CHAPTER II

Eco-geographical Aspects of the Area Surveyed

Landscape and ecological features have bearing on the conservation and sustainable utilization of plant resources. Keeping this in view eco-geographical features of the area surveyed has been studied.

2.1. Geographical location and major river systems of the area

Study area is located between 29° 5′ to 30° 04′ North latitude and 80° 28′ to 80° 57′ East longitude in Dharchula sub-division of Pithoragarh District in Kumaon Himalaya of Uttaranchal State (Figure 1). The area encompasses over 2200 square kilometers and comprises three valleys namely Darma, Chaudas and Byas with altitude ranging from 1,200 m to over 7,000 m. The area is bordered by Nepal in the East, Tibet in the North, Munshiari and Askot sub-divisions of Pithoragarh District in the West and South (Figure 2). Magnificent groups of Panchachuli, Api and Annapurna peaks are located in this region.

These mountains, which are masses of tangled peaks and valleys, are known to be associated with several sacred beliefs and represent one of the most rugged ranges in the region. In the ruggedness of feature they are not surpassed by any inhabited tract in the world. Mountains have such irregular and confused appearance that only the line of river valleys enables one to find a clue to their arrangement. The region consists of succession of deep gorges and steep precipitous hill sides containing Kali, Kuti and Dhauli River systems. Kuti River is tributary to Kali but the total volume of water of Kuti River is more than that of Kali River. All these rivers join and is known as Sarda when it reaches Tanakpur in the foothill, a tributary of the Ganges. Panchachuli, Nampa, Api and Chota Kailash are the main glaciers of this region.

2.2. Geology and soils

Perpetually snowcovered zone is separated by the Lesser Himalaya by the Main Central Thrust. The region is largely composed of gneiss and granite. The component rocks have been subjected to severe compressional forces. In several sections this zone is
made up of: (i) intrusive granite, (ii) complex schists resulting from the intrusion of granite into rocks which it has partly absorbed, and (iii) old gneiss, schists, granulites and highly metamorphosed crystalline limestones, which may include Precambrian and palaeozoic representations. Northern most belt on the North and North-east of greater Himalaya is made up of highly fossiliferous sedimentary formations ranging from Palaeozoic to the Eocene times and is remarkably uniform in lithological sequence (Joshi, et al. 1983). Dhauki river valley in Darma is characterized by porphyritic gneiss zone with the amphibolitic sills with a tectonic contact passes over to sedimentary quartzite, phyllite and limestone zones. The porphyritic gneiss is overlain by mica schist with multilayered weathered amphibolitic sills in Chaudas. The well marked tectonic zone is exposed with amphibolitic sills physically overthrusted by an unmetamorphic quartzite-limestone
phyllites sequence. Byas valley is characterized by quaternary sediments along Kali and Kuti rivers. Kuti River flows through the exposed clay rock with more carbonaceous material. Southern portion of the area consist of crystalline metamorphic rocks and some granite and basic magmatic rocks (Sinha. 1989). Soil is dark grey to dark brown and black in colour and silty loam to loamy in texture. Soil properties and processes are influenced by climate. As climate changes with elevation so do soil characteristics.

![Figure 2](image_url)  
Figure 2. Map of Pithoragarh District in Uttarakhand showing Darma, Chaudas and Byas valleys of study area based on Digital Interpretation of IRS ID – LISS – III, 2000 (Source: Forest Survey of India)

In Darma valley, the organic carbon percentage in the soil decreases with increase in elevation probably due to erosion of litter and low decomposition rates due to sub-zero
temperatures. Sand is the predominant constituent of the soils; pH varies from 4.9 to 6.1 and moisture percentage varies between 13.5-34.5% (Ram and Singh, 1994).

2.3. Climate

The region experiences heavy rain (37-50 cm) during the monsoon season commencing from end of June to middle of September, with maximum rainfall being in July-September. In the higher reaches the annual rainfall is just about 10 cm. In this region summers are short and winters very severe and the grounds are entirely covered with snow from October to April. Heavy snow fall and frost are common. Melting of snow in April-May provide abundant moisture. Cloud and fog formation is a common feature even in May, well before commencement of monsoon. Clear sky is limited to only few morning hours. Soil erosion is very pronounced in the region. Frequent landslips in the lower valleys and avalanches in the higher regions and natural perturbations create new ecological niches, which are inhabited by characteristic flora and fauna thereby enhancing biodiversity. A rise of 270 m in altitude corresponds to fall of 1°C in mean temperature up to 1,500 m and this fall in temperature is more rapid towards alpine belt.

2.4. Vegetation

The study area comprises 12,740 ha of dense forest, 3936 ha of open forest, 1153 ha of scrub, 802 ha of water bodies and 203544 ha of non-forest area, which encompass habitations, villages, farmlands, community lands, snow covered areas, etc (Source: Forest Survey of India). The area is known for its rich biodiversity and many of its plant species are of medicinal importance in traditional systems of medicine: Indian, Tibetan and Chinese. Richard Strachey was the first to explore the area in 1846 and subsequently in 1848 with J. E. Winterbottom. Both plant explorers collected over 2000 species between the years 1846-49. J. F. Duthie explored North-Eastern Kumaon in 1883 and catalogued 2672 flowering plants, 201 ferns and allies, 120 mosses and 50 lichens. This catalogue also includes the plants collected by the earlier explorers (Duthie, 1885 and 1906).

The vegetation of the area can be broadly classified in to the following types as per the Champion and Seth Classification (Champion and Seth, 1968) –

1. Upper Himalayan Chir Pine Forests
2. Moist Temperate Deciduous Forests
3. Low Level Blue Pine Forests
4. Kharsu Oak Forests
5. Western Himalayan Upper Oak/Fir Forests
6. East Himalaya Mixed Coniferous Tansen (*Tsuga dumosa*) Forests
7. Montane Bamboo Brakes
8. Himalayan Temperate Pastures
9. Oak Scrub Forests
10. *Hippophae* Scrub
11. Sub-Alpine Forests
12. Sub-Alpine Forests
13. Alpine Pastures and Alpine Scrub River Bed

1. Upper Himalayan Chir Pine Forests - This forest type occurs at altitudes between 1,200 and 2,100 m. Common species are *Rhododendron arboreum*, *Pyrus pashia*, *Myrica esculenta*, *Alnus nepalensis*, *Berberis lycium*, *Rubus ellipticus*, *Artemisia nilagirica*, *Rosa brunnii*, etc. with *Pinus roxburghii* as the dominant species.

2. Moist Temperate Deciduous Forests - This type occurs on deeper and moist soils at altitudes between 1,800 and 2,700 m. Common species are *Aesculus indica*, *Acer caesium*, *Fraxinus micrantha*, *Betula alnoides*, *Juglans regia*, *Quercus semecarpifolia*, *Taxus baccata*, *Rubus niveus*, *Berberis chitria*, *Impatiens* spp., *Aconitum* spp., *Lilium* spp., etc.

3. Low Level Blue Pine Forests - This type is found at altitudes between 1,800 and 3,000 m. Common species are *Quercus semecarpifolia* and *Quercus leucotrichophora* with *Pinus wallichiana* as the dominant species.

4. Kharsu Oak Forests - This type occurs on the southern aspects of mountains at altitudes between 2,500 and 3,500 m extending up to tree line. Common species are *Abies pindrow*, *Betula utilis*, *Thamnocalamus spathiflorus*, *Viburnum nenosum*, *Rosa sericea*, *Anemone* spp., *Ranunculus* spp., *Clematis* spp., etc. with *Quercus semecarpifolia* as the dominant species.

5. Western Himalayan Upper Oak/Fir Forests - This type is found at altitudes between 2,700 and 3,700 m. Dominant species of these forests are *Abies pindrow*, *Quercus
6. East Himalaya Mixed Coniferous Tansen (Tsuga dumosa) Forests – These forests are found at altitudes between 2,500 and 3,300 m in the upper reaches of the valleys. It is the eastern limit of Tsuga dumosa. Common species of these forests are Abies pindrow, Pinus wallichiana, Quercus semecarpifolia, Quercus leucotrichophora, Taxus baccata, Betula utilis, Rosa macrophylla, Viola serpens, Fragaria spp., Clematis montana, etc. with Tsuga dumosa as the dominant species.

7. Montane Bamboo Brakes – These are the under-storey found in Oak, Rhododendron and Bamboo forests at altitudes above 2,500 m. Dominant species of these forests are Arundinaria falcata, Thamnocalamus spathiflorus, Thamnocalamus falconeri, etc.

8. Himalayan Temperate Pastures – These are the pastures that come up as a result of repeated burning and continuous grazing, generally close to the human habitations. Common species are Heteropogon contortus, Chrysopogon gryllus, Dactylic spp., Agrostis spp., etc.

9. Oak Scrub Forests – This type is developed as a result of degeneration of the Oak forests because of repeated lopping, burning, cutting for firewood and overgrazing. Dead trunks of Quercus leucotrichophora and Quercus floribunda are found accompanied with Berberis spp., Crataegus crenulata, Prinsiapia utilis, Indigofera spp., Cotoneaster spp., etc.

10. Hippophae Scrub – This forest type is found at altitudes between 2,800 and 3,400 m. Dominant species are Hippophae salicifolia and Thymus serpyllum.

11. Western Himalayan Birch/Fir Forests – This forest type is found at altitude above 3,000 m extending up to tree line. Dominant species are Betula utilis, Rhododendron anthropogon, Rhododendron campanulatum, Thamnocalamus spathiflorus, Rubus niveus, Rosa secica, etc.

12. Sub-Alpine Forests – these forests occur at the altitudes between 3,000 and 3,700 m. Abies pindrow, Quercus semecarpifolia, Betula utilis with undergrowths of Rhododendron campanulatum, Rosa secicus, Ribes glaucum, Rubus niveus, Smilax vaginata, Taraxacum officinale, Rumex nepalensis, Senecio chrysathemoides, Anemone rivularis, etc. are common species of these forests.
13. Alpine Pastures and Alpine Scrub Rive: Bed – These forests are found at altitudes above 3,300 m and are covered by snow most of the time. Common species are *Rhododendron campanulatum, Rhododendron anthropogon, Betula utilis, Juniperus spp.*, *Sorbus foliolosa, Viburnum nervosum, Aconitum spp.*, *Corydalis govaniana, Gentiana spp.*, *Iris spp.*, *Anemone spp.*, *Potentilla spp.*, *Primula spp.*, etc.