

Chapter - 2

AREA OF STUDY

India, the land of diverse language, culture, religion, ethnicity, and topography occupies the largest peninsula of the Asian continent and is the seventh largest and 10th industrialized country of the world. Its geographical area measuring 3200 km from south to north and about 3000 km from east to west, covers an area of about 32,87,263 km² makes. It is also has the second largest human population of the world with more than 1027 million people supporting nearly 16.8 % of total world’s population (Singh, 2008). It is situated between 8°4’ N and 37°6’ N latitude and 68°7’ E and 97°25’ E longitude. The land frontier is about 15,200 km long, while the total length of the coastline of the mainland is about 7516.6 km. Altitudinally, it extends from the sea level up to 8598 m above m.s.l. at the high mountain range of Himalayas. Politically the country is divided into 29 states and 7 union territories with New Delhi as the national capital. The national boundary is surrounded by the Himalayan mountain range in the North, and North-East, the Thar desert of Rajasthan in north-west, the Arabian Sea in the West, Indian ocean in south and the Bay of Bengal in its eastern side. Countries having a common boundary with India are Afghanistan and Pakistan to the west and north-west; China, Tibet, Nepal and Bhutan to the north; Myanmar to the northeast; Bangladesh to the east and Sri Lanka is separated from India by a narrow channel of sea formed by the Palk Strait and Gulf of Mannar. (Map: 1)

2.1 The Physiographic Regions of India:

The Indian mainland may be divided into following four broad physiographic regions

A. The Himalayan Mountains:

According to the continental drift theory, the Indian part of the Gondwanaland (Peninsular India), which on breaking some 1000 million years ago during Cretaceous era moved northwards and crashed against Laurasia causing the upliftment of the
Taxonomic studies on the tribe - Cymbidieae Pfitz. (Orchidaceae) in India

Himalayas and obliteration of the former Tethys sea (Rao, 1994). The rising of Himalayas created a vast chain of events resulting in shaping of land formations and river systems. These geological events resulted in the evolution of flora, extinction of vulnerable groups due to climatic changes, migration of flora through new corridors of mountain chains and their adaptations in the new ecological niches.

Himalayan ranges are one of the largest and youngest mountain chain in the world covering about 10% of total land surface of the country. The Himalayan mountains are the highest mountain ranges in the world occupying the extreme northern margins of India and have a great influence on the climate of the entire region. From Nanga Parbat on the Indus, the Himalaya stretches eastwards for 2250 km to Namcha Barwa on the bend of the Tsang-Po in South-East Tibet. In India, the Himalaya spreads along its northern boundary from Kashmir in the north to Manipur and Tripura in the northeast and include some of the highest peaks of the world. In the north-east, it grades into a series of subsidiary mountain ranges that merge with the Arkun Yomu mountain chains of Myanmar. It comprises of three parallel ranges interspersed with plateaus and valleys like Kashmir and Kullu valleys.

The Himalayas can be divided into the following ranges:

i. The Great Himalaya or the Trans Himalaya with about 6000 m elevation.

ii. The Lesser Himalaya or the middle Himalaya with average of 4500 m elevation.

iii. The outer Himalaya or the Siwalik ranges with the elevation of upto 1200 m.

B. Indo-Ganga-Brahmaputra Plains:

Paralleling the mountain wall to the south are the low lands of alluvial Indo-Gangetic plain. It is about 2400 km long and 240–320 km broad one of the largest plains of the world formed by the thick pile of sediments brought by the drainage systems of the rivers- Indus, Ganga and Brahmaputra and their tributaries. It extends from Punjab in the west through the arid and semi-arid tracts of Rajasthan to densely populated areas of
Taxonomic studies on the tribe - Cymbidieae Pfitz. (Orchidaceae) in India

Uttar Pradesh and Bihar to the plains of Assam in the east. It is further subdivided into following:

a. Indus Plain: It comprises of the arid and semi-arid tracts of western Rajasthan and the plains formed by Ravi, Satluj and Beas rivers. It covers parts of Rajasthan, Punjab and Haryana, and extends westward into Pakistan merging with alluvial tract formed by Indus river. The Delhi ridge acts as its eastern boundary.

b. Ganga Plain: It consists of plains formed by a thick pile of sediments brought by the river Ganga and its tributaries namely Yamuna, Gomti, Chambal, Kosi, Son, Ghagra and Gandak. The Bhabar and Terai tracts, which lies along the transition zone of the Siwalik hills and Gangetic plains are characteristic feature of this plain.

c. Brahmaputra Plain: It consists of the plains formed by the river Brahmaputra and its tributaries. The river Ganga and Brahmaputra merge into the Bay of Bengal through the world’s largest delta, the Sunderbans.

C. Peninsular Region:

The Peninsular India or the Deccan Plateau in the south and the Indo-Gangetic Plains in the north are separated by the boundary of Tropic of Cancer. The region is dominated by the great triangle of the eastward tilting Deccan Plateau and the Archaean shield. It is comprised of ancient crystalline rock formation that have been worn down to form a series of plateau, which generally slope eastward with stable mass of mountains and hill ranges varying from 460 to 1220 meters in height. Prominent among them are the Aravalli, Vindhya, Satpura, Maikala and Ajanta. The region is drained by rivers like Mahanadi, Krishna, Godavari, Tapti and few others. The peninsula is flanked on one side by the Eastern Ghats where average elevation is about 610 m and on the other by the Western Ghats where it is generally from 900 to 1220 m, rising in places to over 2440 m. Between the Western Ghats and the Arabian Sea lies a narrow coastal strip, while between Eastern Ghats and the Bay of Bengal there is a narrow coastal plain with a unique climate and biota. The southern point of plateau is formed by the Nilgiri Hills where the Eastern and Western Ghats meet. The Cardamom hills lying beyond may be
regarded as a continuation of the Western Ghats.

D. The Desert Region:

This region can be divided into two parts namely the Great Desert and Little Desert.

a. The Great Desert: It extends from the edge of the Rann of Kutch beyond the Luni river northward. The whole of Rajasthan-Sind frontier runs through this.

b. The Little Desert: It spreads from the Luni river between Jaisalmer and Jodhpur up to the north-west.

Between the Great and Little Deserts lies a zone of absolutely sterile country, consisting of rocky land cut up by limestone ridges.

2.2 Geology:

Based on the geological timescale and the time of rock formations, the earth’s crust may be classified into six major groups, (a). Archaean or Azoic, (b). Precambrian or Pterozoic, (c). Primary or Palaeozoic, (d). Secondary or Mesozoic (e). Tertiary or Cenozoic and (f) Quaternary or recent. Of these, the Archaean group is the most ancient and the quaternary is the youngest. In India all these major groups and systems have been traced.

The archaen rocks are well developed in South India, Rajasthan, Madhya Pradesh, Singbhum-Gangpur area of Bihar and Orissa. These also occur along the whole length of Himalayan Mountains. Archaean rocks harbor major metal and mineral deposits in India.

In India the Precambrian rocks have given rise to two distinct formations known as the Cuddapah system in Andhra Pradesh and the Vindhyan system in Central India. The Cuddapah system is older than the Vindhyan system in age. These systems are devoid of forests and area having deposition of several mineral ores.

Palaeozoic rocks formed under marine environment contain distinct remains of
organisms as fossils and are developed in the extra-peninsula in Himalayan region. In the peninsula, the palaeozoic group is represented by Talchir and Damunda series in the east and Umaria and upper Vindhyan area in central India.

Mesozoic rocks generally lie above the rocks of palaeozoic age. In India, this group occurs in the extra-peninsular Himalayan range, in Kutch, Rajasthan and eastern coast of South India. These include Jurassic, Triassic and Cretaceous rocks.

In India, tertiary rocks are particularly well developed in the extra peninsula especially along the whole length of Himalayas. In the peninsula small patches of tertiary rocks occur in Rajasthan, Gujarat and along the eastern coast in West Bengal, Odisha and Tamil Nadu. These rocks are rich in fossils, coal, oil, limestone, and sand stones.

Quaternary rocks are the most recent one which have witnessed widespread glaciations. The Himalaya is marked by glacial tillites. Karewa deposit of Kashmir composed of sand, clay, loam, and breccian beds. Fossil assemblages of land plants and animals were reported from these deposits. This type of rock also prevails in the peninsular region starting from the deposition at Gangetic Plain to western, eastern and southern part of peninsula.

2.3 Soils:

In India, the soils can be classified into 8 categories.

a. Laterite Soil: These are generally reddish or yellowish-red due to high content of iron oxide. Occurs in past of Rajasthan, Madhya Pradesh, Bihar, West Bengal, Assam, Orissa, Tamil Nadu and in Eastern and Western Ghats.

b. Black Cotton Soils or Regur: Black soils are derived from lava-solidified rocks. These soils are rich in lime and iron, magnesium carbonate and alumina and its black colour is due to presence of superficial iron in the rocks. This soil type constitute about 16.6% of the total land area of the country and are mainly found in parts of Tamil Nadu and Karnataka, Andhra Pradesh, southern districts of Orissa, Maharashtra, Western Uttar
Pradesh, Western Madhya Pradesh and some parts of Rajasthan and Gujarat.

c. Red Soil: This is formed by the weathering of ancient crystalline and metamorphic rocks. The red colour of this soil is due to the presence of iron. These are mainly distributed in Karnataka, Andhra Pradesh, Maharashtra, Madhya Pradesh and Orissa.

d. Alluvial Soil: This is the most important soil type, which contributes the largest share to the agricultural wealth of the country and covers about 40% of land area of the country. It is formed by deposition of fine sediments and silts brought by the rivers. It is mainly distributed in parts of Rajasthan, Punjab, Uttar Pradesh, Uttarakhand, Bihar, Jharkhand, West Bengal, Orissa and Assam.

e. Alkaline and Saline Soils: These soils are rich in salts like sodium, magnesium and calcium which makes it unsuitable for agriculture. Such soils are found in parts of Uttar Pradesh, Punjab, Bihar, Orissa, Maharashtra, West Bengal, and Tamil Nadu.

f. Peaty and Marshy Soils: Peaty soils are characterized by excessive organic matters, accumulated in poorly decomposed conditions. They occur in low lying, submerged areas and are peculiarly coloured due to presence of free aluminium and ferrous compounds. These are distributed in the coastal areas of Orissa, Tamil Nadu, West Bengal and Kerala.

g. Desert Soils or Arid Soils: These are found in arid and semi-arid regions, which receive less than 50 cm annual rainfall. It contains high percentage alkali and poor in organic matter. It consists of aeoline sand (90-90%) and clay (5-10%) and occurs in the north-western Rajasthan and adjoining areas of Punjab and Haryana covers about 4.32% of land area of the country.

h. Scanty Soils of Hills and Mountains: These are the loose, immature soil developed on the surface of mountains. Soil particles are loosely aggregated in soft sandy beds. These are prone to soil erosion, less fertile and are mainly distributed in the mountain ranges especially in Himalayas and N.E Indian states.
2.4 River system and Lakes:

The water plays an important role in climatic condition as it controls the humidity and temperature of an area. The river systems of India can be divided into four groups:

a. Himalayan rivers:

These rivers are fed by the melting snow and glaciers and therefore, flow throughout the year. Due to heavy rains during rainy season, these rivers are frequently flooded entailing severe loss of lives, crops and property. The main Himalayan river systems are formed by the rivers Indus and the Ganga- Brahmaputra- Meghna. The river Indus, one of the great rivers of the world originates from Mansarovar and flows through India, enters Pakistan and finally falls in the Arabian sea. Sutlej, Beas, Ravi, Chenab and Jhelum are its main tributaries. The sacred river Ganga is formed by joining of Bhagirathi and Alaknanda at Dev Prayag. It traverses through Uttarakhand, Uttar Pradesh, Bihar and West Bengal states. Yamuna, Ramganga, Ghaghra. Gandak, Kosi and Mahanada are some of the important tributaries of Ganga. The mighty Brahmaputra originates in Tibet, where it is known as 'Tsangpo' and runs a long distance before entering into India in Arunachal Pradesh under the name Dihang and is joined by the rivers- Dibang and Lohit. It runs through Assam in a narrow valley and crosses into Bangladesh. Subansiri, Jia Bharali, Dhansiri, Puthimari, Pagladiya and Manas are its principal tributaries. The river Brahmaputra is joined by Tista in Bangladesh, etc. and finally falls into Ganga. The Barak river, the head stream of Meghna, rises in the hills of Manipur and is joined by several tributaries before entering into Bangladesh where it merges with Ganga-Brahmaputra.

b. Deccan rivers:

Most of the rivers of this system generally flow in east direction and fall into Bay of Bengal. The major east flowing rivers are Godavari, Krishna, Cauvery, Mahanadi, etc. Narmada and Tapti are major west flowing rivers. The Godavari in the southern Peninsula has the second largest river basin covering 10% of the area of India. Next to it is Krishna basin in the region, while Mahanadi has the third largest basin.
c. Coastal rivers:

There are numerous small coastal rivers of which only a small number drain into the sea near the delta of east coast whereas there are as many as 600 small rivers on the west coast.

d. Rivers of the inland drainage basin:

Few rivers in Rajasthan do not drain into sea. These desert rivers flow for some distance and are lost in the desert. These are Luni, Machhu, Rupen, Saraswati, Banas, Ghaggar, etc.

Lakes: Lakes are the depression on the land surface filled up with water. These may be formed due to fluvial erosion and deposition along river valleys or in hilly tracts due to landslides along or across the course of rivers. Deposition of sand away from the sea shore sometimes cuts off a portion of the sea to form saline lakes. The lakes Pulicat and Chilka along the eastern coast of India are examples of saline lakes. Some major lakes of India are Pangong Tso, Tao Morari (Ladakh); Dal lake, Wullar (Jammu and Kashmir); Harke, Kanjli (Punjab); Sambhar, Pichola, Pachpadra, Lunkaransar (Rajasthan); Nalsarovar (Gujarat); Renuka (Himachal Pradesh); Nainital, Bhimtal (Uttarakhand); Kabartal (Bihar); Bhoj (Madhya Pradesh); Lonar, Ujni (Maharashtra); Chilka (Orissa); Kolleru, Pulicat (Andhra Pradesh); Asthamudi, Sasthamkotta, Vembanad (Kerala); Chho Lhamo, Gurudongmarchho (Sikkim) and Loktak (Manipur) (Murthy et al. 1996).

2.5 Climate:

Climate plays an important role in economic and social development of a country. The climate of India is extremely varied and may be broadly described as tropical monsoon type and is often referred to as a “tropical country”, though half of it is in the tropics and half in the North Temperate Zone. Due to its varying latitude, longitude, and physiography, this region may be divided into six zones- northern mountains, northern plains, Deccan plateau, west coast region, southeast coastland and extreme northeast. There are four distinct seasons: 1. Winter (January-February), 2. Summer (March-May), 3. Rainy season- a) south-western monsoon (June-September) and b) The post-monsoon,
also known as north-east monsoon in the southern Peninsula (October-December).

A. Temperature:

Temperature is the most important factor of climate. In India the temperature is influenced by the factors such as latitude, altitude, humidity, winds, etc. The mainland of India, situated between 8°–37° north latitudes receives maximum amount of solar radiation during May-June and minimum during December-January. The mean annual temperature exceeds 24°C over the whole country, except hilly areas and extreme northwest. The difference between maximum and minimum temperature over the country as a whole is about 10°C in January and July but 20°C in April and October. On the basis of temperature, India may be divided into:

a. Tropical zone Mean annual temperature over 24°C.

b. Subtropical zone Mean annual temperature over 17 - 24°C.

c. Temperate zone Mean annual temperature over 7 - 17°C.

 d. Alpine zone Mean annual temperature under 7°C

B. Rainfall:

The rainfall in India is seasonal and unevenly distributed which is mostly controlled by the south-west monsoon and the north-east monsoon. The rainy season varies in duration with a general increase from the north-west to east and South of India. Thus, upper Assam experiences the short dry period in contrast to the long dry period of northwest. Foot hills of Western Ghats, Bengal and Assam get the maximum rainfall over 200 cm annually, whereas places like Maharashtra, Madhya Pradesh and Bihar along the Vindhyan mountain receive 100–200 cm annual rainfall. South coastal plains, north-western, Deccan and upper Gangetic plains have 50–100 cm rainfall. The Rajasthan desert extending to Kutch, the high Ladakh plateau (Jammu and Kashmir) constituting the arid zone receive only a nominal rainfall of 15 cm annually.

Thus, about 30% area of the country receive 15–80 cm, 40% gets 80–120 cm, 20% get
120–200 cm and only 10% area receive over 200 cm of annual rainfall.

C. Humidity:

Humidity is the amount of water vapors present in the atmosphere and depends upon the temperature of a particular area. In India, Assam and some part of Western Ghats are extremely damp whereas Rajasthan, Lahul and Spiti (Himachal Pradesh) and Ladakh area (J and K) are dry, falling under the arid zone. The humidity along with temperature and rainfall largely determines the climate and vegetation type of a particular region.

2.6 Phytogeographic regions:

A phytogeographical region can be defined as an area of uniform climatic conditions and each of which has its uniqueness in eco-system, vegetation and floristic composition. The vast expanse of India's geographic area with its extra-ordinary diversity of climate, soil and topography has given rise to almost all types of eco-systems found in the world. Chowdhery and Murti (2000) has recognized 11 phytogeographical regions for India. These phytogeographical regions are 1. Western Himalaya 2. Eastern Himalaya 3. Gangetic Plains 4. North-east India 5. Semi arid and arid regions 6. Deccan plateau 7. Western Ghats 8. Eastern Ghats 9. Andaman and Nicobar Islands 10. Lakshadweep and 11. Coastal regions.

2.7 Forest types:

Forests are the biologically rich and diverse terrestrial systems maintaining the ecological balance and play an important role in social, cultural, economic and industrial development of a country. Realizing this crucial role of forests, the National Forest Policy, 1988 aims at maintaining a minimum of 33% of country’s geographical area under forest and tree cover. Currently, the total forest cover of India is 692,027 km² which forms 21.05% of the geographical area of the country (Bahuguna et al., 2012). The state of Madhya Pradesh has the largest forest cover (77,700 km²) in the country followed by Arunachal Pradesh (67,410 km²), Chhattisgarh (55,674 km²) and Maharashtra (50,646 km²). In terms of the percentage of forest cover in relation to geographical area, Mizoram ranks first having 90.68% followed by Lakshadweep with 84.56% (Bahuguna et al.,
A number of global forest classification systems have been proposed. Champion and Seth (1968), on the basis of climatic and edaphic factors divided Indian forests into six broad groups viz., Moist tropical forests, Dry tropical forests, Montane subtropical forests, Montane temperate forests, Sub-alpine forest and Alpine scrub ranging from tropical to alpine, which are further divided into 16 climatic forest types and subdivided again into 221 minor forest types. Recently Indian Council of Forestry Research and Education (ICFRE), Dehradun (2013) modified the Champion and Seth’s classification and divided Indian forests into the following 10 major and 44 subtypes. (Map: 2)

1. **Tropical Wet Evergreen Forest:**
   - a) Andaman Tropical Evergreen Forest
   - b) West Coast Tropical Evergreen Forest
   - c) Assam Tropical Valley Evergreen Forest
   - d) Cachar Tropical Evergreen Forest

2. **Tropical Semi-Evergreen Forest:**
   - a) Andaman Semi-Evergreen Forest
   - b) West Coast Semi-Evergreen Forest
   - c) Assam Valley Semi-Evergreen Forest
   - d) Cacher Semi-Evergreen Forest
   - e) Moist Bamboo Forest

3. **Tropical Moist Deciduous Forest:**
   - a) Moist Teak Forest
   - b) Mixed Deciduous Forest
c) Moist Sal Forest

d) Moist Peninsular Sal Forest

e) Odisha Moist Deciduous Forest

4. Littoral and Swamp Forest:

a) Littoral Forest

b) Tidal Mangroves Forest

c) Tidal Heriteira Forest

d) Tropical Fresh Water Myristica Swamp

e) Tropical Fresh Water Seasonal Swamp

5. Tropical Dry Deciduous Forest:

a) Dry Teak Bearing Forest

b) Red Sander Forest

c) Dry Mix Deciduous Forest

d) Dry Sal Bearing Forest

e) Dry Grassland

6. Dry Tropical Thorn and Scrub:

a) Dry Thorn Forest

b) Desert Thorn and Ravine Forest

c) Dry Scrubs

d) Dry Evergreen Forest
7. **Southern Montane Broad Leaved Forest:**
   a) Southern Montane Broadleaved Forest
   b) Southern Montane Broadleaved Wet Forest

8. **Northern Sub-Tropical Broadleaved and Coniferous Forest:**
   a) East Himalayan Sub-Tropical Broadleaved Hill Forest
   b) Khasi Wet Hill Forest
   c) Assams Sub-Tropical Pine Forest
   d) Himalayan Sub-Tropical Pine Forest

9. **Himalayan Temperate Forest:**
   a) East Himalayan Broadleaved Temperate Forest
   b) East Himalayan Mixed Temperate Coniferous Forest
   c) West Himalayan Broadleaved Temperate Forest
   d) West Himalayan Deodar Forest
   e) West Himalayan Mixed Coniferous Forest
   f) West Himalayan Dry Temperate Coniferous Forest
   g) East Himalayan Dry Temperate Coniferous Forest

10. **Alpine Forest:**
    a) Trans Himalayan alpine forest
    b) West Himalayan alpine pasture
    c) Himalayan Rhododendron Forest
2.8 Floristic Diversity:

The Indian region is one of the most diverse biogeographic regions of the world. Its wide range of topography, climate, altitude and ecological habitats make it one of the 17 mega-diversity countries and 17th centre of origin of plant diversity in the World. With only 2.4% of the global land area, India possess more than 11.4% of the world's plant species described so far. About 28% of the Indian plants are endemic to the country (Plant Discoveries, 2013). Conservational International identifies 34 hotspots in world, out of which India has 4 namely Himalaya, Western Ghats and Sri Lanka, Indo-Burma, and the Sundaland (Bahuguna et al., 2012), represents a wide range of diversity in ecosystem and high degree of endemism in India. In terms of species diversity, 47,513 plant species occur in India, out of these angiosperms comprise about 18,043 species, (Plant Discoveries, 2013) which represent more than 6% of the world’s known flowering plants. These species represents more than 4000 genera occurring in different ecosystems from the humid tropics of Western Ghats to the Alpine zones of the Himalayas and from Mangroves of tidal Sundarbans to the dry deserts of Rajasthan. The Indian flora represents species and allies occurring in different countries like Pakistan, Afghanistan, Nepal, Bhutan, Tibet, China, Myanmar, Bangladesh, Thailand, Malaysia, Indonesia, Indo-China and even the representatives from European, African, American and Australian countries. Orchidaceae is one of the dominant families and the second largest among all family of flowering plants known from India. In India the family Orchidaceae is represented by 186 genera with about 1379 species, 5 subspecies, 29 varieties and 2 formae (Misra, 2007; Verma and Lavania, 2014) distributed in almost all the phytogeographic regions. However, Eastern Himalayas, N.E. India, Western Himalaya, Western Ghats and Andaman and Nicobar Islands harbor maximum diversity of Orchids in India.