

## GEOGRAPHY OF INDIA

The word geography was coined by Eratosthenes, a Greek philosopher and mathematician, in 3rd century B.C. For his contribution in the discipline, he is regarded as the father of Geography.

**Location:** India as a country, a part of earth's surface, is located in the Northern-Eastern Hemispheres between  $8^{\circ} 4' \text{ N}$  and  $37^{\circ} 6' \text{ N}$  latitudes and  $68^{\circ} 7' \text{ E}$  and  $97^{\circ} 25' \text{ E}$  longitudes. If the islands are taken into consideration, the southern extent goes up to  $6^{\circ} 45' \text{ N}$ .

- In India, Tropic of Cancer ( $23^{\circ} 30' \text{ N}$  latitude) passes through eight states namely (from west to east) Gujarat, Rajasthan, MP, Chhattisgarh, Jharkhand, West Bengal, Tripura and Mizoram.
- **Time:** the  $82^{\circ} 30' \text{ E}$  longitude is taken as the Indian Standard Time meridian as it passes through middle (Allahabad) of the country. It is equal to 5 hours and 30 minutes ahead of GMT. Same longitude is used by Nepal and Sri Lanka.

**Size and Shape:** India is the 7<sup>th</sup> largest country in the world with an area of 3287263 sq. km (32.87 lakh sq. km=3.287 million sq. km), after Russia, Canada, China, USA, Brazil and Australia. It constitutes 0.64% of the total geographical area of the world and 2.4% of the total land surface area of the world.

- The area of India is 20 times that of Britain and almost equal to the area of Europe excluding Russia.
- Rajasthan (342000 sq. km) is the largest state of India while as Goa (3700 sq. km) is the smallest.
- Among the Union territories, Andaman and Nicobar Islands (8000 sq. km) and Lakshadweep (3 sq km) claim the largest and smallest area.
- India is 2<sup>nd</sup> largest populous (1.21 billion, 2011 census) after China. It constitutes 17.44 % of the world population.
- India has almost quadrangular shape. It measures 3214 km from north to south and 2933 km from west to east.
- The western, northern, eastern and southern most points are called as Gaur Mota (in Kachchh Gujarat), Indira col (in POK Kashmir), Kibithu (in Arunachal) and Indira Point or Pygmalion Point (in Great Nicobar Islands). The southernmost tip of mainland is Kanyakumari in Tamil Nadu.

**Frontiers:** India's total land frontier is 15200 km. It shares international border with seven countries namely, Pakistan, Afghanistan (80 km=shortest one), China, Nepal, Bhutan, Myanmar and Bangladesh (4096 km= longest one).

- India-Afghanistan and Pakistan-Afghanistan border is called as Durand line. India-Pakistan border is referred as Radcliffe line and India-China border (eastern section=1140 km) as McMahon Line.
  - Practically, the border between India and Pakistan is called as Line of Control (LOC) and that China-India as Line of Actual Control (LAC).
  - India's total maritime boundary is 7516.6 km. Excluding islands, the coastline is 6100 km only. The names of coastal states are Gujarat, Maharashtra, Goa, Karnataka, Kerala, and Tamil Nadu (in west) and Andhra Pradesh, Orissa and West Bengal (in east).
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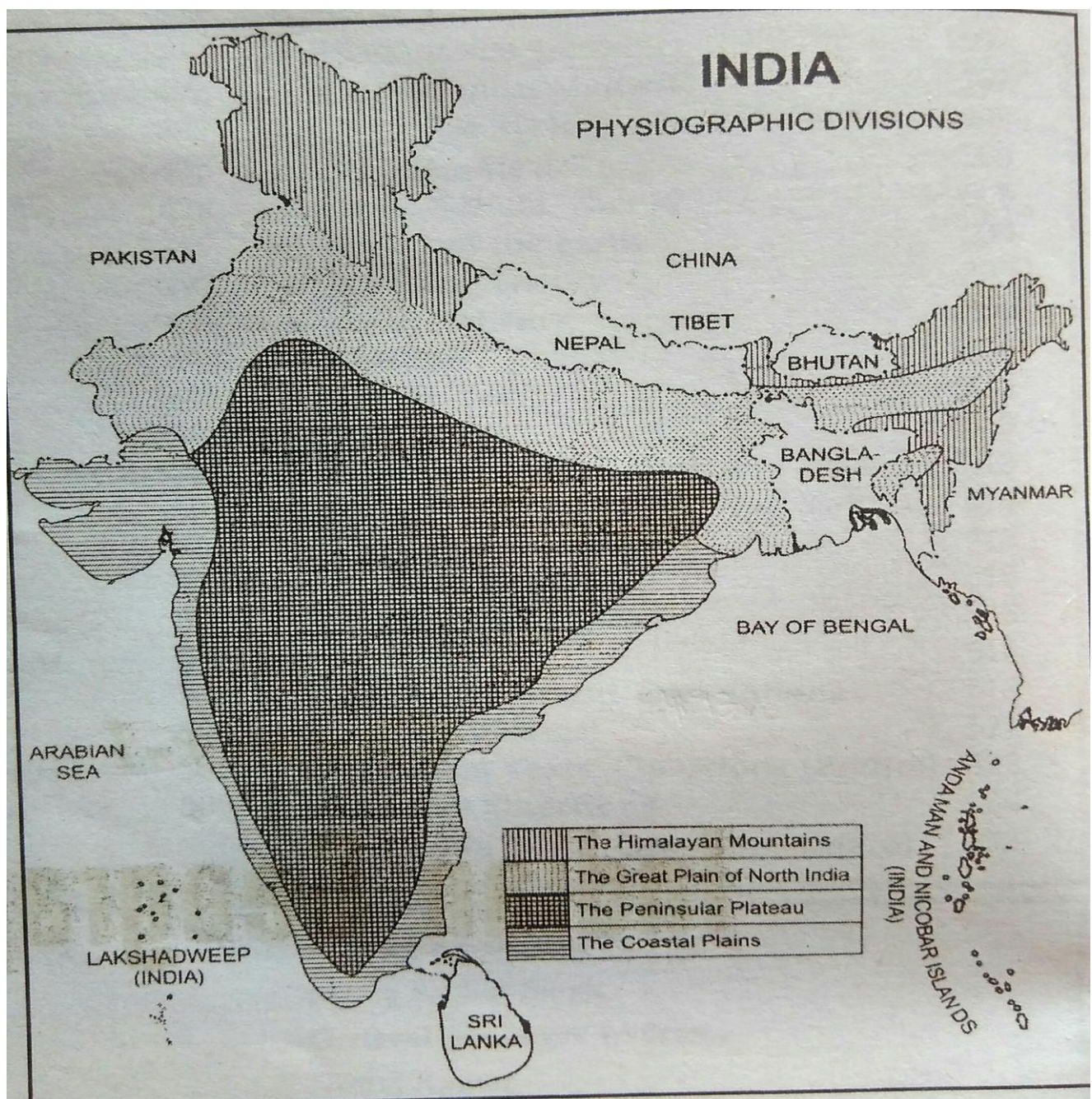
### Physiography of India

In layman's language, the physical features like mountains, plains, plateaus, valleys, etc constitute the physiography.

- The physical features are formed due to the action and/or interaction of endogenetic (inside the earth) such as volcanism, diastrophism, etc. and exogenetic (outside the earth i.e., in atmosphere) such as erosion, mass movement, deposition, etc. processes.
- In India, out of the total area, 10.6% is occupied by mountains, 18.5% by hills, 27.7% by plateaus and 43.2% by plains.

➤ India is divided into five broad physiographic regions:

- 1) The Northern Mountains, 2) The Great Northern Plains, 3) The Peninsular Uplands/Plateaus, 4) The Coastal Plains and 5) The Islands.



**1) The Northern Mountains:** These Mountains were formed due to the folding (convergence of two continental plates-Eurasian Plate and Indo-Australian Plate).

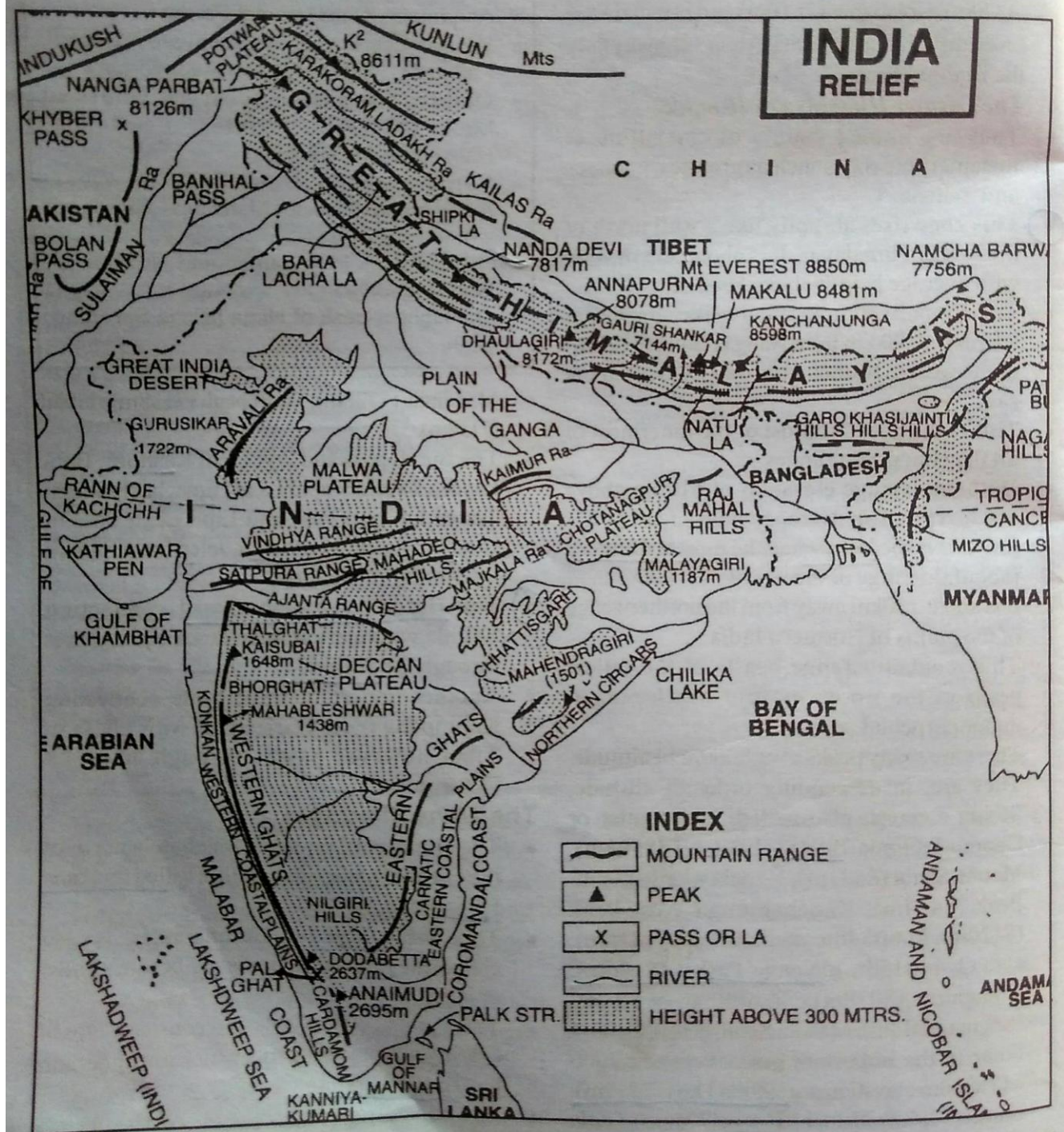
- They are young mountains mainly composed of sedimentary rocks of marine origin. Girdling the country on its north and north-eastern sides, they are spread mainly in the states of Jammu and Kashmir, Himachal, Uttarakhand, Sikkim, Arunachal Pradesh, Nagaland, Manipur, and Mizoram.
- Their width varies from 500 km in Kashmir to 240 km in Arunachal Pradesh.
- In the NW, they are connected with Pamir Knot (a centre and meeting place of many great mountain ranges) that is called the Roof of the World.
- These mountains are divided into three mountain ranges:

***A) Himalayan mountains, B) Trans Himalayas and C) Purvanchal/Eastern Hills***

- **A) Himalayan mountains:** Literally, Himalaya means abode of snow. These are youngest fold mountains of the world. Their total length is 2500 km covering an area of 5 lakh sq. km with width varying from 240-320 km.
  - They were formed in three successive stages from 70 million years to 10 million years before present and that is why we have three Himalayan ranges as:
    - a) **Siwalik (Outer or Sub-Himalaya):** It is the southernmost and youngest (10 mya) mountain range of Himalayas that touches the Northern Plains. It extends from Indus gorge to Brahmaputra Valley for a length of 2400 km. Its width varies from 8-45 km and average height is <1300 m amsl.
    - It is formed of loose sedimentary rocks and is known by Jammu hills in J & K, Dundwa range in Uttarakhand and Churia Muria in Nepal.
    - It is characterized with tectonic valleys called as duns or dhars such as Dehra, Kotah, etc.
    - Tista and Raidak rivers have jointly formed a gap of 80-90 km in Siwalik range through erosion.
    - b) **Lesser or Middle Himalaya or Himachal:** This range lies to the north of Siwalik range and is 80 km wide and its average height is 1300-5000 m. It consists of unfossiliferous sediments or metamorphosed rocks.
    - It consists of following ranges (from west to east):
      - Pir Panjal range (J & K)----longest range in Middle Himalaya
      - Dhauladhar range (Himachal)
      - Mussoorie (Uttarakhand)
      - Nagtiba and Mahabharat ranges (Nepal)
  - Famous hill resorts on this range are Shimla, Mussoorie, Ranikhet, Nainital, Darjeeling, etc.
  - Along the slopes are found a number of pastures called mergs in J & K (such as Gulmarg, Yusmarg,) and Bugyal and Payar in Uttarakhand.
  - Famous Banihal Pass (2835 m) and Pir Panjal Pass (3480m) are located on it.
  - Kashmir Valley (135 km long in NW-SE direction and 40 km wide in middle) is located between Pir Panjal range (Middle Himalaya) and Greater Himalaya (or we say Great Kashmir Himlaya).
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- **c) Greater or Inner Himalayas or Himadri:** This mountain range located to the north of Middle Himalaya is tallest/highest one in the world and rises like a wall. Its average altitude is 6100 m and is 25km wide.
  - It runs in an arc like shape from Nanga Parbat (8126 m) in POK Kashmir in west to Namcha Barwa (7756 m) in Arunachal Pradesh in east.
  - It is loftiest and most continuous mountain range of the world. It has world's highest mountain peak called as Mount Everest (8848m) in Nepal. This peak is also known as Peak XV, Sagarmatha (in Nepal) or Chomolangma (in China). Lhotse I (8501m), Mount Akalu (8481 m), Kanchunjunga South Peak (8474 m), etc. are its other important peaks.
  - Zojila (connecting Kashmir with Ladakh), Shipki La (connecting Shimla with Gartok, Tibet) and Jelep La (connecting Kalimpong, Sikkim with Lhasa, Tibet).
  - **B) Trans Himalayas:** These are located to the north of Greater Himalayas. These are also known as Tibetan Himalayas because most part lies in Tibet. Their total length is 1000 km.
  - They include Zaskar, Ladakh, Kalaish and Karakoram ranges.
  - Karakoram is most important one. It has world's second highest peak called as K<sub>2</sub> (8611 m), or Qogir or Godwin Austen. Its length is 800 km. It houses the largest glaciers of the world after Polar ice caps such as Siachen (75 km), Biafo, Boltoro, Hispar, etc.
  - Ladakh Plateau (5000 m) is located in Trans Himalayas.
  - **C) Purvanchal or the Eastern Hills:** After crossing the Dihang gorge in Arunachal Pradesh, the Himalayas take a sudden southward turn and form a series of low hills in the shape of a crescent with its convex side towards west. They are called Purvanchal because they are located in eastern part and form India's boundary with Myanmar.
  - They are known by local names such as Patkai Bum (Arunachal Pradesh), Naga Hills, Manipur hills, Mizo hills, etc. Saramati (3826 m) in Naga Hills is highest peak in Purvanchal.
  - Blue Mountain is found in Mizo Hills.
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**2) The Great Northern Plains:** This physiographic region covers an area of 7.8 lakh sq. km. It is an aggradational plain formed by alluvial deposits of Indus, Ganga and Brahmaputra river systems.

- It lies between the Northern Mountains in the north, the Peninsular Uplands in the South, the Ravi and Sutluj in the west and Ganga Delta in the East. Its total length is 2400 km and depth is 1300-1400 m.
- Its width varies from 500 km in Punjab-Rajasthan Plains to 90-100 km in Assam Valley.
- **Divisions:** On the basis of characteristics of alluvium, surface gradient, drainage, etc., the Great Northern Plains are divided into following:

- **Bhabar:** It lies along the foot of Siwaliks. It has 8-16 km width. It consists of gravel and unassorted sediments deposited by rivers. Because of high porosity, the streams disappear. It is not suitable for agriculture.
- **Terai:** South of Bhabar lies a 15-30 km wide marshy tract called Terai where streams reappear. It is a zone of excessive dampness, thick forests, rich wildlife and malarial climate.
- It is relatively suitable for agriculture.
- **Bangar:** It represents older alluvium and lies above flood-limit of plains. It consists of clay, sand and calcareous matter called kankar.
- **Khadar/Bet:** It is the younger or newer alluvial plain characterized with light color and deficiency of calcareous matter.
- **Delta:** It is simply extension of Khadar into water.

➤ **Regional Divisions:** Regionally, Great plains are divided into four sub-plains as follows:

1. **Rajasthan Plains/Indian Desert:** It includes Marushtali (dead land=true desert=arid area) and Rajasthan Bagar areas (Steppe lands=semi arid) to the west of Aravallis. It is a sandy plain. Luni is only flowing river in this area. It slopes from east to west towards Indus basin.
2. **Punjab-Haryana Plain:** It extends from Punjab (Punjab means an area of five waters or rivers i.e., Jehlum, Chenab, Ravi, Sutluj and Beas) to Yamuna. This plain is drained by Sutluj, Beas and Ravi rivers. It is famous for doabs like Bist doab (between Beas and Sutluj) and Bari doab (between Beas and Ravi). It slopes towards west (Indus) and south (Rann of Kachch).
3. **Ganga Plain:** It is the largest part of Indian plain. It extends from Yamuna to Bangladesh for the length of 1400 km covering the states of UP, Bihar and West Bengal. It is drained by Ganga and its tributaries. It slopes gently towards Bay of Bengal. Its altitude varies from 271 m in Saharanpur to 3 m in Sagar Islands.
4. **Brahmaputra Plain/Assam Valley:** It is drained and formed by Brahmaputra and its tributaries. It is known for largest river island of the world named as Majuli (352 sq. km).

**3) The Peninsular Uplands/Plateaus:** It is the largest physiographic division of India. It covers an area of 16 lakh (nearly half of the total area of country) sq. km. It is composed of old crystalline, igneous and metamorphic rocks. It is the mineral storehouse of India. Delhi ridge in the northwest (extension of Aravalis), the Rajmahal hills in the east, Gir range in the west and the Cardamom hills in the south constitute the outer extent of the Peninsular plateau.

- Narmada River which flows through a rift valley/fault divides the region into two unequal parts: the northern smaller part called as central highlands and southern larger part as Deccan Plateau. The north-eastern part called Shillong/Meghalaya Plateau is separated from main plateau by a fault called Malda Gap/Fault. It comprises of Garo, Khasi and Jaintia hills.
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- **Central Highlands:** They refer to a group of oldest relict mountains with altitude varying from 600-900 m. They include Aravalli, Vindhya, and other hills. Aravallis cover them from west in NE to SW direction for a distance of 800 km from Delhi to Palanpur representing the relict of one of the world's oldest fold mountains. Gurushikhar (1722m) is highest peak in Aravallis. Malwa plateau and Bundelkhand plateau fall in this region. The slope is towards north and west.
- **Deccan Plateau:** This is the largest unit of Peninsular plateau covering an area of 5 lakh sq. km. It is formed of volcanic/lava material during Cretaceous (60 million ya) period and is bounded by Satpuras in north, Western Ghats in west and Eastern Ghats in east. It is triangular in shape and slopes towards east with average altitude of 600 m. It comprises of Maharashtra plateau, Karnataka plateau, Telangana plateau and Rayalseema plateau. It is covered by black soil which is famous for cotton cultivation. It is drained by four river systems of Mahanadi, Godavari, Krishna and Cauvery.
- **Chhotanagpur Plateau** is famous for Gondwana coal and other mineral deposits. It is drained by Damodar, and other rivers.
- **Chhattisgarh Plain** is the only plain in the whole Peninsular uplands. It is a saucer shaped depression drained by Mahanadi River. The area is characterized by red and yellow soils.
- **Western Ghats**, locally known as Sahyadri in Maharashtra, Nilgiri hills in Karnataka and Tamil Nadu and Anaimalai hills and Cardamom hills in Kerala, are continuous escarpments that run parallel to western coast of India for about 1600 km in north-south direction from the mouth of Tapi river (Gujarat) to Cape Camorin (Kanyakumari, Tamil Nadu). They form the real watershed of the Peninsula. They are Block Mountains formed due to down warping of part of land into the Arabian Sea. Anai Mudi (2695 m) is the highest peak in Sahyadris and whole of South India. In the Nilgiri hills, Western Ghats join the Eastern Ghats. Doda Beta (2637 m) is the highest peak in Nilgiris.
- **Eastern Ghats** are the discontinuous hills starting from Mahanadi in Orissa to Vagai in Tamil Nadu having heterogeneous character and heavily eroded by rivers of Mahanadi, Godavari, Krishna and Cauvery. Some of the important hills include Javadi hills, Velikonda hills, Nallamalai hills and Mahendragiri hills. Mahendra Giri (1501 m) is the highest peak in Eastern Ghats.

**4) The Coastal Plains:** On the basis of location and geomorphological processes, coastal plains are broadly divided into:

- **1) Western Coastal Plains:** These are located between Arabian Sea in the west and Western Ghats in the east and extend from Rann of Kachch up to Cape Camorin for 1840 km. They are narrow plains with only exception of Gujarat plains.
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- Extending from the Gujarat coast in the north to the Kerala coast in the south, the western coast may be divided into following divisions – the Kachchh and Kathiawar coast in Gujarat, Konkan coast in Maharashtra, Goan coast or Kanara coast in Karnataka, and Malabar/Kerala coast in Kerala. Gujarat (1215 km) has longest coastline among states.
  - The western coastal plains are narrow in the middle and get broader towards north and south.
  - The rivers flowing through this coastal plain do not form any delta. The Malabar Coast is characterized with '*Kayals*' (backwaters).
  - The western coastal plains are an example of submerged coastal plain. It is believed that the city of Dwaraka which was once a part of the Indian mainland situated along the west coast is submerged under water.
- **2) Eastern Coastal Plains:** These are located between Bay of Bengal in the east and Eastern Ghats in the west and extend from Ganga Delta up to Cape Camorin for 1800 km.
- Compared to the western coastal plain, the eastern coastal plain is broader and wider and is an example of an emergent coast. Because of its emergent nature, it has less number of ports and harbours. They are formed of recent alluvium.
  - There are well developed deltas of the Mahanadi, the Godavari, the Krishna and the Kaveri.
  - They include the Utkal plains, Andhra plains and Tamil Nadu plains.
  - These are famous for beaches such as Marina in Chennai and Chilka Lake (biggest in India) in Orissa.
- **5) The Islands:** India has a total of 247 islands. There are two major island groups in India –one in the Bay of Bengal called as Andaman and Nicobar Islands and the other in the Arabian Sea called as Lakshadweep Islands. Saddle peak (732 m) located on Andaman islands is highest peak.
- **1) Andaman and Nicobar Islands:** It comprises of two Island groups: Andaman group and Nicobar group separated by 10<sup>0</sup> Channel. Duncan Passage separates Little Andaman from Great Andaman. They have greater coastline (1962 km) than Gujarat state.
- The Middle Andaman is largest island in the group.
  - Most of the islands are continuation of Arakan Yoma Mountains.
  - The volcanic islands include the Barren Island and Narcondam.
- **2) Lakshadweep Islands:** These are tiny coral islands and separated from Maldives by 8<sup>0</sup> Channel. The northern, central and southern islands groups within this island group are called as Amindivi, Laccadive and Minicoy (smallest as well) islands.

### **Drainage/River Systems of India**

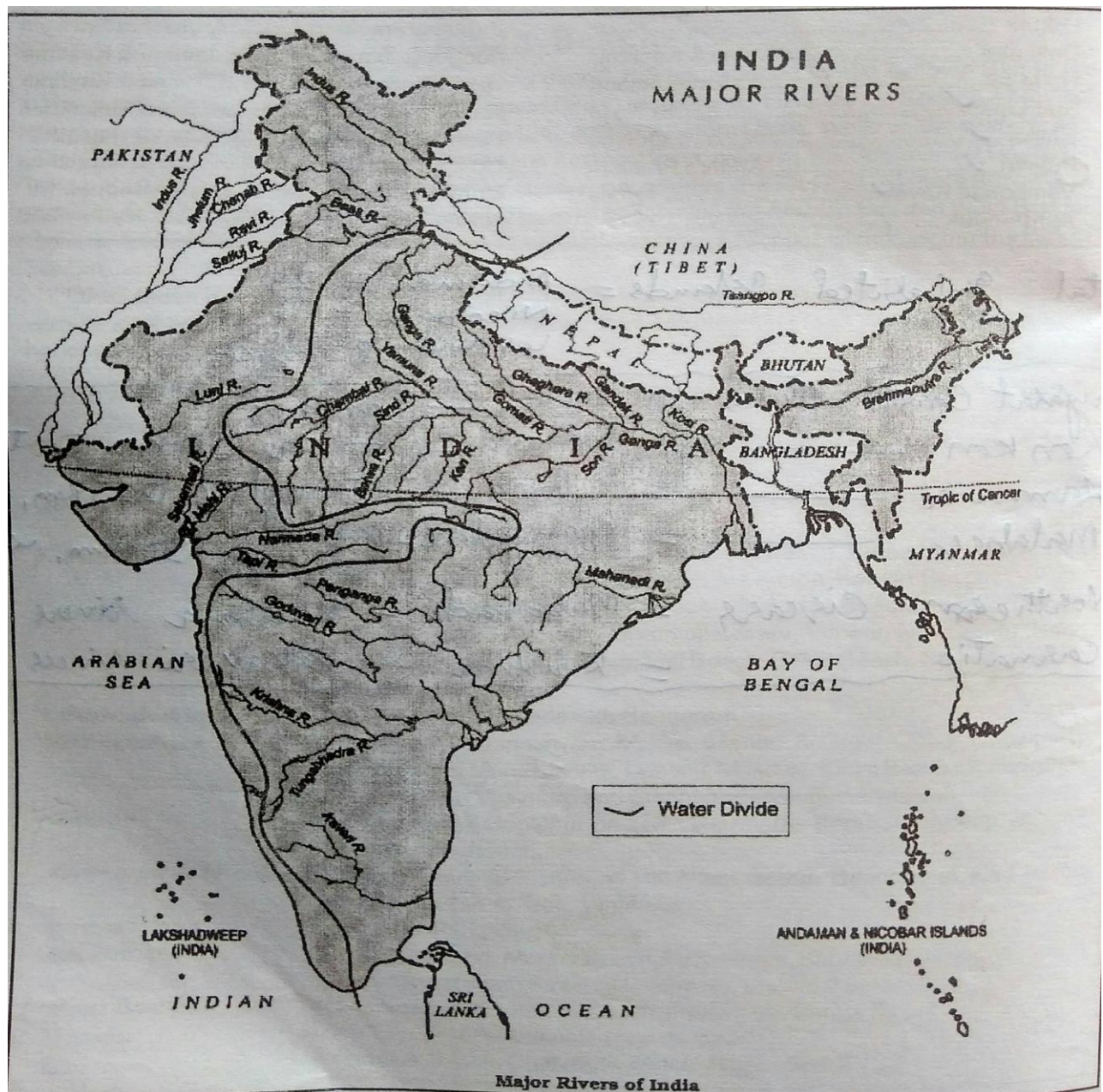
The annual yield of water in the rivers of the country is 1.858 trillion cubic metres. Among the rivers the greatest contribution from Brahmaputra (33.8%) followed by Ganga (25.2%), Godavari (6.4%), and etc. more than 90% river water reaches into Bay of Bengal and rest into Arabian Sea or becomes inland

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drainage. The area that contributes water to a river is its basin. There are three types of river basins in India:

- Major river basins ( $\geq 20,000$  sq. km) account for 58% of total run-off.
  - Medium river basins (2,000-20,000 sq. km) account for 7% of total run-off.
  - Minor river basins ( $< 2,000$  sq. km) account for 8% of the total run-off of the country.
- On the basis of origin, the rivers of India are divided into: Himalayan Rivers and Peninsular Rivers.
- **Himalayan rivers** are antecedent (i.e., originated before formation of Himalayas) and form deep gorges and valleys. They have large basins and are youthful in nature. They are fed by glaciers and so are perennial. There are three famous river systems: Indus, Ganga and Brahmaputra.
  - **Peninsular rivers** are consequent and form shallow valleys. They have small basins and are in maturity stage. They are fed by rain and so are seasonal and non-perennial. There are six famous river systems: Narmada, Tapi, Mahanadi, Godavari, Krishna and Kaveri (Cauvery).



❖ **Himalayan River Systems**

❖ **Indus River System:** It is one of the largest river basins of the world, covering an area of 11, 65,000 sq. km (in India it is 321, 289 sq. km and a total length of 2,880 km (in India 1,114 km).

The Indus also known as the Sindhu, is the westernmost of the Himalayan rivers in India

- It originates from a glacier near Bokhar Chu in the Tibetan region at an altitude of 4,164 m in the Kailash Mountain range. In Tibet, it is known as '*Singi Khamban*'; or Lion's mouth.
- After flowing in the northwest direction between the Ladakh and Zaskar ranges, it passes through Ladakh and Baltistan. The Indus receives a number of Himalayan tributaries such as the Shyok, the Gilgit, the Zaskar, the Hunza, the Nubra, the Shigar, the Gasting and the Dras. It finally emerges out of the hills near Attock where it receives the Kabul River on its right bank.
- The river flows southward and receives 'Panjnad' a little above Mithankot. The Panjnad is the name given to the five rivers of Punjab, namely the Satluj, the Beas, the Ravi, the Chenab and the Jhelum. It finally discharges into the Arabian Sea, east of Karachi. The Indus flows in India only through the Leh district in Jammu and Kashmir.
- **Jhelum** rises from a spring at Verinag situated at the foot of the Pir Panjal in Anantnag.
- The **Chenab** is the largest tributary of the Indus. It is formed by two streams, the Chandra and the Bhaga. Hence, it is also known as Chandrabhaga.
- The **Ravi** rises west of the Rohtang pass in the Kullu hills of Himachal Pradesh.
- The **Beas** originates from the Beas Kund near the Rohtang Pass. It enters the Punjab plains where it meets the Satluj near Harike.
- The **Satluj** originates in the Rakas lake near Mansarovar at an altitude of 4,555 m in Tibet where it is known as Langchen Khambab. It passes through the Shipki La on the Himalayan ranges and enters the Punjab plains. It feeds the canal system of the Bhakra Nangal project.

❖ **Ganga River System:** The Ganga is the most important river of India both from the point of view of its basin and cultural significance. Its total basin is 8, 61, 404 sq. km (26.3% of total area of country) and its length is 2525 km in India. It rises in the Gangotri glacier near Gaumukh (3900 m) in the Uttarakhand. Here, it is known as Bhagirathi.

- At Dev Prayag, Bhagirathi meets Alaknanda, hereafter, it is known as Ganga. Pindar joins at Karna Prayag and Mandakini or Kali Ganga at Rudra Prayag. Ganga debouches into plains at Haridwar.
  - The left tributaries of Ganga are Ramganga, Gomti, Kali, Gandak, Kosi, and Mahanadi.
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- Its right bank tributaries are Yamuna, Chambal, Damodar and Son. Yamuna joins Ganga at Allahabad. Beyond Farakka, it is known as Padma in Bangladesh.
  - It bifurcates and is known as Bhagirathi-Hooghly in West Bengal and Padma-Meghna in Bangladesh. Finally, it meets Brahmaputra and forms world's largest delta called as Sunderbans or Ganga-Brahmaputra delta (58,752 sq. km).
  - Kosi is called as Sorrow of Bihar and Damodar as Sorrow of Bengal as these rivers cause floods in the states.
  - **Yamuna** is the largest tributary of Ganga. It rises from Yamnotri glacier in Uttarakhand.
  - **Chambal** is famous for badland topography caused by excessive erosion.
- ❖ **Brahmaputra River System:** The Brahmaputra (Son of Brahma) rises in the Chemayundung glacier in the Kalaish range in Tibet and moves in eastward direction up to Arunachal Pradesh. At Namcha Barwa, it takes southward and south-westward turn and enters India west of Sadiya town. Here, it receives the waters of Dibang and Lohit and is named as Brahmaputra. In Tibet, it is called as Tsangpo (Purifier). Tista is its captured tributary.
- It looks like 'Delta in reverse' where it meets Dibang and Lohit.
  - Its total length is 2900 km and is one of the longest rivers of the World.
  - Near Gwalpara, it enters Bangladesh as Jamuna and meets Padma at Goalundo.
  - In Assam, it has a braided channel and gives birth to river islands. Majuli (352 sq. km) is the largest river island of the world.
  - It is a navigable river with boats sailing at an altitude of 4000 m. National Waterway-2 is on the Brahmaputra River from Sadiya to Dhubri.
  - It is largest river of India in terms of volume of water and Ganga is longest.
- ❖ **Peninsular River Systems:** There are three directions of these rivers. Narmada, Tapi, and Mahi flow westward and debouch into the Arabian Sea. The Mahanadi, Godavari, Krishna and Kaveri flow eastward and drain into the Bay of Bengal. Some rivers originating in the north of the Peninsula such as Chambal, Son, Betwa, Damodar etc. join Ganga and flow into Bay of Bengal.
- ❖ **Mahanadi:** The Mahanadi rises near Sihawa in Raipur district of Chhattisgarh and runs through Orissa to discharge its water into the Bay of Bengal. It is 858 km long and its catchment area spreads over 1.42 lakh sq. km. It mainly drains Chhattisgarh and Orissa/Odisha.
- Hirakud Dam is built on this river.
- ❖ **Godavari:** It is the largest river system of Peninsular India and is called as Dakshina Ganga or Vridha Ganga. It rises in Trimbak plateau in the Nasik district of Maharashtra and discharges its water into the Bay of Bengal. It is 1,465 km long with a catchment area of 3.13 lakh sq. km.
- The Penganga, the Indravati, the Pranhita, and the Manjra are its principal tributaries.
  - Drains the states of Maharashtra, Madhya Pradesh, Chhattisgarh, Orissa and Andhra Pradesh.
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- It forms a large delta of lobate shape.
- ❖ **Krishna:** It is the second largest east flowing Peninsular River which rises near Mahabaleshwar in Sahyadri. Its total length is 1,401 km. The Koyna, the Tungbhadra and the Bhima are its major tributaries. It drains the states of Maharashtra, Karnataka and Andhra Pradesh.
  - Koyna dam is made on Koyna River, its tributary. It forms delta of arcuate shape.
- ❖ **Kaveri:** It rises in Brahmagiri hills of Kogadu district in Karnataka. Its length is 800 km and it drains an area of 81,155 sq. km in Tamil Nadu, Karnataka and Kerala. Since the upper catchment area receives rainfall during the southwest monsoon season (summer) and the lower part during the northeast monsoon season (winter), the river carries water throughout the year with comparatively less fluctuation than the other Peninsular Rivers.
  - It is most revered and sacred river of South India. Sivasamudram waterfall is on this river.
  - 90-95% of its irrigation and power potential stands harnessed.
- ❖ **Narmada:** It is the largest of all the west flowing rivers of the Peninsula. It rises from Amarkantak plateau in Shahdol district of Madhya Pradesh. Flowing in a rift valley between the Satpura in the south and the Vindhyan range in the north, it forms Dhuandhar waterfall near Jabalpur. Its length is 1310 km. The Sardar Sarovar Project has been constructed on this river.
  - Aliabet is the largest island in the estuary of the Narmada.
- ❖ **Tapi:** It originates from Multai in the Betul district of Madhya Pradesh and is known as 'the twin' or handmaid of Narmada. Tapi and Narmada drain into Gulf of Khambat in Arabian Sea.
- ❖ **Luni (Salt River or Lonari or Lovanavari):** It is largest river system of Rajasthan rising from Aravallis. Its water is brackish. It drains into Rann of Kachchh.
- ❖ **Mahi, Sharavati, Sabarmati, Varahi and Periyar** are the other west flowing rivers. Kunchikal Falls (455 m high), the highest waterfalls in India, are on Varahi River in Karnataka.

### **Climate/Weather of India**

**Climate** is average of atmospheric conditions over a long period of time. The climatic elements or atmospheric conditions such as temperature, rainfall, etc. are influenced by latitude, relief/altitude, distribution of land and water, and the like. As we know that Tropic of Cancer passes through middle of the country and monsoons play a significant role in determining the climate of the country, India is par excellence a tropical monsoon country.

#### **➤ Extremes in the Climate of the Country:**

- In June, the day temperature at Barmer, Rajasthan is  $48^{\circ}$ - $50^{\circ}$  C while is  $22^{\circ}$  C at Gulmarg.
  - In December, the night temperature may dip to  $-40^{\circ}$  C at Dras or Kargil while it may be  $20^{\circ}$  -  $22^{\circ}$  C at Thiruvananthpuram or Chennai.
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- Mawsynram in Meghalaya receives as high as 1221 cm of annual rainfall while at Jaisalmer the annual rainfall rarely exceeds 12 cm. A single day rainfall in Garo hills exceeds the 10 years of rainfall in Jaisalmer.
- The coastal areas Mumbai, Konkon, etc. have equable climate while the interior areas like Delhi, Agra, etc suffer from extremes.

➤ **Factors Influencing the Climate of India:** It is influenced by number of factors:

- **Location and Latitudinal Extent:** Most part of the country is located in the tropical latitudes and some areas in north in temperate latitudes. High temperatures are experienced to the south of Himalayas and mild and cool temperatures in the Himalayan states.
  - **Distance from the Sea:** The coastal areas have equable/mariline climate while the interior locations have extreme or continental climate. More than 300 cm annual rainfall in Western Ghats and less than 25 cm in Rajasthan.
  - **The Northern Mountain Ranges:** They protect India from cold and dry winds of Central Asia in winter and help in bringing rain. They act as climatic divide between Indian sub-continent and Central Asia.
  - **Mountains/Relief:** The relief has a great bearing on the elements of climate. Since, we know that temperature decreases with altitude ( $6.5^{\circ}\text{C/km}$ ), Ooty has cool climate than other peninsular areas. The hill stations in Himalayas have cool weather as compared to places in plains though on same latitude. But, in India, the relief plays another very important role and i.e., in the causing and distribution of rainfall. Generally, rainfall decreases from windward side to leeward side of the Western Ghats and from Bengal delta towards Northwest and from Himalayan slopes towards plains.
  - **Monsoons Winds:** It is the most determining factor of Indian climate and is named after as monsoonal climate. Since, monsoons are seasonal; India is characterized with different weather seasons. The SW monsoons from Arabian Sea and Bay of Bengal cause rainfall almost in the entire country in summer and NE monsoons in Caromandel coast in winter.
  - **Jet Streams:** The upper air circulation in the form of Westerly Jet streams brings Western disturbances to NW and North India in winter and helps in onset and reversal of monsoons.
  - **Tropical Cyclones and Western Disturbances:**
    - Tropical cyclones, the very low pressure centers, originate both in the Arabian and the Bay of Bengal during July-August and October-November seasons and influence the weather conditions.
    - The western disturbances are the low pressure centers that originate from Mediterranean Sea and move eastwards under the influence of westerly Jet Streams and cause rainfall/snowfall in North India after crossing Iran, Iraq, Afghanistan and Pakistan. **They** play a good role in determining the climate of J & K. They also cause rains in Punjab, Haryana, UP, Himachal, Uttarakhand, Sikkim and Arunachal Pradesh
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- **El Nino:** It is the oceano-climatic phenomenon characterized with complex changes in the Pacific Ocean mainly accumulation of warm water along the Peru coast. It has negative impact on monsoons.
  - **La Nina:** After El Nino, the condition returns to normal and accumulation of cold water in the eastern and central part of Pacific Ocean which is referred as La Nina. It has positive impact on monsoons. It is the harbinger of heavy monsoon showers in India.
  - **Southern Oscillation:** It has been noticed that whenever the surface level pressure is high over the Indian Ocean, there is low pressure over the Pacific Ocean and vice-versa. This relationship of high and low pressure over the Indian and the Pacific Oceans is called SO. When the winter pressure is high over the Pacific Ocean and low over the Indian Ocean, the SW monsoons in India tend to be stronger and the reverse is true.
  - **Monsoons, Mechanism and Types:** The term monsoon has been derived from the Arabic word “mausam” meaning season or the Malayan word “monsun” meaning season. Thus, the monsoons are the seasonal winds which completely reverse their direction of flow with the change of season. They flow from sea to land during summer in SW-NE direction called as SW monsoons and from land to sea during winter in NE-SW direction called as NE monsoons.
  - The monsoons are experienced in the tropical area roughly between 20°N and 20°S. To understand the mechanism of the monsoons, the following facts are important: (a) The differential heating and cooling of land and water creates low pressure on the land mass of India while the seas around experience comparatively high pressure. (b) The shift of the position of Inter-Tropical Convergence Zone (ITCZ) in summer over the Ganga plain (this is the equatorial trough normally positioned about 5°N of the equator- also known as monsoon trough during the monsoon season. (c) The presence of the high pressure area over Madagascar approximately at 20°S over the Indian Ocean. The intensity and position of this high pressure area affects the Indian monsoon. (d) The Tibetan plateau gets intensely heated during summer which results in strong vertical air currents and the formation of high pressure over the plateau of about 5 km above sea level. (e) The movement of the westerly Jet-stream to the north of the Himalayas and the presence of the tropical easterly jet over the Indian peninsula during summer.
  - **South West Monsoons/Summer Monsoons:** They are divided into two branches after striking the Peninsular plateau. Their onset is characterized with sudden burst.
    - **Arabian Sea branch:** This branch strikes Western Ghats at right angles and causes heavy orographic rainfall on the windward slopes with a pronounced rain-shadow belt on the leeward slopes. Though the winds penetrate deep inside the plateau but the intensity of rainfall goes on decreasing towards inside. A smaller branch of this branch moves through Kachchh plains upto J & K without causing any rainfall in the way since they move parallel to the Aravallis.
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- **Bay of Bengal branch:** This branch mainly influences the SE Asian countries like Indonesia, Malaysia, etc. A part of it enters India through Bengal Delta and causes heavy rainfall in Mawsynram (1221 cm) flanked by Garo, Khasi and Jaintia hills. Another part of this moves in SE-NW direction guided by Himalayas causing rainfall in the foothills and northern plains. The intensity of rainfall decreases from east to west and from north to south in the northern plains because of increase in distance from the source of moisture.
  - **Arabian Sea branch** is more powerful than **Bay of Bengal branch** because the size of Arabian Sea is bigger and whole of Arabian Sea branch enters India while most part of Bay of Bengal branch impacts SE Asian countries.
  - **North East or Retreating Monsoons:** Towards the end of September, the high pressure builds in NW India, ITCZ shifts towards south and anticyclonic conditions are set and thus winds start blowing from land to sea in a gradual manner. They are generally dry but pick up moisture from Bay of Bengal and cause rainfall in coastal Tamil Nadu, Karnataka, Orissa and Kerala.
  - **Theories:** Classical and Modern and Recent views
  - **Classical Theory/Thermal Concept:**
    - Although monsoons are mentioned in our old scriptures like the Rig Veda and in the writings of several Greek and Buddhist scholars, the credit for first scientific studies of the monsoon winds goes to the Arabs. Near about the tenth century, Al Masudi, an Arab explorer from Baghdad, gave an account of the reversal of ocean currents and the monsoon winds over the north Indian Ocean. Date of commencement of monsoons at several places was reported by Sidi Ali in 1554 A.D.
    - In 1686 the famous Englishman Sir Edmund Hailey explained the monsoon as resulting from thermal contrasts between continents and oceans due to their differential heating. Accordingly, Hailey conceived summer and winter monsoons depending upon the season.
      - (a) **Summer Monsoon:** In summer the sun shines vertically over the Tropic of Cancer resulting in high temperature and low pressure in Central Asia while the pressure is still sufficiently high over Arabian Sea and Bay of Bengal. This induces air flow from sea to land and brings heavy rainfall to India and her neighboring countries.
      - (b) **Winter Monsoon:** In winter the sun shines vertically over the Tropic of Capricorn. The north western part of India grows colder than Arabian Sea and Bay of Bengal and the flow of the monsoon is reversed.
  - Hailey's ideas are basically the same as those involved in land and sea breezes except that in the case of the monsoon day and night are replaced by summer and winter, and the narrow coastal strip and adjacent sea are replaced by large portions of continents and oceans.
  - **Modern Theories:** Hailey's classical theory based on differential heating of land and water as the main driving force of the monsoon winds dominated the scene for about three centuries. However, the
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monsoons do not develop equally everywhere and the thermal concept of Hailey fails to explain the intricacies of the monsoons. Besides differential heating, the development of monsoon is influenced by the shape of the continents, orography, and the conditions of air circulation in the upper troposphere. Therefore, Hailey's theory has lost much of its significance and modern theories based on air masses and jet streams are becoming more relevant. Although Hailey's ideas have not yet been out-rightly rejected, studies during the last five decades have thrown much light on the genesis of the monsoons.

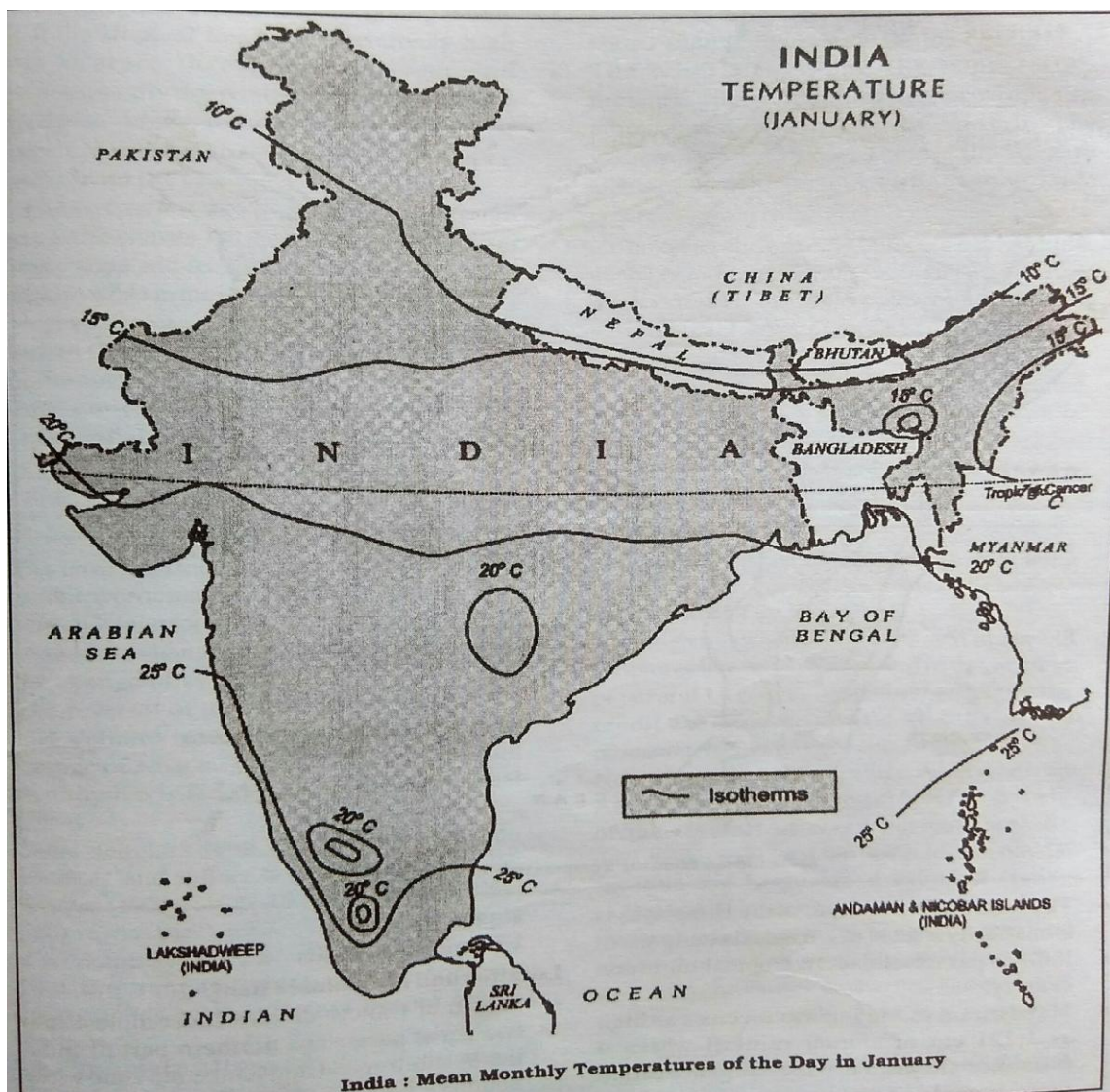
- During these years, Flohn, Thompson, Stephenson, Frost, M.T. Yin, Hwang, Takahashi, E. Palmen, C. Newton and Indian meteorologists including P. Koteswaram, Krishnan, Raman, Ramanathan, Krishna Murti, Rama Rattan, Ramaswami, Anant Krishnan, etc. have contributed a lot to the study of the monsoon winds.
  - **Air Mass Theory/ITCZ Concept:** The southeast trade winds in the southern hemisphere and the northeast trade winds in the northern hemisphere meet each other near the equator. The meeting place of these winds is known as the Inter-Tropical Convergence Zone (ITCZ).
  - Satellite imagery reveals that this is the region of ascending air, maximum clouds and heavy rainfall. The location of ITCZ shifts north and south of equator with the change of season. In the summer season, the sun shines vertically over the Tropic of Cancer and the ITCZ shifts northwards.
  - The southeast trade winds of the southern hemisphere cross the equator and start flowing from southwest to northeast direction under the influence of Coriolis force. These displaced trade winds are called south-west monsoons when they blow over the Indian sub-continent. The front where the south-west monsoons meet the north-east trade winds is known as the Monsoon Front.
  - In the month of July the ITCZ shifts to 20°- 25° N latitude and is located in the Indo-Gangetic Plain and the south-west monsoons blow from the Arabian Sea and the Bay of Bengal. The ITCZ in this position is often called the Monsoon Trough.
  - H. Flohn of the German Weather Bureau, while rejecting the classical theory of origin of monsoons suggested that the tropical monsoon of tropical Asia is simply a modification of the planetary winds of the tropics. He thinks of the thermal low of northern India and the accompanying monsoon as simply an unusually great northward displacement of the Northern Inter-Tropical
  - Convergence Zone (NITCZ). The seasonal shift of the ITCZ has given the concept of Northern Inter-Tropical Convergence Zone (NITCZ) in summer (July) and Southern Inter-Tropical Convergence Zone (SITCZ) in winter (Jan.). The fact that the NITCZ is drawn to about 30° latitude may be associated with the unusually high temperature over north India.
  - According to this interpretation the main westerly current of the monsoon is simply the expanded equatorial westerlies which lie embedded in the great mass of tropical easterlies or the trade winds. NITCZ is the zone of clouds and heavy rainfall.
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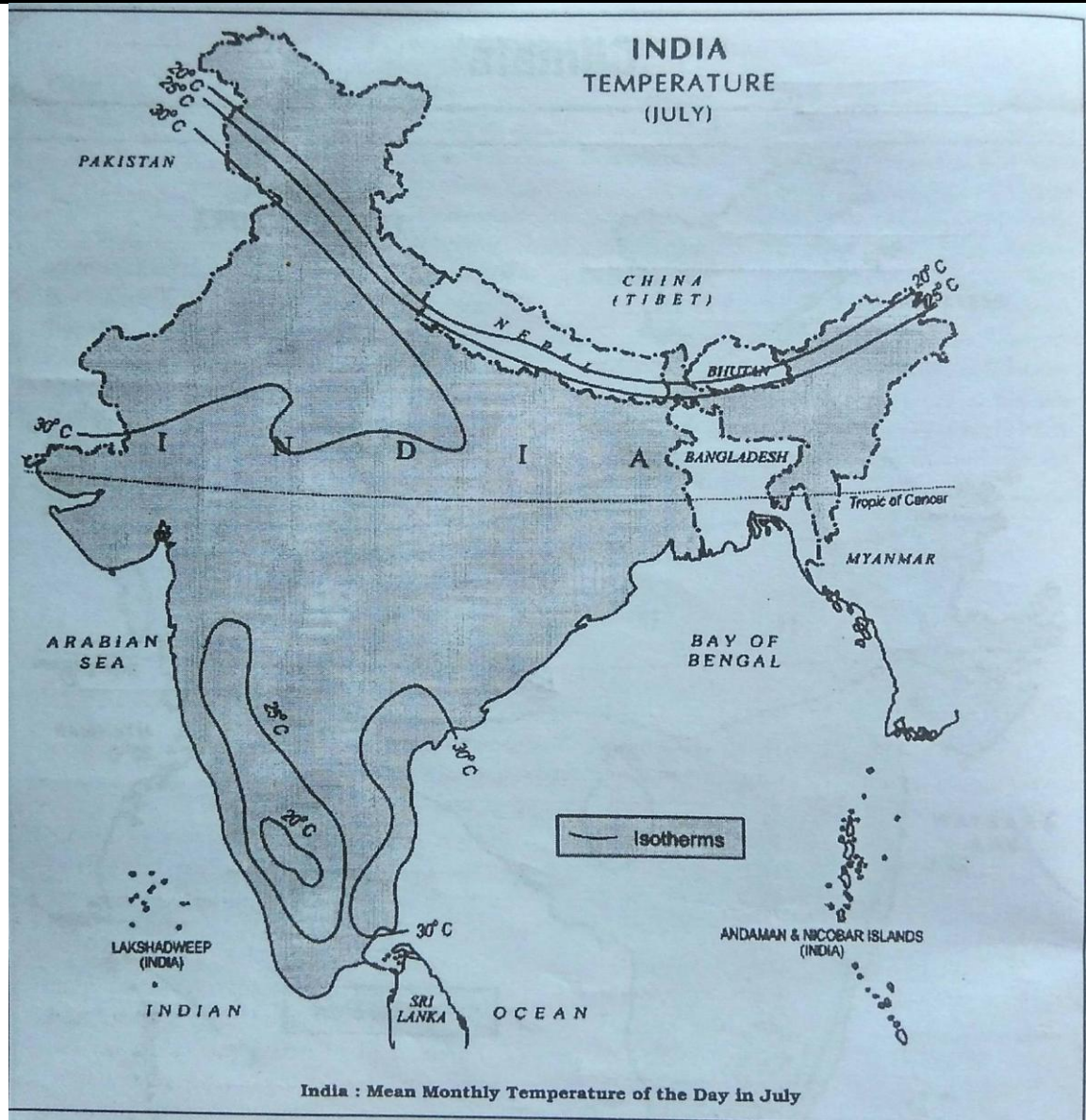


➤ **Jet Stream Theory:**

- Jet stream is a band of fast moving air from west to east usually found in the middle latitudes in the upper troposphere at a height of about 12 km. The wind speeds in a westerly jet stream are commonly 150 to 300 km p.h. with extreme values reaching 400 km p.h. Jet stream is the latest theory regarding the origin of the monsoons and has earned world wide acclaim from the meteorologists.
  - M.T. Yin (1949), while discussing the origin of the monsoons expressed the opinion that the burst of monsoon depends upon the upper air circulation. The low latitude upper air trough shifts from 90° E to 80° E longitude in response to the northward shift of the western jet stream in summer. The southern jet becomes active and heavy rainfall is caused by south-west monsoons.
  - Yin's ideas are well recognised by Pierre Pedelaborde (1963), in his book entitled 'The Monsoon'. The map, showing the seasonal shift of the westerly jet stream. It shows that in winter the western jet stream flows along the southern slopes of the Himalayas but in summer it shifts northwards, rather dramatically, and flows along the northern edge of the Tibet Plateau. The periodic movements of the Jet stream are often indicators of the onset and subsequent withdrawal of the monsoon.
  - P. Koteswaram (1952), put forward his ideas about the monsoon winds based on his studies of upper air circulation. He has tried to establish a relationship between the monsoons and the atmospheric conditions prevailing over Tibet Plateau.
  - **Seasonal Rhythm of India: IMD (Delhi)** has identified four seasons in India:
    - **Summer Season:** It is called pre-monsoon season and extends from March to June.
      - High temperature and low humidity (dry air) and low pressure are its chief characteristics. High temperature (50.5<sup>0</sup> C) is recorded in Rajasthan at Alwar.
      - Hot, dust laden and strong wind called as loo blows over Indian plains.
      - Norwesters or Kalbaisakhis/black storms characterized with thunderstorms and wind speeds of 60-80 km/h occur from mid-March to mid-April and cause rainfall. They are called Tea showers in assam, Mango showers in Andhra Pradesh and Tamil Nadu and Cherry blossoms in Karnataka. 1% rainfall occurs during this season.
    - **Rainy Season/Monsoon Season/South West monsoon season/wet season/hot-wet season:**
      - It extends from June to September. High heat, high humidity, extensive clouding, and heavy rains are its features.
      - Due to heavy rains, temperature falls down. Still highest temperatures of 32<sup>0</sup> C are experienced in Thar Desert of Rajasthan.
      - Winds called SW monsoons blow in SW-NE direction. Around 75% of total rainfall occurs in this season.
    - **Cool Season/Autumn/Retreating Monsoon Season:** It extends from September to November. It begins with the withdrawal of the SW monsoons in September.
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- The SW monsoons reach NW India last of all but withdraw from there first of all. With the withdrawal of SW monsoons, clouds disappear, sky becomes clear and temperature once again rises. Average temperature varies from  $25^{\circ}\text{C}$ - $30^{\circ}\text{C}$ .
  - Winds called NE Monsoons blow from land to sea. Since, they are generally dry and cause no rainfall. But, in coastal areas of Eastern coast of India called as Coromandel Coast, rainfall occurs because of these winds. Kerala has bi-modal pattern of rainfall.
  - This season is characterized with devastating cyclones originating in Bay of Bengal with greater frequency in the month of October.
- **The Cold Weather Season/Winter Season:** It extends from November to March.
- Northern parts of the country have below  $21^{\circ}\text{C}$ . Dras is coldest place in India. The southern parts have warm temperatures.
  - High air pressure prevails over large parts of NW India due to low temperature. So, winds blow from NW India (1019 mb) to south India (1013 mb).
  - In this season, three to five western disturbances are experienced per month that cause rains/snow in North Himalayan and foothill states.





- The average rainfall in India is 118 cm.
- The Indian Flood Commission is named as Rashtriya Barh Ayog. Floods are caused by heavy rains due to cloud bursts and tropical cyclones, deforestation, siltation in rivers, etc. One-eighth (12.5%) of the total area is flood prone. The largest flood prone areas are in UP, Bihar, etc.
- Drought is a situation when the mean annual rainfall is less than 75% of the normal rainfall of the area. It is reduction in rainfall/moisture below normal requirement. The largest drought prone areas are in Rajasthan, Gujarat, Maharashtra (rain shadow area), Karnataka, etc.

### Koeppen's Classification of Climatic Regions of India

Koeppen's Classification of Climatic Regions of India is an empirical classification based on mean annual and mean monthly temperature and precipitation data. Koeppen identified a close relationship between the distribution of vegetation and climate. He selected certain values of temperature and precipitation and related them to the distribution of vegetation and used these values for classifying the climates.



Koeppen recognized five major climatic groups, four of them are based on temperature and one on precipitation.

The capital letters: A, C, D and E delineate humid climates and B dry climates.

The climatic groups are subdivided into types, designated by small letters, based on seasonality of precipitation and temperature characteristics.

The seasons of dryness are indicated by the small letters: f, m, w and s, where

f – no dry season,

m – monsoon climate,

w – winter dry season and

s – summer dry season.

The above mentioned major climatic types are further subdivided depending upon the seasonal distribution of rainfall or degree of dryness or cold.

a: hot summer, average temperature of the warmest month over 22°C

c: cool summer, average temperature of the warmest month under 22°C

f: no dry season

w: dry season in winter

s: dry season in summer

g: Ganges type of annual march of temperature; hottest month comes before the solstice and the summer rainy season.

h: average annual temperature under 18°C

m (monsoon): short dry season.

The capital letters S and W are employed to designate the two subdivisions of dry climate: semi-arid or Steppe (S) and arid or desert (W).

Capital letters T and F are similarly used to designate the two subdivisions of polar climate: tundra (T) and icecap (F).

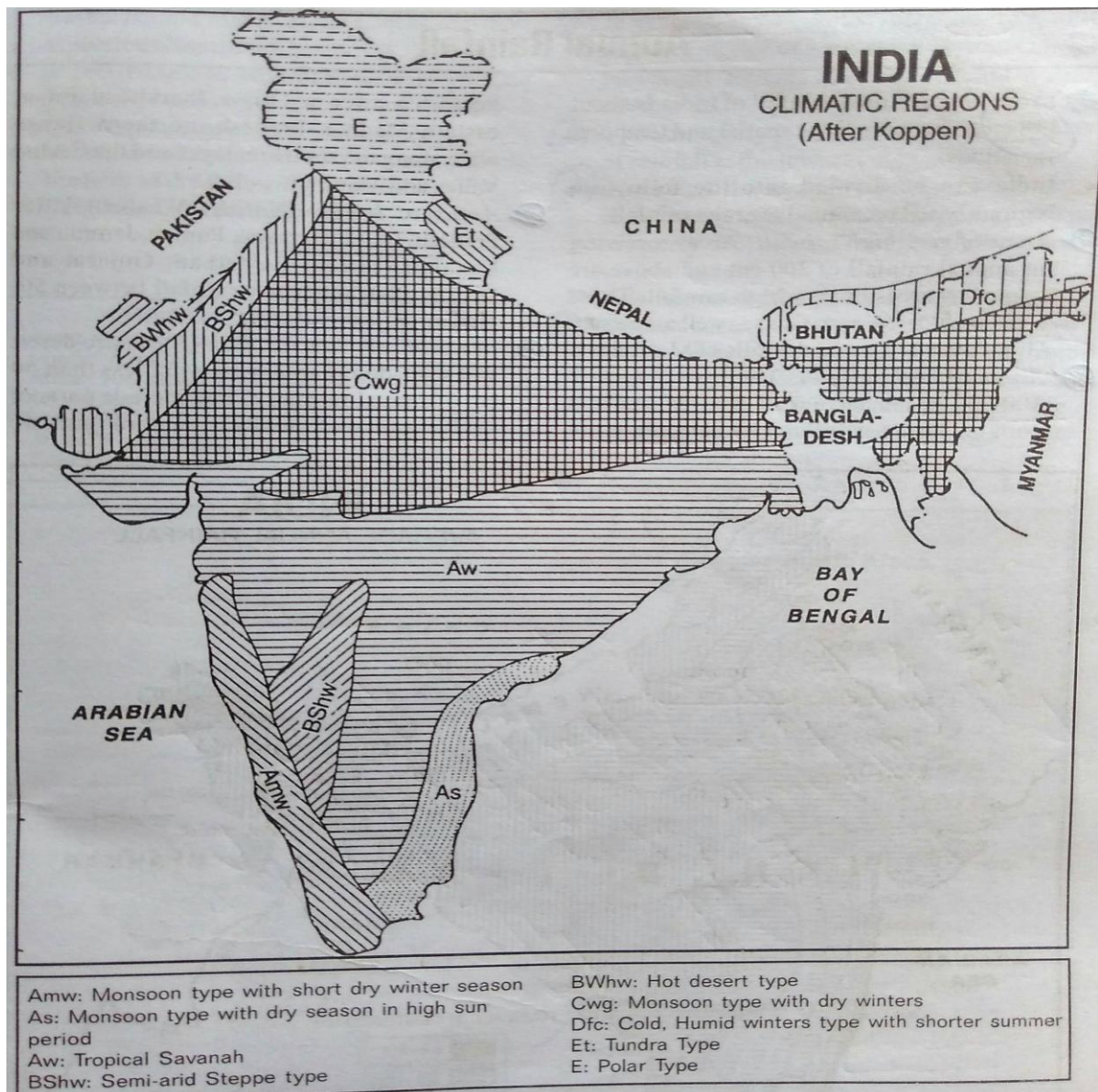
➤ **Koeppen divided India into nine climatic regions making use of the above scheme.**

<b>Koeppen's Scheme – Climatic Regions of India</b>		
<b>Climate type</b>	<b>Region</b>	<b>Annual rainfall</b>
<b>Amw</b> <b>(Monsoon type with short dry winter season)</b>	Western coastal region, south of Mumbai	over 300 cm
<b>As (Monsoon type with dry season in high sun period)</b>	Coromandel coast = Coastal Tamil Nadu and adjoining areas of Andhra Pradesh	75 – 100 cm [wet winters, dry summers]
<b>Aw (Tropical Savanah type)</b>	Most parts of the peninsular plateau barring Coromandel and Malabar coastal strips	75 cm
<b>BShw</b>	Some rain shadow areas of Western Ghats, large part of	12 to 25 cm

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<b>(Semi-arid Steppe type)</b>	Rajasthan and contiguous areas of Haryana and Gujarat	
<b>BWhw (Hot desert type)</b>	Most of western Rajasthan	less than 12 cm
<b>Cwg (Monsoon type with dry winters)</b>	Most parts of the Ganga Plain, eastern Rajasthan, Assam and in Malwa Plateau	100 – 200 cm
<b>Dfc (Cold, Humid winters type with shorter summer)</b>	Sikkim, Arunachal Pradesh and parts of Assam	~200 cm
<b>Et (Tundra Type)</b>	Mountain areas of Uttarakhand The average temperature varies from 0 to 10°C	Rainfall varies from year to year.
<b>E (Polar Type)</b>	Higher areas of Jammu & Kashmir and Himachal Pradesh in which the temperature of the warmest month varies from 0° to 10°C	Precipitation occurs in the form of snow

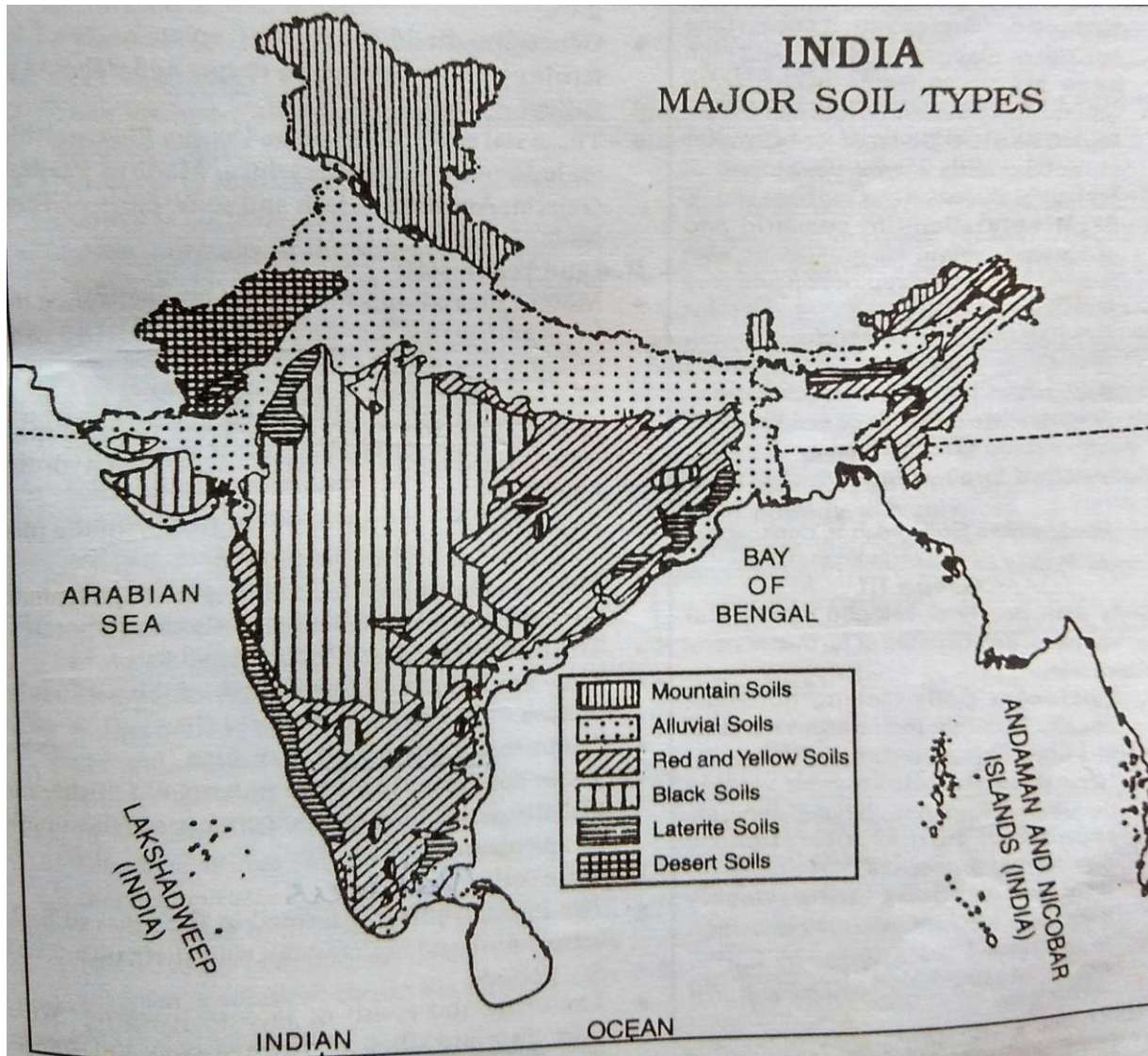


### Soils of India

The upper thin, loose, weathered layer of the crust is called as Soil. The scientific study of the soils is called as Pedology and the soil formation process as Pedogenesis. Sub-soil or parent material is the unweathered hard layer under the soil. It is composed of solids, liquids and gases. The solids are both organic and inorganic in nature. Soils also contain colloids, oxides of iron (Limonite), oxides of Aluminium (Bauxite), etc.

- **Soil color** is determined with the aid of Munshell color chart.
  - **Soil acidity** is measured as per pH scale (0-14). 0 means extreme acidity and 14 means extreme alkalinity. Water has 7 (neutral) pH. pH value of 6.5 is ideal for cereals crops.
  - **Soil Texture** means ratio/proportion of sand, silt and clay in the soil. Loam is an ideal soil which as 40:40:20 (sand, silt and clay ratio). Texture determines soil characteristics such as water retention capacity, aeration, tillage, etc.
  - **Soil Formation Processes:**
    - **Weathering:** It is the breakdown and decomposition of rocks/parent material in situ. It is the first process/first step in soil formation.
    - **Translocation:** It refers to the material flow within the soil body.
      - **Eluviation** refers to downward transport of fine particles, minerals, etc.
      - **Illuviation** means accumulation of materials brought downward from A Horizon.
    - **Salinization/Alkalization:** Accumulation of salts and alkalies in the surface soil as a result of capillary action in dry environments where evaporation is greater than precipitation.
  - **Factors Controlling Soil Formation: Five Factors**
    - **Climate:** It is the most important factor controlling soil formation. Two elements of climate i.e., precipitation and temperature influence soil formation. Where rainfall exceeds evaporation, leached soils called pedalfers or laterites are formed due to removal of free calcium ions leaving behind iron and aluminium oxides. Where evaporation exceeds rainfall, salts and calcium ions accumulate in the soil due to capillary action giving rise to pedocals/saline soils/alkaline soils. Temperature helps in decomposition of organic matter due to bacterial activity.
    - **Parent Material:** It influences the color and composition of the soil. The red soils have red color because of iron oxides in the parent material. The black color of soil is because of titaxiferous oxides.
    - **Relief/Topography/Slope:** On steep slopes, the soils are shallow, coarse and immature. While as on gentle slopes and plain areas, the soils are deep, fertile and fine grained.
    - **Vegetation and other Biota:** Vegetation adds humus to the soil and binds it together. The soil biota keeps it healthy through aeration and other activities.
    - **Time:** Soil takes thousands of years to form.
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- **Major Soil Groups of India:** In ancient times, soils were classified into two main groups *Urvara* and *Usara*, which were fertile and sterile, respectively. In the 16th century A.D., soils were classified on the basis of their inherent characteristics and external features such as texture, colour, slope of land and moisture content in the soil. Based on texture, main soil types were identified as sandy, clayey, silty and loam, etc. On the basis of colour, they were red, yellow, black, etc. On the basis of genesis, colour, composition and location, the soils of India have been classified into:



- **Alluvial Soils:** These soils were formed of alluvium eroded and deposited by rivers. That means they are found in all river valleys. They cover all the Indian River plains.
- Cover 15 lakh sq. km (45.6%) of the total area of the country....largest.
  - They are found in UP, Bihar, West Bengal, Punjab, Haryana, and deltas of peninsular rivers. Sometimes, divided into bhangar, khaddar, etc.
  - Immature but fertile. They are rich in potash, phosphorus, organic matter, and deficient in nitrogen and humus. One thing should be kept in mind that all Indian soils except forest and peat soils lack nitrogen and humus content. Tarai soils of these soils are nitrogen rich.
  - Suitable for rice, wheat, sugarcane, jute, soyabean, etc.



- **Black Soils:** They are known as Regur soils (Telugu word Reguda) or Black cotton soils because cotton is main crop grown in these soils. They are formed volcanic material (basalt). Their black color is attributed to titaxiferous magnetite present in the parent material.
    - Cover 5.46 lakh sq. km (16.6%) of the total area of the country. They are found in Deccan Plateau in the states of Maharashtra, MP, parts of Karnataka, Andhra Pradesh, etc.
    - Mature and fertile soil. They contain iron, lime, and potash but lack nitrogen and humus.
    - They are highly retentive of moisture because of high clay content. They swell and become sticky in rainy season and shrink when dried. So, they are self ploughing soils.
  - **Red Soils:** They are derived from ancient crystalline and metamorphic rocks and develop a reddish color due to iron in parent material. It looks yellow when it occurs in a hydrated form.
    - Cover 3.5 lakh sq. km (10.6%) of the total area of the country. They are found in Tamil Nadu, parts of Karnataka and Maharashtra, MP, and NE states.
    - They are generally normally fertile but poor in nitrogen, phosphorous and humus.
    - Suitable for cotton, rice, wheat, etc. if fertilized and irrigated properly.
  - **Laterite Soils:** Laterite has been derived from the Latin word '*Later*' which means brick. Laterite soils are widely cut as bricks for use in house construction.
    - The laterite soils develop in areas with high temperature and high rainfall. These are the result of intense leaching due to rains. With rain, lime and silica are leached away, and soils rich in iron oxide and aluminium are left behind. Humus content of the soil is removed fast by bacteria that thrive well in high temperature.
    - They cover 2.48 lakh sq. km (7.5%) of the total area of the country and are found The laterite soils are commonly found in high temperature and rainfall areas of Maharashtra, Karnataka, Kerala, Tamil Nadu, Madhya Pradesh, Orissa and Assam.
    - These soils are poor in organic matter, nitrogen, phosphate and calcium, while iron oxide and potash are in excess. Hence, laterites are not suitable for cultivation; however, application of manures and fertilizers are required for making the soils fertile for cultivation.
  - **Arid and Semi-Arid Soils/Desert Soils:** They consist of sand (90-95%) and clay (5-10%) and are found in western part of Rajasthan and in parts of Punjab, Haryana and coastal states.
    - They are sandy in structure and saline in nature (salts accumulate in top soil). Lower horizons of the soil are occupied by kankar layers (the calcium carbonate deposits).
    - They are poor and contain little humus and insufficient nitrogen.
    - Drought resistant and salt tolerant crops like barley, rape, cotton, millets, etc are grown.
  - **Saline and Alkaline Soils:** These soils are known as usar, thur, kallar, reh, etc. They contain a larger proportion of sodium, potassium and magnesium, and thus, they are infertile, and do not support any vegetative growth. They have more salts, largely because of dry climate and/or poor drainage.
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- They occur in arid and semi-arid regions and in waterlogged and swampy areas and are found in western Gujarat, deltas of eastern coast and in Sunderban area of West Bengal.
- In such areas, especially in Punjab and Haryana, farmers are advised to add gypsum to solve the problem of salinity in the soil.
- They lack in nitrogen and calcium.
- **Peaty and Marshy Soils:** They are found in the areas of heavy rainfall and high humidity, where there is a good growth of vegetation. Thus, large quantity of dead organic matter accumulates in these areas, and this gives a rich humus and organic content to the soil. Organic matter in these soils may go even up to 40-50 per cent. It occurs widely in the northern part of Bihar, southern part of Uttaranchal and the coastal areas of West Bengal, Orissa and Tamil Nadu.
- **Forest Soils:** They are found on hill slopes covered by forests. They are very rich in humus, and are deficient in potash, and lime. The soils found in the lower valleys are fertile.

### **Natural Vegetation**

India is a land of great variety of natural vegetation. Himalayan heights are marked with temperate vegetation; the Western Ghats and the Andaman Nicobar Islands have tropical rain forests, the deltaic regions have tropical swamp forests and mangroves; the desert and semi desert areas of Rajasthan are known for cacti (thorny) vegetation.

- Climate, soil and topography influence the natural vegetation. Climate especially rainfall determine the vegetation zones of India.
- Areas receiving 200 cm or more rainfall per annum have evergreen rain forests.
- Monsoon (moist) deciduous forests dominate in areas having rainfall from 100-200 cm.
- Dry deciduous trees or tropical savanna are found in areas having 50-100 cm of rainfall.
- Areas with less than 50 cm rainfall have dry thorny scrub and open bushes.
- As temperature decreases with altitude in Himalayan region, vegetal cover changes from tropical to sub-tropical, temperate and finally alpine.

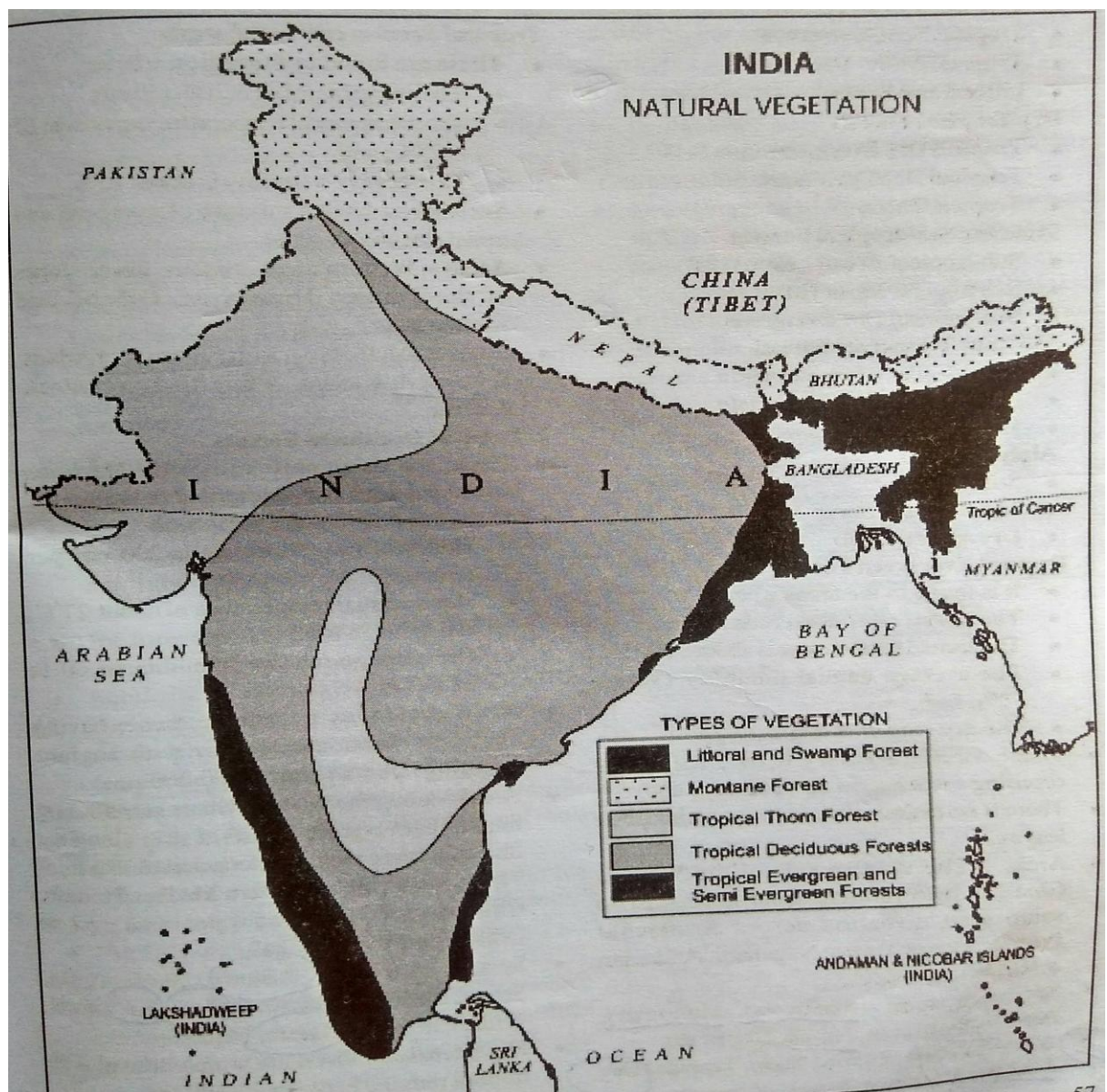
On the basis of certain common features such as predominant vegetation type and climatic regions, Indian forests can be divided into the following groups:

- **Tropical Evergreen and Semi-Evergreen Forests:** These forests are found in the western slope of the Western Ghats, hills of the northeastern region and the Andaman and Nicobar Islands.
    - They are found in warm and humid areas with an annual precipitation of over 200 cm and mean annual temperature above 22°C.
    - Tropical evergreen forests are well stratified, with trees of up to 60 m or above height.
    - There is no definite time for trees to shed their leaves, and so appear green all the year round.
    - Species found in these forests include rosewood, mahogany, aini, ebony, etc.
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- Main species of Semi-Evergreen forests are white cedar, hollock and kail.
- Britishers changed these forests for their vested interests.

➤ **Tropical Deciduous Forests (Moist and Dry):** These are the most widespread forests in India. They are also called the monsoon forests.

- They spread over regions which receive rainfall of 70-200 cm.
- *The Moist deciduous forests* (100-200 cm rainfall): These forests are found in the northeastern states along the foothills of Himalayas, eastern slopes of the Western Ghats and Orissa. Teak, sal, and sandalwood etc. are the main species of these forests.
- *Dry deciduous forest* (70 -100 cm): These forests are found in rainier areas of the Peninsula and the plains of Uttar Pradesh and Bihar. As the dry season begins, the trees shed their leaves completely. Khair, axlewood, etc. are the common trees of these forests.



- **Tropical Thorn Forests:** Tropical thorn forests occur in the areas which receive rainfall less than 50 cm. It includes semi-arid areas of south west Punjab, Haryana, Rajasthan, Gujarat, Madhya Pradesh and Uttar Pradesh. Important species found are babool, ber, and cactii, khair, etc.
  - **Montane Forests:** In mountainous areas, the decrease in temperature with increasing altitude leads to a corresponding change in natural vegetation. Mountain forests can be classified into two types, the northern mountain forests and the southern mountain forests.
    - The Himalayan ranges show a succession of vegetation from the tropical to the tundra (alpine), which change in with the altitude. Tropical deciduous in foothills (<1000 m), followed by temperate forests (1000-2000 m) such as pine, chinar, walnut, etc., temperate grasslands, and finally Alpine forests (3000-4000 m) such as silver fir, juniper, rhodhdendrons, etc.
    - In Peninsular region, vegetation is temperate in the higher regions and subtropical on the lower regions. The temperate forests are called *Sholas* in the Nilgiris, Anaimalai and Palani hills.
  - **Littoral and Swamp Forests:** They occur in and around the deltas, estuaries and creeks. They survive both in fresh and brackish waters. For instance, mangroves which are salt tolerant (halophytes) tropical swamp forests mainly found in West Bengal (Sunderban delta), Gulf of Kutch in Gujarat, etc. Main species are sundari, agar, bhendi, etc.
  - **Classification Scheme for Forest Cover Estimation: As per ISFR, 2015**
    - Very Dense Forest (2.61% of total area): Lands with tree canopy density of 70% or above.
    - Moderately Dense Forest (9.59%): Lands with tree canopy density between 40% and 70%.
    - Open Forest (9.14%): Lands with tree canopy density between 10% and 40%.
    - Lands having tree canopy density below 10% are named as scrub/degraded forests (1.26%).
    - Non-forest (77.40%): water bodies and other lands.
  - **Distribution of Forest (Area and Cover):** The minimum desired area for a tropical country like India is about 33%. Further, it should be about 60% in mountainous areas and 20% in plain areas.
    - The total forest and tree cover is 79.42 million hectare, which is 24.16 percent (forest cover=21.34% and tree cover=2.82%) of the total geographical area.
    - The India State of Forest Report (ISFR) 2015 states that forest and tree cover has increased by 5, 081 sq km. While the total forest cover of the country has increased by 3, 775 sq km, the tree cover has gone up by 1, 306 sq km.
    - The major increase in forest cover has been observed in open forest category mainly outside forest areas, followed by Very Dense Forest.
    - Madhya Pradesh has the largest forest cover (77, 462 sq km) in the country, followed by Arunachal Pradesh (67, 248 sq km) and Chhattisgarh (55, 586 sq km).
    - Haryana has least forest cover followed by Punjab (States). Daman and Diu has lowest (UTs).
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- Mizoram (88.93%) has the highest forest cover in percentage terms, followed by Lakshadweep (84.56%) to their respective total state/UT areas.
  - Jammu and Kashmir is largest producer of timber while as Karnataka is largest producer of fuelwood in India. MP is largest producer of gums and tendu leaves. Arunachal Pradesh leads in resin production and Jharkhand in lac.
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## **Population Composition**

Among various elements of population composition, Sex composition, Age composition and Economic composition are the important components of the population scenario of any place. The spatial spread or in other words the distribution and density of population is not uniform. There are wide regional contrasts for e.g. on one hand we have unpopulated lofty mountains on the other hand we have densely populated river valleys, plains and deltas which have extremely high population. This uneven distribution of population is because of many factors like: Soil fertility, Climate, Types of landforms, Resource availability and Job opportunities, etc.

### **Sex-Ratio**

Sex ratio in India is defined as no. of females per 1000 males. According to the 2011 census, there are 940 females per 1000 males in India. The uneven composition of sex ratio is because of the practice of female infanticide, sex-selective female abortions and neglect of the girl child. The sex composition in some states for e.g. Punjab, Haryana is a matter of concern.

Kerala has a sex ratio of 1084, followed by Tamil Nadu 995 Andhra Pradesh 992. In comparison, Haryana and Punjab, Jammu and Kashmir has a sex ratio lower than 900.

In spite of the sex ratio of India being lower than developed countries, it is gradually increasing and most states have shown an improvement.

The sex ratio in India is characterized by the differences in its rural-urban components. The rural sex-ratio of India according to 2011 census is 946 and the urban sex-ratio is 900. The urban-rural difference in the sex-ratio of India is the product of sex selective migration from rural areas to urban areas. More males move from rural areas to urban areas in India.

### **Age Composition**

Age composition is the description of the age structure which refers to the number of people in different age groups. Generally the population is categorized into these three broad age groups.

1. The young (0-14)
  2. The adults (15-59)
  3. The old (60 and above).
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The larger size of population in the age group of (15-59) indicates the chances of having a larger working population, on the other hand if the children (0-14) and the old (60 and above) are more then the dependency ratio will be high.

The population scenario of India looks bright because more than 58% of its population falls in the 15-59 years age group which means India has a large work force if channelized properly. More than 34% of its population falls in the 0-14 category. Even though it is a dependent population but if this age group is nurtured well i.e., (good education, health, skills etc.) the future of the nation is secure and safe.

Around 8% of the Indian population falls under the age group of 60 and above. A majority of the Indian population falling in this age group is in rural areas. Thus India faces a major challenge because to provide service delivery to remote rural areas is difficult.

### **Population Distribution**

Population distribution represents the total number of people living in a particular area. India according to the 2011 census has a total human population of 1,210,854,977 persons. In its distribution, the majority of the Indian population lives in rural areas. More than 70% of the Indian population lives in its villages.

In spite of being the second most populous country in the world, the population has a very uneven distribution, the productive plains and the urban areas have high concentration of population whereas the inaccessible mighty mountains with harsh climate condition have little or no permanent population. Similarly the forested areas, deserts, arid regions have less population.

Uttar Pradesh with nearly 199.5 million population is the most populous state followed by Maharashtra 112 million, Bihar 103 million, West Bengal and Andhra Pradesh. Sikkim with a population of 6,07,688 persons is the least populous state.

India's economy continues to be agricultural; the factors that govern population distribution are those that promote good agriculture. The availability of cultivable land, fertile soil, availability of water etc. has traditionally guided the distributional pattern. Industrial development, job availability, accessibility have also played an important role in the distribution of population.

### **Density of Population**

The total number of persons living per unit area is described as the density. According to the 2011 census the population density of India is 382 persons per sq.km.

The alluvial belt of U.P, Bihar, Haryana, West Bengal etc. have high density of population.

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The metropolitan cities and major urban areas like Delhi, Mumbai, Chennai also have high population density. Delhi has a population density of 11297 persons per sq.km.

The dry central heartland of Madhya Pradesh, Eastern Maharashtra, Orissa, Andhra Pradesh and Rajasthan, mountainous areas of northern and north eastern areas of India, Rann of Kutch, have low population density because of harsh living conditions.

### **Population Growth**

Growth of population refers to the change in the number of people during a particular time period. The population of India has increased more than four-folds since the beginning of the 20th century.

There has generally been an increase in the growth rate of population of India. However in 1911-1921 and 2001-2011 are the exception years when the growth rate has been negative which means that lesser percentage of people have been added to the Indian population as

compared to the other decades. In fact the percentage decadal growth during 2001-2011 has registered the sharpest decline since independence. A decrease of 3.90 percentage points from 21.54 to 17.64%.

The population of India since 1951 has on an average shown a growth rate of 2% per annum. Such unprecedented increase in the country's population is attributed to large scale developmental activities, better food supply, medical services, check in epidemics etc.

### **Characteristics of Indian Agriculture**

Agriculture is the backbone of Indian economy. In India around 70% of the population earns its livelihood from agriculture. It fulfills the basic need of human beings and animals. It is an important source of raw material for many agro-based industries. India's geographical condition is unique for agriculture because it provides many favorable conditions. Apart from unique geographical conditions, India has been consistently making innovative efforts by using science and technology to increase production. Following are some of the broad features of the Indian agriculture:

1. Indian agriculture is subsistent type of agriculture whose prime aim is to meet the food and other requirements of its vast population. Farmers select the crops with major objective of meeting their domestic needs rather than generating surplus for national and international markets.
  2. Indian agriculture is characterized by heavy population pressure. About 70 per cent of the country's population derives its livelihood from agriculture and allied occupations. Since India's population is growing at a faster rate, the availability of agricultural land has declined. This puts enormous pressure on agriculture.
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3. Indian agriculture has the predominance of the cultivation of food grains which occupy 76% of the total cropped area and account for 80% of the total agricultural production of the country. These cereals include rice, wheat, millet, gram, maize and pulses which are grown to meet the food requirements of India's vast population.
4. The agriculture shows diversity of crops. Sometimes four-five crops are grown simultaneously in the same field. This is done to ensure some agricultural production during unfavorable weather conditions. This mixed cropping reduces the agricultural output and per hectare yield.
5. India has the highest percentage (53%) of its geographical area under cultivation in comparison to many countries (USA 16.3%, China 11.8%, Japan 14.9%, Canada 4.3%, etc.) of the world. The climatic conditions especially temperature helps in providing a long growing season throughout the year.
6. Due to physical, economic and social factors the landholdings are tiny, fragmented and unsuitable for modern methods of agriculture.
7. Indian agriculture utilizes a number of draught animals like bullocks, he buffaloes, camels etc. in agricultural work. It is also labor based enterprise where all agricultural operations like tilling, sowing, weeding, sprinkling of insecticides/ pesticides, harvesting, threshing etc. are carried by human hands. Although the use of agricultural machinery is replacing animal and human power but the pace of progress is very slow and confined to rich sections of the cultivators.
9. Indian agriculture is mostly dependent on rainfall whose variability in time and place has adverse effect on agricultural output. It is really a matter of concern that despite five decades of constant endeavor only 41.2% of the total cropped area has been brought under irrigation. Rest is at the mercy of rain-god. If the entire agricultural area is brought under irrigation agricultural production may be easily doubled.
10. Indian agriculture puts minimum attention on fodder crops (4% of cropped area). This together with lack of good pastures has detrimental effect over the development of dairy farming. India has the largest number of cattle but it occupies an insignificant place in respect of cattle products in the world.
11. Indian agriculture suffers from numerous problems, i.e. small land holdings, unscientific method of farming, less irrigational facilities, less use of chemical and natural fertilizers, greater vulnerability to pests and diseases, poverty amongst and lack of infrastructural facilities etc.

### **Rice Production and Distribution**

Rice is the most important food crop of India. and its growth area stretches from 8°N to 34°N latitudes. Rice is also grown in areas below sea level as in the Kuttanad region of Kerela. Covering about one

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fourth of the total cropped area and providing food to about half of the Indian population . This is the staple food of the people living in the eastern and southern parts of the country. India is the second largest producer of rice in the world, next only to china. Conditions of Growth:For its successful growth, it requires a temperature of 20°C -22°C at the time of sowing, 23°C to 25°C during its growth and 25°C to 30°C at the harvesting time. The average annual rainfall should be 150cms. Deep fertile clayey or loamy soils are best suited for the successful growth of the rice crop. Production: India is the second largest producer and consumer of rice in the world and

accounts for 17.95 % of the world's total rice production. India produced 106.3 million tonnes in 2013-14 with a yield of 2429kg /ha.

### **Distribution:**

1. West Bengal :Rice in west Bengal accounts for more than 60% of the sown area in every district. The winter crop (aman paddy) is the most important accounting for over two thirds of the states production. It produces about 14.33% of the total production from 12.8% of rice producing area of the country and is the largest rice producing state in India.
2. Punjab: Punjab has emerged the second most important rice producing state in India contributing about 12% of the total rice production in the country. Major Rice producing districts are Patiala, Firozpur, Ludhiana, sangrur etc.
3. UP: In UP , the rice cultivation is confined to Saharanpur , Deoria, Gonda , Basti, Rai Barelli, Lucknow, Varanasi and Gorukhpur. The crop is extensively grown in the eastern and north (north-eastern parts). It produces about 11% to the national output of rice with 11% of total acreage under rice in India.
4. Andhra Pradesh : In Andra Pradesh , the deltas of Krishna and Godawari and the adjoining coastal plains form one of the most important rice tracts in the country. It produces about 10% of the total output of rice in the country.
5. Tamil Nadu: In Tamil Nadu north Arcot and Thanjavur districts in the Cauvery delta account for 60% of the state's production. Tamil Nadu produces about 8% of total production of rice in the country.

### **Wheat**

Wheat is the most important food grain of India after rice and is the staple food of millions of Indians, particularly in the northern and north-western parts of the country. It is rich in proteins, vitamins and carbohydrates and provides balanced food.

Conditions of Growth: wheat is primarily a crop of mid-latitude grasslands and requires a cool climate with moderate rainfall. The ideal wheat climate has winter temperature of 10°C to 15°C and summer

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temperature varying from 21°C to 26°C. Wheat thrives well in areas receiving an annual rainfall of about 75cms. annual rainfall of 100cms is the highest limit of wheat cultivation. Well drained fertile friable loams and clay looms are the best

suited soils for wheat cultivation. It also grows well in the black soil of the Deccan plateau.

**Production:** after China India is the largest producer of wheat in the world and accounts for 12.39% of the total production of wheat in the world. Wheat is grown on 14% of the cropped area of India. India produced about 92.46 million tonnes of wheat during 2013-14 with the yield of 3118kg/ha.

**Distribution:**

1. Uttar Pradesh: UP is the largest wheat producing state of India accounting for about one third of area and production of wheat of the country. In 2012-13 UP produced about 30.3million tonnes of wheat. It is mostly cultivated in the „Ganga – Ghaghra doab” and Ganga –Yamuna Doab.
2. Punjab: Punjab accounts for about 17.42% of the wheat production and 11.8 % of wheat area in India. in 2012-13 Punjab produced 16.11 million tonnes of wheat with the yield of 4577kg per ha , which is highest in the country. It is produced in Jalandar , Ludhiana, Sangrur,Bhatinda, Amritsar, Ferozpur, Faridkot etc.
3. Madhya pradesh: it is the third largest wheat producing state and accounts for 14% of the total production of India. Important wheat producing districts are Sagar,Vidisha,Tikangarh, Sehore, Gwalior etc
4. Haryana: it accounts for about 8.43% of the wheat area of India and produces over 12% of the total wheat of the country. Karnal , Kurukshetra , Ambala, Kaithal , Panipat, Sonipat, Rohtak etc are important wheat producing districts.
5. Rajasthan: Rajasthan accounts for 9.68% of the total wheat production and 9.51/5 of wheat area of India.

**Green Revolution- Achievements and Causes**

The Indian economy traditionally was an agricultural economy. Most of the food produced in the village was consumed by the farmers themselves. However India was prone to periodic famines which lead to considerable human loss and suffering. In 1943 i.e. 4 years short of Indian independence 4 million people died in British ruled India because of the famine of Bengal.

So in 1947 food security was of paramount concern on free Indian agenda.

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This concern led to the Green Revolution is applied to the period from 1967 to 1978. Between 1947 and 1967 efforts at achieving food self-sufficiency were not entirely successful.

The term Green Revolution is a general one that is applied to successful agricultural experiments. It is not specific to India. But it was most successful in India.

There were three basic elements in the methods of Green Revolution:

- Continued expansion of farming.
- Double-cropping.
- Using seeds with improved genetics.

### **Achievements:**

The Green Revolution resulted in a record grain output of 131 million tons in 1978-79. This established India as one of the world's biggest agricultural producer. No other country in the world which attempted the Green Revolution recorded such level of success.

1. India became an exporter of food grains around that time.
2. Yield per unit of farmland improved by more than 30% between 1947 and 1979.
3. The crop area under HYV grew from 7% to 22% of the total cultivated area during the 10 years of Green Revolution.
4. The increase in irrigation created new dams. The water stored used to create hydro-electric power. This in turn boosted industrial growth, created jobs and improved the quality of life in the villages.
5. India paid back all loans it had taken from World Bank.

### **Concerns:**

- The Green Revolution however impressive has not succeeded in making India totally and permanently self-sufficient in food. 1979 and 1987- India faced severe drought conditions and had to import food.
  - Small farmers had to bear the burden of Green Revolution because many farmers have difficulty paying for expensive technology and seeds, especially in case of a bad harvest.
  - The excessive use of chemical fertilizers decreased soil fertility and the use of electric tube wells decreased groundwater table in water logged areas the salinity of soil has also increased especially certain areas of Punjab and Haryana are becoming unproductive for agriculture.
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- Since Green Revolution was introduced in traditionally prosperous states like Punjab, Haryana and western U.P in the north, Tamil Nadu etc. but it has not made much of an impact on Bihar, West Bengal, Madhya Pradesh, J and K etc. thus causing wide regional disparities.
  - The sub-continent has lost many indigenous varieties of seeds that were traditionally grown to the H.Y varieties of seed.
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## Introduction

The state of Jammu and Kashmir constitutes northern most extremity of India and is situated between  $32^{\circ} 17'$  to  $36^{\circ} 58'$  north latitude and  $37^{\circ} 26'$  to  $80^{\circ} 30'$  east longitude. It falls in the great northwestern complex of the Himalayan Ranges with marked relief variation, snow-capped summits, antecedent drainage, complex geological structure and rich temperate flora and fauna. The state is 640 km in length from north to south and 480 km from east to west. It consists of the territories of Jammu, Kashmir, Ladakh and Gilgit and is divided among three Asian sovereign states of India, Pakistan and China. The total area of the State is 222,236 km<sup>2</sup> comprising 6.93 per cent of the total area of the Indian territory including 78,114 km<sup>2</sup> under the occupation of Pakistan and 42,685 km<sup>2</sup> under China. The cultural landscape of the state represents a zone of convergence and diffusion of mainly three religio-cultural realms namely Muslims, Hindus and Buddhists. The population of Hindus is predominant in Jammu division, Muslims are in majority in Kashmir division while Buddhists are in majority in Ladakh division. Jammu is the winter capital while Srinagar is the summer capital of the state for a period of six months each. The state constitutes 6.76 percent share of India's total geographical area and 41.83 per cent share of Indian Himalayan Region (Nandy, et al. 2001). It ranks 6<sup>th</sup> in area and 17<sup>th</sup> in population among states and union territories of India while it is the most populated state of Indian Himalayan Region constituting 25.33 per cent of its total population.

The state is bounded on north by China and Afghanistan, Tibet on east, Pakistan on west and on south by Himachal Pradesh and Punjab states of India. The State is well connected with rest of the country by air, rail and road. The National Highway 1-A connects the capital cities of Srinagar and Jammu with rest of the country. The mountain chains that adorn the region include the Karakoram Range, Nun Kun range, the Zaskar range and Nanga Parbat. The State of Jammu and Kashmir has many Himalayan rivers flowing through it; the most significant among these are the Indus, Jhelum and Chenab. Among the glaciers are the Baltoro and Siachen Glaciers. There are many low lying valleys in the state like Tawi Valley, Chenab Valley, Poonch Valley, Sind Valley and Lidder Valley, but the main Valley is the valley of Kashmir, which is 100 km wide and 15520.3 km<sup>2</sup> in area.

## Administrative Divisions

Jammu and Kashmir is a multi-lingual, multi-religious and multi-racial state and each group has its own distinct and peculiar cultural ethos, further deepened by geographical divisions created by

formidable mountain ranges. The state comprises of three natural divisions, namely, Jammu, Kashmir and Ladakh. For administrative purposes, the state is divided into two main divisions, i.e., Kashmir and Jammu Provinces. A Divisional Commissioner heads the administration of each division. The two districts of Ladakh region, namely, Leh and Kargil are part of the Kashmir Division for purposes of administration. A Deputy Commissioner who is also District Development Commissioner, heads each district. In Ladakh region, the 'Autonomous Hill Development Council' was established in 1995 as part of decentralized administration. The districts are divided into blocks for development purposes and into tehsils for revenue purposes. The state consists of 22 districts with Kashmir and Jammu divisions equally having 10 districts each and the remaining two districts belonging to Ladakh division.

**Jammu Region:** The Jammu region is situated on the North Indian plains, close to the Siwalik ranges. This region comprises the plains, hills and mountains south and west of the mighty Pir Panjal range that separates Kashmir Valley from the plains of the subcontinent. North of the Siwaliks, the rest of the Jammu region is drained by the Chenab River whose vast catchment area includes several narrow valleys that extend deep into the Himalayas. Jammu is about 305 meters above the mean sea level (MSL). Jammu is famous for its ancient temples and palaces. Today, the Jammu region comprises the districts of Kathua, Jammu, Udhampur, Doda, Rajouri, Ramban, Kishtiwari, Reasi, Samba and Poonch.

**Kashmir Region:** The Kashmir region or valley is a significant part of the state. The valley is an ancient lake basin 140 km long and 32 km wide (Raza, 1978). The average elevation of the valley is 1630 m above MSL. The tall mountains that surround the valley rising up to 5400 m ensure that the weather here is pleasant for most of the year. The region is famous for its picturesque natural beauty and among other things is known for its Dal Lake that reflects the surrounding snow-capped mountain peaks. Its rich alluvial soil well drained by rivers and streams, yields rice, saffron, vegetables and a variety of fruit. Wular Lake in Kashmir valley is the largest fresh water lake of India which acts as a drainage basin for Jhelum river. The Valley is known for its fresh apples and the intricate embroidery stitching. It comprises of ten districts, namely, Anantnag, Baramulla, Badgam, Kupwara, Pulwama, Shopian, Kulgam, Bandipora, Ganderbal and Srinagar.

**Ladakh Region:** Ladakh constitutes the eastern-most part of the state of Jammu and Kashmir. It comprises of two districts, namely, Leh and Kargil. This is one of the most breathtakingly beautiful parts of the state and its surreal landscape has often been termed as 'moonscape'. Ladakh covers about 117,000 km<sup>2</sup> and includes the Karakoram Range and the upper Indus River valley. Ladakh is

one of the highest places on earth with the average altitude being above 3700 m. Situated on the leeward side of the mountain, it hardly gets any rain. The region is sparsely populated and people live traditional life, herding sheep and yak and growing barley near the river beds in summer. Physical features that characterize the region are its uplands, craggy barren cliffs and plateaus. The mighty river Indus flows right through Ladakh. Leh is famous for its adventure sports. The region is famous for the Leh Palace and the Namgyal Tsemo Gompa monastery.

### **1. Physiography (Physical divisions)**

The state of Jammu and Kashmir possesses a peculiar geo-physical setting as all the major landforms i.e. mountains, plateaus, plains and valleys are present in its landscape. Geographically, the state is divided into four zones – the mountainous and semi-mountainous plain known as Kandi belt, hills including Siwalik ranges, mountains of Kashmir valley and Pir Panjal range, and Tibetan tract of Ladakh and Kargil. The state has a number of lakes, rivers, rivulets and glacial regions. The Physiography of the territory as a whole is divided into seven zones those are closely associated with the structural components of the western Himalayas. These include:

**The Plains:** The outer plain also known as Andarwah and Bajwat is a part of Great Plains of India. The rocks of this region are of fluviate and subaerial formation. Its width varies from 5-25 kilometers and it stretches from river Ravi to River Chenab for an extension of 110 kilometers with the elevation of 330 to 360 meters. The narrow zone of plains in the Jammu region is characterized by interlocking sandy alluvial fans that have been deposited by streams discharging from the foothills and by a much-dissected pediment (eroded bedrock surface) covered by loams and loess (wind-deposited silt) of the Pleistocene Epoch (i.e., those about 10,000 to 1,600,000 years old). Besides Ravi and Chenab the region is also drained by Ujh, Basantar, Tawi and Manawar Tawi. This plain is badly dissected by a series of deep and shallow ravines which carry off the seasonal flood waters of monsoon rains. Such is the number of ravines that there are 200 bridges on the Jammu railway line which passes through this region (Khan, 2001). The mountains of Jammu almost run parallel to the outer plain region. Rainfall is low, amounting to about 15 to 20 inches (380 to 500 millimeters) a year, and it occurs mainly in the form of heavy but infrequent rain showers in the summer (June to September) when the monsoon winds blow. These plains are highly fertile owing to the favorable climatic conditions and assured irrigation which enables the cultivation of crops throughout the year. Jammu, Kathua, Samba, Hiranagar

and Akhnoor belong to the outer plains (Husain, 1987). The countryside has been almost entirely denuded of trees, and thorn scrub and coarse grass are the dominant forms of vegetation. At higher elevations the topography changes and the hill slopes appear wooded.

**The Siwaliks:** The outermost relatively low hills of the Himalayas along its whole length from the Indus to the Brahmaputra are known as the Siwaliks. The width is between 20-50 kms and the altitude ranges between 600 -1200 meters in the state. The Siwaliks are made of the younger tertiary rocks (Husain, 1987). The rocks are deposited in the parallel folded zones. Subjected to folding these low hills resulted in the formation of a series of anticlinal hills with sloping plateaus, gently towards the plain. The hills consist of clay, sand, round pebbles and boulders which are badly dissected by ravines and seasonal stream courses. A series of wide longitudinal valleys called dunes lie to the north of Siwalik hills. Udhampur, Sunderbani, Bosahli, Ramkot and Dansal are typical examples of such dunes. The slope facing the outer plains is gentle covered with deciduous forests while the northern slopes are steep with dense vegetation. Due to the presence of ravines, the Siwaliks appear as isolated and broken hills. Rainfall increases with elevation, and the lower scrubland gives way to pine forests at higher altitudes. The undulating slope adjacent to the plains up to an elevation of 300 m between Ravi and Chenab rivers is locally known as Kandi. Characterized by numerous torrents, hilly soils and scarcity of water. Xerophytic vegetation is common in these areas while agriculture is subjected to the availability of rainfall. Lake Mansar and Sarunsar are situated at an elevation of 600 meters to the east of Jammu city in the Siwalik hills. The important towns are Jammu, Jasrota, Samba and Akhnoor.

**The Middle Himalayas:** The middle Himalayas are also known as the middle mountains, lesser Himalayas or Pir Panjal. They have an east-west extension. They vary in elevation between 1820 m to 2240 m with a width of about 60 kms in the eastern part of Jammu division and 10 kms near Rajouri. This physical division lies between the Ravi in the east and the Poonch in the west and continues up to Muzafarabad. They are locally known as Pahar (mountain) in Jammu region. They are composed of highly compressed and altered rocks of various geological ages, ranging from the puranas and carboniferous to Eocene (Wadia, 1928). Consisting of an ancient rock core of granites, gneisses, quartz rocks and slates, it has been subject to considerable uplift and fracturing and was heavily glaciated during the Pleistocene Epoch (Diener, 1912). Several important rivers like Tawi, Manawar Tawi, Basantra and Ujh have their sources in middle Himalayas. However, Chenab is an important river of this region and the famous Salal

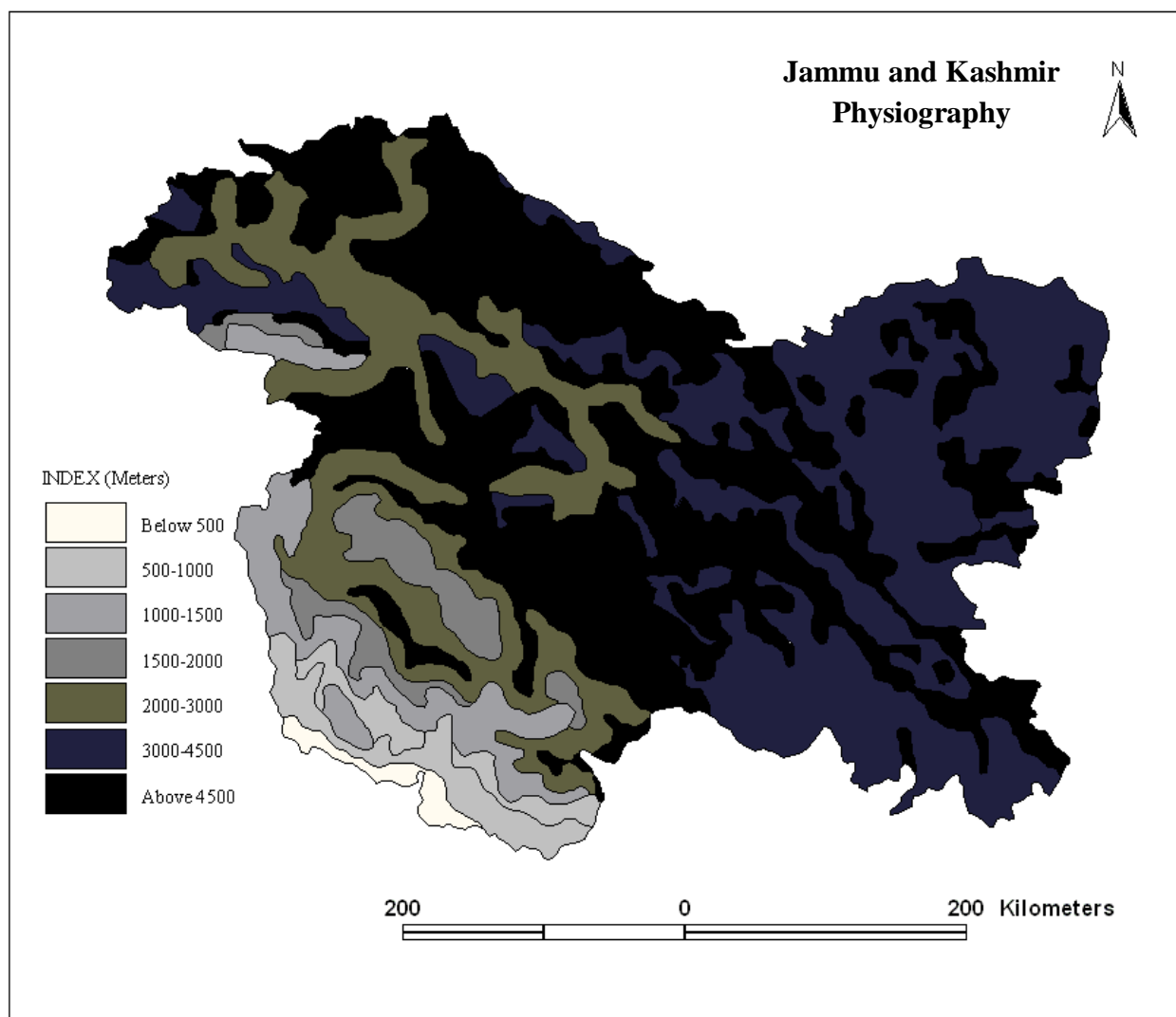


Hydroelectric project near Reasi is constructed on it. The mountains are orthoclinal which is helpful in preserving soil and supporting huge and thick temperate vegetation like deodar, oak, pine, spruce and fir. The range receives considerable precipitation in the form of winter snowfall and summer rain and has extensive areas of pasture above the tree line. The people are largely dependent on forestry, lumbering, herding and tourist activity.

**The Valley of Kashmir:** Between the Pir Panjal and the western end of the Great Himalayan ranges lies a deep asymmetrical basin called the Vale of Kashmir and has an area of 15220 km<sup>2</sup>. Average height of the valley is 1630 metres above MSL (Lawrance, 1996) but the surrounding mountains, which are always snow-clad, rise from 3000-4000 metres above MSL. The river Jhelum, which flows out from the spring at Verinag in Anantnag district, passes through this Valley at a very slow speed and ultimately flows out through a narrow gorge at Baramulla. There are also some small valleys in this region. On the north of Baramulla is Lolab valley which is 6 kms. long and 4.4 kms. wide. It has many meadows and groves of walnut trees. Forests are so thick that they hide villages in them. Sind is the largest tributary of the river Jhelum. The Sind valley is 100 Kms long upwards and its scenery is diversified. At the head of the valley is the Zojilla pass which leads to Ladakh. Towards Pahalgam lies the Lidder Valley. Its length is 64 Kms. It has glaciers, grassy meadows, huge rock walls and gorges in its upper mountains. The path to the holy Amaranth cave passes through this valley. The Kolahoi and Sheshnag streams join at Pahalgam to form the Lidder River. The karewa formation cover a wide range of area on the southern periphery of the valley all along its longitudinal extent. They are divided into sloping karewas and flat topped karewas on the basis of surface characteristics. The sloping karewas are found along the flanks of Pir Panjal range, where they form a continuous series, reaching from Shalura in the north-west to below Shopian in the south-east. The flat topped karewas consist of horizontal beds and attain a thickness of 92 m near Anantnag. Up to 2000 m, woodlands of deodar cedar, blue pine, walnut, willow, elm, and poplars occur; from 2000 to 3000 m coniferous forests with fir, pine, and spruce are found; from 3000 to 3500 m birch is dominant; and above 3500 m there are meadows with rhododendrons and dwarf willows as well as honeysuckle. The climate is characterized by an annual rainfall of about 30 inches, some of which is derived from the summer monsoon winds and some from winds associated with winter low-pressure systems. Snowfall often is accompanied by rain and sleet.

**The Greater Himalayas:** The Greater Himalayan range along with the Zaskar range lie in the northern side of Kashmir valley (Raza, et al. 1978). Geologically complex and topographically immense, the Great Himalayas contain ranges reaching more than 6000 m in altitude and deeply entrenched, remote valleys. The region was heavily glaciated in the Pleistocene (Wadia, 1928) and remnant glaciers and snowfields are still present. Beyond this range lies the high plateau-desert which is devoid of any kind of vegetation. The elevated plateaus and ridges are separated from one another by great depressions. The altitude rises further north till the peak K2 (second highest peak in the world) in the Karakorum range attains the height of 8621 m. The Zaskar range is situated at an altitude of 5940 m. This range is famous for its two river valleys-the Zaskar and the Suru. The famous Kargil town lies in the Suru valley. The Karakoram region is aptly named the "roof of the world." The zone receives some rain from the southwest monsoon winds in the summer months and hence the lower slopes are forested, but the mountains constitute a climatic divide, representing a transition from the monsoon climate of the Indian subcontinent to the dry, continental climate of Central Asia.

**The Ladakh plateau:** Ladakh is the loftiest inhabited region of the world. Most of the surface area of Ladakh is mountainous and uninhabited as it comprises of old deserts and desolate plateaus intervened by difficult passes and valleys. The mountain chain of Ladakh stretches through the region from south-east to north-west with the altitude ranging between 5180-6400 m. Owing to the great aridity of the atmosphere, the climate is extreme, from burning heat of some of the deserts to several degrees below freezing point at night.



## 2. Drainage

The drainage system of Jammu and Kashmir state is of recent origin owing to the mountain building process of late Tertiary age. The drainage system is antecedent in nature which means that most of the rivers are older than the mountains they traverse. The state is drained by river Indus and its tributaries like Jhelum, Kishanganga, Ravi and Chenab and their tributaries. Fresh and transparent water of these rivers and their tributaries form the most significant features of the landscape. These rivers have the perennial flow due to melting of snow in the Himalayas where from they originate. Indus and Chenab have their sources to the north of Greater Himalayas while Jhelum has its origin near Verinag in the Pir Panjal Range.

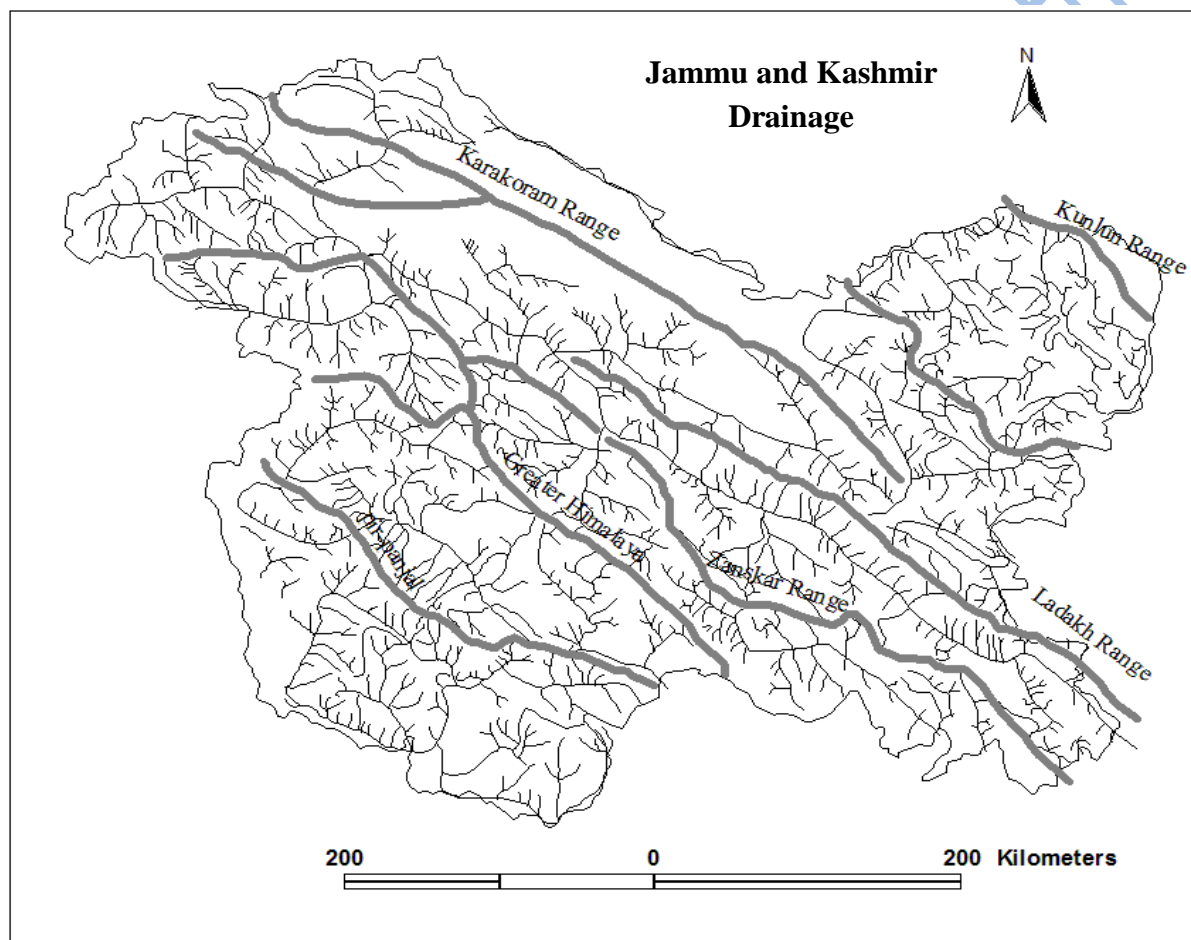
**Indus:** The Indus is one of the largest (25<sup>th</sup>) river systems in the world. The common name of Indus river is Singge-Chhu which means the Lion-River or Sher-Darya. It rises from the northern slopes of Tibet near Mansarowar lake and enters Jammu and Kashmir state near Gartok where it meets Gurtang stream at an altitude of 4245m. The Indus river flows in a north-westerly direction through the trough between the Kailash and the Ladakh range. Hanle, Suru and Zaskar are the left bank tributaries while Shyok, Shigar, Astor and Gilgit are the right bank tributaries. The river has many alluvial fans and river terraces on its either sides stretching over a distance of 30kms. The flow is subjected to extreme variations with the maximum flow in the summer months (June to August) when the snow melt is high. The total length of the river is 2900 kms of which it runs for a distance of 966 kms in Jammu and Kashmir and finally through Pakistan falls in the Arabian sea near Karachi.

**Jhelum:** The river Jhelum rises from Pir Panjal Ranges about one kilometer ahead of Verinag. The river Jhelum is known as Veth in Kashmir valley. When it leaves Kashmir at Baramulla it is called the Kashur Darya and after joining the Kishanganga it is called Jhelum. Jhelum joins the Indus in the Punjab state of Pakistan. The river meanders in the valley, enters the Wular lake, leaves it near Sopore and flows in the narrow Gorge across the Pir Panjal from Baramulla to Muzafarabad (Raza, et al. 1978). In ancient times the river Jhelum served as the most important highway of Kashmir. The famous waterfall of Aharbal (21m) is formed by the stream of Vishav. The Jhelum and its tributaries are the main channels of drainage which sculpture the area during their course. The discharge is maximum during south-west monsoon when heavy and widespread rainfall occurs throughout the length and breadth of the valley. Sandran, Breng, Arpat, Lidder, Harwan, Sind, Erin, Madhumati, Pohru and Viji-Dakil are the right bank tributaries while Vishav, Rambhara, Romushi, Dudhganga, Sukhnag and Ningal are the left bank tributaries.

**Kishanganga:** This is an important tributary of river Jhelum. It has its origin in Kishansar lake located in Drass mountains and hence named as Kishanganga. It drains the Gurez valley and finally merges into Jhelum river at Domel near the city of Muzafarabad. The total length of the river is 288 kms. Throughout the Gurez front, the river is completely frozen over during the winter season. It separates the valley of Kashmir from Pakistan at present.

**Chenab:** This river is formed by two streams of Chandra and Bhaga at an elevation of 4891 m in Himachal Pradesh. The river flows between the Himalayas and the Pir Panjal Range and then takes a turn to the south through a gorge. It flows through Doda, Reasi and Akhnoor. From

Akhnoor the river assumes the plain stage and is navigable. From Tandi to Kishtiwar the river has many gorges, rapids and falls. At Kishtiwar the river receives a perennial tributary known as Wadwan stream and makes a typical gorge about 1000 feet below Kishtiwar valley. The Chenab is about 1180 kms long in the state of Jammu and Kashmir. Important power projects of Salal Hydel Project (345MW) and Dulhasti (390MW) are generating electricity through the waters of river Chenab in Reasi and Kishtwar areas respectively.



**Tawi:** This river arises from Sewajdhar near Badarwah. The river passes through Ram Nagar, Chenani, Udhampur, Nagrota and Jammu before its confluence with Chenab at Akhnoor. It has a total length of 120 kms.

**Ravi:** This river rises from the southern slopes of the Pir Panjal. The river passes through Madhupur and Kathua before entering into Pakistan to meet Indus. Total length of this river is about 65 kms.



### 3. Climate

The climate of the state differs from region to region on account of great variations in altitude, location and topography. The tropical heat of the Punjab and the arctic cold of Ladakh are the extremes, and there are certain places where snow makes the life stagnant for about seven months in a year. The climate of the state varies from tropical in Jammu plains to semi-arctic cold in Ladakh with Kashmir and Jammu mountainous tracts having temperate climatic conditions. The temperature of the state varies spatially. Leh is the coldest ( $-28^{\circ}\text{C}$  average) while Jammu is the hottest. Mean monthly temperature is lowest in January and highest in July except in Jammu where highest temperature is experienced in June. Mean monthly temperature in January varies from  $-17^{\circ}\text{C}$  at Drass to  $14^{\circ}\text{C}$  at Jammu; Kargil and Leh being other stations of below freezing average. Considering the overall distribution of climatic elements, four units become obvious:

1. The windward (Jammu region)
2. The leeward (Ladakh region)
3. The high altitude Kashmir (Himadri, Pir Panjal)
4. The Kashmir valley.

In the winter nights, temperature goes down below zero and very often heavy snowfall occurs during November to February. The annual rainfall varies from region to region with 92.6 mm in Leh, 650.5 mm in Srinagar and 1,115.9 mm in Jammu. In the outer hilly region of the Jammu Province, climate has three main seasons: (i) hot weather from April to June, (ii) a rainy season from July to September and (iii) cold weather from October to March. The altitude of the State rises steeply from 305 metres to 6910 metres above MSL. There are the hot plains of the Jammu Province and the cold dry tableland of Ladakh. The area has different weather conditions at different places because of the lofty mountains like the Pir-Panjal, the Zaskar and the Karakoram that check the moisture-laden winds from entering the valleys.

In summers, the outer plains and the outer hills receive rainfall from monsoon winds while in winters, winds from the Mediterranean cause snowfall and rainfall in the Valley of Kashmir. The moisture-laden winds cause rainfall in the forests on the hills making the temperature to fall in summer; hence, the thickly wooded areas such as Pahalgam and Gulmarg have milder weather conditions than that of Srinagar. Similarly, the climate of the valley of Kashmir is comparatively

milder than that of the Outer Plains as it is on higher altitude therefore making it one of the most liked tourist destinations during summer.

### Seasons of Kashmir Valley

Season	Date	Local Name
Spring	16 March to 15 May	SONTH
Summer	16 May to 15 July	RETKOL
Rainy season	16 July to 15 September	WAHARAT
Autumn	16 September to 15 November	HARUD
Winter	16 November to 15 January	WANDAH
Ice cold	16 January to 15 March	SHISHUR

The climate of the valley of Kashmir has its own peculiarities. The seasons are marked with sudden change and the climate can be divided into six seasons of two months each (Raina, 2002). In the Kashmir Province there is not much rise in the temperature up to and end of May, but in June, July and August the temperature can rise up to 32°C in shade. After August there is a decrease in the temperature and by the end of October it becomes cold and by January cold becomes intense with the snowfall. The snowy period lasts for two and half months beginning December through January to middle of March. During winter Dal Lake sometimes gets frozen, enabling people to skate over it. The distinctive features of Kashmir's climate is the absence of monsoon rain, because the monsoons cannot cross the mountains enclosing Kashmir on the south.

### 4. Natural Vegetation

The term natural vegetation is used loosely to describe any plant life that is not organized or influenced by mankind. The state is well endowed in forest resources. The forests have great diversity in species and varieties, ranging from the lush green margs (alpine pastures) to evergreen conifers on the gentle slopes of the Middle and the Greater Himalayas, and from scrub jungles of the foothills to the deciduous forests of the Siwaliks and the Pir Panjal Range. The natural vegetation of the state has great altitudinal variations and latitudinal zonation. There is hardly any vegetation at 5550 m above MSL because most of the plants cease growth when the soil temperature drops below 5°C.

There is a great diversity in the natural vegetation of the state as about 4000 species belonging to 1500 genera are found in the state. Some of the important forests of the state consist of deodar, juniper, pine, spruce, fir, yew, alder, elm, sorrel, poplar, birch, maple and mulberry. Being situated at higher latitudes and characterized by undulating and mountainous topography, most of the forest of the state belong to the coniferous category. The lower end of the greater Himalayas are quite rich in timber forest. The state is relatively poor in natural vegetation as compared to the other Himalayan states of India.

During the last 60 years a substantial proportion of forests has been cleared and brought under agriculture and pastures. Forests have numerous productive, protective and bio-aesthetic functions. Forests constitute 14.5 per cent of the state's total geographical area. About 35 per cent of the total forest area lies in Jammu division, the rest being shared by Kashmir and Ladakh divisions. The most valuable timer, that of Deodar (Oak) is mainly found in Baramulla, Anantnag, Doda and Udhampur districts. In order to understand the spatial distribution of different types of natural vegetation, the forests of the state may be classified into the following categories.

#### District-wise forest area, Jammu and Kashmir, 2008-09

S. No.	District	Area under forests (km <sup>2</sup> )			Percentage of total forest area
		Forest area	Wild life area	Total forest area	
1	Anantnag	2068	546.75	2614.75	7.34
2	Pulwama	810	273.25	1083.25	3.039
3	Srinagar	380	311	691	1.94
4	Badgam	477	3.25	480.25	1.35
5	Baramulla	2690	384.75	3074.75	8.63
6	Kupwara	1703	-	1703	4.78
7	Leh	29	13018	13047	36.61
8	Kargil	7	112	119	0.33
9	Jammu	959	256.5	1215.5	3.41
10	Udhampur	2343	42.25	2385.25	6.69
11	Kathua	991	44.75	1035.75	2.91
12	Doda	5555	418	5973	16.76
13	Rajouri	1267	-	1267	3.55
14	Poonch	951	-	951	2.67
<b>Jammu and Kashmir</b>		<b>20230</b>	<b>15410</b>	<b>35640</b>	<b>100.00</b>

Source: Digest of statistics 2008-09, Government of Jammu and Kashmir, p. 138

**Subtropical Forests:** These forests are confined to the Siwaliks and lower slopes of the middle Himalayas. There is great diversity of trees in these forests because of the various edaphic factors and seasonality of rainfall. The dominant species are teak, sal, shisham, papal, tun, silver-pine, and reed. These forests are mainly utilized for fuel wood, timber, agricultural implements and miscellaneous purposes.

**Temperate Forests:** As the latitude and altitude increases towards the north, the subtropical forest are replaced by temperate forests. The slopes of Pir Panjal, Greater Himalayas, Karakorum and Zaskar between 1500 m to 3000 m are dominated by temperate forests. Deodar, pine, silver fir, spruce, alder, cedar, sorrel, birch and hazal are the dominant species.

**Alpine Pastures:** Alpine pastures also known as margs lie between 3600 m to 4000 m above MSL. The climate in these margs is extremely cold over most parts of the year which is supporting only some of the dwarf varieties of birch and junipers making a shrubby appearances. The lush green and nutritious grasses of these pastures are utilized by the Gujjars and Bakarwals who practice transhumance.

Forests are mainly found where the annual rainfall is about 100 cm. However, scrub forests are found where rainfall is less than 100 cm. Forests are one of the most important resources of Jammu and Kashmir. More than 99 per cent of forest area is confined to the province of Jammu and Kashmir only. The forest area of 2008-09 shows that 35640 km<sup>2</sup> of the state's area is under forest which constitutes 35.15 per cent of the total geographical area of the state on this side of the line of Control. Out of this, more than 99 per cent of the forest area is confined to the province of Jammu and Kashmir only, with the largest area of 5973 km<sup>2</sup> in the district of Doda and smallest area of 119 km<sup>2</sup> in the district of Kargil. Leh records the highest percentage of forest area (36.61 per cent) only because of the fact that it has got the highest percentage of the total wild life area (84.47 per cent) of the state. Vegetation is influenced by climate, rainfall soil and altitude. Since these factors vary as the altitude rises from the outer plains of Jammu Province to the loftiest mountain ranges of the Inner Himalayas, it is but natural that the vegetation should vary from the Inner Himalayas to the middle mountains and the outer plains of Jammu region. Over 19,236 km<sup>2</sup> is under coniferous softwood (Pine) and 946 km<sup>2</sup> under non-coniferous softwood. In the coniferous category, fir accounts for 3355 km<sup>2</sup>, kail for 1874 km<sup>2</sup>, chir for 1773 km<sup>2</sup> and deodar for 1122 km<sup>2</sup>.

## Demographic Profile

The state has a population of 12548926 (census of India, 2011) with a density of 124 persons per km<sup>2</sup>. The most striking feature of population is its uneven distribution, which is closely related with relief and climate. The state is one of the least populated state's of India because only 10 per cent of its area is suitable for cultivation.

### 5. Population distribution

The spatial distribution of population in Jammu and Kashmir is highly uneven. The physical factors like terrain, topography, slope, climate, soil, natural vegetation and accessibility have largely controlled the distribution and density of population in the state. In general, about 85 per cent of the total population of the state is occupying the Jammu plain and Kashmir valley (Jhelum floor), 14 per cent is living in the Kandi areas and the side valleys within 2000 m above MSL while the remaining 1 per cent is sprinkled in the high altitudinal zones of the Himalayas, Zaskar, Ladakh, and Karakorum Ranges (Qazi, 2005). Kashmir division constitutes 55 per cent of the total state's population while 42.64 percent is distributed in Jammu division and the rest 2.3 percent population is dwelling in Ladakh division. The population distribution pattern among the districts indicates high concentration in Jammu district followed by Srinagar, Anantnag and Baramulla. These four districts also have maximum concentration of urban population. Least concentration of population is in Leh, Kargil, Poonch, Rajouri, Kathua and Badgam districts.

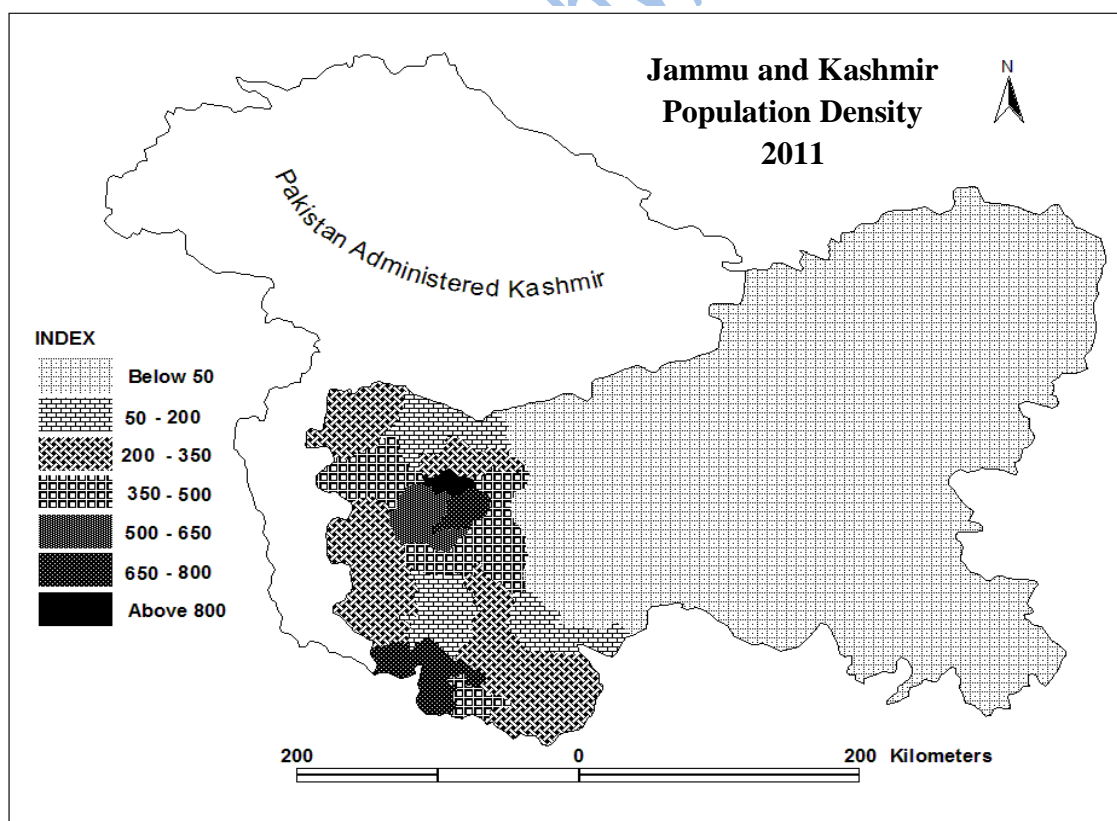
#### Division wise distribution of population, Jammu and Kashmir, 2001 and 2011

S. No.	Division	Population 2001		Population 2011	
		Absolute	Percentage	Absolute	Percentage
1	<b>Kashmir</b>	5441341	54.04	6907623	55.05
2	<b>Jammu</b>	4395712	43.65	5350811	42.64
3	<b>Ladakh</b>	232864	2.31	290492	2.31
<b>Jammu and Kashmir</b>		<b>10069917</b>	<b>100</b>	<b>12548926</b>	<b>100</b>

Source: Census of India, 2001 and 2011.

## 6. Population Density

Density of population in the state is 124 persons per km<sup>2</sup>. Srinagar and Jammu districts recorded high density of population of 2860 and 674 persons per km<sup>2</sup> respectively, mainly on account of being the state's administrative capitals which have made them the hub of socio-economic activities. The lowest population density is found in the Ladakh division with only 3 persons per km<sup>2</sup> in Leh district. The population distribution and density pattern indicates an overwhelming influence of geo-physical disposition across the different regions of the state. In addition to this centralized distribution of small manufacturing and service sectors in few urban centers have also influenced the population density and distribution pattern as well. Since social, economic and technological development are in the early stages, agricultural land capability (growing season, irrigation) and carrying capacity of land (soil fertility) and concentration of non-agricultural economic activities especially service activities has played significant role in population concentration and high density of population in Jhelum Valley Floor consisting of Srinagar, Badgam, Pulwama, Anantnag and Baramulla districts.





**District wise demographic profile, Jammu and Kashmir, 2011**

S. No.	District	Area (km <sup>2</sup> )	Population (persons)		Growth rate (per cent)	Density persons/km <sup>2</sup>	sex ratio	Literacy (per cent)
			2002*	2011				
01	Kupwara	2587	667674	875564	31.14	338	843	66.92
02	Badgam	1243	621750	735753	18.34	592	883	57.98
03	Leh	43215	120347	147104	22.23	3	583	80.48
04	Kargil	14843	122477	143388	17.07	10	775	74.49
05	Punch	2187	382513	476820	24.65	218	890	68.69
06	Rajouri	2715	496125	619266	24.82	228	863	68.54
07	Kathua	2983	525044	615711	17.27	206	877	73.50
08	Baramulla	2320	832650	1015503	21.96	438	873	66.93
09	Bandipora	2622	361592	385099	6.50	147	911	57.82
10	Srinagar	444	1046880	1269751	21.29	2860	879	71.21
11	Ganderbal	1402	218415	297003	35.98	212	869	59.99
12	Pulwama	827	453000	570060	25.84	689	913	65.00
13	Shopian	462	216947	265960	22.59	576	951	62.49
14	Anantnag	2559	759995	1070144	40.81	418	937	64.32
15	Kulgam	1181	300198	422786	40.83	358	951	60.35
16	Doda	2124	328765	409576	24.58	193	922	65.97
17	Ramban	935	220655	283313	28.40	303	901	56.90
18	Kishtiwar	8686	195914	231037	17.93	27	917	58.54
19	Udhampur	2654	471695	555357	17.74	209	863	69.90
20	Reasi	2344	254275	314714	23.77	134	891	59.42
21	Jammu	2266	1393135	1526406	9.57	674	871	83.98
22	Samba	788	279780	318611	13.88	404	886	82.48
<b>Jammu and Kashmir</b>		<b>101387</b>	<b>10269852</b>	<b>12548926</b>	<b>24.61</b>	<b>124</b>	<b>883</b>	<b>68.74</b>

Source: Census of India, 2011; \* Digest of Statistics, 2008-09.

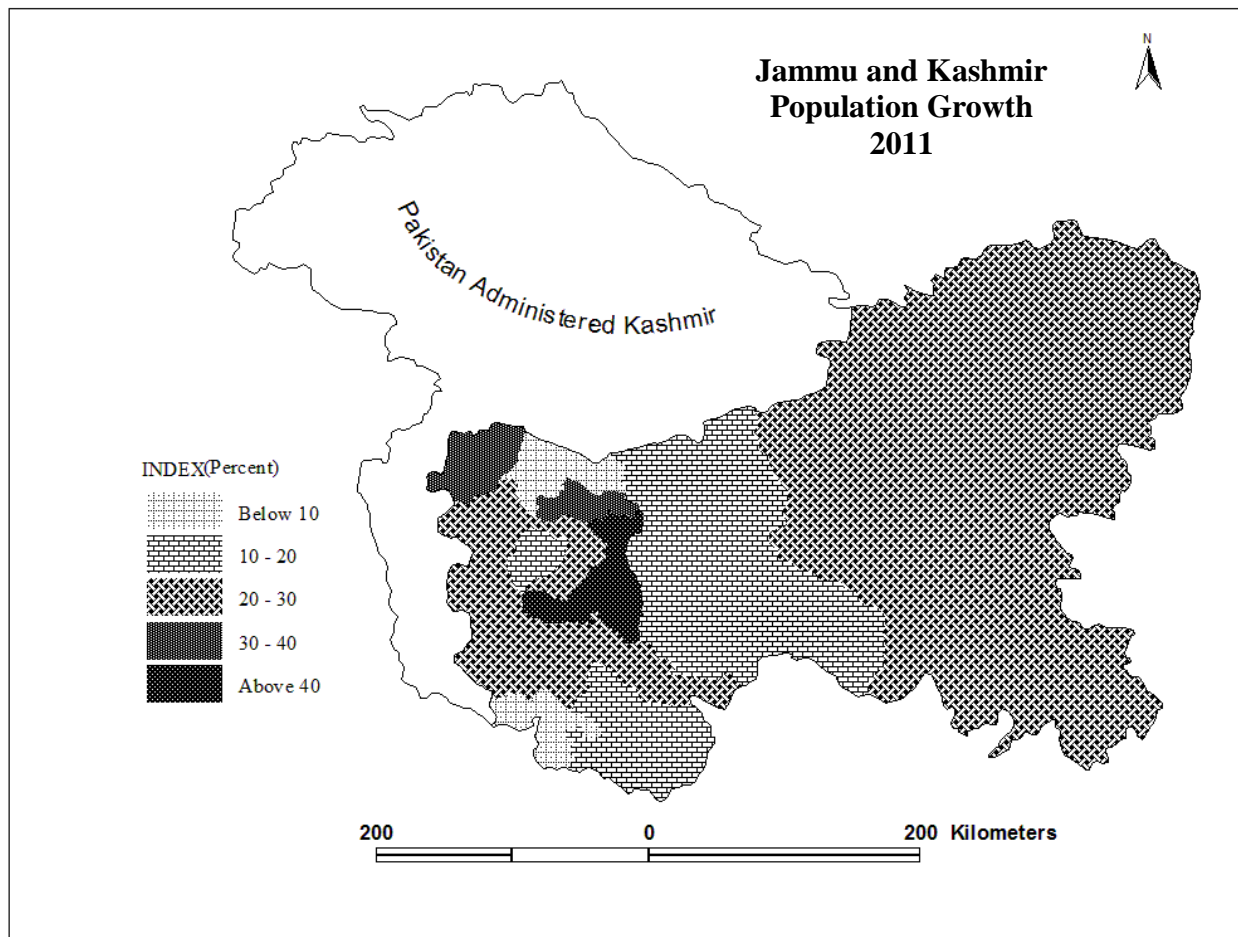
## 7. Population Growth

The size of population and its growth have a direct bearing on the economic development, social well being and political stability of a region. Population growth is, thus, pivotal in the regions demographic dynamism (Chandna, 1992). The population of the state has increased more than two fold in the state during the last 30 years. In the first two decades of the 20th century the population growth was below 10 per cent. After 1931, it was raising at a constant rate of 10 per cent per decade up to 1961, where from it has an unprecedented rise of 29 per cent per decade which is one of the highest growth rates in the country (17.64 percent for India). The districts of Kulgam, Anantnag, Ganderbal, Kupwara, Poonch and Rajouri have registered high decadal population growth rate than the state average of 24.6 percent, while it is very low in the districts of Bandipora and Jammu. Further, it is below the state average in both the districts of Ladakh region. However, decadal population growth was the highest (40.83 percent) in Kulgam district and the lowest (6.5 per cent) in Bandipora district.

### Decadal population growth, Jammu and Kashmir, 1901 – 2011

Year	Population	Density (Persons/km <sup>2</sup> )	Percentage Growth	Urban Population		
				Absolute	Per cent	Percentage Growth
1901	2139362	21	-	158748	7.42	-
1911	2292535	23	+7.16	268518	11.71	+69.2
1921	2424359	24	+5.75	267754	11.04	-0.28
1931	2670208	26	+ 10.14	317805	11.90	+8.7
1941	2946728	29	+ 10.36	386565	13.11	+21.64
1951	3253852	32	+ 10.42	457213	14.05	+ 18.28
1961	3560976	35	+9.44	593315	16.66	+29.77
1971	4616632	46	+29.65	858221	18.58	+44.65
1981	5987389	59	+29.69	1260403	21.05	+46.86
1991*	7803900	77	+30.34	1676914	21.94	+33.04
2001	10069917	99	+29.04	2505309	24.87	+49.4
2011	12548926	124	+24.61	3815585*	30.4	+52.3

Source: Census of India, 2001; \* Projected figures



## **8. Agriculture**

Agriculture is the mainstay of more than 70 per cent people in Jammu & Kashmir and 54 per cent of the total work force directly depends on this sector for their livelihood. Major food crops are wheat, paddy and maize. Barley, jowar and bajra are also cultivated in some parts of the state. Agro-climatic condition of the state support horticulture; about 5 lakh families, directly or indirectly, are related with horticulture activities. Although the net area sown has remained more or less same (7.31 lakh hectare in 1990-91 to 7.38 lakh hectare in 2008-2009), the area under fruit and vegetable cultivation has marginally increased over the same period of time. In respect of fruit and vegetables, it has gone up from 60041 thousand hectare in 1990-91 to 87421 thousand hectare in 2008-2009. Production of food grains has registered an increase of 3.62 per

cent during the year 2008-09 as it has increased to 16275 thousand quintals from 15707 thousand quintals during the year 2007-08 (Economic Survey Report, 2008-09).

Rice, the staple crop, is planted in May and harvested in late September. Maize is the second-most important crop. The best soil for rice is reclaimed swamp and enormous crops are raised from the black peaty land, which lies under the banks of river Jhelum. In the high villages occupied by the Gujjars, very fine crops of maize are grown. In 2008-09 maize was cultivated on 31.14 per cent of the total area under food crops followed by wheat 27.46 per cent and rice 25.41 per cent. Jammu district has the highest area under rice cultivation (18.63 per cent of the total area under rice in the state) followed by Kathua (13.08 per cent), Anantnag (9.82 per cent) and Kulgam (7.1 per cent) while Rajouri has the highest area under maize (14.80 per cent) followed by Udhampur (10.87 per cent), Doda (8.17 per cent) and Jammu (7.45 per cent). Jammu also leads in the area under wheat (29.78 per cent) followed by Kathua (19.14 per cent), Samba (10.5 per cent) and Udhampur (10.25 per cent). The average yield of rice has increased from 16.9 quintals per hectare (Q/ha) in 2001-02 to 21.88 Q/ha in 2008-09 with the highest yield of 24.5 Q/ha in Kashmir Division (Digest of Statistics, 2008-09). The average yield of Maize has increased from 16.48 Q/ha in 2001-02 to 20.05 Q/ha in 2008-09 with the highest yield of 23.58 found in Jammu division. Wheat has also increased its yield from 113.21 Q/ha in 2001-02 to 17.35 Q/ha in 2008-09 with the highest yield of 17.5 recorded in Jammu division. Large orchards in the valley of Kashmir produce apples, pears, peaches, walnuts, almonds, cherries and apricot. Apple cultivation is carried on 65.15 per cent of the area under orchards followed by pear 6.17 per cent, citrus 6.01 per cent and mango 5.26 per cent. The state leads in terms of production of apples, walnuts, pears, saffron, almonds and apricots, and has a huge potential for export of processed food and allied services.

The state of Jammu and Kashmir is the largest producer of saffron in the Indian subcontinent. It is a gifted crop which fetches a fair price in both national and international market. The cultivation of saffron is restricted to the Karewas in Kashmir valley and Kishtwar district in Jammu division. It has been grown on the table lands of Pampore since last 2500 years and is the world's costliest spice. The Pulwama district with 73 per cent of the total saffron area leads in both area and production. Artificial floating gardens on the lakes are favorable for the cultivation of flowers and vegetables. In Ladakh, there is only one cropping season-Kharif, which extends from March to October. Cultivation in Ladakh is restricted to near the main

valleys of Indus, Shyok and Suru rivers, where apricot, barley, buckwheat, turnips and mustard are grown. Recently, strawberry cultivation has also been introduced in Ladakh. Pastoralism and cattle breeding have long been the vital features of the Ladakh economy. The Kashmir goat raised in the region provides pashmina for the production of fine fabrics.

## **9. Tourism**

Kashmir is known as the paradise on earth because of its numerous scenic spots along with other important tourism attractions such as shrines, monasteries, temples and caves in the three regions. Major tourist places are Chashma Shahi springs, Shalimar Bagh and Dal Lake, etc., in Srinagar; Gulmarg, Pahalgam and Sonamarg, etc., in the Valley; various ancient temples, Buddhist sites and scenic beauty in Ladakh; Vaishno Devi temple and Patnitop near Jammu, etc. Tourism is considered to be central nerve of the state economy with both forward and backward linkages and trickle down effects. The tourism sector with a revenue generation of more than Rs 3000 crores, provides employment to about 5 lakh people. It contributes 16 per cent to state domestic product. The sector with its potential for employing people across the skill spectrum and positive externalities for other sectors like handicrafts, handlooms and transport occupies an important place in the development and employment strategy of the state. Tourism as an industry not only preserves the culture and heritage but also conserves the fragile environment of the state. The state is endowed with rich tourism resource and like its power potential tourism too has harnessed only one fourth of potential so far.

### **Tourist arrivals to Kashmir valley and pilgrim tourists**

S.No.	Year	No. of tourists		Growth in percent	
		Kashmir Valley	Yatris	Kashmir valley	Yatris
1	1980	595117	19578	---	---
2	1985	503614	42000	-15.37	114.53
3	1990	10,722	4824	-97.87	-88.51
4	1995	8,520	60000	-20.53	1143.78
5	2000	11,912	173334	39.81	188.89
6	2005	6,05,382	388000	4982.11	123.84
7	2010	6,01,252	264413	-0.68	-31.85

Source: Department of Tourism, Srinagar.

Tourist arrivals in the valley have waxed and waned in tandem with the security situation. After declining to an all-time low of 27,356 visitors in 2002, it steadily increased to 6 lakh plus in 2010. The number of pilgrims who visited Amarnath had gone up to 5 lakh in 2008 while 81.8 lakh tourists visited Vaishno Devi in 2009. However the total tourist arrivals has decreased considerably in 2010. Though the total tourist arrivals in Ladakh are lower than in the other two regions, it attracted the largest number of foreign visitors. Ladakh's potential to develop as an important international tourist destination in the state is evidenced by the steady increase in foreign visitors whose numbers have risen from 22,000 in 2004 to 30,446 in 2009. Tourism Department alone has earned Rs 73 crore in 2006-07 (Economic Survey Report, 2008-09). The 2009 Performance Review of Jammu and Kashmir Economy stresses that developing, expanding, and upgrading tourist infrastructure is a priority in the initiatives being pursued in the state and national development plans. Fifteen development authorities have been established, more than tripling the previously existing total of four. They are specifically charged with developing tourist infrastructure in new areas while upgrading facilities in popular tourist destinations. Directorate of Economics & Statistics Jammu and Kashmir Economy survey report for 2008-09 mentions that the revenue earnings made under the public sector in tourism sector from 2004-05 till 2007-08 was about rupees 103.62 crore. The percentage increase has been 10.48 per cent for the year 2007-08 as compared to 2006-07. The economic and social impacts on the local community depend on how much of the income is generated by tourists go to the host communities. In most all-inclusive package tours more than 80 per cent of traveller's fees go to the airlines, hotels and other outside companies, not to local businessmen and workers.

In a way the state is economically dependent upon the tourism to a larger extent. State Govt. has also been prioritizing the importance of the state tourism. Jammu & Kashmir tourism Development Corporation (JKTDC) is looking after the interests of tourists coming from outside state and country. The said corporation does make necessary and proper arrangements for providing all sort of adequate facilities to the tourists and the kind of facilitation includes transport, lodging, boarding etc. The corporation provides various types of tour packages to the visitors all the time. Similarly, there are numerous travel agencies operational in the State to look after the best interests of the tourists by providing adequate facilitation of transportation, lodging, boarding etc to them.



## 10. Hydroelectric Power

The Jammu and Kashmir state possesses a huge potential of hydel power resources. The state power development corporation has assumed a potential of 20000 MW and identified about 16000 MW for the four rivers in the state- Chenab (10853.81 MW), Jhelum (3141.30 MW), Indus (1598.7 MW) and Ravi (417.00 MW). Despite the fact that the state could be among the frontline states owing to huge hydel power potential but it is presently facing an acute shortage of energy resources as the current generation is only 1658.59 MW where as the current demand on account of domestic, industrial, agricultural and other demands is estimated about 2000 MW. This acute deficiency in energy sector has impeded not only the industrial development but also the other ancillary sectors of the state. If the power sector is fully developed, the state would certainly attain the status of power exporting states. The hydel power is harnessed through state and central sectors as indicated in the following table.

### Installed capacities of power houses under the State and Centre sector

State Sector				Centre Sector	
S.No	Name of the Power House	Installed Capacity (2008-09) (MWs)	Energy Generated (2008-09) (MUs)	Name of the Power House	Installed Capacity (2008-09) (MWs)
	<b>Thermal</b>			<b>Hydel</b>	
1	Gas Turbine Pampore- I	75.00	0	NHPC -Salal	690.000
2	Gas Turbine-II	100.00	0	NHPC- Uri-I	480.000
3	Diesel	20.74	16.64	NHPC- Dulhasti	390.000
	<b>Total</b>	<b>175.74</b>	<b>16.64</b>		
	<b>Hydel</b>				
A	<b>Jhelum River Basin</b>				
1	LJHP*	105.00	491.872		
2	USHP-I	22.6	84.86		
3	USHP-II	105.00	244.34		
4	Ganderbal	15.00	22.20		
5	Karnah	2.00	2.633		
6	Pahalgam	3.00	6.63		

	<i>Sub-Total</i>	<b>252.60</b>	<b>852.535</b>		
<b>B</b>	<b>Chenab River Basin</b>				
7	Baghliar	450.00	707.63		
8	Chenani-I	23.30	57.10		
9	Chenani-II	2.00	2.81		
10	Chenani-III	7.50	11.13		
11	Baderwah	1.00	0		
	<i>Sub-Total</i>	<b>483.80</b>	<b>778.67</b>		
<b>C</b>	<b>Ravi River Basin</b>				
12	Sewa-III	9.00	7.68		
<b>D</b>	<b>Indus River Basin</b>				
13	Satakna	4.00	5.59		
14	Sumoor	0.10	0.05		
15	Bazgoo	0.30	0.55		
16	Hunder	0.40	0.58		
17	Iqbal Bridge	3.70	7.98		
18	Haftal	1.00	0.18		
19	Marpachoo	0.75	0.15		
20	Igoo Marshelong	3.00	10.09		
	<b>Sub- Total</b>	<b>13.30</b>	<b>25.17</b>		
	<b>Gross Total (Hydel Power Generated)</b>	<b>758.70</b>	<b>1692.530</b>	<b>Total</b>	<b>1560.000</b>
	<b>Intermediate Consumption (Baglihar+Auxiliary Consumption)</b>		33.940		
	<b>Net (Hydro Power Generated)</b>		<b>1658.590</b>		

Source: Economic Survey Report, Jammu and Kashmir, 2008-09