Chapter 4

STUDY AREA

Northern India comprises of varied physical diversity. There are high mountain peaks in some areas while in others lie the flat plains formed by rivers. On the basis of physical features, Northern India can be divided into two divisions:

1. The North-Western Mountains  2. The Northern Plains

1. The North-Western Mountains: It is divided into two groups. (i) The Himalayas and (ii) The Trans Himalayas

(i) The Himalaya: Himalaya being the young fold mountains consists of highest mountain range of the world. Indian Himalayas act as natural barrier leading to high degree of endemism. The Indian Himalayan Region (IHR), running a distance of 2500 km from west to east direction from Indus to Brahmaputra respectively, covers an area about 5 lakh km² (about 16.2% of country’s total geographical area) and forms the northern boundary of the country. Their width of IHR varies from 400 km in the west and 150 km in the East. The Himalayas within the study area are divided into three ranges-

(a) The Greater Himalaya or Himadari: The Greater Himalaya comprises of the northern most ranges and peaks. It has an average height of 6000 metres and width lies between 120 to 190 kms. It is the most continuous range. It is snow bound and many glaciers descend from this range. Kamet (7756 m.), Chaukambha (7138 m.) Trishul (7120 m.), Nanda Devi (7811 m.), and Mt. Kailash (6638 m.) etc. are major peak of Western Himalaya with in the study area. The Ganga and Yamuna rivers originate from this Himalaya.
(b) The Lesser Himalaya: The average altitude of this range is 3500 m with an average width of 45-60 km consisting of many famous hill stations like Shimla, Dalhousie, Almora, Chakrata, Nainital etc., along with the famous valleys of Kangra, Kashmir, Kullu, etc.

(c) The Outer Himalaya: These are the outermost ranges present in the study area with an average altitude 900 m and the width ranges between 15-50 km. The valleys present within this are known as ‘Duns’ like Dehradun, Kotli Dun and Patli Dun. The low lying hills of Jammu are also present.

(ii) The Trans-Himalayas: This is the Northern most area in the country. The Trans-Himalayan ranges extend to the north of greater Himalaya and consist of cold-arid region of Ladakh, Lahaul-Spiti, Mana-Niti, Zanskar and Nilang valley. It is an extension of Tibetan plateau around the Himalayas formed due to the collision of Eurasian plates.

The Himalayan and the Trans Himalayan region of the present study area comprise of 3 states viz., Jammu & Kashmir, Himachal Pradesh and Uttarakhand.

A. Jammu & Kashmir: The state of Jammu and Kashmir, located in the extreme north of India, is situated between 32° 17' to 37° 20' North latitude and 73° 25' to 80° 30' East longitude. The state shares the international boundary with Pakistan on west and China on north and east. On south the state is bounded by Himachal Pradesh and a small portion of Punjab. The major rivers of the state and their tributaries are: Indus, Jhelum, Chenab, Ravi, Tawi, Lidder, Kishanganga, Hunza, etc. Spreading over an area of 2,22,236 km², the state comprises of 22 districts with three divisions, Jammu, Kashmir and Ladakh, offering a rich faunal, floral and cultural diversity, with the forest cover of 9.56% of total geographical area. The geological setup of the state has been divided into three structural zones: (i) The Panjal zone, (ii) The Zanskar zone and (iii) The Tertiary groups. The geological setup of Jammu & Kashmir corresponds more or less to the three well known physiographic divisions. The Panjal zone consists of the outer hills and outer plains along with the middle mountains. Whereas the Zanskar zone covers the complete north eastern part, which extends upto the northern Karakoram ranges from Lahaul-Spiti area of the state. The Tertiary group covers the valley of Kashmir and the other valleys formed by the different rivers of the state. The soil profile of the study area generally consists of quite fertile soils of alluvial origin in Kashmir and outer plains of Jammu. Relatively the soil of Kashmir,
being loamy and clayey, is more fertile than the soil of Jammu. The hilly brown soil is found in Pir Panjal and northern Kashmir valley. Podsoil is present in the intermediate zones of Jammu and the temperate regions of Kashmir. Mountain soil with rocky and bare gravel slopes is present in Ladakh and Kargil. Different region of the state varies a lot in their rainfall pattern. The hilly areas receive 50-70 inches of annual rainfall, whereas the outer hill receives 30-40 inches. The cold desert area of the state receives less than 10 inches of precipitation.

B. Himachal Pradesh: The state lies between the parallels of 30°20' to 33°20' north latitude and 75°19' to 79°20' east longitude. The state shares the international boundary with China in the north-east, it is bounded by Jammu & Kashmir in the north, in south-east by Uttarakhand, it is surrounded by Haryana in the south and Punjab in the west. Himachal Pradesh is bestowed with rich and intensive drainage system which is supported by number of perennial rivers, lakes, rain-fed water bodies etc. The major rivers of the state are Chandra-Bhaga, Ravi, Beas, Sutlej and Yamuna. Spreading over an area of 55673 km², which is about 1.69% of India's total area, the state comprises of 12 districts with a rich biological diversity, with the forest cover of ca. 24% of total geographical area. The geological setup of the state is divided into four physio-geographic regions viz. (i) Outer Himalaya consisting of detrital rocks, clay and conglomerates; (ii) Lesser Himalaya consisting of quartz, basalts and crystalline rocks of unfossiliferous sediments; (iii) Greater Himalaya, the crystalline core zone forming the main central thrust; and (iv) Tethys Himalayan zone comprising of rusty ferrous slates and Kinnaur-Kailash granite. The texture of the soil of study area varies from region to region. Shiwalik region mainly consists of detrital rocks, clay and conglomerates whereas alluvial soil is present at Shimla and Sirmour. The remaining districts have forest and hill soil. The soil texture in the Kangra region varies from clayey loam soil in the high rainfall areas to sandy loam soil. The amount of rainfall in this region varies between 110-120 inches at Dharamshala to 2-4 inches at Lahaul-Spiti region and the temperature varies from 26°C during summers to about -4°C during winters.

C. Uttarakhand: Uttarakhand, lying between the parallels of 28° 26' and 31° 13’ north latitude and 77° 58' and 81° 04' east longitude, is located in central Himalayan part. The state shares the international boundaries with China in the north and Nepal
in the east, it is bounded by Himachal Pradesh in the northwest lies and Uttar Pradesh on the south. The state consists of two administrative divisions viz., Kumaun and Garhwal. Uttarakhand is blessed with good river system. Major rivers draining through the state are Ganga and the Yamuna whereas the other minor one are Tons, Bhilangana, Bhagirathi, Kali, Kosi, Gori Ganga, Dhauliganga etc. The geological setting of the state is very complex and divided into following five regions: (1) Trans Himalaya (2) Greater Himalaya (3) Lower Himalaya (4) Shivalik (5) Bhabhar & Tarai. A large variety of rocks are developed in the central crystalline complex. The soil present in the state is mountainous forest soil which varies from region to region. Five main types of soil are found in the state are Quartzite soil, Alluvial soil, Brown soil, Volcanic soil and Tertiary soil. The amount of rainfall in this region varies between 36 to 120 and the temperature varies from 45°C during summers to sub-zero during winters.

2. The North-Western Plains extends over Punjab, Haryana, Delhi and Uttar Pradesh, the former two has been formed by the alluvium brought by rivers Beas, Satluj and Ravi whereas the later formed by the deposits of Ganga, Yamuna, Ramganga, Gomati, etc.

A. Punjab: The state lies between the parallels of 29.30° North to 32.32° North and longitudes 73.55° East to 76.50° East. It shares the international boundary with Pakistan in the west. It is surrounded by Jammu and Kashmir on the north, by Himachal Pradesh on the northeast and on the south by two states viz. Haryana and Rajasthan. The total area covered by the state is 50,362 sq. km, consisting of 22 districts. The word Punjab is self-explanatory that means Punja (Five) and ab (water) i.e. Land of Five Rivers. The five rivers comprising the drainage system of the state are Ravi, Beas, Jhelum, Sutlej and Chenab. The geological setup of the state is represented by Siwaliks and the Alluvium deposits. The Siwaliks consists of the hilly region in the northern and the north-eastern region, whereas the alluvium deposits consist of the plains of the state. The soil of the state, under the influence of climate and topography, is due to the materials deposited by the rivers. Different types of the soils present in the state are Reddish Chestnut Soils, Tropical Arid Brown Soils, Arid Brown Soils, Sierozem Soils, Desert Soils. The amount of rainfall in this region varies between 15 inches to 27 inches and the temperature varies from maximum 44°C during summers to minimum between 0-2.2°C during winters.
B. Haryana: Haryana state, lies between the parallels of and 27º 39' to 30º 55' north latitude 74º 27' to 77º 36' east longitude, is bounded by Uttar Pradesh in the east, Punjab in the west, Himachal Pradesh and Uttarakhand in the north and Rajasthan in the south. The total area covered by the state is 44,212 sq. Km comprises of 22 districts. The major river of the state is Yamuna, flowing along the eastern boundary. Other seasonal rivers and its tributaries are Ghaggar, Markanda, Chautang and Tangri. The geological setup of the state is predominated by the Quaternary alluvium and Aeolian sediments. The rest area of the state comprises of Proterozoic and Tertiary rocks exposed in the southern and north-eastern extremities. This state has a very fertile land and is called as the Green Land/Grain Basket and milk pail of Northern India. The major soil present in the area is brown soil capable of growing cotton. In Bhiwani and Mahendragarh soil is least fertile, consisting of sandy soil. Annual rainfall ca. 14 inches The maximum temperature sometimes crosses 48º in summer, whereas in winters the temperature level touches zero level.

C. Uttar Pradesh: The state of Uttar Pradesh lying between the parallels of 27º 39' to 300 56' N latitude and 74º 27' to 77º 36' E longitude. It is one among the largest state of India occupying an area of about 2,43,290 sq. km out of which 21,291 sq. km, consisting of forest and tree cover accounting to the 3% of total forest cover of the country. Uttar Pradesh is situated on the northern part of the country and shares an international boundary with Nepal. States is bordered by 8 other states viz. Rajasthan in the west, Delhi, Haryana and Himachal Pradesh in the northwest, Uttarakhand in the north, Bihar in the east, Madhya Pradesh to the south, Jharkhand and Chhattisgarh to the southwest. Major rivers flowing within the state are Ganga, Yamuna, Saryu, Ghaghara, etc. The diverse rock types form the geological setup of the state, comprising Granitodes to Quaternary alluvium. State, on the basis of geo-tectonic divisions, is divided into (i) Southern uplands, extending to Central India and the state of Bihar; and (ii) The Ganga Plain, extending from Aravalli-Delhi ridge in the west to the Rajmahal hills in the east. The soil profile of the state due to its topographic features, climate, vegetation, weathering nature, etc., varies a lot. Major soil types of the area are (i) Red loams (ii) brown forest (iii) Podsoils and (iv) Meadow soil. The mean annual rainfall ranges from 25 inches to 40 inches in the southwest to eastern region respectively. The maximum temperature of the state is 45º, sometimes exceeds
to 48° in summer, whereas in winters the temperature is decreases to 8-2°, occasionally at some places it touches zero level.

**D. New Delhi:** Delhi, lying between the parallels of 28° 24’ and 28° 53’ latitude and 76° 50’ and 77° 20’ E Longitude covering an area of 42.7 sq. Km, is situated at an average elevation of 216 m. It is covered from three sides i.e. north, south and west by Haryana and by Uttar Pradesh in the east. Delhi has 3 main rivers: Yamuna river, Sahibi river and Hindon river. The river Yamuna flowing in the North-South direction controls the entire drainage system of the UT. The geological setup of Delhi is constituted by the part of main Aravalli Hills originating from south-west Gujarat to north-east Haryana, constitutes the northernmost tip of the Aravalli ranges. The New Delhi District is occupied by quartzite and Quaternary alluvial sediments. Soil profile of the area is composed of clay, silt and sand. The texture of the soil is calcareous. Annual average rain fall 24 inches. The climate of the area is influenced by its position and environmental condition prevailing there. May & June are the hottest months of the season reaching upto 47°C whereas January, being the coldest month, touches minimum 3°C to 22°C maximum. [Plate-1]

**Forest Cover:**

Diverse range of edaphic, climatic and physiographic conditions is found in India which has resulted in a vast diversity of flora and fauna in the country. Forests in the country vary from tropical evergreen forests in the Andaman & Nicobar Islands, the Western Ghats and the north-eastern states, to dry alpine scrub high in the Himalayan region. Between the two extremes, the country has semi evergreen forests, moist deciduous forests, thorn forests, sub-tropical pine forests in the lower mountain zone and temperate montane forests. Pteridophytes are found all over and are known to occur in a varied range of habitats. Most of them are found in the tropical and temperate areas. They occur from high altitude of tropical rain forest and from sub-desert shrubs. Their diversity varies with the altitude and the nature of forest.

According to Forest Survey of India (FSI) report (FSI, 2015), the total forest cover in the study area (Northern India) is 79,928 sq. km, comprising 11 percent of total geographical area. Among these the state Uttarakhand has maximum forest cover ca. 24,240 sq. km (45.32 percent of geographical area) followed by Himachal Pradesh ca. 14,696 sq. km (26.40 percent), Delhi ca.188.77 sq. km (12.73 percent), Jammu &
Kashmir ca. 22,988 sq. km (10.34 percent), Uttar Pradesh ca. 14,461 km$^2$ sq. km (6.0 percent), Haryana ca. 1,548 km$^2$ sq. km (3.58 percent) and Punjab ca. 1,771 sq. km (3.52 percent). The total forest cover of Northern India has ca.14,268 sq. km of very dense forest, ca. 34,102 sq. km of moderate dense forest, ca. 31,559 sq. km of open forest shrub. While, ca. 2,225.53 sq. km is under shrub forest cover and ca. 5,86,222.70 sq. km is non forest area. [Plate-2 & Figure-1]

**TABLE-1:** Forest cover in States of Northern India

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>States</th>
<th>Geographical Area</th>
<th>VDF</th>
<th>MDF</th>
<th>OF</th>
<th>Total Forest</th>
<th>Scrub</th>
<th>Non Forest</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Delhi</td>
<td>1,483</td>
<td>6.94</td>
<td>57.15</td>
<td>124.68</td>
<td>188.77</td>
<td>1.53</td>
<td>1,292.70</td>
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<tr>
<td>2.</td>
<td>Haryana</td>
<td>44,212</td>
<td>27</td>
<td>452</td>
<td>1105</td>
<td>1584</td>
<td>151</td>
<td>42,477</td>
</tr>
<tr>
<td>3.</td>
<td>Himachal Pradesh</td>
<td>55,673</td>
<td>3.224</td>
<td>6.381</td>
<td>5091</td>
<td>14,696</td>
<td>301</td>
<td>40,676</td>
</tr>
<tr>
<td>5.</td>
<td>Punjab</td>
<td>50,362</td>
<td>0</td>
<td>735</td>
<td>1,036</td>
<td>1,771</td>
<td>37</td>
<td>48,554</td>
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<td>6.</td>
<td>Uttar Pradesh</td>
<td>2,40,928</td>
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<td>4.060</td>
<td>8,206</td>
<td>14,461</td>
<td>803</td>
<td>2,25,664</td>
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<td></td>
<td></td>
<td><strong>6,68,377</strong></td>
<td><strong>14,268</strong></td>
<td><strong>34,102</strong></td>
<td><strong>79,929</strong></td>
<td><strong>2,226</strong></td>
<td><strong>5,86,223</strong></td>
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</tbody>
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Taxonomic Studies on the Genus *Athyrium* Roth in Northern India
MAP OF THE STUDY AREA (NORTHERN INDIA)
FIGURE-1

FOREST COVER OF THE STUDY AREA

Source: Indian State of Forest Report, 2015