

Chapter 2

Forest Types of Pakistan

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Abstract

Pakistan is blessed with diversity of climatic and soil conditions that support various forest types. In this chapter, various forest types are discussed in details that include information on various regions where they exist along with their climatic condition, vegetation type and any silvicultural practices if prevalent are presented. Furthermore, the conclusion portion briefly encompasses the major reasons of the forest declines in Pakistan and the steps that can be taken to curtail such menace.

Keywords: Forest types; Silviculture systems; Climatic conditions; Key species.

2.1. Introduction

The forests of Pakistan reflect the country's physiographic, climatic and edaphic diversity. Pakistan is an oblong stretch of land that runs from Arabian Sea up to Karakoram Mountain between 24°N and 37°N latitudes and 61°E and 75°E longitudes. Total area of the country is 87.98 million hectares. Topography of the country comprises of massive mountainous tracts in the North, the West and the South-West along with a large fertile plain called the Indus plain. The northern mountain system includes the Karakoram, the great Himalayas, and the Hindu-Kush that has one of the biggest masses of snow, glaciers and 100 peaks that are over 5,400 m in elevation. K-2 (8,563 m) is the second highest peak in the world. The mountain slopes are steep therefore fragile watersheds making associated

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forest vegetation extremely important from hydrological point of view. The Indus plain has two distinct landforms; the alluvial plain and sandy deserts. Indus River starts from snow covered northern mountain ranges and bisect the country and produce a wide delta before entering the Arabian Sea. Four rivers i.e. Jhelum, Chenab, Ravi and Sutlej enter the main Indus River from the East at Panjnad and together these rivers fabricate one of the largest irrigation systems in the world.

Despite this extensive irrigation system, Pakistan is poor in forest wealth, which is mainly due to arid to semi arid climate that prevails in most parts of the country (Figure 2.1). According to forest Sector Master Plan (FSMP) 1992, out of total land area of the country (87.98 million ha), only 4.8% (4.2 million ha) are natural forest cover, 0.117% (103,000 ha) are irrigated plantation and (32.40%) 28.507 million ha are rangelands. FAO (2007) recorded that the total area of forests was 5.01% (4.34 million ha, Figure 2.1) out of which 3.44 million ha is state owned and tree cover on private lands or farmlands is about 0.887% (0.781 million ha). Most of the forest area in the country exists in the northern parts especially in Khyber Pakhtunkhwa (KPK) and Azad Jammu & Kashmir (AJK) that has coniferous and scrub forest (Table 2.1). Other main types of forests include the Jumiper, Chilgoza, scrub, riverine and mangrove forests. Irrigated plantations also are important source of timber in the country and are mainly present in Punjab and Sindh Provinces.

Table 2.1 Province wise breakup of area under various forest types. Area under each forest type is represented in hectares (ha)

MAJOR FOREST TYPES & STATUS IN PAKISTAN										
Landcover class	PROVINCE/REGION/TERRITORY									
	Khyber Pakhtunkhwa	Punjab	Sindh	Balochistan	Gilgit-Baltistan	Azad Jammu	Kashmir	FATA	Islamabad	Total
Alpine scrub & Grassland	649597	0	0	0	636125	122398	0	0	1408120	
Sub-Apline Forest	44543	0	0	0	23679	7519	0	0	75741	
Moist Temperate	391769	17249	0	0	0	161842	1648	0	572508	
Dry Temperate Forest	532591	0	0	97367	254961	27776	317986	0	1230681	
Oak Forest	83480	0	0	0	58851	3484	28588	0	174403	
Subtropical Chir Pine Forest	217752	27283	0	0	0	111335	5877	0	362247	
Subtropical Broad Evergreen	236019	333246	0	294636	0	95757	134044	14124	1107826	
Drytropical Thorn Forest	12007	0	0	76746	0	0	34126	0	122879	
Forest Plantations	3970	110905	74867	0	0	0	9610	4433	203785	
Reverine Forest	0	28218	190776	0	0	0	0	0	218994	
Mangroves Forest	0	0	353062	2360	0	0	0	0	355422	
Total	2171728	516901	618705	471109	973616	530111	531879	18557	5832606	

Source: FAO (2007)

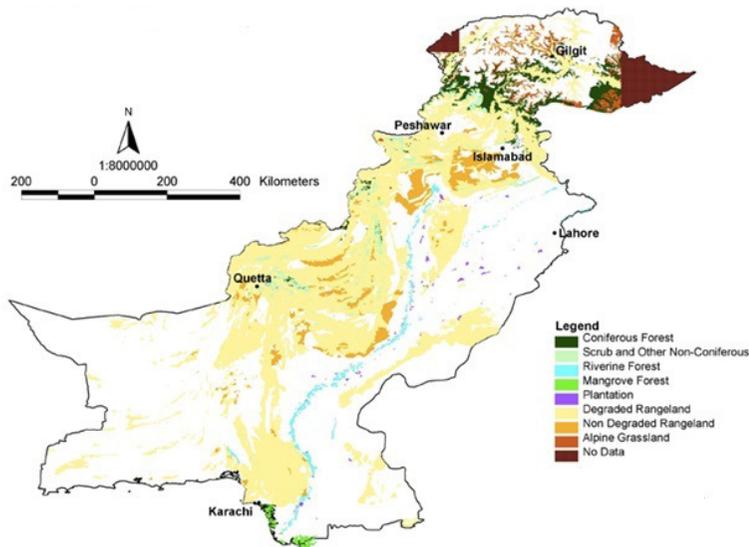


Fig. 2.1 Distribution of forests and tree cover in Pakistan. *Source: FSMP (1992).*

2.2. Alpine Scrub forest

Alpine scrubs are found on mountain tops or high elevations in the extreme northern area of Pakistan. These forests form narrow belt around the mountain tops below the snowline also called alpine pastures and include mountainous region of Himalayas, Karakourm and Hindukush that rises to an elevation that ranges from 4000 m or above from the sea level. Due to extreme elevations, these regions are not easy accessible and experience very long and sever winter with heavy snow falls that may rise to 6 feet annually. Climate is harsh with mean annual temperature and precipitation ranging between 1-6°C and 500-600 mm respectively. The forest type is not fit for good tree growth however scrub formation is common dense and profusely mixed with grasses that may rise up to 0.5 to 2 m high (Siddiqui, 1997). Vegetation is characterized by the development of flexible stem and branches to withstand snow pressure and herbaceous flora include palatable grasses commonly used for grazing and browsing by the local herds. The species include **shrubs**: Willow (*Salix babylonica*), Sumblu (*Berberis lyceum*), Phut (*Lonicera japonica*), Chan (*Rhododendron arboreum*), Juniper(*Juniperus communis*), Ephedra (*Ephedra nebrodensis*), Guchh (*Viburnum nervosum*) and **grasses**: *Draba trineriva*, *Polygonum affine*, *Saxifraga sibirica*, *Primula capitellata*. These regions mostly serve as watersheds and commonly managed for recreational purposes.

2.3. Sub-Alpine Forest

Sub-alpine forest covers the topmost region for tree formation that includes Himalayas, Karakorum, Hindukush, Hazara, Sawat, Dir, Chitral, Skardu, Gilgit (Northern Areas) and Kashmir regions. These forests exist below the alpine scrub zone at an elevation ranging from 3350 to 4000 m or up to the timber line. Vegetation includes the evergreen conifers in the upper elevation like Fir and Blue Pine and evergreen broad-leaved trees dominated by Birch at the lower end. Deciduous shrubby undergrowth of Rhododendrons, Guch, and Willow, etc. is also common. Climate is less intense in comparison to the alpine scrub and is characterized by short summer and severe long winter with mean annual average temperature and precipitation ranges is about 10°C and 650-900 mm respectively. Snowfall is of great importance that may exceed 1m annually therefore soil formation is very slow and rocks are therefore with little soil cover. Dwarf juniper trees are abundant towards the upper limit that rarely exceeds 8 m in height however the broad leaf species on the lower limits commonly exceeds 9 m in height and the shrub growth remain between 1-3 m. common species found in this forest types are **Conifers:** Only few conifer species occur in this forest type which are Fir or Partial (*Abies pindrow*), Kail or Blue Pine (*Pinus walllichiana*) Juniper (*Juniperus communis*), **Broadleaved:** Birch (*Betula utilis*), Guchh (*Viburnum nervosum*), Chan (*Rhododendron arboreum*), Batangi (*Pyrus pashia*), Willow (*Salix acmophylla*), (*Salix babylonica*), (*Salix tetrasperma*) and **Grasses:** (*Primula capitellata*), (*Phleum alpinum*), (*Agrostis gigantea*). Managed under selection wood system, these forests are highly valuable watersheds and are also used for recreational purposes.

2.4. Himalayan Dry Temperate Forest

These forests occur at elevation between 1700 – 3350 m and cover parts of Chitral, Nilam Valley (AJK), Gilgit, Skardu, Hunza, Upper parts of Suleiman Mountain Range to the North West including Takht-i-Suleiman, Tribal areas (Waziristan), district Loralai (Ziarat). These forests are located just below the sub alpine forests and mixes with moist temperate forest towards the lower boundaries. Climate is characterized by long and cold winters and short dry summer with mean annual temperature and precipitation that less than 500mm and 5 -15°C respectively. Being beyond effective reach of the Monsoon penetration, these forests have open canopy as trees are wide spread with poor productivity with open scrub undergrowth. Grazing and browsing is common and intense by goats and sheep, which are damaging the natural balance of palatable and unpalatable species composition in these forests. Some shrub species of medicinal and aromatic importance like Artemisia species are also found in these forests. Dry zone deodar, *Pinus gerardiana* (Chalghoza) and *Quercus ilex* are the main species. Higher up, blue pine communities occur and in the driest inner tracts, forests of blue pine, *Juniperus macropoda* (Abhal, Shupa, Shur) and some *Picea smithiana* (e.g. in Gilgit) are found locally. The vegetation includes **Conifers:** Deodar (*Cedrus deodara*), Chalghoza (*Pinus gerardiana*), Blue Pine (*Pinus walllichiana*), Spruce

(*Picea smithiana*), Pencil Juniper (*Juniperus macropoda*), (*Juniperus excelsa*), Barmi (*Taxus bacata*), **Broadleaved:** Walnut (*Juglans regia*), White oak (*Quercus incana*), Barungi (*Quercus dilatata*), Chan (*Rhododendron arboreum*), Horse Chestnut/ Bankhor (*Aesculus indica*), Ash (*Fraxinus hookeri*), Maple (*Acer oblongum*), Poplar (*Populus ciliata*) and **Shrubs:** Artemisia (*Artemisia maritima*), Ephedra (*Ephedra nebrodensis*), Jangli badam (*Prunus padus*), Daphne, Phut (*Lonicera japonica*), Astragalus, Unab (*Zizyphus sativa*). These forests are managed through Shelters Wood silviculture system.

2.5. Himalayan moist Temperate Forest

These are evergreen forests of conifers occasionally mixed with oaks and broad-leaved species. These forests occur in Azad Kashmir, Murree, part of district Abbottabad, Mansehra, Sawat, some tribal areas (Hazara and Malakand civil division) and Naran Kaghan valleys at an elevation ranging from 1700 to 3350 m above the sea level. These forests extend into dry temperate and occasionally into sub-Alpine forests. Winters are long and cold with snow and hail storms and summers are short mild and moist. Mean annual temperatures and precipitation is around 12°C and 650 to 1500 mm. Vegetation is characterized by a small number of dominant species mainly conifers but good canopy cover. Trees height between 25 to 50 m and stem girth may rise to 4.5 m. These forests are considered as the most productive forests of the country. On flat ground with deep soils and in depression areas, deciduous broad-leaved forest is also found that are subject to extent of lopping, grazing and cleaning for cultivation.

In open patches grass vegetation covers the forest soil. Vegetation include species like **Conifers:** Kail (*Pinus wallichiana*), Deodar (*Cedrus deodara*), Spruce (*Picea smithiana*), Fir /Partal (*Abies pindrow*), Barmi (*Taxus bacata*), **Broadleaved:** White oak (*Quercus incana*), Barungi (*Quercus dilatata*), Brown oak (*Quercus semicarpifolia*), Chan (*Rhododendron arboreum*), Horse Chestnut/ Bankhor (*Aesculus indica*), Ash (*Fraxinus hookeri*), Maple (*Acer oblongum*) and **Shrubs:** Kainthi (*Indigofera oblongifolia*), Phut (*Lonicera japonica*), Jangli gulab (*Rosa moschata*), Desmodium, Black berry (*Rubus lasiocarpus*), Guchh (*Viburnum nervosum*), Strobilanthus. Due consideration is given to soil and water conservation in these forests as they constitute major portion of the Mangla and Terbela lake watershed. These forests receive heavy monsoon rains in the summers as well as heavy snowfall in winters, which is typical to these moist temperate zones. Forests are managed under Shelter wood silviculture system.

2.6. Subtropical Chir Pine Forest

Subtropical Pine forests are mainly located in Kashmir, Abbottabad, Mansehra, Ghoragali (Muree Hills), Margla Hills, and Kahuta at an elevation from 920 to 1700 m. These occupied regions have hot and moist summer with severe winter with some snowfall. Rainfall is received mainly during Monsoon season and means

annual temperature and precipitation ranges around 15-20°C and 700-1500 mm respectively.

These forests are composed of pure strand of Chir pine that comprises of almost even-aged individuals. However, in depression as well as flat areas evergreen oaks and some deciduous species are also found. Tree growth is reasonably good with average tree height up to 36 m and average stem girth up to 2.5-3.5 m. Forest fire is relatively common in these forests especially in the months of May-June due to heavy needle fall that are full of oils and resins conducive to fire catching. Vegetation structure consists of **Conifer:** Single coniferous species Chir (*Pinus roxburghii*) that is completely dominant and **Broad leaved species:** Walnut (*Juglans regia*), Oak (*Quercus incana*), Pear (*Pyrus pashia*), Chan (*Rhododendron arboreum*), Kangar (*Pistacia integerrima*), Jaman (*Syzygium cumini*) and Anar (*Punica granatum*). Subtropical Pine Forests are generally managed through Shelter wood Silvicultural System.

2.7. Sub-tropical Broad Leaved Evergreen Scrub Forest

These forests are found throughout the country at suitable elevation especially in the Foot Hills of Murree, Margalla Hills (Islamabad), Pothwar Region, Kalachitta Hills (Attock), Salt Range (Jehlum), and Suleiman Mountain Range. Mostly occur below the Subtropical Chir pine forest at an elevation of 460 to 920 m mostly along the foothills and lower slopes of Himalayas. Hot and long summers and a definite cool short winter characterize the climate. Long and dry months are common features of these forests. Mean annual temperatures ranges from 20-25°C where summer temperature may rise to 40°C. Mean annual precipitation ranges from 250-750 mm. Terrain of these forests is stony and difficult. Forest merges upwards with sub-tropical Chir Pine forest and downwards with the Tropical thorn forests. Species present are xerophytic with thorns and small evergreen leaves mostly broad leaved. The typical species include Kao and Phulai, the two species occurring in mixed or pure form and the shrub Sanatta that is particularly abundant in most degraded areas. Total area of these forests is estimated to be 1,108,826 ha (Table 2.1). These forests are useful for small timber, fuel wood and forage purposes. Scrub forests are also suitable for controlled grazing and browsing however during monsoon profuse growth of grasses and herbs are found that are highly suitable for grazing. Along with other species as mentioned above, large dimension Pistacia trees are also common in moist pockets as well as higher elevations. Vegetation include **Trees:** Phulai (*Acacia modesta*), Kau (*Olea ferruginea*), Ber (*Zizyphus mauritiana*), Lahura (*Ticoma undulata*) and **Shrubs:** Snatha (*Dodonaea viscosa*), Kanir (*Nerium odorum*), Pataki (*Gymnosporia royleana*), Granda (*Carrissa spinarum*), Kangar (*Pistacia integerima*). Due to harsh and unpredictable climate, these forests are mostly managed for soil and water conservation under Selection wood silvicultural system.

2.8. Dry Tropical Thorn Forests

This forest type occurs throughout the Indus plains except the driest regions. The vegetation is dominated by short and predominantly xerophytic species that are mostly leguminous in nature with small leaves. The species composition varies from evergreen to deciduous mixture depending upon the geographical location. Climate is dry and hot in these forests. Mean annual temperature ranges from 20-26°C with the hottest months of June where temperature may rise to 51°C in some areas. Mean annual rainfall is from 120 to 500mm with large temporal variations from year to year. The major tree species found in these forests are *Prosopis cineraria* (Jhand), *Capparis decidua* (Karir, Karil), *Zizyphus mauritiana* (Ber), *Tamarix aphylla* (Farash) and *Salvadora oleoides* (Pilu, wan) along with large number of shrubs species with individuals of all sizes. Heavy grazing and browsing is a major problem in these forests that result in the tree climax at short stature especially for the palatable species. Edaphic and other biotic factors also contribute to the poor state of trees in these forests where salinity, water scarcity and soil shallowness is becoming more intense due to climate change. Average height of trees is between 20 to 30 ft. Prior to the extension of agricultural lands the forest area extended from the foothills of the Himalayas and low-hills in the south-west Punjab plains and Balochistan to the Arabian sea. The climax species of these forests depends upon the various soil properties like soil textures, type and depth that vary from region to region. Resultantly, climax species are *Salvadora oleoides*, *Capparis decidua*, *Tamarix aphylla* and *Prosopis cineraria*, which grow on a wide range of soils.

These forests are the home of many important endemic wildlife species as well as many migratory species. These forests provide ideal habitat to these migrated wildlife species according to their need of food and shelter during extreme winters. Vegetation include species of trees like **Trees:** Van (*Salvadora oleoides*), Kikar (*Acacia nilotica*), (*Acacia senegal*), (*Acacia jacquemontii*), Jand (*Prosopis cineraria*), Frash (*Tamarix aphylla*), Phulai (*Acacia modesta*), Lahura (*Ticoma undulate*), Ber (*Zizyphus mauritiana*), Sohanjna (*Moringa oleifera*), **Shrubs:** Van (*Salvadora persica*), Karir (*Capparis decidua*), Mallah (*Zizyphus nummularia*), Phog (*Calligonum polygoides*), Khar (*Haloxylon recurvum*), Lana (*Sueda fruticosa*), Lani (*Salsola foetida*), Ak (*Calotropis procera*) and **grasses:** Dhamman (*Cenchrus ciliaris*), Malai (*Panicum antidotale*), Lamb (*Aristida depressa*), Chhimber (*Eleusine flagellifera*), Gorkha (*Lasiurus cindicus*). Along with climatic extremes and heavy grazing and browsing, illegal cutting is also of major concern in these forests.

2.9. Tropical Littoral and Swamp Forest / Mangrove (Coastal) Forest

These forests are located on the narrow belts along the muddy coasts of the Arabian Sea around Karachi and along the coast of Gawader. Mean annual rainfall is between 150 – 200 mm that has an important effect on soil salinity regulation rather

than bringing additional moisture. Single specie Timar (*Avicennia marina*) dominates this forest type 95% which is evergreen in nature. These forests are dense with a very low average tree height, often between 10 to 15 ft and branchy and bushy in nature. Terrain is difficult to access because soft mud, accessible parts over utilized for grazing and lopping and fire wood collection. Roots produce aerial out-growths (finger like structure from the soil called Pneumatophores) for the exchange of gases. Viviparous germination is dominant where seed germinate on the mother plant before shedding. These forests are not important from timber point of view but are basically protected forests as they provide habitat, protection and feed to aquatic wildlife and marine animals such as prawns, shrimps, fish, turtle, etc. They also protect coast line of country from strong tidal erosion and sea storm. Forest is inundated twice a day by the sea water during high tides. The water and soil within Mangrove ecosystem have high salt contents. Soil is water logged and poorly oxygenated. Species present in this forest type are Timar (*Avicennia marina*), Kiriri (*Ceriops tagal*), Kamri (*Rhizophora mucronata*). This forest reserve is seventh largest coastal forest in the world and is managed under Selection Wood Silvicultural System.

2.10. Man Made Irrigated Forest Plantations

Irrigated forest plantations spread over the plains of Pakistan i.e. Changa Manga in Distt. Kasur, Chichawatni in Distt. Sahiwal, Pirowal in Distt. Khanewal, Duffar in Distt. Gujrat, Kundian in Distt. Mianwali etc. These plantations spread over the plains of Pakistan covering an area of nearly 203,785 ha (Table 2.1), out of which 50% is stocked (productive). Size of each plantation varies 300 acres to 30000 acres, for example Changa Manga Plantation spread over 12510 acres as it was planted in 1866. Few examples of these man-made irrigated forest plantations are (i) Changa Manga Forest Plantation, (ii) Chichawatni Forest Plantation, (iii) Kamalia Forest Plantation, (iv) Duffar Forest Plantation, (v) Pirowal Forest Plantation, (vi) Lal Sohanra National Park, (vii) Machu Forest Plantation (viii) Kundian Forest Plantation. Mostly these plantations were established in Agro-ecological zones of Punjab and Sindh (sub-tropical climate) where canal water was available. Originally, these plantations were established to provide fire wood for railways engines. However, after coal discovery, these forests were managed for providing high quality timber for furniture, sports goods and for providing recreational facilities. Species in these plantations include Shisham (*Dalbergia sissoo*), Mulberry (*Morus alba*), Babul (*Acacia arabica*), Desi Kikar (*Acacia nilotica*), Simal (*Bombax ceiba*), Bakain (*Melia azedarach*), Neem (*Azadirachta indica*), Sufeda (*Eccalyptus camaldulensis*), Siris (*Albizia lebbek*), Willow (*Salix tetrasperma*), Poplar (*Populus deltoides*). These forests are managed under clear felling system and coppice with standard silvicultural system for producing high quality large timber as well as small timber and fuel wood.

2.11. Riverine (Bela) Forest

The forests also known as Bela Forests occur along the river Indus and its five major tributaries and in the flood plains. Total estimated area under these forests is about 218994 ha (Table 2.1). The climate is generally sub-tropical dry however the soil is moist, deep, sandy/silty and alluvial that is good for tree growth. The forests are irrigated by the flood water that spills over the river banks during Monsoon season of July, August and September. The intensity of this spill over may vary from year to year, therefore the width of this flooded belt varies from 1 to 15 Km. these forests are dense with tall tree that may rise to 12-15 m. The major tree species found in these forests is Babul (*Accacia arabica*). These forests are fast growing due to water availability through flood spills and seepage and produces good quality timber. Forest floor is generally covered with heavy grass growth and serves as a good source for local grazing and browsing animals. High biodiversity of flora is one of the key features of these forests however this wealth is under several biotic and abiotic pressures and getting restricted within the protective boundaries. Regeneration in these forests is mainly through artificial means. Vegetation found in these forest include tree species like Shisham (*Dalbergia sissoo*), Kikar (*Acacia nilotica*), Jand (*Prosopis cineraria*), Frash (*Tamarix dioca*), (*Tamarix articulata*), Van (*Salvadora oleoides*) and Poplar (*Populus deltoides*), (*Populus euphratica*) and grasses like **Grasses:** Sarkanda (*Saccharum munja*), Kai (*Saccharum spontaneum*), Dib (*Typha elephantina*). Riverine forests are managed according to clear felling silvicultural system as well as with artificial seed spreading

2.12. Agro-Forest / Farm Forest

Agro-forestry is a component of social forestry. Social forestry is planting of trees on farmlands and in urban areas along roads, canals, railway tracks, in schools, colleges, universities, hospitals, airports, cantonments, on waste lands, on saline and water logged areas. Whereas agro-forestry is growing together of woody vegetation and farm crops on the same piece of land either side by side or one after the other in the best interest of site and man.

Agro-Forestry is being practiced all over Pakistan especially in plain areas of the country. Generally, under agro-forestry, trees are planted in lines along field boundaries, inter planting is done along with the farm crops or in compact blocks without farm crops. Contribution of farm forests for timber production is already 5 to 9 times more than that of state forests as, 60% of total demand of timber and 90% of total demand of fire wood is fulfilled by these forests (Government of Pakistan 2009). Trees growing in lines on farm lands grow fast because less competition among trees as compared to trees growing in natural forests/compact plantations. Farm trees also get some share of water and nutrients from farm crops. Still, there is lot of potential that is untapped where timber and fuel wood production from farm lands can be easily increased by 8 times. Ecological conditions of the area, availability of water, nature of farm crops and market

demand must be evaluated before choosing tree species for agro-forestry. However, tree species selected for a particular farm should have following properties:

- i. Preferably be a fast growing
- ii. Must have a short rotation age
- iii. Should produce straight/erect stem
- iv. Canopy must not be dense or crown should preferably be conical or columnar as it will cast less shade
- v. Species must have deep root system
- vi. Preferably be deciduous in nature and finally
- vii. Wood should be of high market value.

Agro-forestry system is an integrated land use approach (including various combinations of agriculture and forestry) for obtaining maximum possible benefits from a unit area of land. Different agro-forestry systems are applied in different areas of Pakistan for example Agri-silviculture system, Silvi-pastoral system, Agri-silvi-pastoral system. Tree species that are being planted on include shisham (*Dalbergia sissoo*), Kikar (*Acacia nilotica*), Sufeda (*Eucalyptus camaldulensis*), siris (*Albizia lebbek*), poplar (*Populus deltoides*), neem (*Azadirachta indica*), bakain (*Melia azedarach*), simal (*Bombax ceiba*), sohanjna (*Moringa oleifera*), pipal (*Ficus religiosa*), burgad (*Ficus benghalensis*). These species also include fruit trees like mango (*Mangifera indica*), jaman (*Syzygium cumini*), guava (*Psidium guajava*), ber (*Zizyphus mauritiana*) and mulberry (*Morus alba*).

2.13. Linear Plantations

Tree planted along the roads, canals and railway tracks are called linear plantations. These Linear plantations are very important from ecological point of view as they act as windbreak, improve environment, reduce noise and environmental pollution, provide timber, fuel wood and forage for local animals. Linear plantations especially along the canal sides are very productive and are commonly regarded as timber mines. As these plantations are mostly in urban areas they are also known as Urban Forestry. The science and art of growing trees in urban and peri-urban areas for obtaining various environmental benefits is known as urban forestry.

These plantations have landscape and ornamental values and are planted according to landscape principles and designs. Presently these are planted and managed by government but these plantations should be managed through participatory approach with the involvement of local people and farmers. These plantations need continuous management and protection. Clear felling is strictly prohibited in these plantations, only those trees are harvested which have attained rotation age. Plantation along the Motorway (M-2) is a good example of well-managed linear plantation. Following tree species are preferred under linear plantation: Shisham (*Dalbergia sissoo*), Kikar (*Acacia nilotica*), Sufeda (*Eucalyptus camaldulensis*), Siris (*Albizia lebbek*), Poplar (*Populus deltoides*), Neem (*Azadirachta indica*), Bakain (*Melia azadarech*), Mulberry (*Morus alba*), Simal (*Bombex ceiba*). Flowering trees that

are planted includes Gul Mohar (*Delonix regia*), Amaltas (*Cassia fistula*), Neelam (*Jacaranda mimosifolia*), Gul-e-Nishtar (*Erythrina suberosa*), Dhak (*Butea frondosa*), Kachnar (*Bauhinia purpurea*), Kabli kikar (*Parkinsonia aculeata*) and Paulownia (*Paulownia tomentosa*). Foliage ornamental trees include Devil Tree (*Alstonia scholaris*), Toon (*Cedrela toona*), Pilkhan (*Ficus infectoria*), Silver oak (*Grevillea robusta*), Kangar (*Pistacia integerrima*), Kanak-champa (*Pterospermum acerifolium*), Jiaputra (*Putranjia roxburghii*), Baid-e-Majnoo (*Salix babylonica*), Baid-e-Laila (*Salix tetrasperma*), Arjun (*Terminalia arjuna*).

2.14. Conclusion

Pakistan has a wide range of forest reserves but due to variations in the climatic and edaphic factors, the country is still poor in forest resources with only 0.03 ha of forest available per capita, which is declining due to population growth (NIPS 2009). There are number of contributing factor responsible for such decline i.e. inherited a very small forest area since independence, most of the country is arid to semi-arid, receives low precipitation that can support optimum growth. Forest contractors who ruthlessly cut forests for the development of the country that heavily depended on the indigenous wood resources. Ban on timber harvesting in Sept 1993 resulted in decline of legal wood harvesting but illegal harvesting took over and the volumes increase almost en folds as compared to legal harvesting (Fischer et al. 2010). Ever increasing wood demand and supply gap that was 15 million m³ in 1992, increased up to 29.36 million m³ in 2003 and will be 43.97 million m³ by 2018 (Government of Pakistan 1992). Total fuel wood consumption is estimated at 34.95 million m³ in 2011 for the population of 170.52 million³ (Government of Pakistan 2005).

Issue of low forest cover and demand and supply gaps can be met by promoting Agro forestry on emergency basis as the country has a lot of potential in this sector. Fast growing and high yielding species must be promoted like teak (*Tectona grandis*), poplar (*Populus* spp.) Simle (*Bombax ceiba*), *Eucalyptus* spp. and Shisham (*Dalbergia sissoo*). Plantation for the fuel wood purposes must be encouraged along the roads and railway tracks, along the rivers, canals and drainage channels. Furthermore, steps like credit facilities, subsidized saplings or planting material, expansion of irrigation facilities for the forests, tax exemption on local timber production to encourage private sector. Watershed management and restoration programs can be initiated. This would not only increase our forest area and biodiversity but also supply increase the life of our dams. Finally, the implementation if policies and forest sector reforms remain inadequate (Fischer et al. 2010) and must address the obvious factor of forest degradation like fuel wood/energy supply issue and illegal commercial harvesting of forest trees.

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