

CHAPTER 3

TERRESTRIAL ECOSYSTEM

- 3.1 Introduction
- 3.2 Land Resources: Status and Trends
- 3.3 Forest Resources: Status and Trends
- 3.4 Biodiversity: Status and Trends
- 3.5 Policies and Programmes
- 3.6 Conclusions

Terrestrial Ecosystem

3.1 Introduction

There is substantial evidence of widespread environmental degradation throughout the terrestrial ecosystem in Pakistan. In many instances this degradation is far advanced and may be difficult if not impossible to arrest or reverse, particularly with limited financial means. In other areas the process of ecological deterioration has recently begun to accelerate and threatens to present insoluble problems unless remedial action is taken very soon. In still other areas destructive forces have begun to emerge, but serious consequences could still be averted with appropriate action. The primary manifestation of ecological deterioration in the field may be broadly categorized into three groups: a) land degradation and desertification, b) deforestation and c) loss of biodiversity and species extinction. This chapter discusses these problems along with the policy responses that have been adapted to tackle these problems.

3.2 Land Resources: Status and Trends

3.2.1 Land Use

The land cover/land use classification in the Land Use Atlas of Pakistan uses ten categories which were developed from Landsat ETM image data. Among these, forest including scrub, riverine, mangroves and plantation covers about 5 percent of the country. Agriculture land including irrigated, rainfed and rodkohi agriculture extracted from spectral reflection of crop cover is about 20 percent (not including the fallow land that is included in open space/ground class, which as a whole covers about 10 percent of the country). Rangelands cover over 27 percent area, while rock outcrops occupied another 25 percent of the country. The snow/glacier coverage is recorded at about 2 percent while 10 percent of the area are deserts.

The details of agricultural land use, compiled by the Ministry of Food, Agriculture and Livestock are given in table 3.1. It shows that the land available for cultivation is 29.4 million ha but only 70 percent (21.2 million ha) of this is actually cultivated accounting for 27 percent of the total land area. An area of 24 million ha is not available for cultivation either because of extremely unfavourable conditions or because it lies under water or is covered by cities, towns, villages and roads. About 8 million ha (14 percent) of land is culturable waste, mainly because of lack of water. Average delivery efficiency of water in current irrigation system in Pakistan has been estimated at 35 to 40 percent from the canal head to the root zone, with most losses occurring in watercourses. The loss of such large portion of water reduces its availability for crops (See Chapter 4 for details). If this delivery efficiency could be improved, the water availability for bringing culturable wasteland under plough could be ensured and food production could be enhanced to feed the fast growing population.

The pressure on cropped areas is quite high in Pakistan and the per capita availability of cropped land is only

Table 3.1: Pakistan: Land Utilization

| Area excludes Gilgit-Baltistan Province | | | | | | | | | | |
|---|---------------|------------------|----------------|---------------------------------------|---------------------|-------------------|------------------|-----------------------------------|--------------------------------|------------------------------------|
| | | | | | | | | | | (Million ha) |
| Fisc Year | Total Area | Reported Area | Forest Area | Not Avail- able for Cultivation | Culturable Waste | Cultivated Area | | | Area Sown more than once | Total Cropped Area (8+10) |
| | | | | | | Current Fallow | Net Area Sown | Total Area Cultivated (7+8) | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 1990 - 91 | 79.61 | 57.61 | 3.46 | 24.34 | 8.85 | 4.85 | 16.11 | 20.96 | 5.71 | 21.82 |
| 1991 - 92 | 79.61 | 57.87 | 3.47 | 24.48 | 8.86 | 4.87 | 16.19 | 21.06 | 5.53 | 21.72 |
| 1992 - 93 | 79.61 | 58.06 | 3.48 | 24.35 | 8.83 | 4.95 | 16.45 | 21.40 | 5.99 | 22.44 |
| 1993 - 94 | 79.61 | 58.13 | 3.45 | 24.43 | 8.74 | 5.29 | 16.22 | 21.51 | 5.65 | 21.87 |
| 1994 - 95 | 79.61 | 58.50 | 3.60 | 24.44 | 8.91 | 5.42 | 16.13 | 21.55 | 6.01 | 22.14 |
| 1995 - 96 | 79.61 | 58.51 | 3.61 | 24.35 | 8.87 | 5.19 | 16.49 | 21.68 | 6.10 | 22.59 |
| 1996 - 97 | 79.61 | 59.23 | 3.58 | 24.61 | 9.06 | 5.48 | 16.50 | 21.98 | 6.23 | 22.73 |
| 1997 - 98 | 79.61 | 59.32 | 3.60 | 24.61 | 9.15 | 5.48 | 16.48 | 21.96 | 6.56 | 23.04 |
| 1998 - 99 | 79.61 | 59.28 | 3.60 | 24.52 | 9.23 | 5.35 | 16.58 | 21.93 | 6.28 | 22.86 |
| 1999 - 00 | 79.61 | 59.28 | 3.78 | 24.45 | 9.09 | 5.67 | 16.29 | 21.96 | 6.45 | 22.74 |
| 2000 - 01 | 79.61 | 59.44 | 3.77 | 24.37 | 9.17 | 6.73 | 15.40 | 22.13 | 6.64 | 22.04 |
| 2001 - 02 | 79.61 | 59.33 | 3.80 | 24.31 | 8.95 | 6.60 | 15.67 | 22.27 | 6.45 | 22.12 |
| 2002 - 03 | 79.61 | 59.45 | 4.04 | 24.25 | 8.95 | 6.61 | 15.60 | 22.21 | 6.25 | 21.85 |
| 2003 - 04 | 79.61 | 59.46 | 4.01 | 24.23 | 9.10 | 6.23 | 15.89 | 22.12 | 7.05 | 22.94 |
| 2004 - 05 | 79.61 | 59.48 | 4.02 | 24.39 | 8.94 | 6.86 | 15.27 | 22.13 | 7.51 | 22.78 |
| 2005 - 06 | 79.61 | 57.22 | 4.03 | 22.87 | 8.21 | 6.72 | 15.39 | 22.65 | 7.74 | 23.13 |
| 2006 - 07 | 79.61 | 57.05 | 4.18 | 22.70 | 8.30 | 5.72 | 16.16 | 21.88 | 7.40 | 23.56 |
| 2007 - 08 | 79.61 | 57.08 | 4.21 | 23.41 | 8.19 | 4.93 | 16.34 | 21.27 | 7.51 | 23.85 |
| 2008 - 09 | 79.61 | 57.08 | 4.21 | 23.45 | 8.20 | 4.93 | 16.28 | 21.18 | 7.52 | 23.80 |
| 2009 - 10 P | 79.61 | 57.08 | 4.21 | 23.45 | 8.20 | 4.93 | 16.28 | 21.21 | 7.52 | 23.80 |

P : Provisional

Source: Ministry of Food and Agriculture

Note:

TOTAL AREA REPORTED is the total physical area of the villages/deh, tehsils or districts etc.

FOREST AREA is the area of any land administered as forest under any legal enactment dealing with forests. Any cultivated area which may exist within such forest is shown under heading "cultivated area".

AREA NOT AVAILABLE FOR CULTIVATION is that uncultivated area of the farm which is under farm home steads, farm roads and other connected purposes and not available for cultivation.

CULTURABLE WASTE is that uncultivated farm area which is fit for cultivation but was not cropped during the year under reference nor in the year before that.

CURRENT FALLOW (ploughed but uncropped) is that area which is vacant during the year under reference but was sown at least once during the previous year

CULTIVATED AREA is that area which was sown at least during the year under reference or during the previous year.

Cultivated Area = Net Area sown + Current Fallow.

NET AREA SOWN is that area which is sown at least once during (Kharif& Rabi) the year under reference.

AREA SOWN MORE THAN ONCE is the difference between the total cropped area and the net area sown.

TOTAL CROPPED AREA means the aggregate area of crops raised in a farm during the year under reference including the area under fruit trees.

about 0.21 ha, against the world average of 0.24 ha. The process of land degradation that has affected a large portion of arid and semi-arid land in the country is compounding this. Pakistan is predominantly a dryland country where 80 percent of its land area is arid or semiarid, about 12 percent is dry sub-humid and the remaining 8 percent is humid. Out of a total land area of 79.6 million ha in the country, only 16 million ha is used for irrigated farming.

Two third of country's rapidly increasing population depends on drylands to support their livelihood mainly by engaging in agro-pastoral activities. Pakistan's land area by aridity and population by aridity zones are given in Figures 3.1 and 3.2. Within the arid and semi-arid areas three major types of agriculture-canal irrigated, rainfed and rainwater harvested are practiced. The extent of land under each, compiled by land cover estimates using NOAA satellite imagery is given in table 3.2. All these areas have been affected by land degradation.

Fig. 3.1 Pakistan: Land Distribution by Aridity Zones

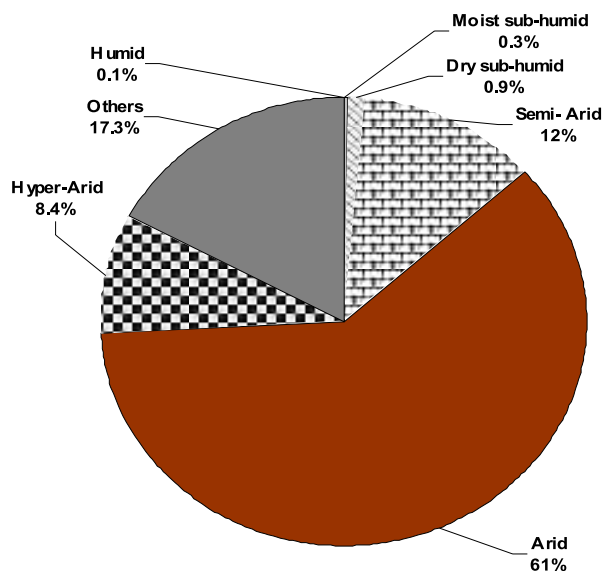


Fig. 3.2 Pakistan: Population Distribution by Aridity Zones

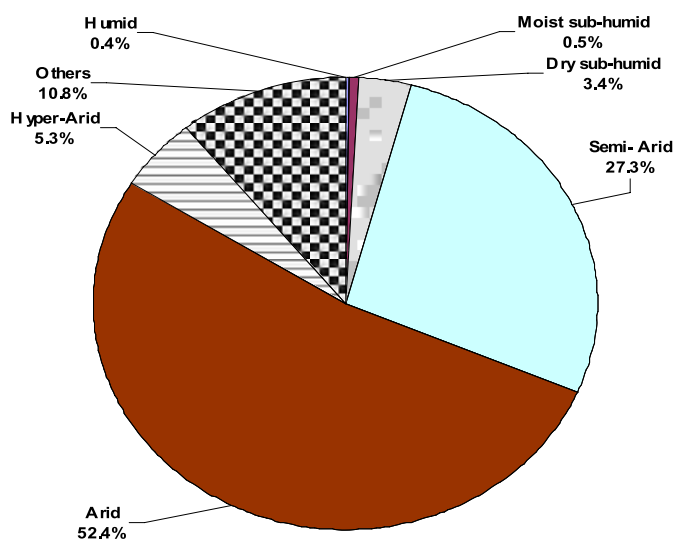


Table 3.2 Pakistan: Land Area under Various Types of Agriculture

| Type of Agriculture | Estimated area (Million ha) | Percent of land area |
|-----------------------|-----------------------------|----------------------|
| Canal irrigated | 15.98 | 19.16 |
| Rain fed | 2.73 | 3.28 |
| Rain water harvesting | 0.82 | 0.99 |

3.2.2 Land Degradation

Land degradation and desertification is a serious problem globally but it is more acute in case of Pakistan where almost three fourth of the land is either already affected or likely to be affected. Desertification is a process or a set of processes, which cause diminution of the biological potential of land, ultimately leading to desert like conditions and a complete loss of production and resources. A desertification process has been active in the Pakistan area since historical times. The decline of the Indus Valley Civilization with its great cities of Moenjodaro and Harrapa has been attributed to a prolonged process of desertification and desiccation bringing irreparable damage to agriculture.

Among the factors affecting land degradation and desertification in Pakistan, population pressure is a fundamental underlying cause. Major immediate physical causes of ecological degradation include a) excessive felling of trees, b) uncontrolled and excessive livestock grazing and browsing in forest and rangeland thereby damaging the vegetative cover and preventing natural and/or managed regeneration of grasses, shrubs and trees, c) inappropriate cultivation practices in hilly and rain fed farming areas contributing to wind and water erosion, d) inadequate drainage in heavily irrigated area causing waterlogging and salinity and e) inadequate efforts with regard to watershed protection and management in the catchment areas of reservoirs.

Social, economic, political, legal and institutional factors and forces underlie much of this. Traditional land and resource utilization rights, particularly in tribal areas where they are very difficult to challenge, frequently conflict with the sound management and preservation of existing natural resources. Long-standing legal arrangements concerning forest and range resource exploitation are increasingly anachronistic, but extremely difficult to challenge or reform and combined with rapid population growth cause excessive forest depletion and range overstocking. Skewed patterns of land ownership and access to public sector resources and services present major obstacles to effective environmental resource management with the limited financial means available. Individual and collective perceptions of short-term needs heavily out-weight considerations of resource conservation for the more distant future. Institutional arrangements and financial provisions for natural resource management and conservation are inadequate. Traditional attitudes concerning wealth and prestige among livestock owners run counter to sound husbandry practices and proper pasture and range management. In matters concerning environmental protection, official attention is focused far more on their immediate financial costs than on their longer-term economic and social benefits. Technical solutions to the challenge to generate increased outputs from available natural resources are far more readily available, understood and applicable than are solutions to the often complex socioeconomic, physical and biological problems and the inter-relationships encountered in efforts to conserve these productive resources.

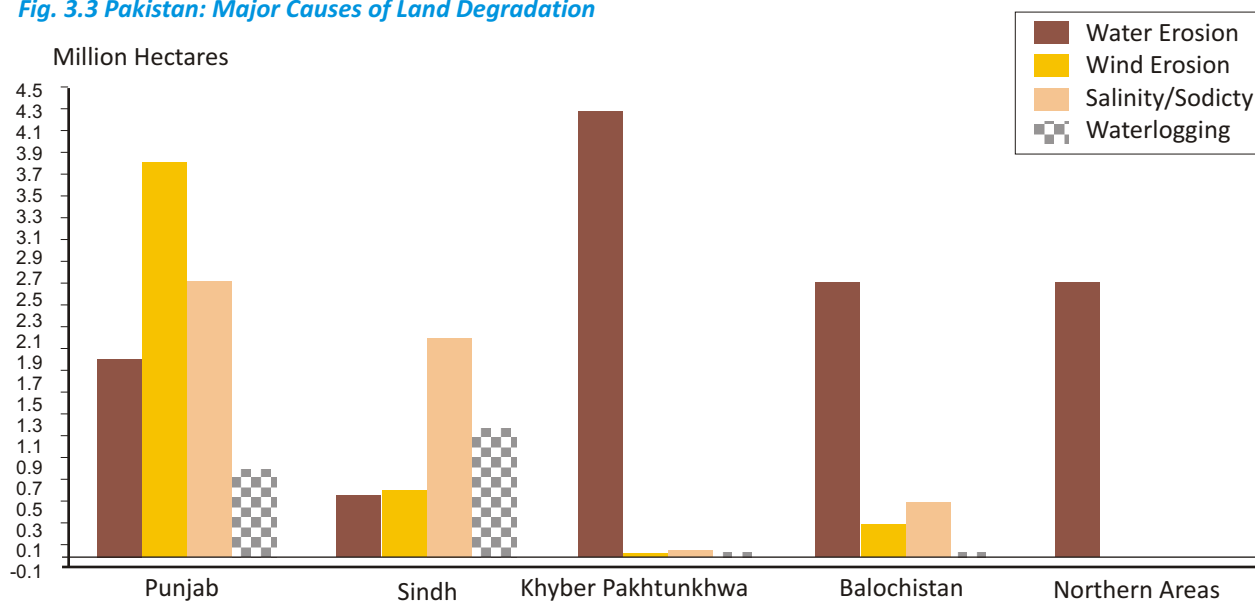
3.2.2.1 Land Degradation/Desertification in Dry Lands/Areas of Rain fed Agriculture

Like many other developing countries dry lands in Pakistan are severely affected by land degradation and desertification due to unsustainable land management practices and increasing natural resources demands causing severe environmental problems, including degradation of dry land ecosystems, loss of soil fertility, flash floods, loss of biodiversity, reduction in land productivity, soil erosion and many problems associated with the pressure on natural resources from the rapid growth in population. The situation is further aggravated by scarcity of water, frequent droughts and miss-management of land resources, contributing to an expansion of the deserts, reduced productivity and consequent increase in rural poverty. Moreover there is limited knowledge of consequences and economic implications of land degradation, information gaps and

limited institutional capacity to address degradation and desertification problems through an integrated land management approach.

Overall land degradation in Pakistan is mainly due to four major causes: water erosion, wind erosion, salinity/sodicity and water logging (Fig 3.3). About 16-18 million ha (estimates vary), mostly northern mountain regions, are affected by erosion. Water erosion is very serious in Khyber Pakhtunkhwa, Sindh and Northern Areas (Gilgit–Baltistan province). About 3-5 million ha of land is affected by wind erosion in arid regions of Punjab (Cholistan), Sindh (Tharparkar), and Balochistan (Chagai Desert and sand areas along the coast). Some of the areas have 0.5 to 4 meter high moving sand dunes, posing danger to cultivated land and local infrastructure. Another 2 million ha have been affected by waterlogging and around 5 million ha by salinity and sodicity. Wind erosion is another issue concerning land degradation in Pakistan.

Fig. 3.3 Pakistan: Major Causes of Land Degradation



Source: GOP, 2007

Causes and effects of land degradation in rain fed lands are given in table 3.3. It can be seen that soil erosion to poor management of resources are the factors contributing to land degradation with wide ranging impacts from loss of agricultural land to rangeland degradation and siltation of rivers and dams.

3.2.2.2 Degradation on Arable Land by Erosion

Degradation of arable land caused by wind and water erosion increased by almost 3.5 million ha from 1993 to 2003 (Ahmed and Rashid, 2003 and Brandon, 1995) and affected about 18 million ha of land in 2003. Figure 3.4 presents the distribution of eroded areas by province. The regions most affected by soil erosion during this period were Sind (about 1.5 million hectare area was added to eroded land of which an estimated 0.36 million ha to eroded croplands) and Balochistan (about 2 million ha increased in eroded land of which an estimated 0.5 million ha to eroded croplands). Accelerated or man-caused erosion is severe throughout the area. Overgrazing and clean cutting of forested lands, cultivation on marginal lands and intensive cultivation of other lands without suitable protective soil and water management practices, failure to provide suitable

Table 3.3 Pakistan: Causes and Effects of Degradation in Rainfed Lands

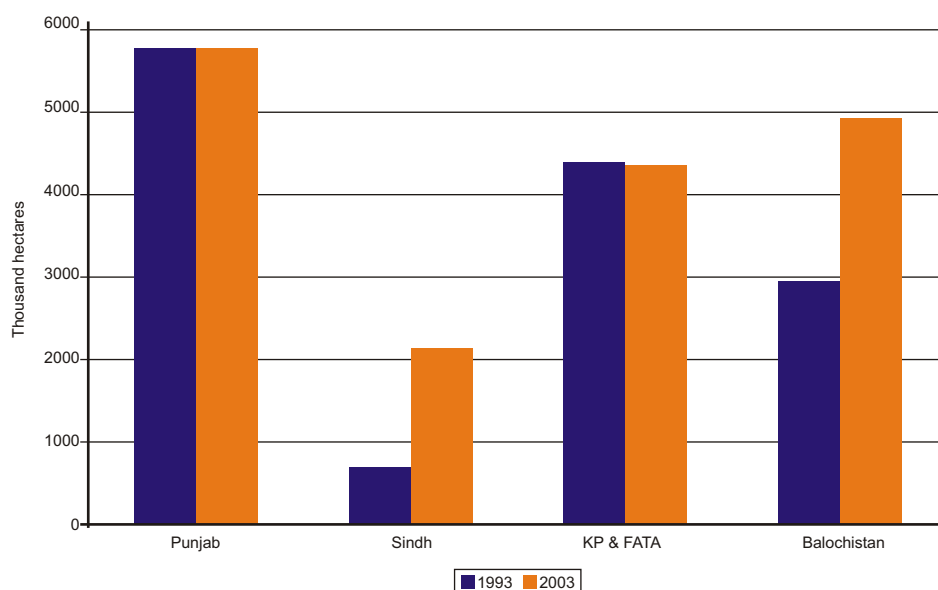
| Causes of land degradation | Effects and implications |
|--|---|
| Soil erosion | Soil erosion results in siltation of rivers, irrigation systems and small dams, debris flow and land slides on hill slopes impairing of texture and structure of soil and loss of soil nutrients, excessive water runoff, rise in frequency of floods decrease in water retaining capacity of soils. |
| Sloping cultivation | Clearing of forest land for crop cultivation, illicit cutting of trees for firewood and agricultural implements. |
| Over-grazing | Overgrazing cutting and lopping of forage trees, damage to young forest crop and nurseries, disturbance or compaction of soil, increase in soil erosion. Reduction in wildlife habitat quality and quantity, competition with livestock for forages and space, less regeneration of natural vegetation due to compaction of soil. |
| Deforestation | Deforestation results in excessive soil and water erosion, drying of aquifers, reduced carbon sequestration, aridity in climate, reduction in water retaining capacity of soil, excessive water runoff, destruction and deterioration of wildlife resulting in lower number of wild animals and birds. |
| Land tenure issues | Fragmentation of land holdings, cutting of forest for fuel, timber and lopping for forage, clearing of forest areas for crop cultivation. |
| Poor management of natural resources/forests | Illegal cutting of trees in forests and watersheds, reduction in scrub forest cover, inadequate reforestation due to insufficient resources has increased soil erosion and siltation of rivers. Weak law enforcement to check theft and illegal removal of vegetation quite evident. |

Source: National Action plan to Combat Desertification, M/o Environment

water disposal systems and many other related factors have damaged or destroyed large areas of productive land. Officials in Khyber Pakhtunkhwa operate with a working estimate of annual average soil losses on unprotected land averaging 400 kg per hectare; in several of the steeper, more critical parts of Tarbela Catchment in the Punjab soil erosion has been measured at 2-4 kg per square meter annually. Officials in Balochistan estimate that effective watershed protection in priority areas would reduce soil erosion by as much as 2-5 kg per square meter treated annually. According to the World Bank (2006), the estimated economic losses from reduced productivity as a result of soil erosion in Pakistan is around Rs 15 billion per year, or 0.25 percent of GDP. No information is available on the offsite costs such as the siltation of dams and changes in hydrology.

Sediment studies in rivers in the Pakistani area have been carried out from 1916. In early 70's soil at the rate of 1500-2500 thousand tons per square kilometre was carried annually in the river Chenab and Jhelum (GOP, 1973). According to recent estimates the sediment load in the Indus is greater and in fact one of the highest in the world. Without effective watershed protection, it is estimated that Tarbela might be completely silted up in about 35 years. An evaluation of the impact of watershed management activities undertaken in the Mangla catchment concluded that the economic life of the Mangla Reservoir, provided it were solely dependent on the rate of siltation, has been lengthened by about 60 years through the reduction in soil erosion and siltation rates in the catchment area achieved during the past 25 years (IBRD, 1985). With a gross catchment area for Kalabagh of over 28000 square kilometres the volume of silt carried into a planned reservoir in the absence of effective anti-erosion activities would be enormous and it would be highly imprudent to invest the financial

Fig. 3.4 Pakistan: Eroded Land 1993-2003



Source: Ahmed and Rashid (2003); Brandon (1995)

Box 3.1 Economic Losses from Salinity in Pakistan

Salinity is one of Pakistan's most serious problems. Common to arid regions, Pakistan has naturally saline soils, but the problem has been compounded by consistent mismanagement of irrigation. Official statistics indicate that over 25 percent of irrigated land suffers from various levels of salinity, with over 1.4 million ha being rendered uncultivable due to excessive salinity levels. Salinity imposes direct economic losses, through reduced yields and less visible indirect losses through changes in farming practices or the cropping mix. The total annual yield reductions from salinity are estimated at Rs 15-55 billion. If lost opportunities from cropping on the 1.4 million ha of land with high salinity level are included, it adds a further Rs 15-25 billion. This brings the total estimated cost of salinity to Rs 30-80 billion, with a mean cost of Rs 55 billion, or 0.9 percent of GDP in 2004. The box table below gives the cost of salinity compared to other forms of land degradation.

Pakistan: Estimated Annual Cost of Agricultural Losses from Soil Salinity, Erosion and Rangeland Degradation

Total Loss (billion Rs)

| | Low | Mean | High |
|-----------------------|------|------|-------|
| Salinity Costs | 30 | 55 | 80 |
| Soil Erosion | 15 | 15 | 15 |
| Rangeland Degradation | 3.6 | 4.2 | 5.4 |
| Total Loss | 48.6 | 74.2 | 100.4 |

Source: World Bank, 2006, Ahmed and Rashid, 2004 and Brandon, 1995.

resources currently envisaged in the construction of this dam without ensuring that it is sufficiently protected against rapid siltation.

The seriousness of siltation can be gauged from the fact that the Warsak Reservoir, built in 1960, is now completely silted up. The water's silt burden has caused serious wear on all rotating parts of the reservoir's hydroelectric generating station, and the main powerhouse structure is suffering from alkali-aggregate reaction (WAPDA 1994). Efforts at watershed management should lengthen the life of more recent projects.

3.2.2.3 Degradation of Irrigated Land:

The menace of land degradation and desertification is not only affecting rainfed agriculture and pastoral systems, but also reducing productive potential of irrigated agro-ecosystems due to water logging and salinity. Trends in land degradation (salinity, water logging and fertility loss) coupled with the pressures of industrialization have enhanced the limits on the ability to expand cropped area and there is little prospect of increasing cultivable land. Estimates suggest that about 40 percent of irrigated land has been affected by either salinity (Box 3.1) or water logging.

3.3 Forest Resources: Status and Trends

The forests, scrub and trees on farmlands, according to Forest Department, cover nearly 5 million ha or 5.2 % of the country (GOP 2009b) against a recommended 20 to 25 percent by IUCN. The contribution of the forestry sector to the national economy is less than one percent due to a ban on forest harvesting (GOP 2009b). The forest types include coniferous forests, subtropical dry forests, tropical thorn forests, riverine forest, scrub forest and mangroves. In addition irrigated plantations also constitute a unique characteristic for Pakistan. The two major products of forests are timber and firewood. Wood for fuel is produced in the state-owned forest plantations, and private farmlands. The trees and bushes growing on degraded lands are a source of free fuel wood collection for the poor. A study on Household Energy Strategy revealed that the country's consumption of fuel wood is high, with about 79% of all the households using fuel wood for cooking (82%), space heating (7.3%), water heating (9.8%) and the remaining is used for other purposes such as ovens etc. Fuel wood is also used in the commercial sector by bakeries, restaurants, in ovens, brick kilns, for tobacco curing, in ceramic products manufacturing and food processing, etc. (GOP, 2009a).

The Natural Forest Resource Assessment Study (NFRRAS, 2004) showed that the forest resources are declining in Pakistan. The estimated deforestation rate over the 1990-2005 period was 2.1 percent or 47 thousand ha annually. Forest types in this definition of forests included coniferous, riverine and mangrove forest. It is estimated that the most valuable coniferous forest is declining at the rate of 40 thousand ha annually. Gilgit Baltistan and Khyber Pakhtunkhwa have the highest annual rates of deforestation (about 34 thousand ha in Gilgit Baltistan and 8 thousand ha in Khyber Pakhtunkhwa). Riverine and mangrove forests are also decreasing at the rate of 2.3 thousand and 4.9 thousand ha annually. This is an alarming rate given the high ecological value of these types of forest.

Forest loss also means habitat loss. Together with forest habitat fragmentation this increases the risk of extinction by isolating small pockets of previously more connected populations. Small and isolated populations are more vulnerable to the loss of genetic variability and run a greater risk of extinction. The estimated costs of deforestation in Pakistan, as per estimates of the World Bank (2006) ranges from 206 to 334 million Rs per annum, as summarized in table 3.4. The direct use values, reflecting local private forest losses, include the losses from sustainable logging, non-timber products, tourism and recreation. The

estimated relatively low figure for deforestation losses is due to the omission of a wide range of forest services related to non-use values for which plausible data are unavailable. Small aggregate losses also reflect the low level of forest cover. Of course this does not imply that interventions are unwarranted and uneconomic. The effectiveness of policies needs to be determined by comparing the cost of investment to the marginal benefits (World Bank, 2006).

The Forest Act of 1927 gives a clear designation of "production" and "protected" forests. Production forests are to be used mainly for the direct material products of their growth. They have a high tree density and, in most instances, a closed tree canopy. They represent the chief source of timber and currently make up 27.6 percent of total forest area. Protected forests are largely intended to guard against soil erosion and account for 72.4 percent of the total forest area. This distinction has done little to prevent the decline of forest areas generally. Over the past 75 years, forests have decreased from 14.2 percent to about 5.2 percent (5 million ha) of Pakistan's total land area. Even the existing forest resources are under severe pressure to meet the fuel wood and timber needs of the country and wood based industries including housing, sports goods, matches, boat making and furniture industry in the country. There is a need to increase the area under tree cover not only to meet the material needs of the growing population but also to enhance the environmental and ecological services provided by the forest.

Table 3.4: Pakistan: Annual Cost of Deforestation (Million Rs)

| | ANNUAL COST | | |
|-------------------------------|--------------|------|---------------|
| | Low estimate | Mean | High estimate |
| Direct use values | 122 | 186 | 250 |
| Sustainable timber production | 28 | 71 | 114 |
| Fuel wood production | 41 | 41 | 41 |
| Non timber products | 25 | 25 | 25 |
| Tourism and recreation | 28 | 49 | 70 |
| Indirect use values | 84 | 84 | 84 |
| Direct Plus Indirect | 206 | 270 | 334 |

Source: World Bank, 2006

In 2001, out of a total of 86.7 million ha land area of Pakistan including Azad Jammu and Kashmir, 3.317 million ha was under contiguous forest cover and 0.781 million ha farmland area was under tree cover, which was taken as a baseline for setting the Millennium Development Goals. Under the Millennium Development Goals of the Forestry Sector, Pakistan is committed to increase its forest cover from the existing 5.2% to 6% by the year 2015. An increase of one percent implies that an additional 1.051 million ha area has to be brought under forest cover by 2015. This includes all state lands, communal lands, farmlands, private lands and municipal lands.

3.4 Biodiversity: Status and Trends

Biodiversity provides services crucial to the well-being of people in Pakistan free of charge but worth billions of rupees every year. These services include cleaning of water, purification of air, pollination, soil formation and protection, crop pest control and the provision of food, fuel, fibres and drugs. Moreover, genetic diversity in domestic species and their wild relatives enables researchers to develop improved varieties of animals and plants for human needs, insuring future food security. Diversity in wild plant species is a major medicinal

resource in *yunani tibb* (traditional medicine) with 40 percent of allopathic drugs originally made from wild medicinal plants (GOP, IUCN and WWF, 2000). This entails safeguarding all components of biodiversity - ecosystems and habitats, species as well as genetic diversity.

3.4.1 Ecosystems/Habitats

Pakistan has a remarkable number of ecological regions. Pakistan includes examples of two of the world's eight biogeographic realms: the Indo-Malayan and Palearctic (Udvardy, 1975) and four of the world's ten biomes: desert, temperate grassland, tropical seasonal forest and mountain (Cox and Moore 1993). Pakistan's seas fall biogeographically within the Arabian Seas Region (Kelleher et al. 1995). The coastal area from Pakistan west to Somalia is considered by Hayden et al. (1984) to be the coastal margin realm, 'Eastern Monsoon (J)'. Regarding its fauna, the Pakistani coast is considered the western most extent of the vast Indo-Polynesian province (GOP, IUCN and WWF, 2000).

To date, no systematic attempt has been made to define the ecological zones of Pakistan. Roberts (1991) has provided an initial classification of natural terrestrial thematic areas as given in table 3.5. These range from the permanent snowfields and cold deserts of the mountainous north to the arid sub-tropical zones of Sindh and Balochistan; from the dry temperate coniferous forests of the inner Himalayas to the tropical deciduous forests of the Himalayan foothills; from the steppe of the Sulaiman Range to the thorn forests of the Indus plains; and from the swamps and riverine communities of the Indus and its tributaries to the mangrove forests lining the Indus Delta and Arabian Sea.

The coast of Pakistan forms the northern boundary of the Arabian Sea, where oceanographic influences dominate over those of the continent, which is essentially a sub-tropical desert. Most freshwater is from the Indus, at the eastern extremity, which discharges some 200 cubic kilometres of water and 450 million tonnes of suspended sediment annually. This creates the Indus Cone; 2,500 metres deep pile of loose sediment on the floor of the Arabian Sea which fans away from the mouth of the river as a vast, sub-aqueous delta (GOP,

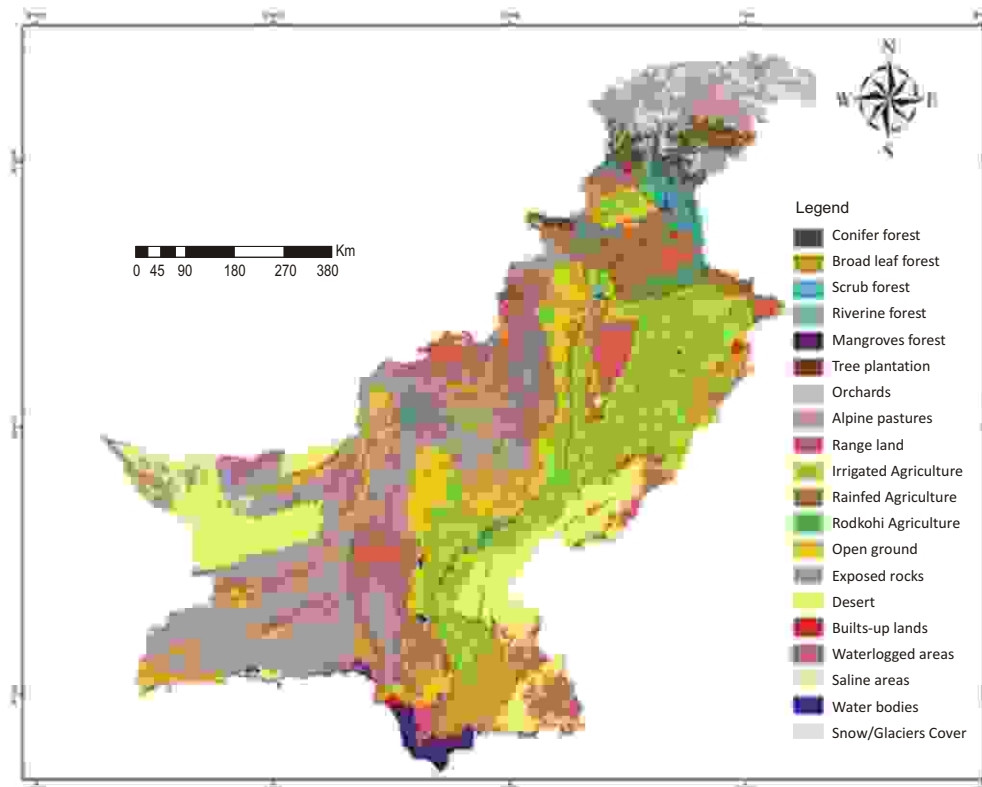
Table 3.5 Pakistan: The Extent of Habitat Types/Ecozones

| S. No. | Ecozone/Habitat Type | CBD Thematic Area | Area (ha) | % of total Area |
|--------|---|------------------------|-------------------|-----------------|
| 1 | Mangrove and littoral | Marine and Coastal | 550,186 | <1% |
| 2 | Tropical thorn forest | Dry lands, Agriculture | 38,146,635 | 43.5% |
| 3 | Arid sub-tropical forest | Dry land, Agriculture | 30,035,234 | 34.2% |
| 4 | Steppe forest and alpine dry steppe | Mountain | 9,305,417 | 10.6% |
| 5 | Dry sclerophyllous and tropical deciduous forest | Dry Sub humid Lands | 471,561 | <1% |
| 6 | Sub-tropical pine forest | Mountain | 2,163,320 | <1% |
| 7 | Dry temperate coniferous | Mountain | 1,831,506 | <1% |
| 8 | Himalayan moist temperate forest | Mountain | 1,070,736 | <1% |
| 9 | Permanent snow, alpine meadows & sub-alpine scrub | Mountain | 4,220,152 | <1% |
| | Total | | 87,794,747 | 100% |

Source: GIS Lab. WWF Pakistan

Note: Area includes Gilgit and Baltistan Province

Fig. 3.5 Pakistan: Landcover/Landuse



Source: GOP (2010) Land Use Atlas of Pakistan

IUCN and WWF, 2000). A land cover map (Fig.3.5) of Pakistan using NOAA satellite imagery was developed in the year 2000 and reproduced in the Land Use Atlas of Pakistan 2010. The map shows 20 land use and land cover classes of Pakistan. This is by far the most detailed map of Pakistan showing the distribution of various ecosystems and habitats. It provides a sound basis for future work on ecosystems and habitat classification.

While the loss, fragmentation and degradation of natural habitats in the territory of Pakistan has been taking place for centuries, the last few decades have seen a particularly rapid acceleration in this process. This trend is most evident in the remaining upland, scrub and mangrove forests, arid and semi-arid rangelands (including sand dune deserts), inland wetlands, the Indus Delta and coastal waters. According to Biodiversity Action Plan (GOP, IUCN and WWF, 2000), more than half of Pakistan's remaining mangrove forests, more than two-thirds of remaining riverine forests, and more than nine-tenths of remaining coniferous forests have less than 50 percent canopy cover. Good quality (greater than 50 percent cover) 'tall tree' forest in Pakistan covers less than 0.4 million ha (fewer than 2 percent of the country). The remaining fragmented and degraded forests are rapidly disappearing (GOP, IUCN and WWF, 2000). Habitat fragmentation isolates populations, exposing species to a higher rate of genetic loss and to a greater risk of extinction.

Provincial case studies support the growing body of evidence for habitat loss. In the upland coniferous forests, for example, a systematic study of the Siran project area in Hazara Division, Khyber Pakhtunkhwa has indicated a 52 percent decline in forest resources between 1967 and 1992. The study concludes that if present trends continue, the Siran forests will be gone soon (Archer, 1996). Similar trends have been observed in the Kaghan and Allai valleys in Hazara Division. The mangrove forests of the Indus Delta have also seen a dramatic decline. They halved from 0.26 million ha in the late 1970s (Pernetta 1993) to 0.1300 million ha in the mid-1990s. It is feared that Pakistan is experiencing the world's second highest rate of deforestation (GOP, IUCN,

and WWF, 2000). This destruction is leading to the wholesale disappearance of trees, shrubs and ground flora, together with the vertebrate and invertebrate fauna they normally support. The loss of forest habitat has had a severe impact on Pakistan's biodiversity, and has serious implications for the nation's natural and agro-ecosystems. Unfortunately, the moratorium on timber harvesting in Pakistan following the 1992 floods has not been very effective (GOP, IUCN, and WWF, 2000). While afforestation cannot be the replacement of natural forests, Pakistan has demonstrated great potential for afforestation and recorded some successes particularly in rehabilitating mangroves (See Chapter 4) that need to be followed up (see subsection 3.5.2.2 on Mass Afforestation and Tree Planting Campaigns).

Trends in Pakistan's arid and semi-arid rangelands, and to some extent the northern alpine grasslands, are no different from forest ecosystem. Of Pakistan's non-alpine rangelands 90 percent have been degraded – 27 percent of the total area of Pakistan (GOP, 2000). Degradation of rangelands reduces the diversity of flora and changes the vegetative composition. Increased competition for grazing affects wild herbivore populations (rodents, lagomorphs and ungulates) and the reduced prey base can then only support smaller populations of predators.

In summary, given the widespread historic conversion of natural ecosystems to agriculture, erosion and rapid degradation of habitats, and the continuing depletion of populations, almost all remaining natural or modified ecosystems are now critically threatened. To date, no systematic and comprehensive assessment with the aim of objectively ranking the biodiversity importance of Pakistan's natural ecosystems has been made. However, based on various reports (Mallon, 1991) and the opinions of recognized authorities (T. J. Roberts and R. Rafiq), the Biodiversity Action Plan of Pakistan (GOP, IUCN and WWF, 2000) identifies at least 10 ecosystems of particular value for their species richness and unique communities of flora and fauna that are threatened with habitat loss and degradation (Table 3.6). These ecosystems are considered to be of critical concern in conservation.

3.4.2 Species Diversity

The species richness and endemism reported in Biodiversity Action Plan (GOP, IUCN, and WWF, 2000) and the Fourth national report of Pakistan to CBD (GOP 2009b) (Table 3.7) remains the best estimate so far. As can be seen in the table, the country has relatively low rates of endemism for some species – about 7% for flowering plants and reptiles and 3% for mammals – but higher for freshwater fish, 15% (GoP 2009b).

No serious work has been done to evaluate taxonomic and functional diversity or the amount of genetic variability within species. The species database is not available in a format that lends itself to be readily sorted into the thematic areas of CBD. Therefore an overview of the available information on biodiversity in the country is presented below.

3.4.2.1 Fauna

Species belonging to the Palearctic realm occur largely in the Himalayan and Baluchistan uplands. Those belonging to the Indo-Malayan realm occur primarily in the Indus plains including the Thar Desert and the Himalayan foothills. In addition, species with affinities to the Ethiopian region occur in the dry southwest, along the Makran coast and in the Thar Desert (Roberts, 1997).

One-third of Pakistan's bird species have Indo-Malayan affinities, and the remaining Palearctic. Of the latter, about one-third are more specifically Sino-Himalayan in distribution (Roberts, 1991). The Suleiman Range,

Table 3.6 Pakistan: Threats to Ecosystems

| ECOSYSTEM | CHARACTERISTICS | SIGNIFICANCE | THREATS |
|--|--|--|--|
| Indus delta and coastal wetlands | Extensive mangroves and mudflats Inadequate protected area coverage | Rich avian and marine fauna Diverse mangrove habitat Marine turtle habitat | Reduced freshwater flow from diversions upstream Cutting mangroves for fuelwood Drainage of coastal wetlands |
| Indus river and wetlands | Extensive wetlands | Migratory flyway of global importance Habitat for Indus river dolphin | Water diversion/drainage Agricultural intensification Toxic pollutants |
| Chagai desert | A desert of great antiquity | Many endemic and unique species | Proposed mining Hunting parties from the Gulf |
| Balochistan juniper forest | Huge and ancient junipers | Largest remaining juniper forest in the world Unique flora and fauna | Fuelwood cutting and overgrazing Habitat fragmentation |
| Chilghoza forest (Sulaiman Rang) | Rock outcrops with shallow mountain soils | Important wildlife habitat for several species at risk | Fuelwood cutting and overgrazing Illegal hunting |
| Balochistan sub-tropical forests | Mid-altitude forests with sparse canopy but rich associated flora | Very few areas now remain important wildlife habitat | Fuelwood cutting and overgrazing |
| Balochistan rivers | Not connected with the Indus river system | Unique aquatic fauna and flora with high levels of endemism | Water diversion/drainage Overfishing |
| Tropical deciduous forests (Himalayan foothills) | Extend from the Margalla Hills National park east to Azad Kashmir | Perhaps the most floristically rich ecosystem of Pakistan | Fuelwood cutting and overgrazing |
| Moist and dry temperate Himalayan forests | Important forest tracts now becoming increasingly | Global hotspot for avian diversity: important wild life habitat | Commercial logging Fuelwood cutting and overgrazing |
| Trans-Himalayan alps and plateaux | Spectacular mountain scenery | Unique flora and fauna; Center of endemism | Fuelwood cutting and overgrazing Illegal hunting Unregulated tourism Habitat fragmentation |

Source: (GOP, IUCN and WWF 2000)

Table 3.7 Pakistan: Species Richness and Endemism in Major Plant and Animal Groups

| Taxa | Total Reported in Pakistan | Endemic | Threatened |
|----------------------|----------------------------|---------|------------|
| Mammals | 195 | 6 | 20 |
| Birds | 668 | ? | 25 |
| Reptiles | 192 | 13 | 6 |
| Amphibians | 22 | 9 | 1 |
| Fish (freshwater) | 198 | 29 | 1 |
| Fish (marine) | 788 | - | 5 |
| Echinoderms | 25 | - | 2 |
| Mollusks (Marine) | 769 | - | 8 |
| Crustaceans (Marine) | 287 | - | 6 |
| Annelids (Marine) | 101 | - | 1 |
| Insects | >5000 | - | - |
| Angiosperms | 5700 | 380 | ? |
| Gymnosperms | 21 | - | ? |
| Pteridophytes | 189 | - | ? |
| Algae | 775 | 20 | ? |
| Fungi | >4500 | 2 | ? |

Source: GOP, 2009b

the Hindu Kush and the Himalayas in Khyber Pakhtunkhwa and Azad Kashmir comprise part of the Western Himalayan Endemic Bird Area. This is a global centre of bird endemism with ten restricted ranges of species in Pakistan. The Indus Valley wetlands constitute a secondary area of endemism, with one restricted range species.

The reptiles of Pakistan include five marine turtles, two tortoise, eight fresh water turtles, one crocodile, one gavia, 98 lizards and 77 species of snakes. Of these, 13 species are believed to be endemic. As with other groups, these are a blend of Palearctic, Indo-Malayan and Ethiopian forms. One genus, the mono specific *Teratolepsis* is endemic, while another, *Eristicophis* is near endemic. The Chagai Desert is of particular interest for reptiles, with six species endemic to Pakistan and a further six species found only here and in bordering parts of Iran. Two important species of marine turtles nest on Pakistan's southern beaches. As Pakistan is a predominantly arid and semi-arid country, it is not surprising that only 22 species of amphibians have been recorded, of which 9 are endemic.

Regarding invertebrates, more than 5,000 species have been identified in Pakistan so far, including insects (1,000 species of true bugs, 400 species of butterflies and moths, 110 species of flies and 49 species of termites). Other invertebrates include 109 species of marine worms, over 800 species of molluscs (700 marine molluscs, 100 land snails) and 355 species of nematodes. The total number of butterfly species probably exceeds 400, with high rates of endemism in the Satyrids, Lycaenids and Pierids families (Personal Communication with Experts at Pakistan Museum of Natural History). Butterflies of high altitudes are largely either endemic or are derived from boreal fauna from the west. In the northern mountains alone, 80 species have been recorded, many of which are endemic (Hasan, 1997).

3.4.2.2 Flora

About 5,700 species of flowering plants have been reported, including both native and introduced species (Nasir and Ali, 1970). The flora includes elements of six phytogeographic regions in order of importance, the Mediterranean, Saharo-Sindian, Euro-Siberian, Irano-Turanian, Sino-Japanese and Indian (Ali and Qaiser, 1986). The families with the largest numbers of species are the Compositae (649 species), Poaceae (597), Papilionaceae (439), Brassicaceae (250) and Cyperaceae (202). Among the lower plants, there are at least 189 pteridophytes (ferns and their allies), of which 153 are Sino- Japanese elements and 36 Euro - Siberian. Four monotypic genera of flowering plants (*Douepia*, *Suleimania*, *Spiroseris*, and *Wendelboa*) and around 400 species (7.8 percent) are endemic to Pakistan (GOP, IUCN and WWF, 2000). Most endemics are Irano-Turanian and Sino-Japanese. Almost 80 percent of Pakistan's endemic flowering plants are confined to the northern and western mountains (Ali and Qaiser, 1986). Here, two phytogeographic provinces can be distinguished: the Balochistan Province and the Western Himalayan Province. The Kashmir Himalayas in particular are identified as a global centre of plant diversity and endemism. Families with 20 or more recorded endemics are Papilionaceae (57 species), Compositae (49), Umbelliferae (34), Poaceae (32) and Brassicaceae (20). 31 of the endemics belong to the genus *Astragalus*, the largest genus in Pakistan with about 134 species (GOP, IUCN and WWF, 2000).

3.4.2.3 Losses and threats to Species

Pakistan has experienced depletion in both species and genetic diversity. As an example of species loss, at least four mammal species are known to have disappeared from area of the country within the last 400 years: the tiger (*Pantheratigris*), swamp deer (*Cervusduvauceli*), lion (*Pantheraleo*) and the Indian one-horned rhinoceros (*Rhinoceros unicornis*). A further two species have probably gone extinct in recent decades: the

cheetah (*Acinonyx jubatus*) and hangul (*Cervuselaphushanglu*). The blackbuck (*Antelope cervicapra*) has been listed as locally extinct but has now been bred in captivity while the Asiatic wild ass (*Equushemionus*) is believed to be threatened with extinction in Pakistan (Ahmad, 1997). The IUCN Red List of Threatened Animals (IUCN, 1996) lists 37 species and 14 sub-species of internationally threatened or near-threatened mammals as occurring in Pakistan. Internationally threatened bird species in Pakistan number 25 and internationally threatened reptiles number 10. While a few preliminary attempts have been made to draw up national lists of threatened species, including a list of some 500 plant species believed to be nationally rare or threatened (Davis et al., 1986), no comprehensive and systematic list of species of national concern has been compiled for Pakistan.

In terms of status of threatened species, there are 23 mammals, 11 birds, and 13 reptiles which are threatened with extinction and are included in CITES appendix I. There are 30 mammals, 78 birds and 14 reptiles on CITES appendix II, that is the species that are likely to become extinct unless trade is closely controlled. Twenty mammals, two birds and 12 reptiles are included in appendix III – species for which trade is already regulated. These lists along with the list of threatened species of flora in the country are presented in Pakistan's Fourth National Communication to the CBD Secretariat (GOP, 2009b). There are no national targets for improvements in the status of the threatened species. There have been no surveys to assess the present status of these species and these continue to have a threatened status.

3.4.3 Agriculture Biological Diversity

In terms of genetic diversity, Pakistan's agro-ecosystems are experiencing great losses (Box 3.2). This is mainly due to developments to grow uniform cultivars in very similar environments and using the same agricultural practices.

3.4.4 Causes of Biodiversity Loss and Their Control

Biodiversity loss whether in terms of habitat, species or genetic diversity has both direct and indirect causes. Direct causes include activities resulting in the loss and degradation of habitats, over-exploitation of plant and animal species, agricultural intensification, pollution, invasion by introduced species and climate change. However, the direct reasons for biodiversity loss are not the root cause of the problem. As the Biodiversity Action Plan of Pakistan quoting the Global Biodiversity Strategy points out, the crisis is not 'out there' in the forest or the rangelands, but embedded in the way we live (GOP, IUCN and WWF, 2000). It identifies six fundamental indirect causes of biodiversity loss: a) the unsustainably high rate of human population growth b) consumptive economic systems that fail to value the environment and its resources, c) inequity in the ownership, management and flow of benefits from both the use and conservation of biological resources, d) deficiencies in knowledge and its application, e) legal and institutional systems that promote unsustainable exploitation and f) the steadily narrowing spectrum of trade products from agriculture, forestry and fisheries.

Over-grazing and deforestation in all terrestrial biomes of the country are major threats to the loss of biodiversity. The main driving forces are high population growth rate, increasing poverty and increasing demand of natural resources. The population pressure has increased on the marginal lands for subsistence agriculture. Poor agricultural practices result in loss of soil from wind erosion and water erosion. When the land loses fertility, new lands are broken for agriculture and so the process continues unabated. Game bird and animal species are experiencing population declines due to illegal hunting for sport and meat. Some species are ruthlessly persecuted for their depredations on livestock or agricultural crops.

Box 3.2 Loss of Crop Genetic Diversity and Agricultural Production

The conservation and sustainable use of crop genetic diversity is central to improving agricultural productivity and food security. Pakistan is rich in indigenous crops with an estimated 3,000 taxa of cultivated plants. There are around 500 wild relatives of cultivated crops, most of which are found in Northern Pakistan. In fact, some of the world centres of origin and diversity of cultivated plants are in western and northern Pakistan. The Indus Valley and Gandhara civilizations cultivated species such as wheat, eggplant, pigeon pea and cucumber, while the Gilgit and Baltistan province domesticated several nut fruits.

Many wild and local cultivars survived in Pakistan up to the era of the Green Revolution. However, expansion of land for cultivation, deforestation and dam construction has posed severe threats to wild and weedy landraces of cultivated crops as has the development and use of high-yield varieties (HYVs). The HYVs respond better to water and fertilizer, but are a major threat to indigenous species and primitive cultivars that had been selected and maintained by Pakistani farmers for generations. The genetic erosion is well pronounced in wheat, rice, sorghum, sugarcane and vegetables. Though crossbreeding can lead to relatively rapid gains in productivity, it also increases the rate of genetic loss if the parent stock is not maintained. Many primitive landraces/cultivars and wild relatives of agricultural crops (such as wheat, rice, pulses, sugarcane and cotton) have suffered from genetic erosion due to the introduction of HYVs of these crops, and the excessive use of pesticides and herbicides. As the genetic traits of local species are lost, the ability to adapt to local environments and climates, and to tolerate diseases is also greatly reduced.

Recognizing the importance of preserving crop genetic diversity, the government started collecting indigenous plant germplasm in the early 1970s. Today there are over 15,600 germplasm accessions from more than 40 different crops at the Plant Genetic Resources Institute, National Agricultural Research Commission. Over 50 percent of the germplasm has been evaluated and presented in respective crop catalogues.

Source: GOP, IUCN and WWF, 2000

The diversion of water for irrigation and the drainage of wetlands, constitutes the major cause of wetland habitat degradation in Pakistan. The mean quantity of water entering the Indus Basin in Pakistan is 170 billion cubic meters (BCM), of which 128 BCM are diverted for canal irrigation. Thus, three-quarters of the water entering the Indus Basin is now diverted and only a quarter reaches the Indus Delta and the Arabian Sea directly.

Marine fisheries and shrimps are threatened by the rising number of fishing boats, whereby fishermen have a tendency to fish in shallower waters, with an increased proportion of young shrimp in the catch (GOP, IUCN and WWF 2000). The introduction of new technology and bigger fishing trawlers has resulted in overexploitation of the fishery resource. However, the incidental take of marine turtles by commercial shrimp trawlers has declined due to the use of turtle excluding devices.

Medicinal plants are indiscriminately harvested from the wild. There are about 40,000–50,000 practitioners of Greco-Arabic and *Ayur vedic* medicine in the country. Over 200 plant species are used in traditional and folk medicines. In recent years, there has been a consistent growth in the demand for plant-based drugs and products throughout the world. This has given rise to unsustainable collection and loss of biodiversity and resulting in scarcity of a number of valuable medicinal plant species. Crop genetic diversity in the county is also dropping.

3.5 Policies and Programmes

3.5.1 Land Management

The Government is undertaking a number of programmes under its land management strategy: the Federal Government is supporting provincial governments to combat desertification as recommended under Poverty Reduction Strategy Paper (PRSP) while the National Action Programme (NAP) on Combating Desertification has been aligned with the 10-year Strategic Plan (2008-2018) of the United Nations Convention to Combat Desertification (UNCCD) and it is under implementation. According to National Forest Policy, a National Desertification Control Fund as envisaged under NAP and UNCCD will be established to ensure continued financial sustainability for sustainable land management (SLM) interventions at grassroots level. A GEF, UNDP and Government of Pakistan Project to combat desertification is also under implementation (Box 3.3).

Watershed management has also been promoted. This involves a sound multidisciplinary approach

Box 3.3 Sustainable Land Management Project to Combat Desertification in Pakistan

Sustainable Land Management (SLM) Project is a GEF, UNDP, and Government of Pakistan funded initiative following an integrated and participatory approach to combat land degradation and desertification in Pakistan. The overall goal of the project is to combat land degradation and desertification in the country to protect and restore ecosystems and essential services that are key to reducing poverty. The project is to be implemented in two phases, with the first phase focused on creating an enabling environment for SLM and piloting innovation while a the second phase drawing on lessons learned will enhance the policy and institutional commitment to SLM and complete demonstration projects that can successively be scaled up and replicated.

The project has five components that include “Creation of Enabling Environment for promoting SLM; Building Institutional Capacity for SLM; Mainstreaming SLM into Land use Planning; Implementation of 9 pilot projects for demonstration of best SLM Practices; and Adaptive Management and Documentation of Best Practices and Lesson Learned. The major achievements made by the project so far include:

- Preparation of advocacy material and its wide dissemination to diverse target audience, including, parliamentarians, top decision making institutions, research and academia, civil society, and community groups. This has resulted in increased funding from the government resources to implement best practices for SLM.
- Nine pilot projects under implementation in different agro-ecological zones. The major interventions pertain to rainfed agriculture, rangeland rehabilitation, dry-forestation, rainwater harvesting, soil and water conservation measures, irrigation efficiency improvement, and sustainable use of non-timber forest products.
- Participatory GIS based draft landuse plans prepared for 20 villages covered by 9 pilot projects. Guidelines for village landuse planning prepared and village community groups trained for the implementation and use of land use plans.
- National Criteria and Indicator (C&I) for SLM prepared.
- A Public-Private Partnership initiative for “Promotion of drought and disease resistant varieties in Barani Tract of Punjab” launched.

Source: UNDP 2011

combining engineering works, afforestation, forest management, improved hill farming methods, and range management. The watershed and soil conservation programmes in the catchment of large dams, especially Tarbela and Mangla, have substantially reduced loss of soil through water erosion and improved the natural habitats. The watershed management has also been carried out where small and mini dams have been developed in mountainous and sub-mountainous environments. They have helped in recharging groundwater and provided water for wildlife and migratory birds (GOP, 2009b).

There is a need now for an assessment and evaluation of the experience gained with watershed management activities in the Mangla and Tarbela catchments. This should cover the technical aspects, staffing arrangements and economics of past efforts to assist in planning future watershed protection programmes for Kalabagh and any other catchments requiring comprehensive treatment. The assessment should also address the issue of long-term watershed management. At present the responsibility of the Water and Power Development Authority's Watershed Project Unit for structures built and areas reforested lapses after only five years when control reverts to the private owners of the land treated. This practice far too often negates the efforts made to stabilize these areas, as private interests (tree felling, range overstocking) often override considerations of watershed protection.

3.5.2 Forest Management

3.5.2.1 Policies

Pakistan plans to manage all types of forests by an ecosystem approach. This enables the conservation of forest biodiversity, provides sustainable livelihood to forest dependent communities, meets national demands for wood and contributes to mitigating global environmental problems. A good example of the same is National Strategy & Action Plan (NSAP) prepared under Mangroves for Future Initiative (Box 3.4).

A broad framework for addressing issues of forests and renewable natural resources and their sustainable development for the maintenance and rehabilitation of environment and enhancement of sustainable livelihoods has been provided in Pakistan's National Forest Policy drafted in 2010. The Policy gives broad guidelines to the Federal Government, Provincial Governments, Federally Administered Tribal Areas and Local Governments for ensuring the sustainable management of their forests and renewable natural resources. A Federal Forestry Board comprising the representatives of the Provincial Forest Departments, Azad Jammu and Kashmir, Gilgit-Baltistan, NGO's progressive gamers and other stakeholders, has been established to develop policies and strategies related to the Forestry Sector and also monitor the forest cover and activities of the Provincial Forest Departments.

The National Environment Policy (GOP, 2005) also calls for sustainable management of natural forests of Pakistan and increased tree cover for safeguarding economic growth and food security in the country. The specific policy recommendations include the following:

- Finalize the National Forestry Policy.
- Carryout intensive institutional and legal reforms both at the federal and provincial levels to promote good forest governance.
- Promote social forestry and integrated watershed management.
- Promote farm forestry and irrigated plantations.
- Eliminate all sorts of import duties on timber products while taking into account the environmental sensitivities of neighbouring Afghanistan.

- Develop and sustainably manage the riparian forests along with irrigated plantation and tree plantation on farmlands.
- Develop and implement a strategy and an action plan for protection and rehabilitation of mangrove forests with the participation of communities.
- Preserve unique forests eco-systems and the cultural heritage of people of Pakistan.
- Provide alternative sources of energy, like piped natural gas, LPG, solar energy and micro-hydro power stations, to the local inhabitants to reduce the pressure on natural forests, and to substitute firewood in the upland ecosystems.
- Strengthen the existing forestry research and training institutions with adequate infrastructure and technical manpower development.
- Promote sustainable management of rangelands and pastures through preparation and Implementation of integrated range management plans.

Box 3.4 Mangroves for Future National Strategy and Action Plan

Mangroves for Future National Strategy and Action Plan (NSAP) does not solely focus on mangrove forests but entails mangrove ecosystems and associated biodiversity, thus the term 'mangrove' is used as a symbolic label. Pakistan's NSAP specifically addresses and treats issues related to the dominant coastal ecosystems viz. mangroves, estuaries, turtle nesting beaches and coral reefs. NSAP Pakistan will contribute to ecosystem-based integrated coastal management (ICM) and improve the quality of life of dependent communities. Inherently, ICM requires actions at local sites - both entire ecosystems and parts thereof. The strategy was prepared under the Mangroves for the Future (MFF) programme, which provides a collaborative platform among different agencies, sectors and countries who are addressing challenges to coastal ecosystem and livelihood issues, to work towards a common goal.

Mangroves for the Future (MFF) initiatives focus on countries worst-affected by the Indian Ocean Tsunami of 2004. However, MFF will also include other countries that face similar issues with an overall aim to promote an integrated ocean wide approach to coastal zone management. Pakistan joined MFF as a dialogue country in 2008 and prepared its draft NSAP as per requirements of Regional Steering Committee of MFF to become a regular member of this regional programme. The 6th Regional Steering Committee (RSC) meeting of the MFF held in Thailand during January 2010 considered Pakistan's NSAP and made it a model for other countries. Pakistan also became a regular MFF member and is now entitled to receive assistance for institutional strengthening, capacity building and for implementation of relevant projects in the coastal areas of Pakistan.

The NSAP builds on the principles that a National Coordinating Body (NCB) should perform only those tasks, which cannot be performed effectively at a local level. Programme of Works at this level will be implemented by different organizations under the guidance of the NCB. The NSAP follows a cross-sectoral collaborative approach in harmony with other policies and programmes such as climate change mitigation and adaptation policy.

In the context of challenges to the coastal areas of Pakistan, the NSAP paves the way for the development of an ICM programme for Pakistan to ensure good governance, knowledge management, community empowerment, and public-private partnership for sustainable financing by:

- Setting up ICM models in selected coastal ecosystems
- Scaling up the successful models along the entire coastal belt

Source: UNDP, IUCN, Care, FAO, UNEP and other partners 2010

3.5.2.2 Mass afforestation and Tree Planting Campaigns

In order to enhance tree cover, tree-planting campaigns are held in the country twice a year, in spring and monsoon. During the tree planting campaigns all the government departments, private organizations, defence organizations and NGOs are involved in planting activities. The achievements during 2001-2010 are given in table 3.8.

Table 3.8 Pakistan: Trees Planted 2001-2010 (in millions)

| Year | Spring | Monsoon | Total |
|------|--------|---------|--------|
| 2001 | 83.04 | 47.11 | 130.15 |
| 2002 | 67.95 | 39.71 | 107.65 |
| 2003 | 55.02 | 39.00 | 94.02 |
| 2004 | 63.17 | 58.00 | 121.17 |
| 2005 | 65.80 | 30.65 | 96.45 |
| 2006 | 57.17 | 35.34 | 92.51 |
| 2007 | 61.48 | 37.32 | 98.80 |
| 2008 | 73.26 | 38.12 | 111.38 |
| 2009 | 55.77 | 35.96 | 91.73 |
| 2010 | 57.72 | 34.54 | 92.26 |

Source: GOP 2010

Over a billion trees (1,036 million) were planted in the country in the first decade of twenty first century. As a part of the campaign, the President of Pakistan launched a mass afforestation programme with the assistance of the private sector on December 22, 2008. This programme is spread over a period of five years and is largely being sponsored by private entrepreneurs for planting trees on state and other suitable lands. Many private companies have expressed interest in investing in environmental forestry as part of their Corporate Social Responsibility.

3.5.3 Conservation of Biodiversity

The biodiversity conservation concerns in Pakistan were first addressed comprehensively in the National Conservation Strategy (NCS) that was approved in 1992 (GOP, 1992). The NCS was followed by the formulation of provincial conservation strategies that have been prepared for all the provinces (GONWFP & IUCN 1996, GOB & IUCN 2000, GOP and IUCN 2003, IUCN, 2007 and GOPU 2010). The strategies that were completed after the approval of the Biodiversity Action Plan (GOP, IUCN and WWF 2000) have incorporated many of the recommended actions. In addition, district conservation strategies were also prepared for two districts and now the process of preparation of integrated district development plans has been initiated. The district strategies and plans also address the biodiversity conservation issues and poverty-environment nexus.

There is an increasing awareness among the planners and policy makers about the United Nations Convention on Biodiversity. A Biodiversity Secretariat has been established in the Ministry of Environment (now Climate Change Division). The secretariat coordinates the implementation of the Biodiversity Action Plan (GOP, IUCN and WWF, 2000) at national and provincial levels. The biodiversity concerns are also

gradually being addressed in the policies and programmes of different sectors. The progress however, has been slow so far, mainly because of a lack of adequate capacity and partly because of the fact that many of the concepts are new. The agriculture and livestock policies are being formulated and drafts include biodiversity concerns. The fisheries policy of 2006 calls for sustainable harvest, establishment of protected areas and rehabilitation of marine environments damaged by pollution. The biodiversity concepts have also been included in the curricula of high school grades. Moreover, the forestry sector has launched large-scale projects to rehabilitate the degraded forest ecosystems (GOP, 2009b).

3.5.3.1 Ecosystem Conservation

Although no specific targets were set for effective conservation of ecological regions, most of these are adequately represented in the protected areas network in Pakistan for effective conservation. The natural habitats that are outside the protected areas system are generally degraded under heavy population pressure. This is especially true of the arid lands – the largest ecological region in the country, where the food security of pastoral communities is threatened. It is important to promote sustainable rangeland management in this region. The outcome of pilot studies under GEF, UNDP and Government funded project on Sustainable Land Management will provide good guidelines in this direction (See Box 3.3).

3.5.3.2 Protected Areas

Pakistan has designated 23 national parks, 97 game sanctuaries and 104 game reserves as Protected Area (PA), covering almost 10 million ha of land (GOP, 2009b). A review of the PA system was carried out in 2000 and an Action Plan was prepared (Somuncu, Khan and Waseem 2000). The review revealed that many of the areas did not meet the international criteria for PAs. Of the 224 PAs listed at the time, about one fourth were considered to be satisfying the IUCN criteria whereas the remaining were established mainly to control hunting. The Action Plan included elements for filling ecological gaps, securing financial resources, capacity building, and addressing policy, legislative and institutional barriers (GOP, 2009b).

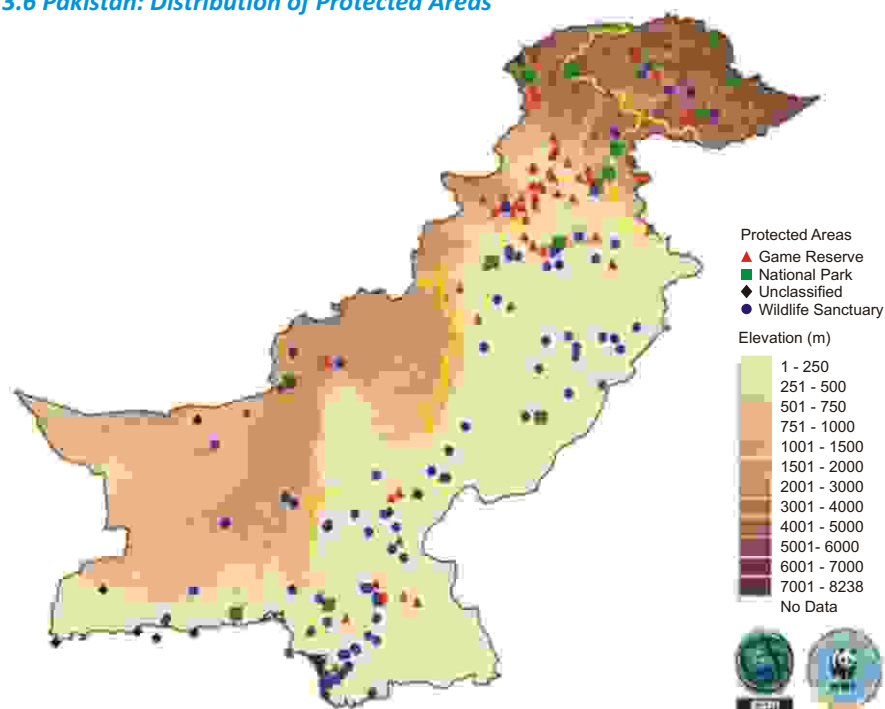
The review observed that the PA system needed to be upgraded to conform to the principles of conservation. The follow-up on this Action Plan has rather been negligible as far as the reclassification of PAs, upgrading of PAs, and establishment of Environmentally Significant Areas (ESAs) is concerned. Progress has however been made in achieving partial targets such as filling ecological gaps, capacity-building, addressing policy, legislative and institutional barriers and to some extent in securing financial resources (GOP, 2009b). The definitions of “comprehensive”, “ecologically representative” and “effectively managed” have not been developed so far. The number of PAs in three of the major classifications along with their areas is given in table 3.9 and their distribution is shown in figure 3.6.

Table 3.9 Pakistan: Designated Protected Areas

| Classification | Number | Proportion of designated Protected Area (%) | Area and proportion of Country's Land Surface | |
|----------------------|--------|---|---|------|
| | | | Hectares | % |
| National Parks | 23 | 10.3 | 2,845,420 | 28.9 |
| Wildlife Sanctuaries | 97 | 43.3 | 1,970,424 | 20.0 |
| Games reserves | 104 | 46.4 | 5,036,162 | 51.1 |
| Total | 224 | 100 | 9,852,006 | 100 |

Source: GOP 2009b

Fig. 3.6 Pakistan: Distribution of Protected Areas



There has been a significant increase in the extent of PAs since they were first established in 1972. In 1997, the PAs covered 9.01 million ha while in 2009; there were 9.85 million ha under PAs. National Parks constitute the most important and prominent category of PAs. In 1997, there were 12 national parks while in 2009 their number stood at 23. Except for the addition of Central Karakorum National Park, the increase is mainly due to change in the status of existing PAs or changes in their boundaries (GOP, 2009b).

Coverage of ecological regions (with a target of 10%) however has not been equitable. Except for marine ecosystems, most other major ecosystems are covered in the PA system of Pakistan. However, because of the great diversity in habitats, some habitats are not covered by PAs. The information on environmentally significant areas (ESA) is not included in the PA system but is available in the PA review of 2000. In general, the representation of coastal areas is rather low and the dry and sub-humid lands are overrepresented in the PA system. Eleven National Parks out of 23 have management plans in place. Most of these management plans were prepared recently and employed a participatory approach for planning. Three national parks and four wetland complexes are included in GEF projects and it is hoped that the best practices and standards for management developed and tested in these national parks will be widely replicated for the management and governance of PAs in the country. As yet there are no transboundary PAs in Pakistan, but negotiations have been going on with China for establishing one.

The PAs in Pakistan are presently being managed under the wildlife laws that were made in the early 1970s. These laws are now being revised to incorporate participatory approaches, particularly through the involvement of local governments. In addition a number of trainings have been organized for the local communities on value added marketing of non-timber forest products (NTFPs) from the PAs. A general lack of proper technical knowledge for the management of the PAs is observed as most managers had education mainly in forestry.

Communities living around PAs have always depended on them for some of their subsistence needs. These economic and socio-cultural costs were ignored in the planning and management of PAs in the past, but are now increasingly being taken into consideration. This is true for almost all the national parks. Initial consultative meetings were held in the villages all around the protected areas and villagers are now invited to nominate representatives to work closely with the functionaries during the planning process and report back to them on any issues of concern. During the planning process, the functionaries and the local communities agree on the structure and functions of the joint committees for management. Community-based models for conservation have also been promoted (Box 3.5).

Trophy hunting programmes to conserve wildlife have also been successfully launched with the assistance of IUCN (Pakistan) and WWF-Pakistan. The two organizations have devoted special efforts to ensure that local communities have strong economic incentives to protect wildlife and the associated biodiversity. Village

Box 3.5 Torghar - A Model of Conservation through Sustainable Use in Pakistan

Northeast Baluchistan has long been famous for Suleiman Markhor (*Capra falconeri*) a wild goat, and Afghan Urial (*Ovis orientalis cyclcoros*) a wild sheep. The abundance of modern weapons (mostly Kalashnikov) and readily available ammunition have led to indiscriminate hunting and by early 1980s the populations of Suleiman Markhor and Afghan Urial had become endangered and species like gazelles and leopards had become extinct. Overgrazing and heavy use of wood for fuel and heating had seriously degraded the habitat. A local tribal leader and a filmmaker while trying to make a documentary on wildlife got concerned with the rapidly dwindling wild population. They initiated discussions with local tribesmen and in collaboration with the United States Fish and Wildlife Service and the Baluchistan Wildlife Department developed a Conservation Plan for the Torghar area based on the principles of sustainable use.

The tribes, though sceptical, agreed to cooperate and to stop all hunting. Local hunters agreed to become game guards to enforce a strict ban on hunting. The project continued to advance slowly as the years passed and limited trophy hunting was possible in 1986. The income was used for hiring additional game guards to boost conservation and provide livelihoods to local people. The income from hunting was also used for improving the agro-pastoral activities of local people, and for social development such as health care.

The conservation programme in Torghar has provided a successful model of biodiversity conservation through sustainable use in Pakistan. It has not only resulted in the recovery of populations of Markhor and Urial, but also of the other species of fauna and flora such as small mammals like the Pika, *Ochotona rufescens*, and the Afghan mole vole, *Ellobius fuscocapillus*. About 78 bird species have been recorded, many of which breed in the area.

According to a survey held in December 2005, there were 2540 Markhors and 3145 Urials in the Torghar conservancy. Markhor is listed as protected and is included in appendix 1 of CITES. The CITES Conference of the Parties in June 1997 approved a quota of Markhor trophies for Pakistan, citing the success of Markhor conservation. Recognizing the best practices in sustainable hunting around the world, particularly in Torghar, the International Council for Game and Wildlife Conservation known as CIC launched the "Markhor Award" during the 9th Conference of Parties (COP 9) of the Convention on Biodiversity (CBD) at Bonn Germany in 2008.

Source: GOP 2009b

organizations have been formed for the purpose. For example, seven Khunjerab village organizations within the buffer zone of Khunjerab National Park (KNP) receive 80 percent of the annual park entrance fees and jointly participate in trophy hunting programmes. In the Baltistan, Hushey, and Skoyo-Karabathang-Basingo areas and the Shahi Khyber Imamabad Welfare Organization (SKIWO) communities also participate in trophy hunting programmes along with receiving other tangible benefits from IUCN-Pakistan under its Mountain Areas Conservancy Project (MACP). Environmentally appropriate small-scale, village-based conservation and depredation alleviation initiatives are aimed at protecting snow leopards, prey species, their habitats and associated mountain biodiversity, while benefiting humans at the same time. According to local residents, populations of Asiatic or Himalayan Ibex (*Capra sibirica*) and flare-horned Markhor (*Capra falconeri falconeri*) have increased notably due to a significant reduction in poaching, much to the benefit of the snow leopard, the numbers of which have also increased (Jackson, 2004).

3.5.3.3 Conservation of Genetic Diversity

On-farm conservation of crop genetic resources is a difficult task. Therefore ex-situ conservation is a preferred option in Pakistan. A small gene bank for short-term storage and a laboratory has been established at the National Agriculture Research Center (NARC) and a programme on collection, conservation, and evaluation is under way. The collection of wild relatives of crop plants is limited. However, most wild relatives of crop plants are found in the PAs and thus by default they are being conserved in-situ. However, their ex-situ conservation is also needed.

Botanical gardens also provide a venue for ex-situ conservation particularly for floral diversity. The botanical gardens of Government College University in Lahore, Shah Abdul Latif University in Khairpur, and University of Peshawar Botanical Garden in Azakhel have good collections of native tree and shrubs and other important plant species. Recently UNESCO has developed the concept of Qur'anic Garden in collaboration with the Jamia-Usmania, Peshawar, an institution primarily involved with religious education. Moreover, a federally funded project on the establishment of a Botanical Garden Network is a step towards a well-defined program for ex-situ conservation of floral genetic diversity.

3.5.3.4 Protection of Important Areas of Biodiversity

Although there are no national targets for protection of important areas of biodiversity, a few hot spots that are not covered in the PA system or were not being effectively protected otherwise are now receiving attention. The most prominent among these are:

- Conservation of Endemic Reptiles: Chagai desert is home to six endemic species of reptiles. These were being unsustainably harvested for export as pets and other uses. A GEF/UNDP medium scale project has initiated a program to conserve and develop protocols for a sustainable collection of these reptiles for marketing by the local communities.
- Conservation of Juniper Forest Ecosystems: IUCN-Pakistan is implementing a GEF medium scale project for the conservation of this ecosystem of global biodiversity significance. Local communities and key stake holders are actively involved in the planning and implementation of this project.
- Conservation of Chilghoza Pine Forest Ecosystem: *Pinus gerardiana* or Chilghoza pine forest ecosystem is yet another threatened ecosystem in Pakistan. Through a UNDP funded grant, WWF-Pakistan is trying to develop markets for edible pine nuts, as a means to save the pine forests. It is expected that the income from pine nuts would not only substitute the income from cutting of trees

but would be more profitable and sustainable.

- Conservation of Brown and Black Bear: Himalayan Wildlife Foundation has been actively involved in the conservation of the Himalayan Brown Bear in the alpine ecosystem of the Deosai Plateau. Through their efforts a new national park has been established in Azad Jammu and Kashmir, which will not only extend the home range of brown bear but also highlight the conservation of Musk Deer as the National Park has been named after these. Efforts are also being made to save the Asiatic Black Bear in Baluchistan. The Sustainable Use Specialist Group of IUCN for Central Asia is actively taking actions to conserve the remnant population.
- Medicinal Plants in the Wild: In order to conserve the medicinal plants in the wild and to meet the growing demand of the herbal industry, research and development for their cultivation has been going on for some time, but their large-scale propagation has not been taken up. Two large producers of herbal medicines - Qarshi and Hamdard have established farms for cultivation of some species, which is helping towards their conservation in nature.

3.5.3.5 Implementation of Convention Biological Diversity (CBD)

The CBD has made significant impacts on conservation and sustainable use of biodiversity in Pakistan. There is a growing realization among the policy makers and planners about the need to conserve biodiversity and preserve the integrity of the ecosystems for livelihoods and sustainable development. The impact of the convention is hard to quantify, however, the following positive changes have occurred:

- Conservation was seen as a responsibility of the government alone but now public and private sector partnerships (local communities, NGOs and corporate sector) are emerging for conservation of biodiversity and environmental rehabilitation.
- Local people were considered as a part of the problem, but are now made part of the solution. The capacity of local organizations is being strengthened not only to conserve and make sustainable use of their natural resources, but also to join hands with the government and NGOs for the management of protected areas and community conservation areas.
- Biodiversity considerations have been integrated in the guidelines for environmental impact assessments and proper safeguards are being undertaken during the implementation of infrastructure projects to protect important elements of biodiversity.
- Historically, establishment of protected areas was seen as a sufficient measure to conserve species, habitats and ecosystems. The canvas of biodiversity conservation has now been expanded to include landscape and seascape.
- High yielding varieties of crops, fruit trees, poultry and livestock were seen as the only way forward to meet the growing demand for food. The importance of the need to conserve the genetic diversity is now being increasingly realized and measures are being taken for its conservation.
- Exotic species of flora and fauna were being indiscriminately introduced in the natural habitats. The convention has played an important role in raising awareness about the threats of alien species and their introduction is now being strictly regulated.
- Financial resource allocations for biodiversity, both national and international, have enhanced and international cooperation has increased after the adoption of the convention.

The country has made good progress on the 2010 biodiversity targets despite the lack of adequate institutional, human and financial resources (GOP, 2009b). It has now reached a basic threshold level and is ready to make up for the slow progress in the past. There is a need however, to identify priorities and promote measures to build institutional and financial capacity for the implementation of the convention. Furthermore, in order to stop the erosion of biodiversity, it is imperative to create a policy framework that fosters the sustainable use of biological resources and the maintenance of biodiversity.

3.6 Conclusions

The terrestrial ecosystem in Pakistan is under great pressure in the wake of a growing population. The availability of agricultural land per capita in the country has declined to 0.21 ha compared to the world average of 0.24 ha. The situation is likely to deteriorate in future, as there is very limited potential for further expansion of arable land while the population continues to increase. The problem is compounded by land degradation, which has resulted from natural and human-induced processes. Among natural causes erosion is the most pervasive. Impacts from unsustainable human activities such as deforestation, overgrazing and improper land-use practices have exacerbated land degradation. The intensification of use of water and chemicals has also contributed to the process of land degradation. Together, these have resulted in acidification and salinization, nutrient depletion, pollution and compaction. Moreover, there is human-induced waterlogging and salinity in the irrigated lands. The problem of land degradation has been further exacerbated by losses of land to urban and transport infrastructure.

Specific measures adopted by national governments to control land degradation include promotion of sustainable land management through soil and water conservation, sand dune stabilization, reclamation of waterlogged and saline areas, watershed, forest and rangeland management. It is imperative to strengthen these efforts. More importantly, however, the Federal and Provincial Governments have to integrate Sustainable Land Management principles into sectoral policies, strategies and plans, as land degradation adversely affects natural resource based livelihood of the rural poor.

The forests in Pakistan have declined significantly, both in terms of area and quality. Of the forest areas that remain, the vast majority consists of small or highly disturbed pieces of the fully functioning ecosystems that they once were. Although Pakistan leads in forest plantation development, the plantation forests are no replacement for natural forests as habitats. It is encouraging to note that Pakistan has planned to manage all types of forests by the ecosystem approach. This will enable the conservation of forest biodiversity, provide sustainable livelihood to forest dependent communities, meet national demands for wood and contribute to mitigating global environmental problems.

The reduction of natural habitats, loss of species and depletion of genetic variety are the three most important indicators of the plight of biodiversity in Pakistan. Measuring a loss or decline in biodiversity is not an easy task because only a limited number of species has been identified and catalogued in the country. Therefore it is difficult to say with certainty how many species or genes are lost when a particular habitat is destroyed. The problem of genetic extinction is more serious, since even abundant species are experiencing genetic erosion. The country has already prepared the National Conservation Strategy and Biodiversity Action Plan under the Convention on Biological Diversity. Yet, their implementation is constrained by inadequate human and financial resources. In terms of conservation, however, successes have been achieved in the designation and management of protected areas. The country has made good progress on 2010 biodiversity targets despite the lack of adequate institutional, human and financial resources. There is a need to identify priorities and promote measures to build institutional and financial capacity for the implementation of the Convention.

Strengthening and promoting national biodiversity conservation programmes and promoting international and regional cooperation for the purpose are important. This should not undermine the involvement of local communities, as little can be achieved without their help and support. Finally, the government alone, with its limited resources, cannot perform the mammoth task of biodiversity conservation and management. Hence there is a need to involve the private sector, communities and local groups, as well as NGOs and CBOs in this effort.

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