

## Chapter 4

# Forestry and Biodiversity

## Forestry

### Forest Resources and Their Use

The forest in Nepal is defined as all lands having trees with more than 10% crown cover (DFRS 1999). Covering 37% of the country's total area (JAFTA 2000), the forest is, Nepal's largest natural resource. Forest types range from sub-tropical hardwood to softwood. The forest has three important functions: production of goods (firewood, fodder, timber, and herbs), protection of the natural environment, and regulation of atmospheric conditions. Forest production enhances the economy of the community, while the protection and regulation functions are concerned with ecological conservation.

The forest is the principal source of fuelwood. According to the Ministry of Finance (MOF 2003, p. 70, Table 10.1), energy consumption in Nepal is excessively dependent on fuelwood, which represents 75% of the total fuel consumption (8,416 thousand tons of oil equivalent). In rural areas wood consumption exceeds 94% of the total fuel consumption, compared with 39% in urban areas (see Table 2.5). Terai forests provide most of this fuelwood since they are easily accessible. Excessive use of fuelwood, particularly in rural areas, is due to lack of alternative energy sources. For instance, only 2.3% of rural households use kerosene compared with 36% of urban households.

The forest is also used as grazing land for livestock. The livestock population including cattle, pigs, goats, and sheep reached 17.6 million head (11,226 livestock units) in 1998 from 14.9 million

head (9,790 livestock units) in 1985, while the grazing area (1,757,000 hectares [ha]) has remained more or less constant over the last 20 years (UNEP 2001). The increased numbers of livestock mainly depend on forest for grazing.

Finally, the forest area has been used for infrastructural development such as roads, schools, public places, institutional buildings, human settlements, and so on. More than 120,000 ha of forest have been cleared for infrastructure development (DFRS 1999).

### Change and Distribution of Forest Areas

According to the most recent survey, based on satellite imagery (JAFTA 2001), the country now has 37% forest coverage and 9% shrub area, making up a total of 46% (Table 4.1). The percentage of total area covered by forest and shrub is highest in the Hills (50% and 13%), followed for forest by the Terai and the Mountains. The Hills have 57% of the total forest resources in the country.



D. Joshi

Deforestation

**Table 4.1: Distribution of Forest Resources by Region, 2000**

| Region       | Area (ha)         | Forest           |             | Shrub            |             | Total Forest Resources |              |
|--------------|-------------------|------------------|-------------|------------------|-------------|------------------------|--------------|
|              |                   | Area (ha)        | % of region | Area (ha)        | % of region | Area (ha)              | % of country |
| Mountain     | 5,181,700         | 1,181,631        | 22.8        | 426,363          | 8.2         | 1,607,994              | 23.7         |
| Hill         | 6,134,500         | 3,085,885        | 50.3        | 771,842          | 12.6        | 3,857,727              | 56.8         |
| Terai        | 3,401,900         | 1,237,545        | 36.4        | 85,026           | 2.5         | 1,322,571              | 19.5         |
| <b>Nepal</b> | <b>14,718,100</b> | <b>5,505,061</b> | <b>37.4</b> | <b>1,283,231</b> | <b>8.7</b>  | <b>6,788,292</b>       | <b>100</b>   |

ha = hectare

Source: JAFTA (2001)

The trend of forest coverage in the country is shown in Table 4.2. The table shows the finding of the different surveys regarding overall forest resources in Nepal. However, comparisons of the findings from the different sources are difficult as the definitions and methodologies used are not directly comparable (see discussion in Chapter 3) . This creates serious problems for any comparative analysis of the changing nature of forest resources in Nepal.



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**Community Forest**

**Table 4.2: Change in Forest and Shrub Cover (%)**

| Forest Resources | 1986 <sup>a</sup> | 1994 <sup>b</sup> | 2000 <sup>c</sup> |
|------------------|-------------------|-------------------|-------------------|
| Forest           | 37.4              | 29.0              | 37.4              |
| Shrub            | 4.8               | 10.6              | 8.7               |
| <b>Total</b>     | <b>42.2</b>       | <b>39.6</b>       | <b>46.1</b>       |

Source: <sup>a</sup> LRMP (1986); <sup>b</sup> DFRS (1999); <sup>c</sup> JAFTA (2001)

**Table 4.3: Proportion of Forest Area by Region (ha)**

| Region       | Forest Area per 100 ha (1994) <sup>a</sup> | Per Capita Forest Area (1994) <sup>a</sup> | Forest Area per 100 ha (2000) <sup>b</sup> | Per Capita Forest Area (2000) <sup>b</sup> |
|--------------|--|--|--|--|
|              | Mountain                                   | 2.3  | 0.08                                       | 22.8                                       |
| Hill         | 39.68                                      | 0.29                                       | 50.3                                       | 0.30                                       |
| Terai        | 35.17                                      | 0.14                                       | 36.4                                       | 0.11                                       |
| <b>Total</b> | <b>29.00</b>                               | <b>0.23</b>                                | <b>37.4</b>                                | <b>0.24</b>                                |

ha = hectare

Source: <sup>a</sup> DFRS (1999) cited in UNEP (2001), p.63. <sup>b</sup> JAFTA (2001)

Table 4.3 shows the change in forest coverage by area and person in the three regions between 1994 and 2000; there are no consistent patterns in forest, regional forest endowments, or per capita availability. The table suggests that there may be marked differences in the definition or recognition of “forest” in mountain districts between the two surveys.

## Factors of Forest Change and Impacts

Forest surveys carried out from 1986 to 1994 provide information on forest area change and its causes, while the Japan Forest Technology Association (JAFTA 2001) forest survey only indicates the change in forest area. The following analysis looks at the causes of change between 1986 and 1994 (Table 4.2), as there are no data for analysis of the subsequent trends.

Forest depletion refers to the diminishing of forests in quantity and quality. Quantity refers to the gross area covered by the forest whereas quality signifies the density of trees in the forest area. Between 1986 and 1994, the total forest area decreased considerably. The loss can be attributed to (i) uncontrolled use of forest products, (ii) increasing pressure of livestock, (iii) transboundary smuggling of logs, and (iv) inappropriately designed forest policies.

Most rural people (83%) depend on forest fuelwood for cooking, because alternative energy sources for cooking and heating are limited in rural areas. Consumption of fuelwood alone constituted 94% of the total energy output. The fuel consumption for household and industrial biomass was estimated to be 15.4 million tons in 2000 compared with 11.3 million tons in 1985. Per capita annual fuelwood consumption in the Hills is estimated to be 640 kilogram (kg) compared with 479 kg in the Terai. The timber demand at national level was projected to be about 2.5 million cubic meters (m<sup>3</sup>) by 2000. Rapid population growth, which has remained at over 2% per year since 1961, is considered to be the most important factor behind diminishing forest resources in Nepal. In the Terai, migration is a major factor in forest encroachment. There are several reasons for dwindling Terai forests.

Between 1986 and 1991, 99,400 ha of Terai forests were cleared (CBS 1998), much of which was converted into cultivated area. During the early 1990s, many of the forest areas of Jhapa and Morang districts in eastern Nepal were encroached upon by the Bhutanese refugee camps.

A Finnish International Development Agency study (FINNIDA 1993) showed a decline in the growing stock of sal (*Shorea robusta*) forest from 101 to 72 m<sup>3</sup>/ha and from 76 to 58 m<sup>3</sup>/ha for other Terai hardwood forests. The Nepal Australia Community Forestry Project indicated that the thinning of forest in the upper slopes of the Hills was due to over cutting of fuelwood and lopping trees for fodder (Tamrakar 1996).

Degradation of Terai forest all along the Indo-Nepal border is mainly due to transboundary smuggling of logs into India. This activity intensified with the increase in price of logs in India (Rajbhandari 1997).

Some of the government forest policies, such as the Private Forests Nationalisation Act 1957 and the Land Tax Act of 1977, were unfavorable for conserving forest resources. These policies instead allowed local people uncontrolled access to both public and private forests in their areas (Perdo 1993; Shah 1997).

Forest depletion has direct impacts on local environmental degradation. The average annual deforestation rate of 1.7% is high considering Nepal's fragile hill ecosystem. Wyatt-Smith (1982) and Shepherd (1985) estimated that 3 ha of forest would be required to sustain 1 ha of agricultural land or each person would require about 1.65 ha of forest for the country as a whole. The diminishing forest area has further burdened rural women, who are responsible for collecting firewood and fodder and fetching drinking water, besides other household chores. They have little time for other productive activities (Zimsky 1999). Forest depletion contributes to environmental degradation such as landslides, soil erosion, floods, soil depletion, loss of biodiversity, reduction in water flow from upstream areas, and increasing siltation of water bodies in low-lying areas.

Conservation of forest resources is fundamental for stabilizing the systems that help sustain all types of ecological processes essential for human existence and wellbeing. Alternative livelihood activities should be made available to rural people to reduce their dependence on forest resources. In addition, effective public awareness programs about forest conservation and its importance need to be initiated through different communication media and school curricula. Research needs to be carried out for designing effective public awareness programs.

### **Development Efforts in Forest Conservation and Management**

The Government has introduced different programs for conserving and managing forest resources. One effort is the community forestry program initiated in 1978, which has emphasized sustainable management and development of forests through communities' involvement as forest user groups. By 1999, the Government had handed over a total of about 0.7 million ha of state-owned forests to over 10,532 community forestry user groups for development, conservation, management, and sustainable use. A total of six million people had directly benefited from being members of user groups by 2000. Leasehold forest management through user groups is another program. In 1993, 270 ha of state-managed forest was handed over to user groups for leasehold forestry, and this increased to over 6,550 ha in 2000.

Some forest areas have been declared protected areas such as national parks, wildlife reserves, and conservation areas. The coverage of protected areas increased from 0.976 million ha in 1984 to 2.476 million ha in 1998. The Alternative Energy Promotion Center was created to develop programs for providing alternative energy resources and technology to reduce dependency on traditional energy sources such as fuelwood. This center, in collaboration with INGOs and the private sector, has initiated biogas plants to replace fuelwood for cooking and lighting, thereby helping to conserve forests. The number of biogas plants has increased from about 200 in 1975 to 90,000 in 2002 in 66 districts of the country (ENPHO/MOPE 2002). Likewise, the improved cooking stove program has been designed to increase the efficiency of firewood use and to reduce smoke. Over 90,000 improved stoves of various types are being distributed throughout the country (ENPHO/MOPE 2002).

Forest conservation and development in Nepal has been promoted through different Government acts and legislation since 1957. Some of these are listed below. Nepal has also signed various international conventions and treaties related to the conservation of forests and biodiversity.

#### *(i) Acts*

- (a) Private Forests Nationalisation Act 1957
- (b) Forestry Act 1963
- (c) Forest Protection (Special Arrangements) Act 1967
- (d) Soil and Watershed Conservation Act 1982
- (e) National Parks and Wildlife Conservation Act 1973 and Amendment (NPWC) 1993
- (f) Forest Act 1993 and Amendment 1999
- (g) Forest Regulations 1995
- (h) Environment Protection Act 1996

#### *(ii) Policies and Strategies*

- (a) National Forestry Plan 1976
- (b) National Conservation Strategy 1988
- (c) Forestry Sector Policy 1989
- (d) Nepal Environmental Policy and Action Plan 1993
- (e) Master Plan for the Forestry Sector 1989–2010
- (f) Policy Document: Environmental Assessment in the Road Sector of Nepal 2000
- (g) Nepal Biodiversity Strategy 2002

#### *(iii) Regulations and Guidelines*

- (a) Environmental Impact Assessment Guidelines for the Forestry Sector 1995
- (b) Buffer Zone Regulations 1996
- (c) Environment Protection Regulations 1997

# Biodiversity

## State of Biodiversity

Nepal's great variation in topography—altitudes ranging from 60 to 8,848 meters above sea level (masl) over a small distance of 190 km from south to north—has resulted in a great diversity of climate and vegetation ranging from subtropical to cold desert. Nepal has been endowed with a rich variety of plants and animals. The different biological species play a role not only in establishing symbiotic relationships among themselves but also have great economic value. People's relationship with their surroundings has changed over time, affecting the biodiversity of the landscape.

With an area of only 0.1% of the global surface area (147,181 km<sup>2</sup>), Nepal hosts some of the most spectacular natural areas in the world. Nepal possesses over 2% of the world's flowering plants, about 9% of the world's bird species, and about 4% of the world's mammalian species (see Appendix 4.2). In terms of species richness, Nepal is in 11th position in Asia and 25th position at the global level.

“Ecosystem” refers to a unit that includes all organisms (populations, communities, habitats, and environments) in a given area interacting with all components of the physical environment. Nepal has 118 types of forest ecosystems spread over four physiographic regions (Table 4.4), 181 species of mammals, 844 species of birds, 185 species of fish, 143 species of reptiles and amphibians, over 5,884 species of flowering plants, and about 2,287 species of fungus and lichens (CBS 2003) (see Appendices 4.1 and 4.2).

**Table 4.4: Ecosystems in Protected Areas**

| Zone         | Number of Ecosystems | Ecosystems in PAs |
|--------------|----------------------|-------------------|
| Terai        | 10                   | 10                |
| Siwalik      | 13                   | 5                 |
| Middle Hill  | 52                   | 33                |
| Highland     | 38                   | 30                |
| Others       | 5                    | 2                 |
| <b>Total</b> | <b>118</b>           | <b>80</b>         |

PA = protected area  
Source: CBS (2003)

Over 400 species of agro-horticultural crops have been reported in Nepal including 200 species of vegetables (NAA 1995). Of these, around 50 species have been domesticated for commercial and household consumption. Fifteen fruits with more than 100 varieties, 50 vegetables with 200 varieties, and 10 varieties of potatoes are cultivated commercially. Some wild genotypes have also been

identified and domesticated by local people because of their economic value.

Sixteen protected areas (together with six Buffer Zones) have been established for the protection of flora and fauna (Figure 4.1). These protected areas are in the form of national parks (9), conservation areas (3), wildlife reserves (3), and a hunting reserve (1) and are intended to provide protection to diverse species of plants and animals in climates ranging from sub-tropical to cold desert. The protected areas make up about 17% of the country's total area. Of these, the Sagarmatha National Park and the Royal Chitwan National Park have been included in the World Natural Heritage List; and the Koshi Tappu Wildlife Reserve, Bishajari Tal (Chitwan), Jagdishpur Jalasha Reservoir (Kapilbastu), and Ghodaghodi Tal (Kailali) have been designated as Ramsar sites.

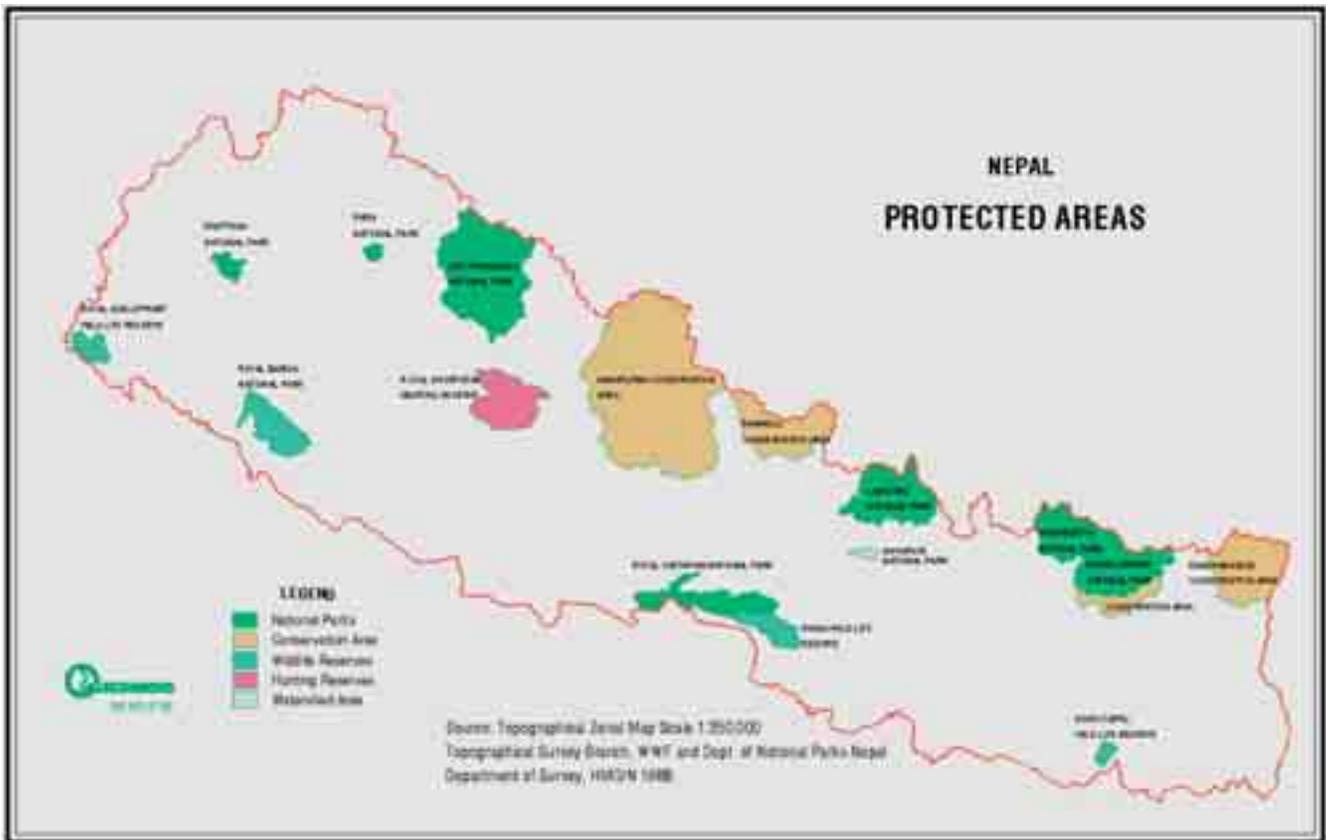
## Factors Diminishing Biodiversity

Wildlife and biodiversity are an important natural resource in Nepal, as well as an indicator of environmental quality. Loss of wildlife and biodiversity means degeneration of environments such as forest and water bodies. Any human or other intervention can cause environmental imbalance, with unfavorable implications for these natural ecosystems. The preservation of these unique ecosystems and the sustainable use of products obtained from them remains an environmental challenge for the country.

Forests are the most important natural ecosystem in Nepal. Much of the former forest area has been converted to cultivated land, built up area, roads and other infrastructure-related uses. Deforestation has a significant impact on flora and fauna. Nepal's threatened animal species constitute 3.8% of the world's threatened mammals and 2.3% of birds (CBS 2003). Clearing and burning forests, draining and filling wetlands, converting natural ecosystems into agricultural land, and meeting the demand for fuelwood, fodder, litter, medicinal plants, and animals for meat and other requirements has resulted in a huge loss of biodiversity.

Habitats have suffered due to loss, alteration, over-extraction or illegal collection of species, poaching or hunting of wild animals, over-grazing, fire, and commercial trade. The economic value of endangered or rare species in the world market is very high. Illegal trade of wildlife products such as rhino horn, tiger skin and bone, ivory, fur, and antlers is a serious problem in and around protected areas. In two decades, the country lost 76 rhinos due to poaching (DNPWC 2001). Likewise, the populations of musk deer, red panda, bears, and many other species have declined in the mountains (Shrestha and Joshi 1996). Due to increased pressure on their

Figure 4.1: Protected Areas in Nepal



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**Russell's Viper** (*Vipera russelli*)

usage, many species of plants, butterflies, fish, insects, birds, and mammals have been listed as threatened, vulnerable, or rare (Shrestha and Joshi 1996; Suwal et al. 1995). Out of 32 rare plant species listed, 8 are already extinct (CBS 2003).

**Efforts Towards Biodiversity Conservation**

The Government has established the Department of National Parks and Wildlife Conservation and created a network of protected areas. After creation of the protected area network, there has been an increasing trend in the population of wild animals. The rhino population increased from 60 in the late



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**Rhododendron Dalhusiae**

1960s to 612 in 2000, the last year for which reliable statistics are available (DNPWC 2000). Similarly, a continued conservation effort in protected areas has improved the habitat and increased the number of wildlife such as endangered tiger, musk deer, and many other species (DNPWC 2000). Translocation and reintroduction of some species has reduced the risks of loss of these animals from being in only one area. However, species outside protected areas are still under great pressure. Wildlife species such as greater one-horned rhinoceros (*Rhinoceros unicornis*) have been translocated from one park to another to set up other viable populations.

The Government has given legal protection status to 13 plants, 26 mammals, 9 birds, and 3 reptile species. Almost all these faunal species and about 20 plant species are included in the CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) appendices.

Different alternative energy sources to replace or reduce fuelwood use such as back-boilers, kerosene depots, small hydropower plants, solar water heaters, and space heaters have been introduced in Mountain areas (such as Annapurna Conservation Area Project [ACAP] and Sagarmatha areas); and biogas, electricity, kerosene, improved cooking stoves, and solar power in the Terai. Studies

show that these have reduced fuelwood consumption and thereby increased conservation of forests (DNPWC 1999; Lama and Lipp 1994; Wells and Brandon 1992).

The Government has formulated acts and regulations to safeguard the biodiversity of the country. Some of these have been listed above. The National Planning Commission in collaboration with The World Conservation Union (IUCN) is to implement a national conservation strategy, which has biodiversity conservation as a key component. In 1993, these two organizations developed the Nepal Environmental Policy and Action Plan. This plan identified four priority actions for biodiversity conservation. In addition, Nepal has signed different international conventions such as the Ramsar Wetland Convention, World Heritage Convention, and CITES to show its commitment to the conservation of biodiversity.

A buffer zone approach has been implemented around the borders of the Royal Chitwan National Park, Royal Bardia National Park, Langtang National Park, Sheyphoksundo National Park, Makalu Barun National Park, and Sagarmatha National Park to solve park-people conflicts and protect park animals, as well as to ease the biotic pressure on core areas and to promote sustainable management of natural resources. This conciliatory approach is aimed at motivating local communities to undertake participatory management of forest resources through user groups. This program refunds 50% of the total revenue of protected areas, which the communities can use for their socioeconomic betterment. This provision has demonstrated the direct benefit of protected areas as a long-term measure for conservation of biodiversity resources through government-community partnership.

Wetlands like rivers, lakes, reservoirs, village ponds, paddy fields, and marshlands are rich in biodiversity and different indigenous communities often have cultural attachments to them (Table 4.5). Wetlands cover some 5% (743,500 ha) of the land area of the country (MOFSC 2003). There are a total of 242 designated wetlands: 163 in the Terai and the remainder in the Hill and Mountain regions.

Nepal's wetlands are home to 193 of 841 recorded bird species. Terai wetlands alone have 187 bird species, of which 180 are found in the Koshi Tappu Wildlife Reserve. In addition to birds, wetlands are home to a number of fish species, reptiles, and amphibians. Other wild animals such as rhinoceros (*Rhinoceros unicornis*), wild buffalo (*Bubalus bubalis*), swamp deer (*Cervus duvaucelli*), Gangetic dolphin (*Platanista gangetica*), and otter (*Lutra lutra*) also depend on wetlands. Wetlands are probably the last refuges of some wild relatives of



**Long-Billed Vulture** (*Gyps indicus*)

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**Freshwater Gangetic Dolphin** (*Platanista gangetica*)

IUCN



**Wetland area**

IUCN

**Table 4.5: Wetland Types in Nepal**

| Wetland Type  | Estimated Area (ha) | Percent of Total |
|---------------|---------------------|------------------|
| Rivers        | 395,000             | 53.12            |
| Lakes         | 5,000               | 0.67             |
| Reservoirs    | 1,380               | 0.19             |
| Village ponds | 5,183               | 0.70             |
| Paddy fields  | 325,000             | 43.71            |
| Marshland     | 12,000              | 1.61             |
| <b>Total</b>  | <b>743,563</b>      | <b>100.00</b>    |

ha = hectare  
Source: MOFSC (2003)

cultivated plants, and also have significant value for fishing, irrigation, and religious and recreational (boating, rafting) use. Many indigenous communities depend on wetland resources for their survival. Accordingly, Nepal has sought to conserve the wetland ecosystem and ensure the participation of local communities for sustainable use of its components (MOFSC 2003). This policy recognizes wetlands management as an essential component of an ecosystem approach to natural resource management and has identified participatory wetlands management, classified wetlands from a management perspective, and developed other components of sustainable development.

Ecotourism development is an integral part of the protected area system in Nepal. The prime objective of ecotourism has been to promote a symbiotic relationship between tourism and the environment, with a particular focus on uplifting the local host economy. This concept is also applied in village communities sited in and around protected areas.

Through ecotourism, tourists get opportunities to observe and learn. Its potential contribution to cultural conservation and long-term sustainability of communities and natural resources is huge. Ecotourism is considered a form of sustainable tourism that benefits the community, environment, and local economy. This may be achieved through various means such as employment for local people or programs in which tourists contribute money to community activities. In Nepal, the ACAP provides one of the best examples of ecotourism. Under this project, several village sites have been identified for community-based ecotourism development.

The ACAP, covering an area of 7,629 km<sup>2</sup> in the western Himalayan region, covers one of the three conservation areas of Nepal. ACAP was created in 1986 under the King Mahendra Trust for Nature Conservation and gazetted as a Conservation Area in 1992. The main aim of ACAP is to balance natural resource conservation and sustainable community

development. The area is characterized by both biodiversity and cultural diversity. ACAP has been successful in gradually changing traditional subsistence activities into a framework of sound resource management, supplemented by conservation, development of alternative energy programs (such as micro hydroelectricity, biogas plants, solar power, kerosene depots, and fuelwood saving technology) to minimize the negative impacts of tourism and to enhance the living standards of local people. It follows the principles of maximum people's participation, sustainability, and a catalytic role. The focus in Jomsom, Manang, and Ghandruk, which are popular trekking areas, is on integrated tourism management and agro-pastoralism, where local communities are involved in tourism-based income generating activities.

The Annapurna Conservation Area has been a prime destination for trekkers ever since it was opened to visitors. Of Nepal's total 100,828 trekkers in 2001, 65% visited the Annapurna area. ACAP is authorized to collect entry fees from visitors, and the revenue from trekking has been used to create an endowment fund with the objective of achieving financial self-sustainability. The fund is used for natural resource conservation and community development, which has brought positive results to the livelihoods of the people of the Annapurna area. An understanding of conservation and the sustainable use of natural resources has proved to be a crucial catalyst for sustaining development. ACAP has since become a model for conservation and development not only for other parts of the country but also for the rest of the world. Many national parks and protected areas in Nepal have either adopted or refined the ACAP model (ACAP 2002).

## Summary

The forest is the most important natural resource, and the most important natural ecosystem, in Nepal. Forests are the principal source of fuelwood and fodder, and are also used for grazing and building of roads, public buildings, and other infrastructure. Any change—decrease or increase—in the forests can affect wildlife, biodiversity and water sources, all of which depend upon forests. Analysis of forest resources in Nepal has been based on different sources and methods. These sources and methods have shown a change in forest coverage—a decrease from 1986 to 1994 followed by an increase up to 2000, but the surveys used different methodologies and techniques and it is difficult to draw any firm conclusions. Anecdotal evidence and local observations show that depletion of forest area is most common in areas with relatively better



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Elizabeth Kerkhoff

**Different ways of maintaining biodiversity: in protected areas (Shey Phoksundo National Park, top) and through indigenous agroforestry practices (shifting agriculture field, bottom)**

access for people, as the majority of rural people still use forests as sources of fuelwood and fodder. A very critical issue that has emerged is that of the lack of comparability of forest data. Unless comparable data is made available that covers all aspects of forest resources, it will be very difficult to design appropriate interventions for the different regions.

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## Appendix 4.1: Forests and Other Ecosystems by Region

| Region       | Major Ecosystems |   |   |
|--------------|------------------|---|---|
|              | Number           | Sub-region                                  | Ecosystem Type  |
| Terai        | 10 + 3 = 13      | Upper Tropical Eastern Region               | Tropical riverine forest<br>Sal ( <i>Shorea robusta</i> ) forest  |
|              |                  | Lower Tropical Western Region               | Terai tropical sal forest ( <i>Shorea robusta</i> , <i>Terminalia tomentosa</i> , ...)<br>Khair-sossoo ( <i>Acacia</i> - <i>Dalbergia</i> ) riverine forest<br><i>Samalia malabarica</i> , <i>Trewia nudiflora</i> - riverine forest<br>Bhabar light sal forest<br>Pseudo steppe with Gramineae (tropical elephant grasses)   |
|              |                  | Lower Tropical Eastern Region               | Terai tropical sal forest<br>Tropical mixed wet forest<br>Tropical dense forest with <i>Terminalia</i> sps.   |
|              |                  | Other                                       | Cultivated areas<br>Terai cultivated areas<br>Water bodies  |
| Siwaliks     | 13 + 1 = 14      | Upper Sub-tropical Western Region           | Upper Siwalik chir pine-oak forest  |
|              |                  | Upper and Lower Sub-tropical Western Region | Siwaliks chir-pine forest<br><i>Alnus nitida</i> riverine forest  |
|              |                  | Upper Tropical Western Region               | Tropical hill sal forest in large valleys<br>Tropical riverine forest ( <i>Albizia lebbek</i> , <i>Toona ciliata</i> ..)<br>Sal forest in inner valleys ( <i>Shorea robusta</i> , <i>Terminalia tomentosa</i> ),<br>Mesophytic tropical forest on southern slopes of the Siwaliks<br>Hygrophytic tropical forest on northern slopes of the Siwaliks<br>Siwalik tropical deciduous forest  |
|              |                  | Upper Tropical Eastern Region               | Tropical hill sal forest<br>Dense forest with <i>Shorea robusta</i> , <i>Lagerstroemia parviflora</i> ....<br>Dense forest with <i>Terminalia tomentosa</i> , <i>T. belerica</i> ...  |
|              |                  | Lower Tropical Level Western Region         | Dun valleys sal forest  |
|              |                  | Other                                       | Dun cultivated areas  |
| Middle Hills | 52 + 2 = 54      | Montane Western Region                      | Mesophytic montane oak-rhododendron forest<br>Mixed blue pine-oak forest<br>Mixed hygrophytic oak-hemlock-fir forest<br>Open and dry montane blue pine forest<br>Blue pine-spruce forest<br>Juniper forest ( <i>Juniperus indica</i> )<br>Rhododendron-hemlock-oak forest<br>Hemlock forest ( <i>Tsuga dumosa</i> )<br>Mountain oak forest ( <i>Quercus semecarpifolia</i> )<br>Blue pine-spruce-fir forest<br>Spruce mountain forest ( <i>Picea smithiana</i> )  |
|              |                  | Montane Eastern Region                      | <i>Lithocarpus pachyphylla</i> forest<br>Rhododendron forest<br>Deciduous mixed broad-leaved forest<br>Mixed broad-leaved forest ( <i>rhododendron-acer-symplocus-lauraceae</i> )<br><i>Daphniphyllum himalayense</i> forest with a few <i>Rhododendron grande</i>  |
|              |                  | Collinean Western Region                    | Blue pine-cypress forest<br>Cypress forest with dwarf barberry<br>Collinean oak forest ( <i>Quercus leucotrichophora</i> , <i>Q. lanata</i> )<br>Mixed blue pine-oak forest<br>Mixed oaks-laurels forest with shrubs<br>Mixed hygrophytic broadleaved forest with oaks<br>Cedar forest ( <i>Cedrus deodara</i> )<br>Open blue pine forest ( <i>Pinus wallichiana</i> )<br>Collinean oak-mixed broadleaved forest ( <i>Quercus lanata</i> )<br>Aesculus, Juglans riverine forest<br>Deciduous broadleaved forest ( <i>Alnus</i> , <i>Juglans</i> , <i>Acer</i> ) |

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Appendix 4.1: Table continued

| Region                  | Major Ecosystems |   |  |
|-------------------------|------------------|---|--|
|                         | Number           | Sub-region                                  | Ecosystem Type   |
| Middle Hills<br>(cont.) |                  | Collinean Central Region                    | Hygrophytic <i>Quercus lamellosa</i> forest  |
|                         |                  | Collinean Eastern Region                    | Hygrophytic forest with <i>Quercus lamellosa</i><br>Hygrophytic forest with <i>Castanopsis tribuloides</i><br>Mesohygrophytic forest with <i>Quercus glauca</i><br>Mesohygrophytic forest with <i>Quercus lanata</i> and <i>Pinus excelsa</i>  |
|                         |                  | Sub-Tropical Eastern Region                 | <i>Eugenia tetragona</i> , <i>Ostodes paniculata</i> forest  |
|                         |                  | Upper Sub-tropical Western Region           | Mixed chir pine - oak forest ( <i>Pinus roxburghii</i> , <i>Quercus leucotrichophora</i> )<br><i>Quercus glauca</i> , <i>Alnus nepalensis</i> , <i>Betula alnoides</i> riverine forest<br>Open <i>Olea cuspidata</i> forest<br>Sub-tropical mixed broadleaved forest<br><i>Quercus incana</i> and <i>Schima wallichii</i> forest   |
|                         |                  | Upper Sub-tropical Central Region           | Hygrophytic <i>Schima wallichii</i> , <i>Castanopsis tribuloides</i> forest  |
|                         |                  | Upper Sub-tropical Eastern Region           | <i>Castanopsis tribuloides</i> forest with <i>Schima wallichii</i> ..<br><i>Castanopsis hystrix</i> forest with <i>C. tribuloides</i> ..<br><i>Alnus nepalensis</i> forest   |
|                         |                  | Upper and Lower Sub-tropical Western Region | Chir-pine forest with grasses and Engelhardia<br>Mixed chir pine broadleaved forest<br><i>Alnus nepalensis</i> riverine forest<br>Euphorbia royleana steppe in inner valleys<br>Grasses - <i>Artemesia</i> steppe  |
|                         |                  | Upper and Lower Sub-tropical Central Region | Hygrophytic <i>Schima wallichii</i> forest   |
|                         |                  | Upper and Lower Sub-tropical Eastern Region | <i>Schima wallichii</i> , <i>Castanopsis indica</i> hygrophytic forest<br><i>Schima wallichii</i> , <i>Pinus roxburghii</i> mesohygrophytic forest<br><i>Pinus roxburghii</i> xerophytic forest with <i>Phyllanthus emblica</i><br><i>Schima wallichii</i> , <i>Lagerstroemia parviflora</i> hygrophytic forest  |
|                         |                  | Other                                       | Pokhara cultivated areas<br>Water bodies   |
| Mountains               | 38 + 1 = 19      | Nival level                                 | Glaciers, snow, rock   |
|                         |                  | Upper Alpine Level                          | Alpine meadow with Gramineae and Cyperacea<br>Xerophytic mat patches , scarcely vegetated rocks , and scree<br>Mesophytic mat patches , scarcely vegetated rocks , and scree<br>Mesophytic and hydrophytic mat patches and scarcely vegetated rocks<br>Alpine meadows on the southern side of the Himalaya s<br>Dry alpine vegetati on on the northern side of the Himalayas<br>High altitude discontinuous vegetation cushion plants<br>Meadows and mat patches<br>Scarcely vegetated rocks and scree of upper alpine level<br>Meadows and land communities |
|                         |                  | Lower Alpine Level                          | Rhododendron mesohygrophytic scrublands -Juniperus ... meadows<br>Rhododendron mesohygrophytic scrublands ( <i>R. anthopogon</i> , <i>R. nivale</i> ...)<br>Juniper mesohygrophytic scrublands ( <i>J. indica</i> , <i>R. recurva</i> , <i>J. squamata</i> )<br>Xerophytic closed alpine mat and scrub<br>Mesophytic closed alpine mat and scrub<br>Shrub lands with patches of abundant <i>Rhododendron anthopogon</i> , <i>R. nivale</i>   |
|                         |                  | Upper Sub-Alpine Level Western Region       | Mesophytic closed sub -alpine mat and scrub ( <i>R. anthopogon</i> )<br>Rhododendron -birch forest ( <i>Betula utilis</i> , <i>R. campanulatum</i> )<br>Birch-blue pine open fore st   |
|                         |                  | Upper Sub-Alpine Level Central Region       | North Himalayan alpine vegetation  |

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Appendix 4.1: Table continued

| Region               | Major Ecosystems |   |  |
|----------------------|------------------|---|--|
|                      | Number           | Sub-region                                | Ecosystem Type   |
| Mountains<br>(cont.) |                  | Upper Sub -Alpine Level<br>Eastern Region | <i>Betula utilis</i> forest with rhododendron and <i>Abies spectabilis</i><br>Rhododendron shrub lands<br>Rhododendron -juniper shrub lands  |
|                      |                  | Lower Sub -Alpine Level<br>Western Region | Mesophytic fir forest with oak and rhododendron<br>Hygrophytic fir -hemlock -oak forest<br>Fir forest ( <i>Abies spectabilis</i> )   |
|                      |                  | Lower Sub -Alpine Eastern<br>Region       | <i>Abies spectabilis</i> forest with rhododendron<br><i>Larix griffithiana</i> forest<br><i>Larix griffithiana</i> and <i>L. potanini</i> forest<br><i>Larix potanini</i> forest   |
|                      |                  | Steppic Formations - North<br>West Region | High altitude cushion plant formation<br><i>Caragana vericolor</i> and <i>Lonicera spinosa</i> steppe<br><i>Caragana gerardiana</i> and <i>Lonicera spinosa</i> xerophytic steppe<br><i>Caragana brevispina</i> and <i>Artemisia</i> steppe<br><i>Caragana pygmaea</i> and <i>Lonicera spinosa</i> xerophytic steppe<br>Myricaria -Hippophae -Salix riverine thickets<br><i>Sophora moorcroftiana</i> and <i>Oxytropis mollis</i> steppe |
|                      |                  | Other                                     | Water bodies   |
| <b>Total</b>         | <b>118</b>       |   |  |

Source: BPP (1995)

## Appendix 4.2: Protected Plant and Wildlife Species

| <b>Table A4.2.1: Protected Plant Species and Forest Products (Pursuant to Section 70 (kha) of the Forest Act 1993)</b>  |                      |                  |        |       |
|---|----------------------|------------------|--------|-------|
| Scientific Name   | Local Name           | Family           | Status |       |
|   |                      |                  | IUCN   | CITES |
| <b>Plants banned</b> for collection, use, sale, distribution, transportation and export   |                      |                  |        |       |
| <i>Dactyloporhiza hatagirea</i>   | Panchounle           | Orchidaceae      |        | II    |
| <i>Juglans regia</i> (only bark)  | Okhar                | Juglandaceae     |        |       |
| <i>Picrorhiza scrophulariiflora</i> <sup>a</sup>  | Kutki                | Scrophulariaceae |        |       |
| <b>Plants banned for export</b> except processed in the country and permission issued from DOF along with the recommendation of DPR or HPPCL  |                      |                  |        |       |
| <i>Abies spectabilis</i>  | Talis patra          | Pinaceae         |        |       |
| <i>Cinnamomum glaucescens</i>   | Sugandakokila        | Lauraceae        |        |       |
| <i>Lichens spp.</i>   | Jhyau                |                  |        |       |
| <i>Nardostachys grandiflora</i>   | Jatamansi            | Valerianaceae    |        |       |
| <i>Rauvolfia serpentina</i>   | Sarpaganda harbaruwa | Apocynaceae      | V<br>E | II    |
| <i>Taxus baccata subsp. Wallichiana</i>   | Loth salla           | Valerianaceae    |        |       |
| <i>Valerianna jatamansi</i>   | Sugandabala          | Valerianaceae    |        | II    |
| <b>Forest products banned</b> for export except processed in the country through boiling and extraction method and permission issued from DOF along with the recommendation of DPR or HPPCL   |                      |                  |        |       |
| Asphaltum (rock exudate)  | Silajit              |                  |        |       |
| <b>Ban on export</b> except processed in the country through steaming and packaging, and permission issued from DOF along with the recommendation of DPR or HPPCL   |                      |                  |        |       |
| <i>Cordyceps sinensis</i>   | Yarcha gumba         | Clavicipitaceae  |        |       |
| <b>Timber trees banned</b> for felling, transportation, and export for commercial purposes  |                      |                  |        |       |
| <i>Acacia catechu</i>   | Khayer               | Leguminosae      |        |       |
| <i>Bombax ceiba</i>   | Simal                | Bombacaceae      | T      |       |
| <i>Dalbergia latifolia</i>  | Satis sal            | Fabaceae         |        |       |
| <i>Juglans regia</i> (only from national forests)   | Okhar                | Juglandaceae     |        |       |
| <i>Michelia champaka M. kisopa</i>  | Chanp                | Magnoliaceae     |        |       |
| <i>Pterocarpus marsupium</i>  | Bijaya sal           | Fabaceae         | E      |       |
| <i>Shorea robusta</i>   | Sal                  | Dipterocarpaceae |        |       |
| <p>CITES = Convention on International Trade of Endangered Species of Wild Fauna and Flora; DOF = Department of Forest ; DPR = Department of Plant Resources; HPPCL = Herbs Production and Processing Company Limited ; IUCN = The World Conservation Union, Ex = extinct, E = endangered, T = threatened, V = vulnerable; Notes: CITES Appendix I = Species threatened with extinction; Appendix II = Species not yet threatened but which could become endangered if trade is not controlled; Appendix III = Species that are protected by individual countries within their borders and for which cooperation of other convention signatories is sought.</p> <p><sup>a</sup> Species to be specified and recommended for export by DPR, and availability to be considered by DoF before issuing license for export.</p> <p>Source: His Majesty's Government of Nepal ( 2001)</p> |                      |                  |        |       |

**Table A4.2.2: Status of Protected Wildlife under the National Parks and Wildlife Conservation Act 1973**

| Scientific Name                 | Local Name           | Common Name                 | Status |       |
|---------------------------------|----------------------|-----------------------------|--------|-------|
| Mammals                         |                      |                             | IUCN   | CITES |
| <i>Ailurus fulgens</i>          | Habrey               | Red panda                   | V      | I     |
| <i>Antilope cervicapra</i>      | Krishna sagar        | Black buck                  | V      | III   |
| <i>Bos gaurus</i>               | Gauri gai            | Gaur bison                  | V      | I     |
| <i>Bos mutus</i>                | Yak/Nak              | Wild yak                    | E      | I     |
| <i>Bubalus arnee</i>            | Arna                 | Wild water buffalo          | E      | III   |
| <i>Canis lupus</i>              | Bwanso               | Grey wolf                   | V      | I     |
| <i>Caprolagus hispidus</i>      | Hispid kharayo       | Hispid hare                 | E      | I     |
| <i>Cervus duvauceli</i>         | Barasinghe           | Swamp deer                  | E      | I     |
| <i>Elephas maximus</i>          | Hatti                | Asiatic elephant            | E      | I     |
| <i>Felis lynx</i>               | Pahan biralo o       | Lynx                        | E      | II    |
| <i>Hyaena hyaena</i>            | Hundar               | Striped hyaena              | E      |       |
| <i>Macaca assamensis</i>        | Assamese rato bandar | Asamese red monkey          |        |       |
| <i>Manis crassicaudata</i>      | Salak                | Indian pangolin             |        | II    |
| <i>Manis pentadactyla</i>       | Salak                | Chinese pangolin            |        | II    |
| <i>Moschus chrysogaster</i>     | Kasturi              | Himalayan forest musk deer  | E      | I     |
| <i>Ovis ammon</i>               | Nayan                | Great Tibetan sheep         |        | I     |
| <i>Panthera tigris</i>          | Bagh                 | Bengal tiger                | E      | I     |
| <i>Panthera uncia</i>           | Hiun chituwa         | Snow leopard                | E      | I     |
| <i>Pantholops hodgsoni</i>      | Chiru                | Tibetan antelope            |        | I     |
| <i>Pardofelis nebulosa</i>      | Dhwanse chituwa      | Clouded leopard             | V      | I     |
| <i>Platanista gangetica</i>     | Souns                | Gangetic dolphin            | V      | I     |
| <i>Prionailurus bengalensis</i> | Chari bagh           | Leopard cat                 |        | I     |
| <i>Prionodon pardicolor</i>     | Silu                 | Spotted lingsang            |        | I     |
| <i>Rhinoceros unicornis</i>     | Gainda               | Asian one-horned rhinoceros | E      | I     |
| <i>Sus salvanius</i>            | Sano (Pudke) bandel  | Pigmy hog                   | Ex (?) | I     |
| <i>Tetracerus quadricornis</i>  | Chauka               | Four-horned antelope        | V      | III   |
| <i>Ursus arctos</i>             | Himali rato bhalu    | Brown bear                  |        | I     |
| <b>Birds</b>                    |                      |                             |        |       |
| <i>Buceros bicornis</i>         | Raj dhanesh          | Great-horned hornbill       |        | I     |
| <i>Catreus wallichii</i>        | Cheer                | Cheer pheasant              | E      | I     |
| <i>Ciconia ciconia</i>          | Seto saras           | White stork                 |        |       |
| <i>Ciconia nigra</i>            | Kalo saras           | Black stork                 |        | II    |
| <i>Eupodotis bengalensis</i>    | Khar mujur           | Bengal florican             | E      | I     |
| <i>Grus grus (G. antigone)</i>  | Saras                | Common crane                |        | II    |
| <i>Lophophorus impejanus</i>    | Danfe                | Impeyan pheasant            |        | I     |
| <i>Sypheotides indica</i>       | Sano khar mujur      | Lessor florican             | E      | II    |
| <i>Tragopan satyra</i>          | Monal                | Crimson-horned pheasant     |        | III   |
| <b>Reptiles</b>                 |                      |                             |        |       |
| <i>Gavialis gangeticus</i>      | Ghadijal gohi        | Gharial                     | E      | I     |
| <i>Python molurus</i>           | Azingar              | Asiatic rock python         | V      | I     |
| <i>Varanus flavescens</i>       | Sun gohoro           | Golden monitor lizard       | I      | I     |

CITES = Convention on International Trade in Endangered Species of Wild Fauna and Flora; IUCN = The World Conservation Union, V = vulnerable, E = endangered, Ex = extinct

Notes: CITES Appendix I = Species threatened with extinction; Appendix II = Species not yet threatened but which could become endangered if trade is not controlled; Appendix III = Species that are protected by individual countries within their borders and for which cooperation of other convention signatories is sought.  
Source: MOFSC (2002)

**Table A4.2.3: Nepal's Share in Plant Species in the World**

| Groups                        | Nepal                |                              | World Species <sup>c</sup> | Nepal's Share (%) |
|-------------------------------|----------------------|------------------------------|----------------------------|-------------------|
|                               | Species <sup>a</sup> | Endemic species <sup>b</sup> |                            |                   |
| Nonflowering plants           |                      |                              |                            |                   |
| Algae                         | 687                  | 3                            | 26,000                     | 1.7               |
| Fungi                         | 1,822                | 16                           | 69,000                     | 2.6               |
| Lichen                        | 465                  | 39                           | 20,000                     | 2.7               |
| Bryophytes                    | 853                  | 30                           | 16,600                     | 6.1               |
| Pteridophytes                 | 380                  | 8                            | 11,300                     | 3.2               |
| <b>Non-flowering total</b>    | <b>4,207</b>         |                              |                            | <b>2.7</b>        |
| <b>Flowering plants total</b> | <b>5,884</b>         | <b>246</b>                   | <b>220,529</b>             | <b>2.4</b>        |

Source: <sup>a</sup>CBS (2003); <sup>b</sup>MOFSC (2002); <sup>c</sup>Wilson (1988; 1992)

**Table A4.2.4: Nepal's Share in Animal Diversity in the World**

| Groups                | Nepal                |                              | World Species <sup>c</sup> | Nepal's Share (%) |
|-----------------------|----------------------|------------------------------|----------------------------|-------------------|
|                       | Species <sup>a</sup> | Endemic species <sup>b</sup> |                            |                   |
| Arthropods            |                      |                              |                            |                   |
| Insects               | 5,052                | 5                            | 1,000,000                  | 0.44              |
| Butterflies and Moths | 2,893                | 30                           | 112,000                    | 2.6               |
| Spiders               | 144                  | 108                          | 73,400                     | 0.2               |
| Freshwater fishes     | 185                  | 8                            | 18,150                     | 0.1               |
| Herpetofauna          |                      |                              |                            |                   |
| Amphibians            | 43                   | 9                            | 4,184                      | 1.0               |
| Reptiles              | 100                  | 2                            | 6,300                      | 1.6               |
| Birds                 | 844                  | 2                            | 9,040                      | 9.3               |
| Mammals               | 181                  | 1                            | 4,000                      | 4.5               |

Source: <sup>a</sup>CBS (2003), <sup>b</sup>MOFSC (2002); <sup>c</sup>Wilson (1988; 1992)