

3.3 Forests

The LUPP (1994) identified nine broad forest types (fir, mixed conifer, blue pine, chir pine, broadleaved mixed with conifers, broadleaved, and forest scrub), which are briefly described below:

3.3.1 Fir forest

The Fir forests (345,240 ha) are found on the highest ridges, between 2,700 m and 3,800 m. It requires relatively high precipitation, part of which is obtained as condensation. A thick layer of moss with rhododendron, sub-alpine bamboo, primula, and Bryocarpum hamalaicum characterizes the undergrowth. Few hemlocks (*Tsuga dumosa*) and birches may also be present. Toward the tree line (at 3 600 to 3 800 m) the fir forests become stunted and grade into juniper and rhododendron scrub.

3.3.2 Mixed conifer forest

The Mixed Conifer forests occupy the largest portion of the sub-alpine regions of the country between 2,000 m and 2,700 m altitude and covers an area of about 486,710 ha. The dominant species are spruce (*Picea spinulosa*), hemlock and larch. Hemlock tends to be found on wetter slopes than spruce. The undergrowth consists of rhododendrons, bamboo and other shrubs.

3.3.3 Blue pine (*Pinus wallichiana*) forest

The blue pine forests occur in the temperate regions between 1,800 m and 3,000 m in the Ha, Paro and Thimphu valleys in the West and Bumthang and Gyetsa valleys in central Bhutan covering an area of about 128,570 ha. The blue pine is dominant and demonstrates fast colonization. It is sometimes found mixed with oak (*Quercus griffithi*) and rhododendron (*R. arboratum*). This is probably a secondary type and the original might have been a dry oak Forest with scattered blue pine.

3.3.4 Chir pine (*Pinus roxburghii*) forest

The Chir forests are found at low altitude (900-1 800 m) in the deep, dry valleys of the Sankosh, Kuri Chu and Kulong/Dangmechu river systems under sub-tropical conditions and cover about 100,870 ha. A long dry season is characteristic of these areas and the annual precipitation (1,000-1,300 mm) falls primarily during the summer monsoon. These forests are influenced by biotic activities such as resin tapping, tree felling, and frequent ground fires, which are deliberately set to produce fresh grazing for livestock and to promote new lemon grass growth for essential oil production.

3.3.5 Broadleaved mixed with conifer

The total area in this forest type is about 135,770 ha, which generally consists of oak mixed with blue pine or upper hill forest mixed with spruce or hemlock

3.3.6 Broadleaved hardwood forest

The total area under broadleaved hardwood forests is about 1,512,160 ha and can be divided into three subcategories; Upland (Temperate) Hardwood, Lowland Hardwood and Tropical Hardwood. The upland

hardwood type dominates temperate hillsides, occurs between 2,000 and 2,900 m altitudes and includes two main forest sub-types:

- i) **Evergreen oak forests:** These are more common in the drier areas, especially in the Trongsa and Mongar districts. Maple and *Castanopsis* spp. predominate at lower altitudes, while oak predominates higher up. With increasing altitude these forests grades towards blue pine with xerophytic oaks.
- ii) **Cool broad-leaved forests:** These are located on the wetter hills and are richer in species.

The lowland hardwood forests occupy the sub-tropical hills between 1,000-2,000 m altitudes and are very rich in species of both sub-tropical and temperate genera.

The tropical lowland forests are multistoried, very rich in species diversity, and found on the low hills below 700 m. These forests are broadly classified as semi-evergreen but vary from almost totally deciduous on exposed dry slopes to almost totally evergreen in the forest valleys.

3.3.7 Forest scrub

The forest scrub includes alpine and temperate scrub occurring naturally between the limits of the tree line and barren rocks and covering an area of about 325,730 ha. The dwarf juniper (*J. squamata*), *Rhododendron setosum* and *R. lepidotum* and sometimes even dwarf oaks and willows are common species in the forest scrub. On the drier and higher ridges, however, xerophytic scrub like *Caragana* spp., *Chesneya* spp. and *Ephedra* spp. are much more common. Temperate scrub consists of dense bamboo or other xerophytic, spiny shrubs, which grow in cleared temperate forests that are not converted for agriculture or pasture.

3.4 Forest cover

The land area actually covered by forests (forest cover) is one of the simplest indicators that can be used to assess the extent and change of forest resources. PIS (1970), Negi (1983), MPFD (1991) and Gupta (1992) have assessed forest cover prior to LUPP (1994). The MPFD (1991), Gupta (1992) and LUPP (1994) used the same source of information (SPOT images of 1989) but with different results. The forest assessment information in MPFD (1991) is less useful than Gupta (1992) and LUPP (1997) as it utilized incomplete information from the then ongoing Gupta (1992) study. This chapter utilizes both LUPP (1997) and Gupta (1992) to present information on forest cover and change.

Forest is the main land use followed by agriculture. Table 5 presents land use information for 1989 at the national level based on LUPP (1997) categories. Annex 2, Table A2.2 provides similar information for each dzongkhag.

Table 5. National land use

Land use categories	Area (1 000 ha)	Percent share
Natural -Forest -Closed*	2396	59.72
Natural - Forest - Open*	178	4.44
Forest Scrub	326	8.12
Shifting Cultivation	88	2.20
Forest Plantation	6	0.16
Horticulture	6	0.15
Pastures	156	3.90
Agriculture	220	5.50
Settlements	12	0.30
Others	622	15.52
Total	4011	100.00

Note:* = The "closed" and "open" are two categories of natural forest based on crown density, which for "closed forests" should be more than 40 percent, and that for "open forest" between 10 percent to 40 percent. (Source: Atlas 1997)

Figure 5 presents the variation in extent of natural forest among different dzongkhags (Annex 2, Table A2.2). The natural forest includes both "closed" and "open" forests but excludes forest shrub and forest fallow (FRAWP1, 1998).

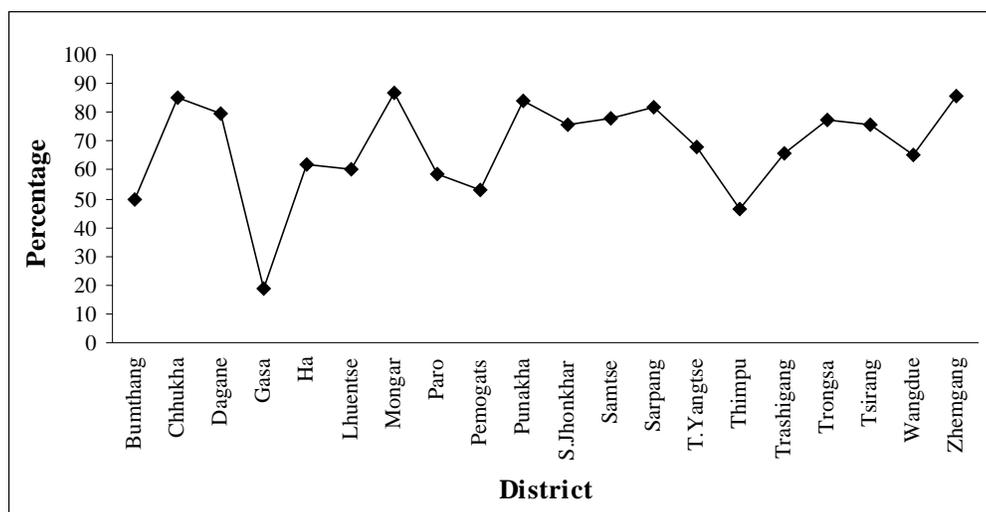


Fig. 5. Percentage of natural forests of the total area in the district

The Table 6 provides a breakdown of national "natural forest" cover by crown cover density (FAO, 1999). In this table, the "conifer" includes fir, mixed conifer, blue pine, and chir pine forests and the "broadleaved" includes hardwood-mixed conifer, and hardwood forests. Similar information for each of the districts is provided in Annex 2 at Table A2.3.

Table 6. Natural forest cover (1 000 ha) by crown cover density

Crown density	Conifer by Crown density				Broadleaved by Crown density			Total Cover	
	10-40%	40-80%	>80%	Subtotal	10-40%	40-80%	>80%	Subtotal	
Natural Forest	130.75	773.20	157.46	1061.41	47.20	619.56	845.40	1512.16	2573.57

(Source: LUPP, 1994)

The land-cover figures (Annex 2, Table A2.2) indicate that in some northern dzongkhags factors other "population density" like "high average altitude" explain large proportion of scrub and pasture land. For example, Gasa has a total scrub area of 623.58 km² that mostly represents the natural grasslands and scrub. However, in southern and eastern regions, the steeper terrain and heavy rainfall coupled with higher population density explain higher forest degradation.

3.5 Change in forest cover

The analysis of satellite imageries of 1989 by Land Use and Planning Project (LUPP, 1997) of Bhutan indicates (Figure 6a) that the declining trend (1958 to 1978) of forest cover has reversed during 1978 - 1989. The total forest cover has increased while the areas under agriculture and shifting agriculture have declined substantially. This analysis also indicates that the areas under close forests have significantly increased and that under open forest categories have decreased.

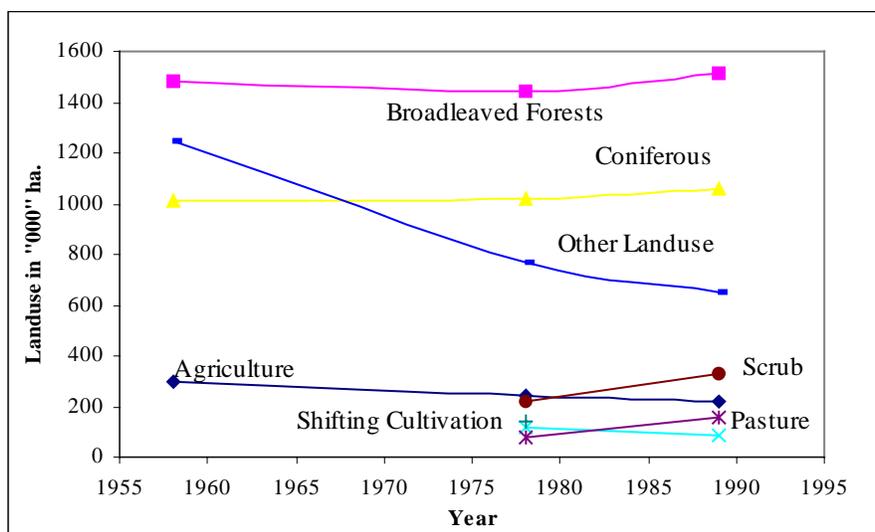


Fig. 6a. Change in Landuse over last four decades based on LUPP (1997)

However, analysis of same imageries by Gupta (1992) indicates (Fig. 6b) that loss of natural forest during last ten-year period (1978-89) has been much more than that during the earlier period of twenty years (1958-1978) mainly due to extensive expansion of agriculture. It also indicates that the area of closed forest has declined and that of open forest has increased over the entire period.

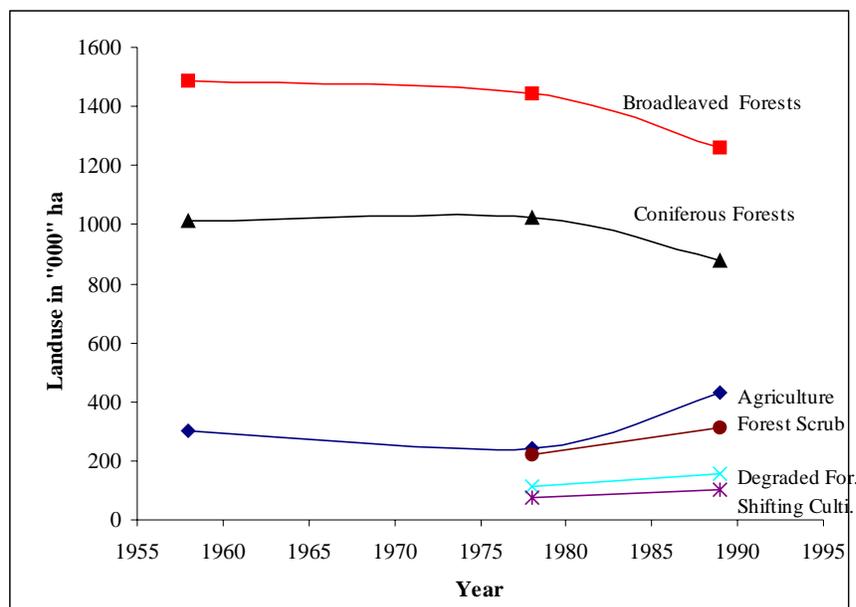


Fig. 6a. Change in land use over last four decades based on Gupta (1992)

Table A2.4 at Annex 2 provides detailed information on the above in a tabular form. The current forest cover of Bhutan is being assessed with Japanese assistance using satellite imageries of 1999.

3.6 Forest growing stock

The total growing stock of forests in Bhutan is about 640.32 million cubic meters (Annex 2, Table A2.5). Figure 7 presents the amount of growing stock by district. The Forest Department does not conduct regular forest inventories to assess entire growing stock. The forest inventories are done for preparing management plans for specific forest units. These units are spread over almost all the districts (17 out of 20). The per-unit-area growing stock in these units is the basis for estimation of growing stock in Bhutan.

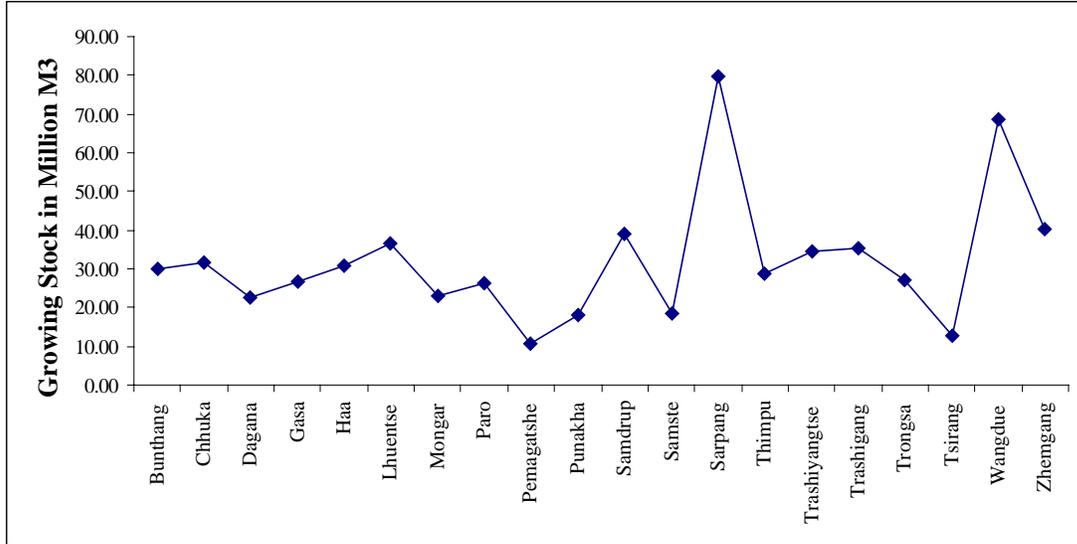


Fig. 7. Growing Stock in the districts of Bhutan

3.7 Annual yield

The annual allowable cut (AAC) is 1.2 million m³ and planned level of harvest is about 450,000 m³ excluding more than one million cubic meters of firewood extracted by rural people (MPFD, 1991). The yield from plantations is negligible. The share of broadleaved in the yield is about 60 percent while that of coniferous forests is about 40 percent.

3.8 Biomass production

The production of biomass at district level generally corresponds (Fig. 8) with their share in the national stock of biomass (Table A2.6 at Annex 2).

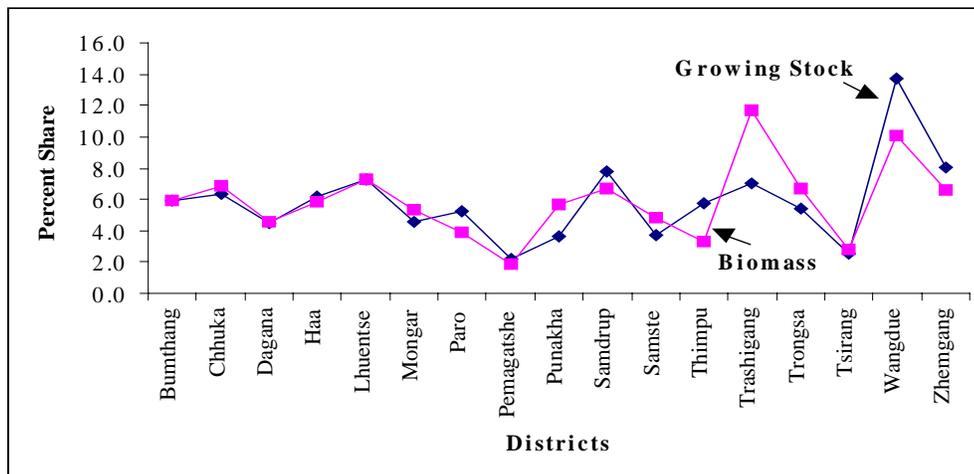


Fig. 8. Share of the districts in biomass and production

3.9 Biological diversity

Basic ecological and systematic information on the biodiversity of Bhutan is limited (BAP, 1998). There is no countrywide inventory of ecosystems. Information on bio-diversity of birds and plants is based on an extensive plant inventory conducted in the 1970's (Grierson and Long, 1983). However, there are no base line data to determine status and trend. The number of described plant and vertebrates may be as little as 3 percent of the estimated number (Reid, 1996)

The flora of Bhutan is very rich and consists of several elements. Southeast Asian-Malesian elements are common in the tropical and sub tropical evergreen and semi-evergreen forests. The bulk of the temperate and sub-alpine flora consists of Himalayan-Chinese elements, including plants of the West Himalayas, East Himalayas and pan-Himalayan species. A small portion of flora in drier parts of Duars and the tropical zone is Deccan in distribution. The northwest portion of Bhutan consists of typical Tibetan species. Some plant species in the alpine zone have Euro-Siberian and Arctic-alpine affinity.

Bhutan has more than 300 species in the alpine zone that are used in Chinese and Tibetan traditional medicine. More than 168 horticulture species from Bhutan have been introduced into Europe (MPFD, 1991).

The fauna of Bhutan is also very diverse. More than 160 mammal species have been reported. Grey langurs, macaques, tigers, leopards, goral, serow, black bear, fox, deer, and many other species live in the temperate zone. The high altitude fauna is mostly paleoartic in origin and includes takin, blue sheep, red panda, snow leopard, brown bear, wolf, steppe cat, and Tibetan antelope (MPFD, 1991).

Oriental species from India and South-East Asia such as elephant, gaur, wild buffalo, tiger, cloud leopard, binturong, Indian rhinoceros, swamp deer, pygmy hog, hispid hare, the endemic golden langur, and sloth bear are seen in the tropical zone (MPFD, 1991).

Bhutan has more than 770 species of birds of paleoartic and oriental origin. Bhutan is important for summer and winter migrant birds from the south and north, respectively (e.g., Bhutan is a major wintering area for the black-necked crane). Biodiversity of birds is highest in the tropical and sub-tropical zones where about 700 species of bird are found below 2 000 m, about 500 bird species between 2,000 and 4,000 m and only 94 above 4,000 m.

Bhutan has many reptiles including mugger, garhial, river turtles, pythons, and lizards. The amphibian fauna is quite rich in the tropical and sub tropical zones. Extremely varied butterflies, including the swallowtail and other rare species (*Bhutanitis lidderdali*, *Troides spp.*, *Atrophaneura spp.*, *Parnassus spp.* and *Teinopalpus imperialis*) are found in Bhutan.

3.10 Conservation of biodiversity

Bhutan ranks in the top ten percent of countries with the highest species density (species richness per unit area) in the world, and it has the highest fraction of land in protected areas with highest proportion of forest cover of any Asian country. Bhutan is distinctive among developing countries in that it has allocated 26.3 percent of its geographical area to national parks and wildlife sanctuaries, even though it is using loans to augment its financial resources for development.

The Royal Government of Bhutan has a policy of establishing protected areas to protect representative samples of the pristine mostly intact Himalayan ecosystem for the conservation of biodiversity and genetic resources. The government revised its previous protected area system in 1993 to built a new of four national parks, four wildlife sanctuaries and one strict nature reserve. The protected area management provides for zoning (core, administrative, buffer and multiple use) of the parks to respect the rights and needs of local communities for timber and fuelwood. The conservation areas have special regulations to ensure protection of local species important from the point of view of conservation. Table 7 indicates six such areas and local species protected within them.

Table 7. Conservation areas of Bhutan

Conservation Area	Dzongkhag	Local Species needing conservation
Docchula	Thimpu	Rhododendrons, birds, and red panda
Pele la	Wangdue	Langurs, red panda, birds, and scenery
Yutong la	Trongsa	Pine forests, birds and scenery
Durtsachu	Bumthang	Hot springs, geology and scenery
Pohobjikha	Wangdue	Black-necked crane
Doga	Paro	Goral

(Source: BAP, 1998)

Aquatic habitats are equally important and found in different ecological zones and landscapes. These range from glacial origin, perennial torrential rivers to seasonal rivulets or streams, high altitude lakes and springs to lowland lakes, swamps and marshy lands of river flood plains to paddy fields and man-made reservoirs to village ponds. In the near future an additional area of water surface will be added from the implementation of a series of hydropower, irrigation and aquaculture development projects.

3.11 Protected areas

Bhutan has categorized its nine protected areas into strict nature reserves, national parks and wildlife sanctuaries. The protected areas represent typical biodiversity at different levels (species, genetic, landscape, eco-systems etc.) The Forest and Nature Conservation Act of 1995 and other relevant legislation provide legal support to these protected areas. The objective of these areas is in-situ conservation of flora and fauna, including the wild relatives of domesticated species.

The nine protected areas representing alpine to dry deciduous ecosystems are well dispersed in 15 of the 20 dzongkhags (districts) of Bhutan over about 1.12 million ha of forest land. The individual areas of the nine protected areas vary from about 26,000 ha to 435,000 ha. Bhutan’s natural resources provide shelter to about 7,000 vascular plants, 700 bird species, 200 mammals and at least 5 globally endangered species of flora and fauna.

Torsa Strict Nature Reserve (TSNR)

The Torsa Strict Nature Reserve extends over 64 960 ha, falling in two dzongkhags (Haa and Paro). The main activity is research on the biodiversity of this protected area. The reserve displays a variety of landscapes and ecosystems of westernmost temperate forest from broadleaved forests to alpine parks

including the small lakes of Sinchulungpa. This area has no human habitation and is a military security area near the Chinese border.

Royal Manas National Park (RMNP)

The Royal Manas National Park is spread over two dzongkhags (Samdrup-Jongkhar and Zhemgang) and covers about 102,280 ha from lowland tropical ecosystems to permanent snow clad mountain. It is a fully operational national park and has more significant species than any other park in Bhutan (BAP, 1998). About 362 species of birds have already been identified. Many plant species have high value as cultivars for crop and horticulture, and many other species have medicinal, traditional, and religious importance.

The first management plan for a national park in Bhutan was developed for this park in 1955. The Bhutan Trust Fund (BTF) provides financial support for infrastructure development and preliminary activities. The World-wide Fund for Nature is currently financing the implementation of its management plan. The National Women Association of Bhutan is implementing some activities for community development in this area. Prioritized activities include enhancing rural income through increasing farmland productivity, promoting cottage industries and creating rural credit facilities.

Jigme Dorji National Park (JDNP)

Jigme Dorji National Park, a fully operational National Park, covers 434,950 ha in four dzongkhags (Thimpu, Paro, Gasa, and Punakha). The Global Environmental Facility and the United Nations Development Programme are co-financing the integrated management plan for the park. Activities include recruitment and training of staff and infrastructure development to strengthen park management. The plan deals with such issues as poaching, eco-tourism, and enforcement of legal systems. The plan provides for the development and implementation of community resource management plans to promote sustainable livelihoods and alternative approaches to help conserve and utilize the rich biodiversity on a sustainable basis.

This park has the largest protected area and is natural conservatory of glaciers, alpine meadows and scrub lands, sub-alpine and temperate conifer forests, warm and cool temperate broad-leaved forests, major rivers and streams, and the flora and fauna that inhabit these ecosystems. The park harbours endangered or extinct species including the takin, snow leopard, blue sheep, musk deer, Himalayan black bear, marmots, red panda, tiger and several species of pheasants.

Several plants found in the park are valuable cultivars, useful for horticulture and have commercial, medicinal, traditional and religious value. Over 300 plants are currently used to make indigenous medicine, most of which are found in the park.

Black Mountain National Park (BMNP)

The Black Mountain National Park is contained in three dzongkhags (Zhemgang, Wangdue, and Trongsa) over an area of 172,760 ha. It represents a wide range of ecosystems and habitat types including permanent snow-covered areas near Dorshingla Peak (4,925 m), alpine lakes and pastures and coniferous and broad-leaved forests. The reserve constitutes the largest and richest temperate forest nature reserve in the entire Himalayas. The combined area of BMNP and RMNP supports maximum

number (449) of bird species among the Asian reserves. The grazing of yaks in summer on the northern alpine areas of the park is the only major intervention in the park.

Most of the preliminary biological and socio-economic surveys for the park have been completed and very soon its management plan will be ready for approval. This park is a fully operational National Park and is supported by the Netherlands SNV Co-operative program.

Thrumshingla National Park (TNP)

Thrumshingla National Park comprises 88,930 ha of forest area in Bumthang and Mongar dzongkhags. It is the second largest major temperate park in Bhutan and contains some spectacular scenic views. The ecosystems and landscapes range from alpine to sub-tropical broadleaved, and include some unique protected chir pine forests. The soil of the park is particularly fragile, which renders it quite unsuitable for logging or other development. The park has excellent tourism potential with a good wildlife trail from the Ura Valley right down to the Bumthang Valley. The VIII Five Year Plan provides for completion of its management plan.

Bomdiling Wildlife Sanctuary (BWS)

The Bomdiling Wildlife Sanctuary conserves a rich diversity of flora and fauna in 118,430 ha spread over two dzongkhags (Trashiyangtse and Lhuentse). The natural landscape and ecosystems range from sub-tropical forests to alpine meadows with scenic alpine lakes in the higher elevations. The sanctuary includes the Bomdiling Valley, one of main wintering spots in Bhutan for the migratory rare black-necked crane. The sanctuary is endowed with several cultural and religious sites of international significance, including Singye Dzong and Khempa Jong, sites held sacred by Buddhists throughout the region. The VIII Five Year Plan provides for development of a management plan for this sanctuary.

Sakteng Wildlife Sanctuary (SWS)

The Sakteng Wildlife Sanctuary represents the easternmost temperate ecosystems and landscapes of Bhutan over an area of 74,950 ha in Trashigang dzongkhag. The sanctuary protects some unique endemic species such as the eastern blue pine, black-rumped magpie and many other species found only in the eastern part of the country. The management plan is planned to be completed during the VIII Five Year Plan.

Khaling-Neoli Wildlife Sanctuary (KNWS)

The Khaling-Neoli Wildlife Sanctuary in Samdrup-Jongkhar dzongkhag extends over 33,380 ha of sub-tropical forests of two forest reserves (Khaling and Neoli), and hence the name. The sanctuary supports elephant, gaur, and other tropical wildlife and may be the only locality for pygmy hog and hispid hare. It is planned to revise the boundaries to combine the two forest reserves areas without changing the size. The Khaling reserve on the Assam side of the border forms the transfrontier reserve (BAP, 1998). The VIII Five Year Plan envisages the completion of a management plan.

Phibsoo Wildlife Sanctuary (PWS)

The Phibsoo Wildlife Sanctuary is located in the south-central dzongkhag (Sarpang) covering an area of 26,520 ha of unique dry Shorea forest ecosystem. It is a fully operational wild life sanctuary occupying the important bio-geographic position. The sanctuary conserves tropical fauna such as elephant, gaur and golden langur, and is the only protected area in Bhutan having chital deer and natural sal forests. Preliminary surveys of the flora and fauna have been completed and other surveys are ongoing. The World-wide Fund for Nature is providing support

3.12 Land use within protected areas

Fig 9 presents the picture of the combined land use in the network of the nine protected areas. Annex 2, Table A2.7 provides similar information on land use for each of the nine protected areas. Although all the protected areas are rich in biodiversity and have more than 70 percent forest cover, the presence of farming and shifting cultivation in each of them raises some concerns about their sustainability.

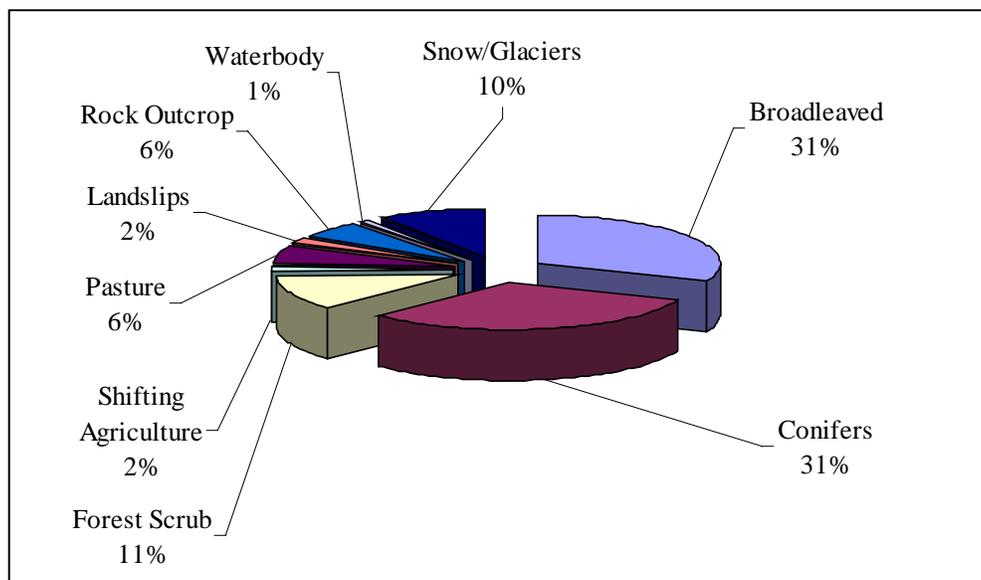


Fig. 9. Land use in the protected areas

3.13 Management of protected areas

Management of protected areas follows an integrated program approach that combines conservation and development efforts. Two of the national parks (Royal Manas National Park and Jigme Dorji National Park) have well developed integrated management plans. The current emphasis is on protection of endangered species from poaching and understanding their habitats and population dynamics. The present policy is not to resettle people residing within the national parks unless they want to move or it is absolutely necessary to do so. The management allows current habitants to harvest of wood, collect

minor products and graze their animals. The Forestry Services Division provides necessary direction and support to all the protected areas, which comprise about 26.3 percent of the country.

3.14 Summary

Forest degradation in Bhutan is basically a biotic phenomenon where man, in his quest to survive and improve his well being, has taken short-term unsustainable measures. Population density and economic development are directly linked with the enhanced degradation. The increasing population is likely to aggravate the situation further unless timely measures counter this trend. Bhutan's effort in setting aside areas for conservation and protection is commendable and provides a positive hope for sustainability of natural resources.