because most companies, after plundering one area, look for greener pastures.

Patenting:

Most of the biodiversity is found in the Third World countries and in communities living in remote areas. There are several instances of germplasm being extracted from biodiversity-rich countries and the subsequent patenting of products based on these genes for commercial gains. Local communities who have been traditionally using these plants and animal varieties for their sustenance over several generations for centuries, have been deprived of the right to their own resources due to patenting.

Illegal Exploitation of and Trade in Medicinal Plants

- *Rauvolfia serpentina*, a herb used in the treatment of high blood pressure, is on the verge of extinction due to overexploitation for commercial purposes.
- The entire plant of Daru haldi (*Berberis aristata*) is uprooted for extracting berberine which is used in preparing eye medicines.
- *Coleus forskohlii* is a medicinal plant which has been traditionally used to cure cardiovascular diseases, abdominal colic, insomnia, etc. Hoechst has taken six patents covering uses for compounds extracted from this plant.
- *Taxus baccata*, known locally as Rakha, found in Himachal Pradesh, has properties of curing cancer. Researchers in the West use Taxol, its by-product, in the manufacture of anti-cancer medicines. Its roots are uprooted, thus causing soil erosion.
- In Garhwal and Kumaon, a private firm has been involved in indiscriminate illegal trade of genetic materials.
- In the Western Ghats, the Americans and British nationals posing themselves as tourists, are collecting samples of plants, soils and insects. They take all these back home to study.
- In Arunachal Pradesh, India, some companies have offered Rs 300/kg to collect *Coptis teeta*, commonly known as Mishmitita, which cures malaria. Local people are enticed by these companies to overexploit this plant.
- Tetu Lakda (*Nothatodytes foetida*), a tree found in the forests of southern India, is facing a threat from traders for its use in the treatment of cancer. Twigs of this tree are available for just Rs 9 per kg. However, after being processed, the extract is sold by pharmaceutical companies for \$15,000 per kg.

5.4 Other Threats

Alien Invasive Species

Introduction of exotic flora and fauna is an increasing threat to the endemic biodiversity of South Asia. Some of these introductions in the region - some consciously and some due to oversight - are the acacia, eucalyptus, lantana, etc. Invasive species have flexible habitat requirements; most of them are extremely aggressive and quickly establish themselves as the dominant species.

In Bangladesh, invasive floral and faunal species have been intentionally introduced for increasing productivity. Two controversial genera of flora introduced to the country are the acacia and eucalyptus, which exercise adverse effects on soil fertility, water, the humus-dependent species and terrestrial wildlife. There are also several species of invasive fish, the most 'disastrous' being *Clarias gariepinus*, *Pangasius giganticus*, *Tilapia mossambica* and *Oreochromis niloticus*. Bangladesh has a high fish diversity due to its extensive wetlands, but indiscriminately introduced invasive species have spread rapidly during severe floods, posing a threat to the indigenous fauna. As a result, 54 indigenous fish species are now threatened with extinction in the country. Some invasive fish species are predators of indigenous aquatic fauna, and the *Tilapia mossambica* and *Oreochromis nitrous* compete with indigenous fish species and occupy their niches.



Bleaching of corals in Maldives
Source: www.noaa.gov

In Sri Lanka, several alien plants, including *Salvinia molesta*, *Eichhornia crassipes*, *Lantana camara*, *Mimosa pigra*, *Opuntia stricta*, *Lantana camara*, *Eupatorium riparium* and *Myrosylon balsammum* have been reported to have spread at alarming rates. Invasive fauna in the country include six species of freshwater fish (*Oncorhynchus*, *Sarotherodon mossambicu*, *Trichogaster pectoralis*, *Poecilia reticulata*, *Chitala chitala* and *Hypostomus plecostomus*), two species of snails (*Achatina fulica* and *Pomacea spp.*) and two species of mammals (*Rattus rattus* and *Bubalus bubalis*).

In India and Pakistan, exotics account for up to 40 per cent of the flora. In Pakistan (Sind) the figures are higher. The exotic plants are mainly from South America or Mexico. *Eupatorium adenophorum* (in north-eastern India) and *Parthenium hysterophorus* (in the south Indian plains) are the two most invasive species in the Indian subcontinent. *Eichhornia crassipes* is an alien invader of the water bodies.

Disasters and Episodic Events

The South Asian region is prone to natural catastrophes and episodic events such as cyclones, earthquakes, floods, etc. which wash away the topsoil, thus directly affecting the floral vegetation. The recent years have

been witness to an unprecedented warming of the oceans, particularly around the Indian Ocean, due to El Nino. This has adversely impacted on the region's coral reefs, a fragile ecosystem (*see box*).

The impact of all the above threats, arising from subsistence and commercial pressures, have resulted in an adverse impact on the biodiversity of the region. The past few decades has already witnessed the extinction of the Javan rhinoceros from India and Bangladesh, and 23 other species including the cheetah and the pink-headed duck are fast disappearing from India. According to the 2000 IUCN Red List, India ranks second in the world with the largest number (80 species) of threatened mammals; Sri Lanka ranks third, next only to Indonesia and Brazil, with 280 species of threatened plants.

Responses

Inspite of the serious threats and the resulting impact as analysed in the preceeding sections, South Asia is still home to nearly 15 per cent of the world's floral and 12 per cent of its faunal biodiversity. This can be attributed to the fact that several countries within the

The Vanishing Ocean Rainforests

Coral reefs, often referred to as the "rainforests of the oceans" are a critical global resource, both biologically and in socio-economic terms. Besides being home to an estimated one million different species, they are a major source of food for coastal communities and are the basis for a huge tourism industry, providing both livelihood and foreign exchange earnings. They are also the sources of medicines and are considered as one of the most productive ecosystems on the earth.

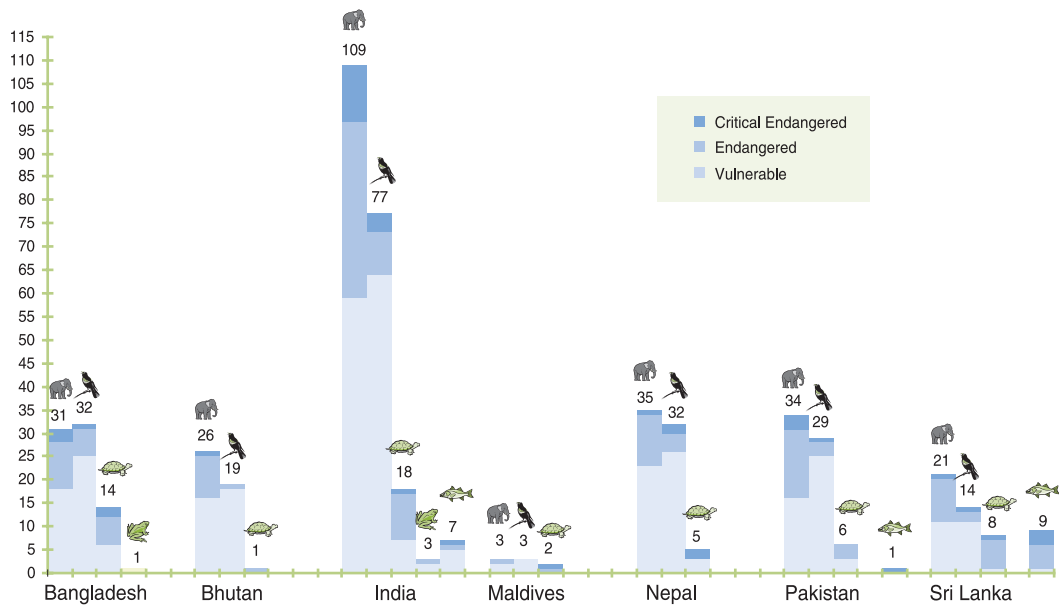
In South Asia, coral reefs are mainly found in the Arabian Sea and the Indian Ocean along the Gulf of Kutch (Gujarat) in India, western India, the Lakshdweep islands, the Andaman and Nicobar islands, the Gulf of Mannar in India and Sri Lanka, and throughout the chain of islands in the Maldives. The distribution of coral reefs in the region is as follows: India (18,000 sq. km.), Maldives (7,64,000 sq. km. approx), Sri Lanka (31,700 sq. km.) and Bangladesh (12,800 sq. km.).

Since the past two years, South Asian reefs have suffered extensive damage due to the increase in ocean temperatures, which is thought to be related to the El Nino phenomenon. The increasing temperatures result in severe coral bleaching. Corals being extremely sensitive to even small changes in temperature, even an increase of one degree above the normal results in them losing their vibrant colours (due to death of the algae which inhabit them and give the corals their brilliant colours).

Coral reefs in the Maldives were reported to have suffered heavy damage during the 1998 ocean warming phenomenon, although some signs of partial recovery have been reported. Maldives reported almost 95 per cent mortality of mostly *Acropora* communities, soft corals and anemones from North Male and Ari Atoll. Many massive corals are still under stress and partially bleached.

Similar bleaching was reported at Kavaratti and Lakshadweep islands in India. In May 1998, the Andaman sea was reported to be two degrees warmer than usual. A study of five sites along a 40-km stretch around the islands conducted by SANE (Society for Andaman and Nicobar Ecology) indicates that there was 100 per cent bleaching in the Andaman reefs and 30-70 per cent in Nicobar. Scientists of the National Institute of Oceanography, Goa in India found major damage to coral reefs of the Kavaratti and Kadamat islands in Lakshadweep.

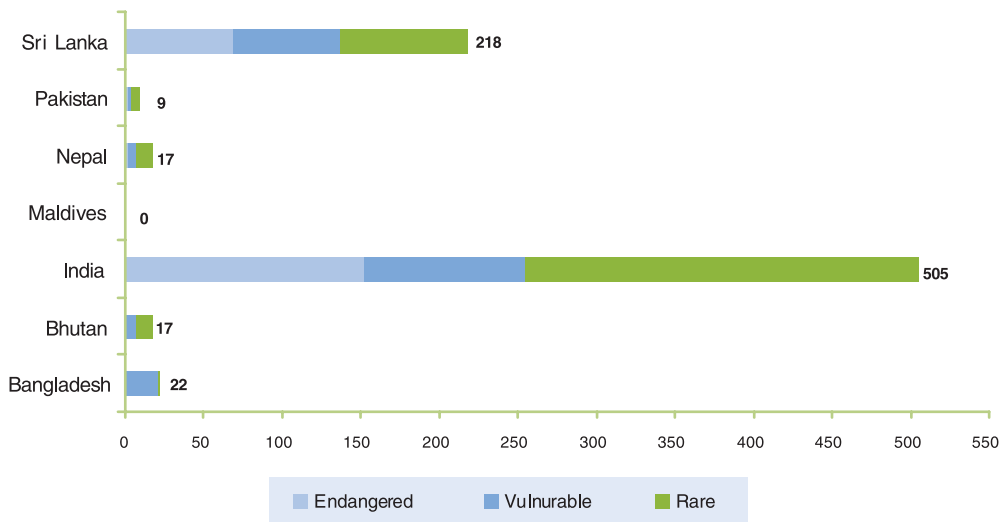
Threatened Fauna of South Asia



	Bangladesh					Bhutan				India					Maldives				Nepal				Pakistan				Sri Lanka								
VUL	18	25	6	1	0	16	18	0	0	0	59	64	7	2	5	2	3	0	0	0	23	26	3	0	0	16	25	3	0	0	11	11	1	0	1
EN	10	6	6	0	0	9	1	1	0	0	38	9	10	1	1	1	0	1	0	0	11	4	0	0	0	15	3	3	0	0	9	2	6	0	5
CR	3	1	2	0	0	1	0	0	0	0	12	4	1	0	1	0	0	1	0	0	1	2	2	0	0	3	1	0	0	1	1	1	1	0	3

Source: WCMC Database, 1998 Web: www.unep-wcmc.org

Threatened Flora of South Asia



Species	Bangladesh	Bhutan	India	Maldives	Nepal	Pakistan	Sri Lanka
Endangered	0	1	152	0	2	2	69
Vulnerable	21	6	102	0	5	2	68
Rare	1	10	251	0	10	5	81

Source: IUCN Red Data Book of Plants 1997

region, particularly India, Nepal, Bhutan and Sri Lanka, have had strong cultural and religious traditions which stress on the importance of environment and conservation. For example, the setting aside of land by local communities as 'sacred groves' (due to religious significance of the flora present in the area) is one of the oldest known conservation practices in the region.

The importance of the conservation of wild plant resources is officially recognised by most countries within the region. Bhutan is not a party to any international convention concerned with protecting natural areas; neither does it participate in the UNESCO Man and Biosphere Programme. But at the national level, Bhutan has maintained a strict conservation policy and places great emphasis on maintaining at least 60 per cent of its land area under closed forests in order to sustain climatic equilibrium and to prevent soil erosion. Within the region, Bhutan has the distinction of being the only country with 70 per cent forest cover and nearly 22 per cent of its land under protection.

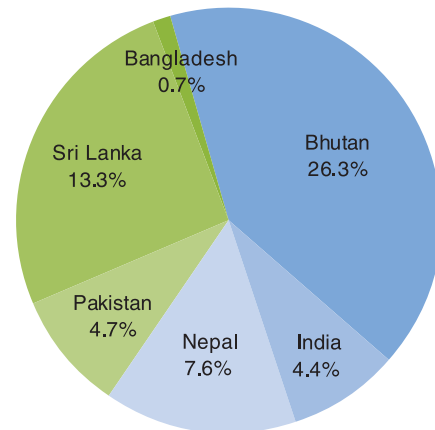
Across South Asia's other nations, there exists an extensive system of protected areas which offer shelter to diverse ecosystems and habitats of endangered and endemic species of wildlife. However, because of the ever increasing demand for space to accommodate the burgeoning populations, not all ecosystems have and can be brought under protection. At the same time, those areas which have been accorded some form of protection are not totally protected, as they are plagued by problems of weak legislation, untrained and limited personnel, and inadequate motivation and training. Besides insufficient funding, inappropriate equipment and lack of practical and effective management plans often render these protective measures ineffective.

At the national level, most countries have come up with National Biodiversity Action Plans which outline the threats to the biodiversity and the proposed planning for promoting conservation. Bangladesh has commenced preparation of such an action plan which is expected to assist in assessing its biodiversity and formulating a plan for sustainable development using the resources it provides. Maldives too is currently working on preparing and implementing a national biodiversity strategy and action plan. This entails identifying sites of high biodiversity significant for conservation, tourism and other sustainable development opportunities.

Nepal is in the process of preparing a National Biodiversity Action Plan under the GEF-funded Biodiversity Conservation Project. The plan is expected

to provide a comprehensive strategy for coordinated efforts by all the stakeholders related to forestry, wildlife, agriculture and tourism sectors, as well as communities. It will also facilitate identification of gaps in biodiversity conservation initiatives and assessment of emerging trends of Nepal's biodiversity.

Protected areas cover in South Asia
as percentage of total land cover



The National Environment Action Plan of the Maldives outlines actions, policies and measures to protect and conserve the fragile biological diversity, particularly the marine ecosystem and integrated sustainable reef resources management. India has developed a National Policy and a Macro-level Action Strategy on Biodiversity, which is aimed at providing the framework for preparing detailed action programmes at the macro level for conservation and sustainable use of the biological diversity that exists in the country.

Sri Lanka's Biodiversity Conservation Plan (BCAP) forms a broad framework for action for biodiversity conservation at the national level. It was prepared through wide stakeholder participation by the government and NGOs. A biodiversity secretariat has been set up by the Ministry of Forestry and Environment for implementation of BCAP, and initiatives include development measures for valuation of biodiversity, conservation of medicinal plants, establishment of a legal task force to identify gaps and recommendations in national legislation.

An increasing trend of decentralisation and devolution of forest management responsibilities to local government, user groups and local communities is evident from the Joint Forest Management Programmes in India and from the transfer of forest lands to local user groups in Nepal. Bangladesh, Bhutan and Pakistan have completed the National Forestry Action Programme Framework (NFAP) planning phase and are in various stages of programme

Table 40: Adherence to International Conventions in South Asia

Country	CITES	World Heritage Convention			Ramsar (Wetlands) Convention			Convention on Biological Diversity	
		Date	No. of sites	Area (ha)	Date	No.	Area (ha)	Date of ratification	of sites
Bangladesh	Ratified (20/11/81)	1983	1	1,39,700	1992	1	59,600	1995	
Bhutan	-	-	-	-	-	-	-	-	-
India	Ratified (20/7/76)	1977	5	2,81,012	1981	6	1,92,973	1994	
Maldives	-	-	-	-	-	-	-	-	-
Nepal	Accession (18/06/75)	1978	2	2,08,000	1987	1	17,500	1994	
Pakistan	Accession (20/04/76)	1976	-	-	1976	12	62,908	1994	
Sri Lanka	Accession (04/05/79)	1980	1	8,864	1990	1	6,216	1994	

Source : IUCN (1998) & WCPAM Membership

execution, while planning activities are underway in India. Nepal and Sri Lanka, who developed their action plans long ago, are presently reviewing and revising their NFAPs.

Some countries in the region, particularly India and Nepal, have initiated conservation projects targeting specific species which are endangered and need imminent attention.

At the regional level, the United Nations Environment Programme (UNEP) in collaboration with the South Asia Cooperative Environment Programme (SACEP) and governments in the region, has initiated the South Asian Seas Regional Programme, to promote the protection of the marine environment and sound management of the South Asian seas. Following the 1998 El Nino-related rise in sea surface temperatures in the region and the resulting extensive damage to coral reefs, there seems to be an increased awareness and need felt in the national government sectors and resource-user groups that better management is required for future sustainability of coral reef resources in South Asia. Trainings conducted by the Global Coral Reef Monitoring Network and SACEP have enhanced monitoring capabilities. While India, Sri Lanka and Maldives have initiated new programmes at the national level, in Pakistan and Bangladesh the new programmes will be conducted under the integrated coastal zone management planned in the near future (*Rajasuriya, Arjan, 1998*). At the international level too, most countries of South Asia are party to different treaties/conventions aimed at promoting and protecting biological resources.

Besides efforts by the governments, a large number of initiatives towards conservation of biodiversity have been undertaken by non-governmental organisations (both national and international), community-based organisations, individuals and institutions, particularly in the past few decades. Most of these efforts have been towards awareness generation, involving local communities in planning and implementation of conservation projects, environmental education by involvement of children and the documentation of traditional conservation practices.

In spite of the responses at different levels, the destruction of biodiversity continues unabated in the region. The loss of the region's biological resources would result inevitably in serious consequences for not only the people within the region, but also for those in other far-flung corners of the world who benefit from the region's biological richness. While the South Asian biodiversity may hold cures for some widespread fatal diseases such as AIDS and cancer, the region as a whole needs to set up systems for using this wealth as a bargaining chip with the rest of the world.

However, with development processes that are accelerating, Bhutan today stands at the crossroads. The kingdom is faced with many difficult issues related to environment, development and population growth and associated demographic changes. The country's future depends on a range of decisions and strategies to be implemented in the coming years, because the right decisions can lead to greater prosperity, greater

Isolation: a Solution to Greenery? Green amidst brown

While many South Asian countries have seen their natural resource base degraded by rampant deforestation, soil erosion and the consequences of over population and pollution, there is one bright spot tucked away in the corner of the Himalayas – the mountain kingdom of Bhutan, which is one of the last remaining green patches in the mountains.

The country remained isolated, by deliberate policy, for centuries, and only began to open up to the rest of the world in the late 1960s. When it was realised what was happening to its neighbours, the government became determined not to develop in the same way, and adopted a strict conservationist policy. In 1974, it stipulated that 60 per cent of the country should remain under forest cover in perpetuity; this was no small target as about 35 per cent of its land is above the tree line. In 1979, it stopped private contractors from cutting timber; national production fell by 87 per cent in two years. Felling by shifting cultivators was also banned, though less successfully. Another law cut the population of goats - one of the great destroyers of the land - by four-fifths and restricted them to stalls where they do no damage. Lastly, the government has started giving every village a patch of forest to manage as its own responsibility

(WWF, 1994).

diversification of the economy and greater security against natural and man-made threats. Though adopting an appropriate path for development that sustains the country's natural resource base will not be easy, the Royal Government of Bhutan is committed towards following its strong tradition of environmental conservation and preservation. The 73rd session of the National Assembly in 1995 mandated that the country must at all times keep 60 per cent of its area under forest cover. Five years since, the pro-environment approach is explicit in the kind of developmental policies that the government has undertaken towards sustainable forest management.

Emerging Priorities/Challenges for the Future

The different countries within South Asia have a wide diversity in terms of culture, history, religion and economy, but as a regional entity, there is a lot of commonality which makes the region a whole unit. It is being felt increasingly that within the region, there is a lot that one country can learn from the others and the region as a whole if united, and can jointly strive towards self-reliance and sustainable development. However, before the mechanisms for the same are set in place, there is a need for greater cooperation and

regional networking. The emerging priorities for protection and sustainable use of the South Asian biodiversity include:

Assessing and documenting the biodiversity wealth of the region:

- Integration of efforts being made at the national level in the countries within the region to assess and document the biological wealth of South Asia as a region.

Promoting regional cooperation and planning:

- Regularising collaboration of scientific and other personnel working in the areas of integrated biodiversity conservation for formulating regional action plans.
- Establishing a mechanism for bringing together people (government officials, community representatives, NGOs and academicians) from the different countries of the region to share their experiences and approaches to biodiversity conservation on a regular basis. This would provide an ideal forum for the exchange of stories of success and failure and an opportunity to learn from failures and replicating and building on successes.
- Promoting regional planning practices to integrate protected areas planning and management with surrounding land use. Variation in the categories of protected areas and regional planning will enable formulation of comprehensive conservation strategies to manage protected areas more effectively, including the management of fragmented habitats and corridors linking protected areas.
- Identification of trans-boundary issues related to protected areas requiring cooperative management.
- Developing the capacity of research institutions within the region to meet the requirement of research support for biodiversity conservation.
- Seek enhancement of budgetary allocations from governments by raising awareness levels among planners, decision-makers and politicians.
- Share fund-raising experiences among countries of the region to take advantage of available funds from bilateral and multilateral sources.

Biodiversity as a bargaining chip in international market to curtail bio-piracy:

- Lack of adequate knowledge and assessment, and poor documentation of the precious biological wealth, increasing unemployment and poor awareness among the common masses, and inadequate regulation have resulted in multinational companies operating within and outside the region as well as individuals in pursuit of their commercial motives, plundering the biodiversity wealth.
- Instead of using the potential of this substantial wealth as a bargaining chip, the countries in the region end up incurring enormous expenditures in importing essential and important drugs, medicines and other products - the raw materials for most of which were surreptitiously taken from the region itself.
- Bio-prospecting as a tool to mitigate bio-piracy can be effectively employed.

The regional regulating authority and the legislation could look into the following issues:

- *Royalty from joint ventures and domestic companies:* Establish a mechanism for demanding a one time royalty from joint ventures and domestic companies with provision for annulment of the agreement in case of violation of law. This must also ensure that the local communities who have been the guardians of our natural wealth for centuries and from generations, receive equitable share of the benefits.
- *Integrating the importance of conservation in all sectors:* Political will and government support for incorporating and integrating conservation and sustainable use of biological resources into all the economic and development sectors.
- *Strengthening the information base on biodiversity:* Inventorisation and documentation of local communities' traditional knowledge of biological resources, particularly of plants (ethnobotany), and their involvement in any measure that is taken to curb bio-piracy.

Effective demarcation incorporating habitat zones:

- Countries within the region should strive to bring more areas under protection within the region.
- National systems plan for protection of terrestrial and marine biodiversity.

- The gap analysed in the National Plan can be addressed in the planning for a regional systems plan incorporating trans-boundary issues and concerns recommending demarcation of protected areas on a bio-geographic basis for the region as a whole.
- Management of marine areas and wetlands needs to be integrated with land use in the surrounding areas in coordination with other agencies and involved parties, such as fisherfolk, coastal communities, etc.
- Setting up of a networking monitoring system to prevent poaching and illegal trade in wildlife.
- Documenting the region's biodiversity, particularly of those species whose population is dwindling and is subject to maximum threat due to illegal trade, and according uniform regional status (threatened, vulnerable, critical, etc.) based on the international criteria set up by the IUCN and other organisations.
- Based on the documentation and information base, mechanisms must be urgently set up through cooperation of enforcement agencies within the different countries of the region for preventing illegal trafficking in wildlife.
- Setting up of a regional network to periodically monitor implementation and also to review the situation in the region.

Revival of traditional knowledge and promoting environment-friendly practices:

- Several countries in the region - particularly India, Sri Lanka and Bhutan - have a history of traditional conservation practices and it is imperative that this knowledge and practice be documented before they are lost.
- Large scale efforts with the involvement of community-based organisations and NGOs should be made for creating awareness on the importance of these traditional practices as well as their revival and propagation.

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