

IIPA2022

# Indian Geography-Physical

## Short Answers

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22

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# 1. Physiographic of India

## About India

India is the seventh largest country in the world in terms of area. It lies on the Indian Plate, which is the northern portion of the Indo-Australian Plate. The Indian subcontinent is surrounded by three different water bodies and is easily recognisable on the world map.

## Location

The Indian mainland extends between 8°4' North and 37°6' North latitudes and from 68°7' East and 97°25' East longitudes. Thus, the latitudinal and the North-south extent is 3214 km and East-west extent is 2933 km. India accounts 2.42% of the total world land area

India lies entirely in the northern hemisphere, and eastern hemisphere. The Tropic of Cancer (23°30' North) passes through the centre of the country. It divides the country into almost two equal parts Northward of this latitude is North India and South of it is known as South India. Similarly 82°30' East longitude passes almost from the middle of the country. It is known as Standard Meridian of India.

India is the largest country in terms of area and population in South-Asia. It is surrounded by the ocean. India is strategically located in the Indian Ocean. It commands sea routes between Europe and Africa, SouthEast Asia, far East Asia and Oceania. It is because of this that India shares good trade relation between many countries since ancient times

## Size

India's total area accounts for about 2.4% of the total geographical area of the world. Thus, it is the 7th largest country in the world, by its size.

- India has a land boundary of about 15,200 km.
- The total length of the coastline of the mainland is 7,516.6 km including Andaman and Nicobar and Lakshadweep.
- India is bounded by the mountains in the northwest, north and northeast. South of about 22° north latitude, it begins to taper and extends towards the Indian Ocean, dividing it into two seas, the Arabian Sea on the west and the Bay of Bengal on its east.
- Time along the Standard Meridian of India (82°30'E) passing through Mirzapur (in Uttar Pradesh) is taken as the standard time for India.



# India and the World

The Indian landmass has a central location between the East and West Asia. India is a southward extension of the Asian continent. The trans-Indian Ocean routes connect the countries of Europe in the West and the countries of East Asia. No other country has as long a coastline on the Indian Ocean as India has. India's contacts with the World have continued through the ages. The spices, muslin and other merchandise were taken from India to different countries. On the other hand, the influence of Greek sculpture, and the architectural styles of domes and minarets from West Asia can be seen in different parts of India.

## India's Neighbours

India has 29 states and seven Union Territories. India shares its land boundaries with:

- Pakistan and Afghanistan in the northwest
- China (Tibet), Nepal and Bhutan in the north
- Myanmar and Bangladesh in the east

## Physical Features of India

- Physiography of an area is the outcome of structure, process and the stage of development. The land of India exhibits great physical variations.
- Indian landmass was the part of great Pangaea (entire landmass) which broke into two parts in the Carboniferous Period due to the force of gravity and buoyancy. The northern and southern parts were subsequently called as Laurasia and Gondwanaland, respectively, leaving



Source: Cosmos Publication

Tethys Sea in the middle.

- Based on these macro variations, India can be divided into the following physiographic divisions:
  - (1) The Northern and North-eastern Mountains
  - (2) The Northern Plain
  - (3) The Peninsular Plateau
  - (4) The Indian Desert
  - (5) The Coastal Plains
  - (6) The Islands
- Geologically, The Himalayan mountains represent a very youthful topography with high peaks, deep valleys and fast-moving rivers. The Himalayas and the Northern Plains are the most recent landforms. The Peninsular Plateau constitutes one of the ancient landmasses and most stable land blocks on the earth's surface. The Northern Plains are formed of alluvial deposits and the Peninsular Plateau is composed of igneous and metamorphic rocks with gently rising hills and wide valleys.
- Gondwanaland further broke up into the peninsular India, Madagascar, Australia, Antarctica etc in the Jurassic Period.
- Peninsular part of India is a part of Gondwanaland, formed from igneous rocks of Archean era which were transformed into Gneiss and Schist.

## 2. Northern Mountain Ranges

### Northern Mountain Ranges

- The Himalayas stretching over the northern borders of India are geologically young and structurally fold mountain ranges of the world. The formation of Himalayas took place due to the collision of the Indian plate and the Eurasian plate.

Karewas are the lacustrine deposits of glacial clay and other material embedded with moraines. They are found on the slopes of Pir Panjal in Jammu & Kashmir.

- Himalayas extending from the Indus Gorge in the west Brahmaputra Gorge in the east terminates suddenly taking sharp southward bend. These bends are called Syntaxial bends of the Himalayas.

#### Important Glaciers in Himalayan Mountains

Glacier	Location	Length (km)
• Siachen	Karakoram	76
• Baltoro	Karakoram	63
• Hispar	Karakoram	61
• Biafo	Karakoram	60
• Batura	Karakoram	58
• Chogo Lungma	Karakoram	50
• Khurdopin	Karakoram	41
• Rimo	Kashmir	40
• Punmah	Karakoram	27
• Rundun	Kashmir	19
• Gangotri	Uttarakhand	26
• Kedarnath	Uttarakhand	14

• Zemu	Sikkim/Nepal	25
• Milam	Uttarakhand	19
• Kanchenjunga	Sikkim/Nepal	16

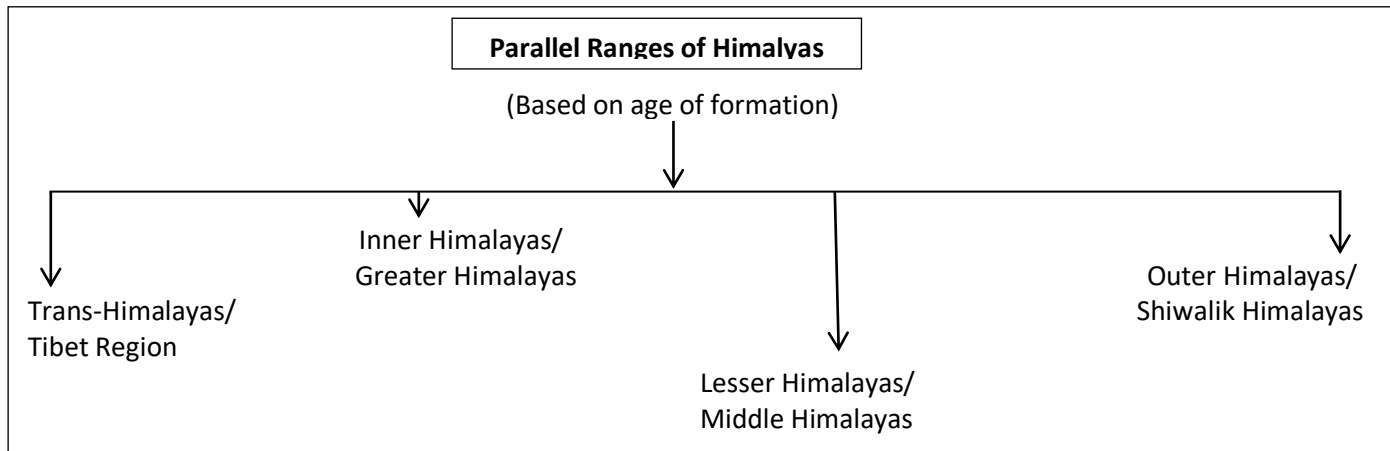
## Valley

A valley is a low lying area between hills or mountains. Geographically, the fertile plains of the rivers are known as the river valley.

### Important Peaks of the Himalayan Mountains

Peak	Country	Height(m)
• Mt. Everest	Nepal	8,848.86
• (K <sup>2</sup> )/Godwin Austen	India	8,611
• Kanchenjunga	India	8,598
• Lhotse	Nepal/Tibet	8,501
• Makalu	Nepal	8,481
• Dhaulagiri	Nepal	8,172
• Mansalu	Nepal	8,163
• Nanga Parbat	India	8,124
• Annapurna	Nepal	7,817
• Nanda Devi	India	7,816
• Kamet	India	7,756
• Namcha Barwa	India/Tibet	7,756
• Saltoro Kangri	India	7,772

## Trans-Himalayas/Tibetan Himalayas



- Trans-Himalayas are the northern parts of the Great Himalayas. These ranges have been formed from sedimentary rocks. Antecedent rivers like Sutlej, Indus, Brahmaputra or Tsangpo originate from this region.
- It is separated in the north from Great Himalayas by the Indus-Tsangpo Suture Zone (ITSZ) or Kailash mountain ranges are categorized under this Himalayas.
- Karakoram ranges are known as the backbone of the Asia. The highest mountain peak of India, K<sup>2</sup> or Godwin Austen is located in this range.
- Karakoram ranges meet the Pamir knot in the west whereas it is extended in the south-east as Kailash range. In the south of this range, Ladakh range acts as a water divide between Indus River and its tributary Shyok River.

Indus River flows between Zaskar and Ladakh range and forms the deepest Gorge (5,200 m) in India by cutting the Ladakh range at bunji.

**Rakaposhi is one of world's steepest mountain peak located in Ladakh ranges.**

## Greater Himalayas

- These are also known as Inner Himalayas or Himadri. This is the highest range of Himalayas. The average height of this range is 6,100 m. It contains all the major ranges of the Himalayas. It ranges 120 km to 190 km.
- Great Himalayan range, also known as the Central Axial range, extends from the gorge of Indus River to the bend of Brahmaputra river in Arunachal Pradesh.
- Almost all the lofty peaks of the world are located in this range. Mt Everest, Kanchenjunga, Nanga Parbat, Nanda Devi, Kamet and Namcha Barwa are its important range.

## Middle or the lesser Himalayas

- These are also known as Himachal.
- Greater Himalayas is separated from the Middle Himalayas by the Main Central Thrust. Its breadth is 60-80 km and average height is 3,000-4,500m.
- Some peaks in this range are more than 5,000 m high and the river flow through deep gorges upto 1,000 m.

<p><b>Famous Duns:</b> Dehradun, Kotlidun, Patlidun. <b>Duar-</b>Haridwar</p>
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- These are part of the Himalayan mountain system having their general alignment form north to south direction.
- In the north, they are known as Patkai Bum, Naga Hills, the Manipur hills and Mizo or Lushai hills. These are low hills, inhabited by numerous tribal groups practicing Jhum cultivation.
- Most of these ranges are separated from each other by numerous small rivers like Barak which is an important river of Manipur and Mizoram.
- Mizoram is also known as the Molassis basin, which is made up of soft unconsolidated deposits.

### 3. Peninsular Plateau

The formation of peninsular plateau can be traced to the Paleozoic era. It was formed due to the breaking and the drifting of the Gondwanaland because of which it is a part of an old landmass.

#### Aravalli Ranges

- Aravalli ranges are located on the western and north-western side of the Peninsular plateau which are highly dissected and are relict of the world's oldest mountain.
- Aravalli hills extend upto 800 km from south-west in Gujarat to north-east in Delhi. They are known as Delhi Ridge near Delhi. The average height of Aravalli is 300-920 m. its highest peak, gurushikhar near Mt. Abu is 1,722 m high.
- These ranges were formed 600 to 570 million years ago during Pre-Cambrian period.
- Mahi and Luhi River originates from the west of Aravallies. Luni river disappears in the Rann of Kutch.

Ephemeral rivers are the rivers that flow only briefly during the period of rainfall and disappears afterwards.

#### Vindhayan Ranges

- These ranges extend parallel to the north of the Narmada-Son rift valley from west to east. They are old residual fold mountains. It extends in the north of Malwa Plateau in Jharkhand, Uttar Pradesh and Chhattisgarh. It separates North India from South India. Its average altitude is 450-600m.
- It extends from west to east upto 1,200 km in the form of Bhandar, Kaimur and Parasnath hills.

#### Satpura Ranges

- Satpura ranges are a part of Deccan plateau. The rift valley of Narmada and Tapi surrounds it from both the sides.

- Structurally, Satpura has been divided into three parts. Rajpipla hills in the west, Mahadeo hills at the centre and Maikal hills in the east. Dhupgarh (1,350 m) is the highest peak of Satpura ranges located on the Pachmarhi hills.
- Maikal range is located in the state of Chhattisgarh. The highest peak of Maikal range is Amarkantak (1,036 m).

**Narmada River** divides the entire plateau region into two parts. Narmada and Tapi both flow through rift valley.

- The Eastern Ghats along this plateau are highly dissected. The plateaus are highly dissected. The slope of the Peninsular plateau in the Northern part is from south to north as depicted from the flow of Son, Chambal and Damodar rivers.
- Mahanadi, Godavari, Krishna and Kaveri rivers flow through these hills and form fertile plains.

## Central Highlands

- The portion of the Peninsular plateau which is located to the north of the Narmada river covers a huge part of the Malwa Plateau.
- A major portion of the Central Highlands is known as Malwa plateau. This plateau region is surrounded by Mahadeo ranges in the east, Aravalli ranges in the north-west and Vindhyan ranges at the centre.
- The rivers that flow in this region are Chambal, Sind, Betwa and Ken.
- Its eastward extension is locally known as Bundelkhand or Baghelkhand. The eastern end of the Central Highlands is drained by Damodar and Subarnarekha rivers which is known as Chhotanagpur plateau.
- Satpura ranges lie parallel to the Vindhyan ranges in its south whereas Amarkantak and Chhotanagpur plateau are located in its east.



## **Dandakaranya region**

- It is a part of the Peninsular plateau of the South India. It is extended upto 89,078 km<sup>2</sup> area in Odisha (Korapet, Kalahandi district), Chhattisgarh (Bastar) and Andhra Pradesh (East Godavari, Visakhapatnam and Srikakulam district).

## **Deccan Plateau**

- It is bordered by the Western Ghats in the west, Eastern Ghats in the east and the Satpura, Maikal range and Mahadeo hills in the north.
- Anaimudi (2,695 m) is the highest peak of Peninsular plateau which is located on the Anaimalai hills of the Western Ghats. It is followed by Doddabetta (2,637 m) on the Nilgiri hills.
- The major parts of Madhya Pradesh, Maharashtra, Western Andhra Pradesh along with parts of Karnataka and Tamil Nadu comes under Deccan plateau.
- Krishna River originates from Mahabaleshwar (1,438 m) which is the major peak of Sahyadri. The eastern part of the plateau is known as Vidarbha.
- Dharwar plateau is located in Karnataka which is made up of metamorphic rocks. Baba Budan Hills and Brahmagiri Hills are located to its west.

## **The North-Eastern Plateau**

- Meghalaya Plateau is the extension of the peninsular plateau which is separated by a fault, Malda Gap, from the Peninsular plateau.

North Eastern Plateau Comprises of Garo, Khasi, Jaintia hills and the outlying Mikir and Rengma hills.
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## **Eastern Ghats**

- The average height of the Eastern Ghats is 900-1,100 m which extends for 1,800 m, parallel to the eastern coastal plain from Mahanadi Valley to Nilgiri in the south.

- Mahanadi, Krishna, Godavari and Kaveri Rivers have eroded it at various places.
- Eastern Ghats are residual mountains. The highest peak is Jindhagoda Peak (1,680m) and Mahendragiri in (1,501m) is the second highest peak.
- It is highly dissected and present in the form of hills. Mahendragiri in Odisha, Nallamala, Palkonda in Andhra Pradesh and Anaimalai, Javadi, Shevroy, Palni, Velangiri in Tamil Nadu are major peaks of Eastern Ghats. These hills are separated by Mahanadi, Godavari, Krishna and Kaveri rivers.

## Western Ghats

- The average heights of Western Ghats are 1,000 m to 1,300 m as compared to Eastern Ghats which are 600 m high. Western Ghats extend for a length of 1,600 m from the Tapi river valley in the north to Nilgiri Hills in the South.
- The four important passes from north to south are Thalghat, Bhorphat, Palghat and Senkota.

<ul style="list-style-type: none"> <li>• <b>Thal Ghat</b></li> <li>• <b>Bhor Ghat</b></li> <li>• <b>Pal Ghat</b></li> <li>• <b>Senkota Pass</b></li> </ul>	<ul style="list-style-type: none"> <li>- Links Nasik to Mumbai</li> <li>- Links Mumbai to Pune</li> <li>- between Nilgiris and Anaimalai Hills</li> <li>- between Nagercoil and Cardamom hill linking Thiruvananthapuram &amp; Madurai</li> </ul>
The Western Ghats meets the Eastern Ghats in the south at Nilgiri Hills.	

- The highest peak of Northern Sahyadri is Kalsubai (1,646 m) whereas the highest peak of southern Sahyadri is Kudremukh (1,892 m). The second highest peak of Southern Sahyadri is Pushpagiri (1714 m). Kaveri river originates near Pushpagiri.
- Cardamom Hills are located in the south of Western Ghats in Kerala and the south of the Annamalai hills in Tamil Nadu. Annamalai is located to its south west, Palani hills to the north-east and the Agasthyamalai is located to its south.

The highest peak of the south India is Anaimudi (2,695 m) which is located on the Annamalai Hills. Dodabetta (2,637 m) is the second highest peak of south India. Nilgiri Mountains are located at the meeting point of Karnataka, Kerala and Tamil Nadu.

## 4. Island Groups

- There are 1,256 islands in the Indian Territory. They are mainly categorized under two groups i.e. Bay of Bengal and Arabian Sea. Along with that there are many islands in the Ganga-Sagar and Mahanadi delta.
- There are around 572 islands in the Bay of Bengal in which human habitation is found only in 36 islands. These islands are located between 6°45'-14°N latitude and 92°- 94°E longitude.

The two principal groups of islands are Ritchie's Archipelago and the Labyrinth Island.

- The islands of the Bay of Bengal reflect the land characteristics of the submerged tertiary mountain ranges. Arakan Yoma is an example of remains of submerged highlands.

### Andaman and Nicobar Islands

- Andaman and Nicobar islands are located in Bay of Bengal near the Myanmar coast. The prominent ranges of this island are Saddle peak (North Andaman – 732 m), Mount Diavalo (Middle Andaman – 515 m), Mount Koyob (South Andaman – 460 m) and Mount Thullier (Great Nicobar – 642 m).

#### Andaman Islands

- North Andaman, Middle, South and Little Andaman Island all constitute Andaman group of Island. Port Blair is the capital of this union territory, which is the largest Island of the South Andaman. Duncan Strait is located between South Andaman and Little Andaman.
- Narcondam, which is a dormant volcano, is also located in Little Andaman Island.
- Landfall Island is the northern most island of the Andaman Nicobar Island group, separated by the Coco Island of Myanmar through Coco Strait.

Barren Island of Little Andaman is the only active volcano of India. It is located 135 km away from Port Blair in Andaman Sea. The first recorded eruption in this volcano dates back to 1787.

#### Nicobar Islands

- 10° channel separates Andaman Islands (Little Andaman) from Nicobar Islands (Car Nicobar). Nicobar Islands are located south of the Andaman Islands.

Nicobar Island consists of Car Nicobar, Little Nicobar and Great Nicobar.

- The Southern part of India is the Indira point or Pygmalion point or Parson Point. The highest peak of Nicobar group is Mount Thullier (642 m)

- Sagar Island is located on the mouth of river Hugli.
- The New Moore Island has been formed due to the depositions at the mouth of river Ganga.
- Pamban Islands are situated in Gulf of Mannar between India and Sri Lanka.
- Sriharikota Island is located on the eastern side of the Pulicat Lake along the Andhra coast. It is the satellite launching Centre of Indian Space Research Organisation (ISRO).
- Wheeler's Island is located at the mouth of Brahmani River at the Odisha coast. This Island is highlighted in newspapers because of regular missile testing. Recently, the Island has been renamed as Abdul Kalam Island.
- Willington Island: It is one of the largest man-made Islands in Kochi, Kerala.
- Kori Creek is a tidal creek in the Kutch region. It is a marshy tract which demarcates the boundary between India and Pakistan.

## Island groups of Arabian Sea

- Lakshadweep Islands located in the Arabian Sea near the Malabar Coast of Kerala, are formed by coral deposits and is divided into two parts by 9° channel.
- These Islands were earlier known as Laccadive, Minicoy and Amindivi. In 1973, it was renamed as Lakshadweep.
- Kavaratti Islands is the Administrative Headquarters of Lakshadweep. It is separated by Minicoy Islands through 9° channel while Minicoy is separated by Maldives through 8° channel. The Northern Island groups are known as Aminidivi and the Southern Islands are known as Cannanore Island.

## 5. Classification of Indian Rocks

### Archean Rocks

- These are the oldest and primary rocks. The cooling and solidification of the upper crust of the earth's surface in the pre-Cambrian era resulted in formation of Archean rocks. About 86.7% part of the earth's historical formation has been done in the Pre-Cambrian era (Archean era).
- The two-third part of Indian Peninsula is made up of Archean rocks. The three fully defined types of Archean rocks found in peninsular India are-
  - (i) Bengal Gneiss
  - (ii) Bundelkhand Gneiss (oldest)
  - (iii) Nilgiri Gneiss
- Archean rocks are the repository of India's mineral wealth. These rocks have abundance of metallic and non-metallic minerals like Iron, Copper, Manganese, Asbestos, Dolomite, Zinc, Silver and Gold.
- These rocks are found mainly in Karnataka, Tamil Nadu, Andhra Pradesh, Madhya Pradesh, Odisha, Chotanagpur Plateau, South Eastern Rajasthan.

### Dharwar Rocks

- These are the oldest metamorphosed sedimentary rocks formed from the erosion and deposition of the Archean rocks. These are highly metamorphosed and are devoid of fossils. These rocks are found in Dharwar and Bellary districts of Karnataka, Aravalli Range, Balaghat, Rewa, Chottanagur, etc. Iron ore, copper and gold are the major minerals found in these rocks.
- Aravalli Mountains are formed in this rock system, which are the oldest fold mountains of the world. These rocks are found in Dharwar and Shimoga districts of Karnataka. This has been found in both peninsular and extra peninsular region.
- Dharwar rocks are found in three regions:
  1. In Dharwar and Bellary districts of Karnataka which spreads into Nilgiri and Madurai districts of Tamil Nadu.

2. It has expanded to Middle East regions of Chhotanagapur, Meghalaya Plateau and Mikir hills.
3. These rocks reach upto the Aravallis of Delhi, Delhi ridge to Alwar and Himachal Pradesh.

## **Cuddappah Rocks**

- These rocks have been formed by the erosion and deposition of Dharwar rocks. They are less metamorphosed but still devoid of fossils. These rocks are found in Krishna valley, Nallamalai hills, Papadahani and Cheyyar valleys. A Cuddappah rock of Rajasthan is also known as Delhi Ridge. These are also sedimentary rocks.
- It is famous for sandstone, limestone, marble and asbestos. Diamonds are also found in same rocks system.

## **Vindhyan Rocks**

- It is named after Vindhyan Mountain which acts as water-divide between the Gangetic plains and the Deccan plateau.
- It is famous for limestone, china clay, dolomite etc.
- These are sedimentary rocks formed by the deposition of silt of river valleys and shallow oceans. These rocks are spread from Chittorgarh of Rajasthan to Sasaram of Bihar.

<b>Bhander ranges, Bikawar ranges and Kaimur ranges come under Vindhyan</b>
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## **Gondwana Rocks**

- These are the rocks formed in Upper Carboniferous to Jurassic era, hence these are especially important for coal deposits.
- About 98% of the coal deposits of India are found in these rocks. These are stratified rocks in which the fossils of fishes and reptiles are found.

## **Deccan Trap**

- This was formed in Cretaceous period of the Mesozoic era. At the end of the Mesozoic era, an extensive volcano erupted through fissure and a vast area of about 10 lakh km<sup>2</sup> got buried under the lava.

- In this region, the thickness of basaltic lava is 600- 1,500 m and even at some places it is 3,000 m. this region is known as Deccan Trap. The Raj Mahal trap was formed even earlier in the Jurassic period.
- The Deccan Trap is found in most parts of Maharashtra, Gujarat and South-western Madhaya Pradesh and Tamil Nadu.
- This structure is made up of Basalt and Dolomite rocks. These rocks are quite harsh.
- Black soil has been formed by the fragmentation of these rocks, which is known as Black Cotton Soil or Regur Soil.

## **Tertiary Rocks**

- The tertiary rocks have been formed between the Eocene era and the Pliocene era.
- The tertiary rocks are found mainly in the Himalayan region. In peninsular India, these are only limited to coastal areas. Petroleum is also found in this series or rocks. This series is found in a developed form in the Kumaon region of Uttarakhand where it is known as the Lilang series.

## **Quaternary Roacks**

- The quaternary rocks include Pleistocene and the current Holocene age rocks. The expansion of the Pleistocene series is found in the upper valleys of Jhelum in Kashmir, Ganga, Brajhmaputra, Narmada, Tapi, Mahanadi, Godavari and Krishna.
- During Pleistocene period, the entire Kashmir Valley was a lake. Due to endogenetic forces, the lake drained through Baramullah gorge leaving lacustrine deposits called Karewas. These rocks are useful for the cultivation of Zafran (a local variety of saffron), almonds and walnut.

## 6. Climatic Regions of India

### Climatic Condition

**Climate** is long term pattern of weather in a particular area or it is also defined as the average atmospheric conditions of a particular region over a considerable time period, usually taken over 35 years.

**Weather** is short term (minutes to months) change in the atmosphere. It includes sunshine, rain, cloud cover, wind, hail, snow, sleet etc.

### Koppen's Classification

The most widely used classification of climate is the empirical climate classification scheme developed by V. Koeppen. 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 recognised five major climatic groups, four of them are based on temperature and one on precipitation.



Group	Characteristics
<b>A- Tropical</b>	The average temperature of the coldest month is 18° C or higher
<b>B- Dry Climates</b>	Potential evaporation exceeds precipitation
<b>C- Warm Temperate</b>	The average temperature of the coldest month of the (Mid-latitude) climates years is higher than minus 3° C but below 18° C
<b>D- Cold Snow forest</b>	The average temperature of the coldest month is minus 3° C or below
<b>E- Cold Climates</b>	Cold Climates Average temperature for all months is below 10° C
<b>H- Highlands</b>	Cold due to elevation



## 7. Indian Monsoon

### Monsoon

The word monsoon originates from the Arabic word mausim which connotes the climate associated with seasonal reversal in the direction of winds. The Arabian geographer Al Masoodi was the first to study monsoon.

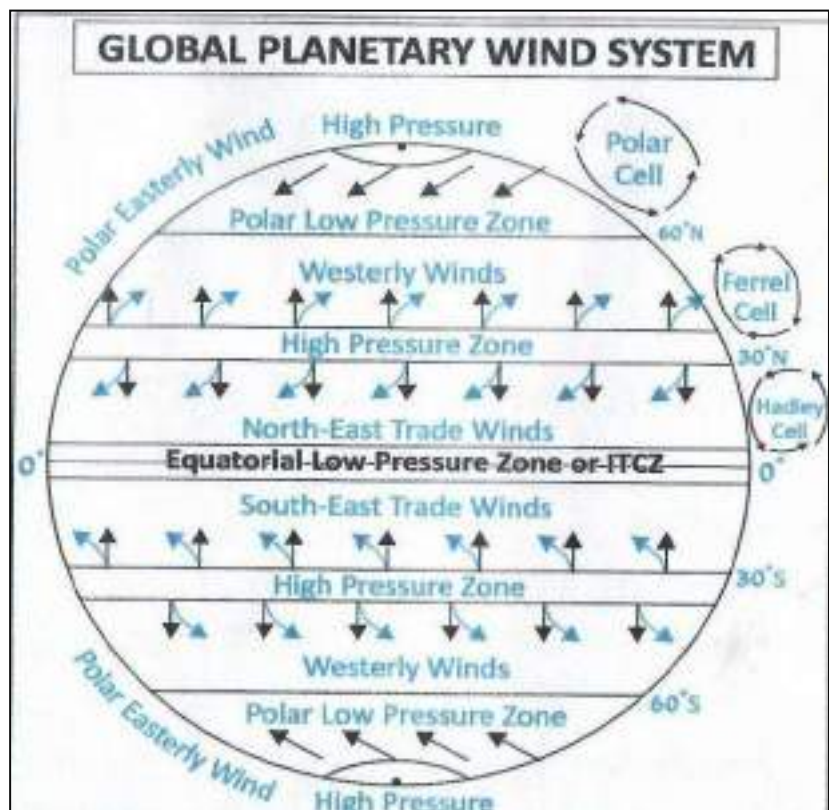
Indian Monsoon is the most prominent example of the world's monsoon system, which primarily affects season, vegetation and lifestyle of the country. The monsoons are seasonal wind which blows from south-west during summers and reverse its direction during cooler month.

### Inter-Tropical Convergence Zone (ITCZ)

The Inter-Tropical Convergence Zone or ITCZ is a **belt of low pressure** which encircles the earth generally **near the equator** where the trade winds of northern and southern hemispheres converge. It is characterised by convective activity which often generates vigorous thunderstorms over large area. It is most active over continental land masses and least over the oceans.

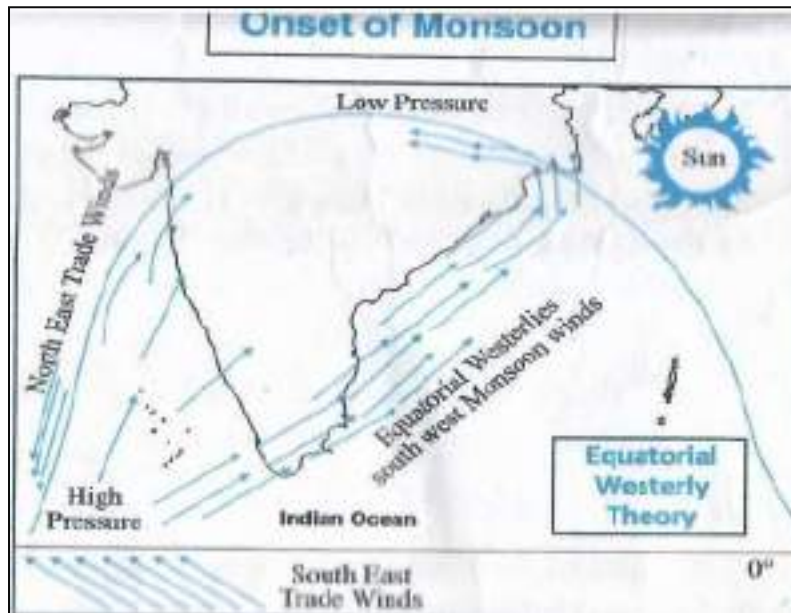
### Trade wind

Trade winds blow steadily towards the equator from the **north-east** in the **northern hemisphere** and from the **south-east** in the **southern hemisphere**. These winds blow between **5° to 30° N and S latitude**.



## Impact of Coriolis force

- An apparent (rather than real) force which causes the deflection of moving objects, especially of air streams, due to the rotation of the Earth on its axis.
- It shows up, for example in the movement of an air stream, relative to the rotating Earth beneath it. Because of Coriolis force, all the winds are deflected towards **right in northern hemisphere** and towards **left in southern hemisphere**.

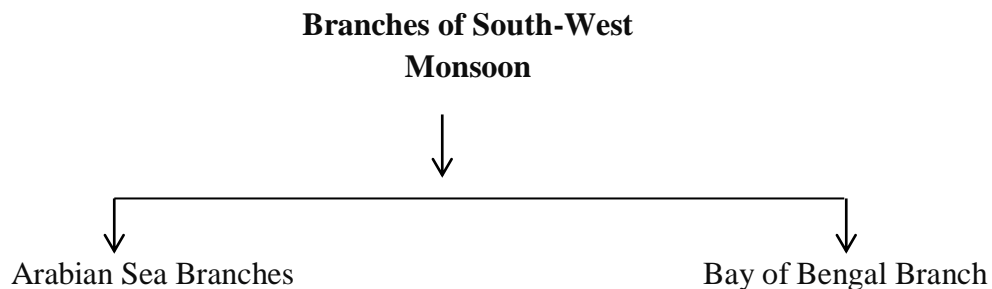


## Onset of Monsoon

1. **ITCZ shifts towards northward** and hence South-East trade winds began to cross equator.
2. **Tibetan plateau** absorbs and radiates heat that is to the development of **anticyclonic conditions**. The out flow above this plateau moves over north-east India as Tropical Easterly Jet.
3. **Low pressure** development over entire north India.
  - With the heating of Tibetan plateau, the sub-tropical jet stream suddenly changes its course to the north of Tibetan highland (due to anticyclonic ridge).

- In June, these easterly Jets get firmly established. Also pressure gradient (or low pressure) attracts the wind blowing from different direction to fill the intense low pressure over north India. South-East trade wind after crossing the equator, deflect towards right (because of **coriolis effect**) and moves toward low pressure (Monsoon trough) region as **South-West Monsoon**.
- In June, easterly jet streams flows in southern part of peninsular India with **90 km/h** velocity of wind. The presence of easterly jet stream intensifies the over the surface. Its subsidence over the **Mascarene Island** increases the high pressure condition over sub-tropical high pressure belt. **The position of Easterly jet controls the location of monsoonal rains.**
- The south westerly winds are very strong and humid (as they carry moisture from Arabian Sea) before reaching the Malabar Coast (southern portion of Western Ghats). These unstable winds than brings around 80% humidity, causing sudden and heavy rainfall with thunder and lighting. This sudden phenomena is known as **Burst of Monsoon**.

## Branches of South – West Monsoon



### Arabian Sea Branch

Monsoon winds originating from the Arabian Sea are further divided into there sub-branches:

Its one branch is obstructed by the Western Ghats. It climbs 900-1,200 meter above the slope of the entire Western Ghats. Therefore, these winds immediately cool down along the hillsides of Sahyadri and causes heavy rainfall (between 250-400 cm) in the western coasteal plains

After crossing the Western Ghats, this wind descends and begins to which reduces the humidity of these winds. As a result, this area receives less rainfall and is known as rain-shadow region (leeward side to the east of the Western Ghats).

The second branch of the monsoon that arises from the Arabian Sea causes rainfall far in Central India through the valleys of Narmada and Tapi rivers to the north of Mumbai. The Chotanagpur Plateau receives 15 cm rainfall from this branch where it enters the Gangetic plain and meets the Bay of Bengal branch.

The third branch of this monsoon strikes the Saurashtra Peninsula and Kutch region from where it crosses western Rajasthan moving parallel to Aravallis and cause very little rainfall.

### **Bay of Bengal Branch**

Monsoon winds of the Bay of Bengal branch strikes along the coast of Myanmar and southeastern Bangladesh. The Arakan Mountains located in Myanmar deflects a large part of this branch towards the Indian subcontinent.

Thus, the monsoon enters from south and southeast direction (rather than south west direction) in West Bengal and Bangladesh. One branch moves along the Gangetic plains and reaches the Punjab plains.

Its second branch goes towards the north-east of the Brahmaputra valley. This branch causes rain in the extensive area and its other sub-branch causes rain in Mawsynram. It receives highest annual rainfall in the world located in the Garo hills of Meghalaya.

During south-west monsoon period, after having rainfall for few days, if rain fails to occur for one or more weeks, it is known as Breaks in the Monsoon.

## **Retreat of Monsoon**

By first week of September with apparent shift of sun towards south, ITCZ also shifts to the south, as a result of which Tibetan plateau starts cooling which ultimately results into weakening and disappearance of easterly jet stream.

In the sub tropical region of Himalayas, the jet stream get bifurcated into tow branch of which one flows to north of Himalayas and southern branch flows along the foot-hills of Shiwaliks. These branches flow over Bay of Bengal and pick up moisture and cause rainfall along the Coromandle Coast as North-East Monsoon.

# Seasons in India

## The Cold Weather Season (winter)

- The cold weather season begins from mid- November in northern India and stays till February. December and January are the coldest months in the northern part of India.
- The temperature decreases from south to the north. The average temperature of Chennai, on the eastern coast, is between 24° – 25° Celsius, while in the northern plains, it ranges between 10° – 15° Celsius.
- Days are warm and nights are cold. Frost is common in the north and the higher slopes of the Himalayas experience snowfall.
- During this season, the northeast trade winds prevail over the country.
- They blow from land to sea and hence, for most part of the country, it is a dry season. Some amount of rainfall occurs on the Tamil Nadu coast from these winds as, here they blow from sea to land.
- In the northern part of the country, a feeble high-pressure region develops, with light winds moving outwards from this area.
- Influenced by the relief, these winds blow through the Ganga valley from the west and the northwest.
- The weather is normally marked by clear sky, low temperatures and low humidity and feeble, variable winds.
- A characteristic feature of the cold weather season over the northern plains is the inflow of cyclonic disturbances from the west and the northwest.
- These low-pressure systems, originate over the Mediterranean Sea and western Asia and move into India, along with the westerly flow.
- They cause the much-needed winter rains over the plains and snowfall in the mountains.
- Although the total amount of winter rainfall locally known as ‘mahawat’ is small, they are of immense importance for the cultivation of ‘rabi’ crops. The peninsular region does not have a well-defined cold season.
- There is hardly any noticeable seasonal change in temperature pattern during winters due to the moderating influence of the sea.

## **The Hot Weather Season (Summer)**

- Due to the apparent northward movement of the sun, the global heat belt shifts northward.
- As such, from March to May, it is hot weather season in India.
- The influence of the shifting of the heat belt can be seen clearly from temperature recordings taken during March-May at different latitudes.
- In March, the highest temperature is about 38° Celsius, recorded on the Deccan plateau. In April, temperatures in Gujarat and Madhya Pradesh are around 42° Celsius.
- In May, temperature of 45° Celsius is common in the northwestern parts of the country.
- In peninsular India, temperatures remain lower due to the moderating influence of the oceans
- The summer months experience rising temperature and falling air pressure in the northern part of the country.
- Towards the end of May, an elongated low-pressure area develops in the region extending from the Thar Desert in the northwest to Patna and Chotanagpur plateau in the east and southeast.
- Circulation of air begins to set in around this trough.
- A striking feature of the hot weather season is the 'loo'. These are strong, gusty, hot, dry winds blowing during the day over the north and northwestern India. Sometimes they even continue until late in the evening.
- Direct exposure to these winds may even prove to be fatal Dust storms are very common during the month of May in northern India.      **THE SEASONS OF INDIA**
- These storms bring temporary relief as they lower the temperature and may bring light rain and cool breeze
- This is also the season for localised thunderstorms, associated with violent winds, torrential downpours, often accompanied by hail.
- In West Bengal, these storms are known as the 'Kaal Baisakhi'.
- Towards the close of the summer season, pre-monsoon showers are common especially, in Kerala and Karnataka. They help in the early ripening of mangoes, and are often referred to as 'mango showers'.

## **The Rainy Season**

- By early June, the low-pressure condition over the northern plains intensifies.
- It attracts, the trade winds of the southern hemisphere. These south-east trade winds originate over the warm subtropical areas of the southern oceans.
- They cross the equator and blow in a south westerly direction entering the Indian peninsula as the south-west monsoon. As these winds blow over warm oceans, they bring abundant moisture to the subcontinent.
- These winds are strong and blow at an average velocity of 30 km per hour.
- With the exception of the extreme north-west, the monsoon winds cover the country in about a month.
- The inflow of the south-west monsoon into India brings about a total change in the weather.
- Early in the season, the windward side of the Western Ghats receives very heavy rainfall, more than 250cm.
- The Deccan Plateau and parts of Madhya Pradesh also receive some amount of rain in spite of lying in the rain shadow area.
- The maximum rainfall of this season is received in the north-eastern part of the country Mawsynram in the southern ranges of the Khasi Hills receives the highest average rainfall in the world.

## **Retreating/Post Monsoons (The Transition Season)**

- During October-November, with the apparent movement of the sun towards the south, the monsoon trough or the low-pressure trough over the northern plains becomes weaker.
- This is gradually replaced by a high-pressure system. The south-west monsoon winds weaken and start withdrawing gradually. By the beginning of October, the monsoon withdraws from the Northern Plains.
- The months of October-November form a period of transition from hot rainy season to dry winter conditions.
- The retreat of the monsoon is marked by clear skies and rise in temperature. While day temperatures are high, nights are cool and pleasant. The land is still moist.
- Owing to the conditions of high temperature and humidity, the weather becomes rather oppressive during the day aka 'October heat'.

THE SEASONS OF INDIA

- In the second half of October, the mercury begins to fall rapidly in northern India.
- The low-pressure conditions, over northwestern India, get transferred to the Bay of Bengal by early November
- This shift is associated with the occurrence of cyclonic depressions, which originate over the Andaman Sea.
- These cyclones generally cross the eastern coasts of India cause heavy and widespread rain.
- These tropical cyclones are often very destructive. The thickly populated deltas of the Godavari, the Krishna and the Kaveri are frequently struck by cyclones, which cause great damage to life and property.

Sometimes, these cyclones arrive at the coasts of Orissa, West Bengal and Bangladesh.

The bulk of the rainfall of the Coromandel Coast is derived from depressions and cyclones.

### **Transitional seasons**

- Spring: During winter to summer (onset of monsoon)
- Autumn: Summer to winter ( withdrawal of monsoon)



## 8. Southern Oscillation Index (SOI)

- The **SOI** is an index of the difference of air pressure

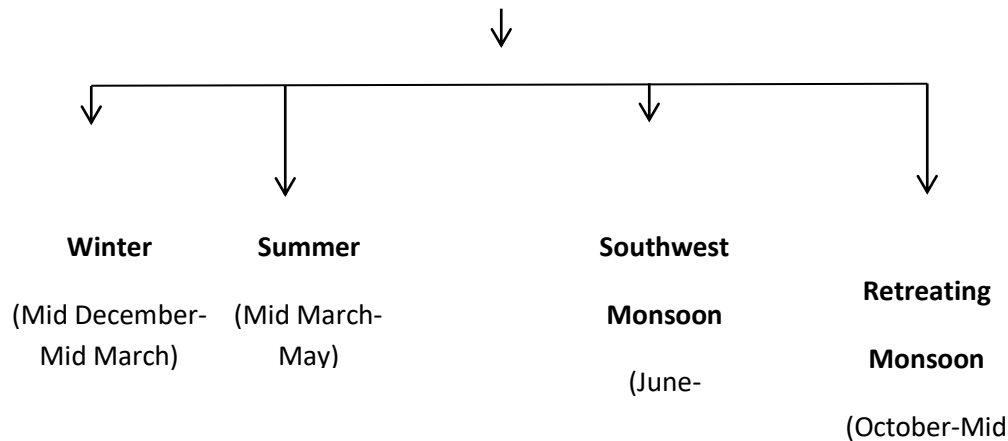
### El Nino

- Trade winds weaken during El Nino and **eastward movement of water** is seen.
- During El-Nino, there occurs warming of the Peruvian current which lowers the pressure gradient.
- It weakens the Indian monsoon.
- El-Nino occurs after **3 to 5 years**.

### La Nina

- During La Nina, strong Pacific trade winds blow from the surface water of **westward alignment**.
- During La-Nina, the cold water rises to the surface & intensifies the high pressure along the Peruvian coast.
- It strengthens the Indian monsoon.
- This occurs roughly half as often as El-Nino. It lasts for **1-3 years**.

### Classification of Seasons



## 9. Western Disturbances

### Western cyclonic disturbances

**Western cyclonic disturbances** are the temperate cyclones which originate over **Mediterranean Sea** and **Western Asia**. It moves towards India along with the westerly jet streams.

By causing cyclonic rains over the plains and snowfall in the mountains, they disturb the weather of north and north-west India.

**Winter** rainfall caused by them is known as **Mahawat** in Rajasthan and is immensely important for the cultivation of Rabi crops.

### Winter Rainfall in North-West Region

It is caused due to **western disturbances** occurring in **Mediterranean sea**, which gets dragged to India by **Sub-tropical Westerly Jet Stream**. This winter precipitation is highly beneficial for **Rabi Crops** grown in region and for feeding Himalayan glaciers.

### Local Winds during Summer

Winds which are caused by **local factors** and **confined** to a limited area compared to planetary winds are called as **local winds**.

### Norwesters

In **West Bengal, Jharkhand, Odisha** and **Assam** direction of local winds in summer is from **North west**, hence are known as **Norwesters**.

**Kalbaisakhi** is a strong wind which blows during the Baisakh Season in **Assam** and **West Bengal** in the evening. It is beneficial for the crops like tea, jute, rice etc.

In Assam, it is known as **Bardoli Chheerha**.

## Loo

Loo winds are strong, hot and dry summer afternoon wind from the west which blows over the western Indo-Gangetic Plain region of North India and Pakistan. It is especially strong in the months of May and June.

During summer, desert regions of South Balochistan and Thar desert in India gets heated up to a greater extent. This creates a vast low pressure area over North Indian plains during afternoon. This low pressure area pulls in moist air from North Arabian sea. When this air mass blows over Gujarat region it loses its moisture to the parched land and becomes dry.

## Pre Monsoon Shower

During **March-April**, sun's apparent movement towards **north** causes **rise in temperature** in **North India**. This local heating causes **conventional rise** in air thereby causing heavy **rain accompanied with thunder** and **lightning** which is known as **pre monsoon shower**.

## 10. Mango Shower & Cherry Blossom Rain

### Mango Shower

**Mango Shower** or **Mango Rain** is a colloquial term to describe the occurrence of pre-monsoon rainfall. Sometimes, these rains are referred to as **April Rains** or **Summer Showers**. These occur across south and southeast Asia including India in **Kerala** and **Karnataka**.

Between **Port Darwin of Australia** and **Tahiti of French Polynesia**. In an El-Nino year, when a warm current develops along the Peru coast, the value of the **Southern Oscillation Index** becomes negative.

The **Walker Circulation** is caused by the pressure gradient force which results from a high pressure system over the eastern Pacific Ocean and low pressure system over Indonesia.

Locally it is known as **Mango Shower** or **Mango Rain** because it is beneficial for mango trees. These rain normally occur from March to April, although their arrival is often difficult predict.

### Cherry Blossom Rain

Due to this rainfall, coffee flowers blossom in Kerala and nearby areas. So, it is termed as **Flower Rain** or **Cherry Blossom** in **Karnataka**.

#### Traditional Season in India

• Spring	Chaitra-Baisakh	March-April
• Summer	Jyesth-Ashadh	May-June
• Rain	Shravan-Bhadrapad	July-August
• Autumn	Ashwin-Kartika	September-October
• Winter	Margshirsh-Paush	November-December
• Cold-Winter	Magh-Falgun	January-Feb.

# Cloud

- Cloud is a **mass of minute water droplets** or fine crystals of ice formed by the condensation of the **water vapour** in **free air** at considerable elevations.
- According to their **height, expanse, density** and **transparency** or **opaqueness** clouds are grouped under **four types**.

Family	Type	Characterstics
<b>HIGH</b>	1. Cirrus (Ci) 2. Cirro cumulus(Cc) 3. Cirro stratus (Cs)	Thin, White and Icy, No rainfall
<b>MIDDLE</b>	4. Alto cumulus(Ac) 5. Alto stratus (As)	Layered or puffy, made of liquid water
<b>LOW</b>	6. Stratus (St) 7. Stratacumulus (Sc) 8. Nimbo stratus (Ns)	Somber skies, drizzle appear as general overcast
<b>VERTICAL</b>	9. Cumulus (Cs) 10. Cumulonimbus	Tall, narrow, puffy

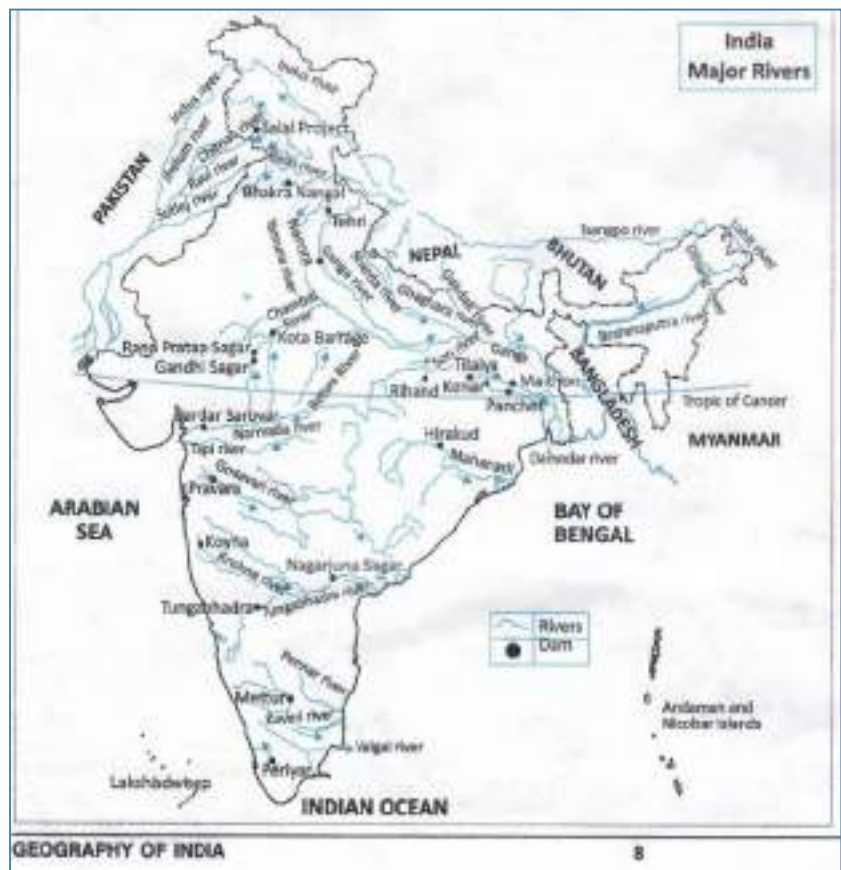
**Precipitation** comes from clouds that have **nimb** in their name eg. **Nimbo stratus**, (develop from stratus could), **Cumulonimbus** (develop from cumulus cloud).

## 11. Drainage System of India

The flow of water through well-defined channels is known as drainage and the network of such channels is called a “drainage system”. The drainage system of an area is the outcome of the geological time period, nature and structure of rocks, slope, topography, amount of water flowing and the periodicity of flow. The area drained by a single river system (river and its tributaries) is called its drainage basin. An elevated area (mountain or upland) that separates two drainage basins is called a “water divide”. The world’s largest drainage basin is of the Amazon river and in India, the river Ganga has the largest river basin.

### Important Points

- An area drained by a river and its tributaries is called a drainage basin. The boundary line separating one drainage basin from the other is known as the watershed.
- The flow of water through well defined channels is known as drainage and the network of such channel drainage system.
- The catchments of large rivers are called river basins while those of small rivulets and rills are often referred to as watersheds.
- On the basis of the mode of origin, nature and characteristics, the Indian drainage may also be classified into the Himalayan drainage and the peninsular drainage.
- There are more than 4, 000 small and big rivers in India which are divided into 23 large and 200 small river basins.



## 12. Types of Discordant Drainage Pattern

### **Antecedent Drainage**

The drainage pattern formed by the rivers that maintain their original course and pattern despite the changes in underlying rock topography is known as Antecedent Drainage. The soil formed is weak and is easily eroded by the rivers. Example: Indus and Ganga drainage river.

### **Superimposed Drainage**

This type of drainage pattern cuts deeper through the existing landform and maintains its original course. Some medium scale rivers of the northern and eastern peninsular India are its examples.

### **Concordant Drainage Pattern**

In a concordant drainage pattern, the path of the river is highly dependent on the slope of the river and topography.

### **Dendritic or Pinnate Drainage Pattern**

The drainage pattern resembling the branches of a tree is known as dendritic, the examples of which are the rivers of northern plains.

Example: Indus, Godavari, Mahanadi, Cauvery, Krishna.

### **Trellis Drainage Pattern**

In this type of pattern the short subsequent streams meet the main stream at right angles and differential erosion through soft rocks paves the way for tributaries.

Examples: The old fold mountains of the Singhbhum (Chotanagpur Plateau).

### **Angular Drainage Pattern**

- The tributaries join the main stream at acute angles.
- This pattern is common in Himalayan Foothill Regions.

### **Rectangular Drainage Pattern**

- The main stream bends at right angles and the tributaries join at right angles creating rectangular patterns.

- Streams found in the Vindhyan Mountain of India.

### **Radial Drainage Pattern**

- The tributaries from a summit follow the slope downwards and drain down in all directions.
- A good example of a radial drainage pattern is provided by the rivers originating from the Amarkantak plateau. River like Narmada, Son and Mahanadi originating from Amarkantak Hills.
- Radial drainage pattern are also found in the Girnar Hills (Kathiawar, Gujarat) and Mikir Hills of Assam.

### **Annular Drainage Pattern**

- When the upland has an outer soft stratum, the radial streams develop subsequent tributaries which try to follow a circular drainage around the summit.
- Some examples of this are however found in **Pithoragargh** (Uttarakhand), **Nilgiri Hills** in Tamil Nadu and Kerala.

### **Parallel Drainage Pattern**

- The tributaries seem to be running parallel to each other in a uniformly sloping region.  
Example: Rivers of lesser Himalayas, the small and swift rivers originating in the **Western Ghats** that flow into **Arabian Sea**.

### **Centripetal Drainage Pattern**

- In a low lying basin the streams converge from all sides forming centripetal pattern.
- Examples: **stream of Ladakh, Tibet** the **Bagmati** and its tributaries **Nepal**.

### **Deranged Drainage Pattern**

- This is an uncoordinated pattern of drainage characteristic of a region recently vacated by an ice-sheet.
- This type of drainage is found in the glaciated valley of **Karakoram**.

### **Barbed Drainage Pattern**

- A pattern of drainage in which the confluence of a tributary with the main river is characterized by a discordant junction when the tributaries flow in opposite direction to their master stream.



- The **Arun River** (Nepal), a tributary of the Kosi is an interesting example of barbed drainage pattern.

### **Consequent Rivers**

- The rivers which follow the general direction of slope are known as the consequent rivers they are also called **dipstreams**. Most of the rivers of peninsular India are **consequent rivers**.
- Example: river like **Godavari, Krishna and Cauvery**.

### **Subsequent Rivers**

## 13. Himalayan Drainage

The Himalayan drainage system has evolved through a long geological history. It mainly includes the **Ganga**, the **Indus** and the **Brahamaputra** river basins.

### The Indus Drainage System

The Indus Drainage System			
River	Source	Length (In km)	Area drained (Sq.km)
1. Indus	Bokhar Chu glacier near Manasarovar Lake	2,880 (1,114 in india)	11,78,440 (3,21,284 in India)
2. Jhelum	Verinag	724	34,775 upto Indo-Pak Border
3. Chenab	Bara Lacha Pass	1,180	26,155 upto Indo-Pak Border
4. Ravi	Near Rohtang Pass	725	14,442 (5,957 in India)
5. Beas	Beas Kund, Near Rohtang Pass	460	20,303
6. Sutlej	Rakas Lake, Mansarovar	1,450	25,900(1,050 in India)

#### Indus (Sindhu)

- The Indus also known as **Sindhu**, is the western most **Himalayan river** in India.
- It flows in the northwest direction between **Ladakh** and **Zaskar**. It passes through **Ladakh** and **Baltistan**.

- It cuts across the **Ladakh Range**, forming a spectacular gorge near **Gilgit** in **Jammu and Kashmir**.
- The Indus flows in India only through the **Leh district** of Jammu and Kashmir.
- Its right bank tributaries are (all originating from Sulaiman range) **Kurram, Shyok, Gomai, Gilgit, Sangar Vibo** and **Tochi**.
- **Shyok river** also known as the **River of Death** in Yarkandi Uyghur and Karakoram regions.

### Jhelum (Vitasta)

- It flows through Srinagar and the Wular lake before entering Pakistan through a deep narrow gorge.
- It joins Chenab near Jhang in Punjab province of Pakistan.
- Lidder, Sindhu and Neelum are its tributaries in Kashmir.

### Chenab (Asikni)

- It is formed by two streams, the Chandra and the Bahaga, which join at Tandi near Keylong in Himachal Pradesh. Hence, it is also known as Chandrabhaga.
- It is the largest tributary of Indus (1,180 km) in India before entering Pakistan.
- It makes a hair pin bend near Kishtwar flowing across the Pir Panjal to enter into Pakistan.
- It receives water of Jhelum, Ravi and Satluj.
- Dulhasti Hydroelectric Project, Salal Hydroelectric **Project** and **Baglihar** Project are located on this river.

### Ravi (Parushni)

- It forms a deep gorge in the **Dhauladhar range**.
- Ravi joins Chenab near **Sarai Sidhu**. Its drainage area lies between the south-eastern part of Pir Panjal and Dhauladhar range.
- It **runs along the Indo-Pak border** in Punjab plains along **Amritsar** and **Gurdaspur** before entering into Pakistan.

### Beas (Vipasa)

- This river flows through Kullu valley and forms gorges in Dhauladhar range.
- This river basin lies completely within the Indian territory.

- It meets Satluj river at Harike in Punjab. India's longest canal Indira Gandhi Canal starts from this Harike Barrage.

### Satluj (Satudri)

- It flows almost parallel to Indus (400 km) before entering India at Shipki La (Himachal Pradesh) and from Ropar enters into Punjab plain. After entering into India, river Spiti joins this river in the north.
- It is known as Langchen Khamban in Tibet. It has created an extraordinary canyon at Nari Khorasan province of Tibet.
- It forms international boundary (120 km) between India and Pakistan where it joins Indus at Mithankot.
- Govind Sagar Dam (Bhakra Dam) is situated on this river. Nathpa Jhakri Hydroelectric Project is located along this river in Shimla, Himachal Pradesh.

## Ganga River System

- It is shared by **Uttarakhand** (110 km), **Uttar Pradesh** (1,450 km), **Bihar** (445 km) and **West Bengal** (520 km). The total length of Ganga river is **2,525 km**.

### The Ganga Drainage System

River	Source	Length (in km)	Area drained (sq km)
• Ganga	Gangotri glacier	2,525	8,61,404
• Yamuna	Yamunotri glacier	1,376	3,66,223
• Chambal	Vindhyan hills	1,050	1,39,468
• Ramganga	Garhwal district	596	32,493
• Ghaghra	Mapchachungo Glacier	1,080	1,27,950
• Gandak	Tibet-Nepal border	425 (in India)	46,300 (7,620 in India)
• Kosi	Sikkim-Nepal-Tibet Himalaya	730 (in India)	86,900 (21,500 in India)

- **Left bank tributaries** are Ramganga, Gomati, Ghaghara, Gandak, Kosi, Mahananda, Kali etc.
- **Right bank tributaries** are Yamuna, Son, Tons, karmansa, Punpun, Keol etc.

### **Doabs of Ganga River System**

<b>Doab</b>	<b>River Region</b>
Ganga-Yamuna Doab	Ganga and Yamuna
Plain of Rohilkhand	Ramganga and Gomati
Awadh Plains	Gomati and Ghaghara
Eastern Plains of UP	Ghaghara and Gandak
Saran Plain	Gandak and Old Gandak
Mithila Plian	Old Gandak and Kosi
Plain of West Bengal	Kosi and Mahananda

- **Namami Gange Project** is an **Integrated Conservation Mission**, approved as **Flagship Programme** by the Union Government in **June 2014** with budget outlay of **Rs. 20,000 crore**.
- **Ministry of Water Resources, River Development and Ganga Rejuvenation** is the nodal agency. The **National Mission for Clean Ganga (NMCG)** is the implementation wing.

## **Yamuna**

- it is the westernmost and the longest tributary of Ganga which join Ganga at Prayag (Allahabad).
- It has its source in the Yamunotri Glacier on the western slopes of the Banderpunch Range.
- The Tons river emerging from the Himalayas is the largest tributary of the Yammuna river.
- **Right bank tributaries:** Chambal, Sind, Betwa & Ken.

- **Left bank tributaries** : Hindan, Rind, Sengar and Varuna.

## Chambal

- It rises near Mhow (Madhya Pradesh) in the Malwa plateau and flows northwards through a gorge upwards of Kota in Rajasthan, where the Gandhisagar dam has been constructed.
- Its main tributaries are Banas, Dhasan, Kali Sindh, Parbati. It joins Yamuna at Etawah (Uttar Pradesh).
- Gandhi Sagar, Rana Pratap Sagar and Jawahar Sagar are the major multipurpose projects built on this river. The Chambal is famous for its badland topography called the Chambal Ravines.

## Son

- It joins Ganga about 16 km upstream of Danapur in Patna, Bihar. It originates from Amarkantak plateau (Madhya Pradesh)
- The important tributaries are Rihand, Johilla, Gopad, Kanhar and North-Koel (almost all the tributaries join it on the right bank).

## Damodar (Sorrow of Bengal)

- Its important tributaries are Barakar, Konar, Bokaro, Ghari and Bhera. The Barakar is the largest tributary of Damodar.
- Tilaiya Project and Maithon Project are located on Barakar river, whereas Panchet Project is located on Damodar river. Once known as the Sorrow of Bengal the Damodar has been now tamed by the Damodar Valley Corporation, a multipurpose project.

## Ramganga

- It is comparatively small river rising in the **Garhwal hills** near **Gairsain**.
- Its important tributaries are **Kho, Ganga, Aril, Kosi and Deaha**. It joins Ganga near **Kannauj**.

## Gandak (Narayani)

- It comprises of two streams Kaligandak and Trishulganga.
- It enters into Ganga plains in **Champan district** of Bihar and joins Ganga at **Sonpur** near Patna.
- Its main tributaries are **Kaligandak, Marshyangdi, Budhi Gandak, Trishuli** etc.

## Ghaghara

- It is also known as **Karnali** in Nepal.
- It passes through Himalayas in Nepal and joins the **Sharda river** at Brahmaghat in India and together, they form the Ghaghara river.

- It is the largest tributary of Ganga in terms of volume.

**Left bank tributaries:** Bheri, Sarju, Kuwana, Rapti, Chhoti Gandak.

**Right bank tributaries:** Seti, Dahawar, Sarda, Budhi Ganga.

### Gomati River

- It originates from **Fular Lake** in **Pilibhit**, Uttar Pradesh.
- It is the only tributary of Ganga that originates in plains. It joins the Ganga near **Ghazipur**.

### Sarda/Saryu River

- It is also known as **Mahakali** or **Kali Ganga** in Uttarakhand.
- It originates from **Milam glacier** in **Nepal Himalayas** where it is known as **Goriganga**. It demarcates western border of Nepal and India.

### Kosi

- It is an antecedent river with its source to the north of **Mount Everest** in **Tibet**, where its main stream rises.
- Kosi river consists of **7 rivers** and is popularly known as **Sapt Kosi**.
- It is known for its frequent shifting courses causing widespread floods in Bihar and hence is infamous as **Sorrow of Bihar**. It has been however tamed by the construction of a barrage in **1965** near **Hanuman Nagar** in Nepal.
- In a joint venture, India and Nepal constructed embankments for floods control on Kosi river.

### Mahananda

- It originates from **Darjeeling hills**. It is the **last left bank tributary** of Ganga joining it in West Bengal.

## Brahmaputra River System

### Brahmaputra

- The Brahmaputra, one of the largest rivers of the world, originates from **Chemayungdung glacier of Kailash range** near Manasarovar Lake in Tibet.
- In Tibet, Brahmaputra river is known as **Tsangpo** means **the purifier**. The **Rango Tsangpo** is major right bank tributary of Tsangpo river in Tibet. In China, it is known as **Yarlung Zangbo**.
- **Mariam La** separates Brahmaputra from Manasarovar Lake.
- The river emerges from the foothills under the same **Dihang or Siang**. It enters India west of **Sadiya Town** in Arunachal Pradesh.

- While flowing southwest, it receives its main left bank tributaries viz., **Dibang or Sikang and Lohit**; thereafter, it is known as the **Brahmaputra**.
- Several islands are found in the path of this river, **Majuli** is the world's largest riverine island. It enters Bangladesh near Dhubri and flows southward.
- In Bangladesh, Teesta joins it at right bank and later it is called as **Jammu** and thereafter it merges with the Padma and falls in Bay of Bengal.
- **Left bank tributaries** – Burhi-Dihang, Dhansiri, Lohit.
- **Right bank tributaries** – Subansiri, Kameng, Manas and Sankosh.

### Sankosh River

- It originates from northern Bhutan making border between Assam and West Bengal.
- This river joins Brahmaputra near Assam-Bangladesh border.

### Teesta River

- It is the westernmost right bank tributary of Brahmaputra. It originates from Kanchenjunga and joins Brahmaputra in Bangladesh.
- This river also forms a deep gorge in Darjeeling hills.
- Its important tributaries are Rangpo, Rangit and Sevak.

### Manas

- It is a **Transboundary River** in the Himalayan foothills between southern Bhutan and India.

### Subansiri River

- It originates in **Tibet** and it is an **antecedent river**. It joins the Brahmaputra river.

### Dhansiri River

- It originates from **Laisang hills** in Nagaland and after flowing through Nagaon, it joins Brahmaputra river.

### Kaland River

- It flows in southern parts of Manipur and Mizoram and drains into Bay of Bengal.
- A hydroelectric project is located on this river.

### Barak River

- it originates from **Mt. Japov in Nagaland** and flows in Manipur. **Mawsynram** and **Cherrapunji** are situated in this river basin where highest rainfall of the world has been recorded.



## 14. Peninsular Drainage System

- The Peninsular drainage system is older than Himalayan river system which is evident from the broad, largely graded shallow valleys and the maturity of rivers.
- Most of the major Peninsular rivers except Narmada and Tapi flow from West to East.

### **Mahanadi (851 km)**

- The Mahanadi rises near Sihawa in Raipur district of Chhattisgarh. It drains an area of around 1.42 lakh square kilometers and has a total course of 851 km.
- The river flows through the states of Chhattisgarh and Odisha.
- Its major tributaries are Sheonath, Mand, Ib, Tel, Ong, Jonk and Hasdeo.
- Hirakud dam, the longest dam in the world, is located on this river.

### **Godavari (1,465 Km)**

- Godavari River is also known as Dakshin Ganga or Vridha Ganga.
- It is the largest peninsular river and second largest river of India.
- It rises from Tirmbakeswar in the Nashik district of Maharashtra.
- The Godavari basin extends over the states of Maharashtra, Madhya Pradesh, Chhattisgarh, Odisha, Telangana and Andhra Pradesh.
- Its principal tributaries are Penganga, Indravati, **Pranhita, Manjara, Wainganga, Wardha and Pravara.**

### **Krihsna (1,401 km)**

- It is the second largest east flowing peninsular river which rises near Mahabaleshwar in Sahyadri ranges.
- The river basin extends over the states of Maharashtra, Karnataka, Telangana and Andhra Pradesh.
- Its major tributaries are Koyna, Tungabhadra, Bhima, Malaprabha, Ghataprabha, Musi and Dudhganga.
- Dudhganga, Srisailem, Ghatprabha Hydroelectric Projects and Nagarjunasagar Dam is located in its basin.

### **Cauvery (800 km)**

- Cauvery, also known as the Ganges of the South, is the fourth largest river of southern India.
- It originates from Brahmagiri hills of Kogadu district in Karnataka. It forms triangular delta near Thanjavur, Tamil Nadu.

- The principal tributaries are Herangi, Hemawathi, Shimsha, Akravati, Lakshman Tirtha, Kabini, Amravati and Bhavani.
- In Madhya district, it forms two islands Srirangapatnam and Shivanasamudra, on either side of the Shivanasamudra falls.

### **Narmada (1,312 km)**

- It is the largest among all the west flowing rivers.
- It originates from the western flank of the Amarkantak Plateau in Madhya Pradesh.
- Flowing through rift valley between the Satpura in the south and Vindhyan range in the north, it forms a picturesque gorge in marble rocks and Dhuandhar waterfall near Jabalpur.
- It forms a 27 km long estuary and flow into Arabian, south of Bharuch.
- Its important tributaries are Hiran, Orsang, Barma, Kolar, Banjar, Tawa Kundi, etc.

### **Tapi (724km)**

- Tapi is known as Twin or Handmaid of Narmada.
- It originates from Multai in the Betul district of Madhya Pradesh. It also flows through rift valley and drains into Gulf of Khambat.
- Ukai Project (Ballabh Sagar Project), Tawa River Valley Project and Kakrapur Dam are located on this river.
- Its important tributaries are Suki, Arunavati, Mona, Amravati, Purna, Sipna etc.

### **Luni**

- It originates near Pushkar Valley of the Aravali range in two branches i.e. Saraswati and Sabarmati, which join with each other at Govindgarh from where it is called Luni.
- It is the largest river system of Rajasthan, west Aravalli.

### **Kali River**

- It originates from the Western Ghats in Karnataka.
- It flows in the form of an arc and drains into Arabian Sea. It has been polluted due to the manganese contamination.

### **Vedavathi River**

- It is tributary of Tungabhadra River and also known as Hagari.
- It originates from Bababudanagiri hills of Western Ghats and flows through Karnataka and Andhra Pradesh.

### **Mahi River**

- It originates in Vindhyan hills of Madhya Pradesh and flows from east to west.
- It flows through Rajasthan and Gujarat making an estuary finally drains into the

## 15. Small Rivers Flowing towards the West

(Draining into Arabian Sea)

1. **Shetruniji:** Rises near Dalkahwa in Amreli district of Gujarat.
2. **Bhadra:** Aniali village in Rjakot district. A dam is built across the river near Lakkavalli.
3. **Dhadhar:** Rises near Ghantar Village in Panchmahal district.
4. **Sabarmati:** Rises from Aravallis in Rajasthan.
5. **Vaitaran:** Raises from the Trimbak hills in Nashik district of Maharashtra
6. **Sharavathi:** It originates from Shimoga district of Karnataka. The famous **Jog falls** is located on this river.
7. **Mandavi:** It is also known as the **Lifeline of Goa**.
8. **Zuari:** It is the largest river of Goa.
9. **Bharathapuzha:** Originates near **Annamalai hills**, Kerala. It is **longest river** of **Kerala**, also known as **Ponnani**.
10. **Periyar:** The second largest river of Kerala. It is impounded by an arch dam at **Idukki**.
11. **Pamba:** River of Kerala which falls in Vemabanad lake after transversing course of **177 km**.

## 16. Small Rivers Flowing towards the East

(Draining into Bay of Bengal)

1. **The Subarnarekha:** It originates from Ranchi Plateau, forming boundary between West Bengal and Odisha in its lower course.
2. **The Brahmani:** It came into existence through the confluence of South Koel and Sankh rivers in Odisha.
3. **The Penneru:** It originates from the Nandi Durg hills in Karnataka and flows in northward direction.
4. **Baitarani:** This river originates from the Kendujhar Hills of Odisha and drains into Bay of Bengal.
5. **Vasmsadhara:** It originates in southern part of Odisha and forms an estuary at the mouth of Bay of Bengal.
6. **Palar river:** It's main tributaries are Poini and Cheyyar. It flows through Karnataka and Tamil Nadu and falls into Bay of Bengal
7. **Tamraparni:** Source of the river is Western Ghats (Near Alwarkurichi) and Drains into the Gulf of Mannar
8. **The Vaigai:** It rises in the Eastern slopes of Varushanadu hills.

## 17. Major Water Falls of India

**Waterfalls** are a spectacular sight to many eyes. Who would not like water crashing from tremendous heights and making plunge pools below it. India is home to most beautiful waterfalls in the world. Here monsoons are the major water providers to many waterfalls. The rains power the rivers and they create gushing waterfalls that become the ultimate travel destination every year. Take a look at such waterfalls in India below.

### Major Water Falls of India

Waterfalls	Height (m)	Location/State	Waterfalls	Height (m)	Location/State
Kunchikal	455	Shimoga/Karnataka	Vantawng	299	Serchhip/Mizoram
Barehipani	399	Mayurbhanj/Odisha	Penchalakona	219	Nellore/ Andra Pradesh
Langshiang	337	Western Khasi Hill/ Meghalaya	Kune	200	Pune/Maharashtra
Nohkalikai	332	Eastern Khasi Hill/Meghalaya	Soochipara	168	Wayanad/Kerala
Nohsngithiang	315	Eastern Khasi Hill/Meghalaya	Joranda	157	Mayurbhanj/Odisha
Dudhsagar	310	Goa	Shivanasamudra	98	Kaveri/Karnataka
Kynrem	305	Eastern Khasi Hill/Meghalaya	Hundru	98	Subarnrekha/Jharkhand
Meenmutty	300	Wayand/Kerala	Kapildhara	100	Narmada/Madhya Pradesh
Thalaiyar	297	Dindigal/Tamil Nadu	Pykara	55-61	Nilgiri Region/Ooty
Barkana	259	Shimoga/Karnataka	Gokak	55	Belagvi/Karnataka
Jog/ Gersoppa	253	Karnataka	Kakolat	49	Nawada/Bihar
Khandadhar	244	Sundaragh/Odisha	Chuliya	18	Rawatbhata/Rajasthan

## 18. Soil Types

- Soil is the network of interacting living organisms within the earth's surface layer which support life above ground. It is a thin upper weathered layer of the earth crust. The major constituents of the soil are minerals, humus, water and air.
- The naturally occurring soil is influenced by (i) parent material, (ii) climate, (iii) physical, chemical and biological agents (micro-organism) in it, (iv) land use practices and (v) time.
- Paedogenesis is the natural process of soil formation. It includes various subsidiary processes such as humification, weathering, leaching and calcification. Pedology is the study of soils in their natural environment. It deals with pedogenesis, soil morphology and soil classification.

The word rock is not used only for hard and highly resisting material like Granite and Sandstone but also for the rare and less resisting soils like kankar, clay, loess and alluvium.

- Soil develops where rock and sediments (lithosphere) are influenced by flora and fauna (biosphere), water (hydrosphere) and climate (atmosphere).

Soils Type	States where found	Rich in	Lacks in	Crops grown
<b>Alluvial</b>	Mainly found in the plains of Gujarat, Punjab, Haryana, Uttar Pradesh, Bihar, Jharkhand etc.	Potash and Lime	Nitrogen and Phosphorus	Large variety of rabi and kharif crops such as wheat, rice, sugarcane, cotton and jute etc.
<b>Black (Regur Soil)</b>	Deccan Plateau, Maharashtra, Madhya Pradesh, Gujarat, Andhra Pradesh, Tamil Nadu, Valleys of Krishna and Godavari Rivers	Lime, Iron, Magnesia, Potash and Alumina	Phosphorous, Nitrogen and Organic matter	Cotton, sugarcane, jowar, tobacco, wheat and rice etc.
<b>Red</b>	Eastern and southern part of the Deccan Plateau, Odisha,	Iron oxide and Potash	Nitrogen, Phosphorous and Humus	Wheat, rice, cotton, sugarcane and pulses.

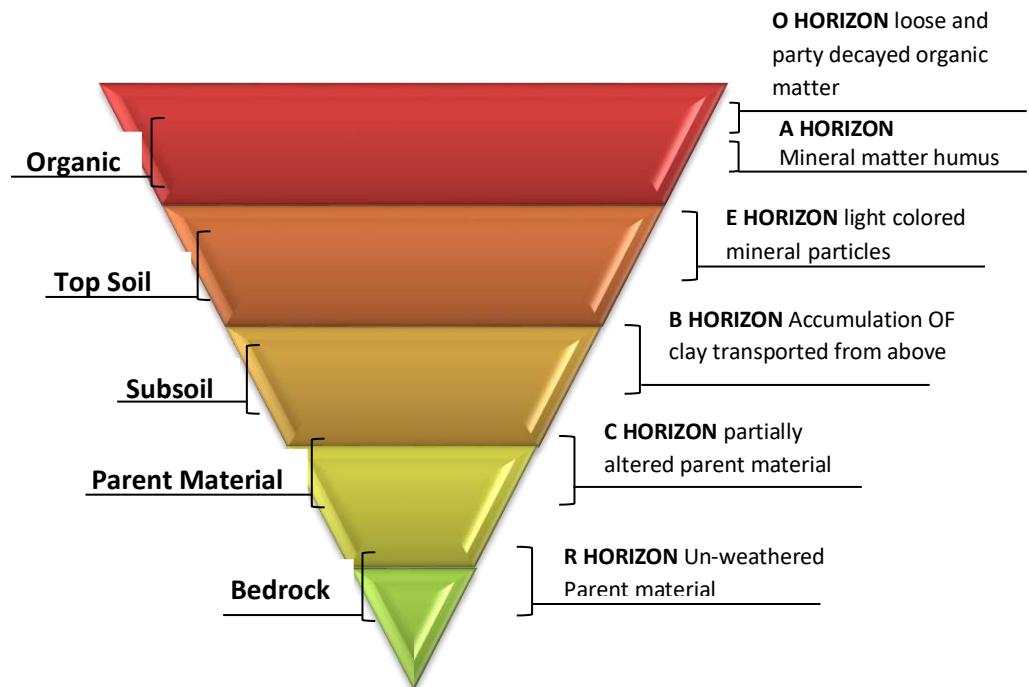
<b>Laterite</b>	Chhattisgarh and southern parts of the middle Ganga plain. Karnataka, Kerala, Tamil Nadu, Madhya Pradesh, Assam and Orissa hills.	Iron oxide and Potash	Organic matter, Nitrogen, Phosphate and Calcium	Cashewnut, tea, coffee, rubber
<b>Arid</b>	Western Rajasthan, North Gujarat and Southern Punjab	Soluble salts and Phosphate	Humus and Nitrogen	Only drought resistant salt tolerant and desert crops such as barley, rapeseed, cotton, millets, maize and pulses.
<b>Saline and Alkaline</b>	Western Gujarat, details of Eastern Coast, Sunderban areas of West Bengal, Punjab and Haryana	Sodium, Potassium, Magnesium	Nitrogen and Calcium	Unit for agriculture

**The World Soil Day** is celebrated every year on 5 December by Food and Agriculture Organization (FAO) of the United Nations. It aims to communicate messages on the importance of soil quality for food security, health ecosystems and human well-being. Keep soil alive protect soil biodiversity-is the theme for 2020.

## 20. Layers of Soil

### Definition of Soil

Soil can be simply defined as a mixture of small rock particles/debris and organic materials/humus which develop on the earth surface and support growth of plants.



### Karewas Soils

- Lacustrine deposits, formed during the Pleistocene period due to endogenetic forces, in the valleys of Kashmir and Bhadarwah in Doda district of Jammu are known as Karewas.
- These are the flat topped mounds, composed of fine salt clay, sand and boulder-clay.
- The Karewas are very fertile deposits and are used for the cultivation of Saffron, almonds, Walnuts, Apple and Orchards.

## **Snowfields**

- The areas under snow and glaciers are collectively known as snowfields. The high peaks of the Greater Himalayas are Karakoram, Ladakh and Zaskar.
- The soils in these areas are immature, generally without soil erosion. They remain frozen and are unsuitable for the cultivation of crops.

## **Laterization**

- It is common to the soils found in the humid tropical and subtropical environments.
- The high temperatures and heavy precipitation results in the rapid weathering of rocks and minerals.
- Almost all of the by-products of weathering are translocated from A horizon to B horizon by leaching.
- The B-Horizon in a lateritic soil has high concentration of illuviated materials. Heavy leaching causes the soils to have an acidic pH because of the net loss of base cations.
- This type of soil is known as Laterite which means brick-like as it used in tropical areas for making bricks.

## **Calcification**

- It occurs when evapotranspiration exceeds precipitations causing the upward movement of dissolved alkaline salts from the groundwater. It occurs in warm, semi-arid environment.
- In some cases, the deposits can form a hard layer called Caliche. The most common substance involved in this process is Calcium Carbonate.

## **Podsolisation**

- It occurs in cool and moist climates.
- It occurs when strongly acid soil solutions cause the breakdown of clay minerals. As a result Silica, Aluminium and Iron form complexes with organic substances in the soil.



## **Gleying**

- It occurs in waterlogged, anaerobic conditions when iron compounds are either reduced or removed from the soil, or segregated out as mottles or concretions in the soils. A
- The removal of iron leaves the soil a grey or bluish colour. Marshy wetlands often contain gleyed soils.

## **Salinization**

- It is the process of accumulation of salts, such as sulphates and Chlorides of Calcium, Magnesium, Sodium and Potassium, in soils in the form of a salty horizon.
- It is quite common in arid and semi-arid regions.

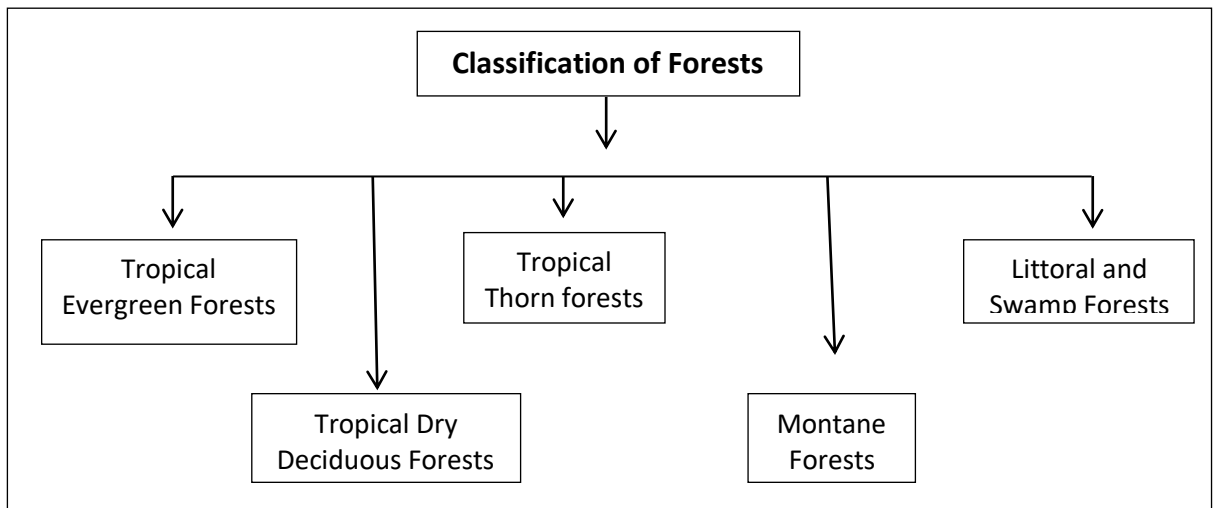
## **International Year of Soils**

The International Year of Soils, 2015 (IYS 2015) was declared by the sixty-eighth session of the United Nations General Assembly on December 20, 2013 after recognizing December 5 as World Soil Day.

## 21 Classification of Forest Based on Administration

### Statutory Conditions

- I. **Reserved Forest:** In these forests, entry of people is prohibited for the collection of timber and grazing of cattle. A total of 53% of forest area of the country fall under this category.
- II. **Protected Forest:** These forests are under the supervision of the government but local people have the right to collect wood for fuel and feed the cattle in this region, but provided there should be no serious threat to forests. A total of 29% the country's forest areas belong to this category.
- III. **Unclassified Forest:** There is no restriction on cutting trees and feeding cattle in unclassified forest. About 18% forest area of the country falls under this category.



### Classification of Forests

#### Tropical Evergreen Forests

- These forests are found in areas receiving more than 200 cm of rainfall and having temperature above 22°C.
- Tropical Evergreen Forests are found in Sahyadri (Western Ghats), Shillong Plateau, Andaman and Nicobar Islands and Lakshadweep.

- These forests are dense and multi-layered. It harbours many types of plants and animals. The trees are evergreen as there is no definite period to shed their leaves.

The vegetation of these forests includes Mahogany, Rosewood, Bamboo, Canes, Cinchona, and Rubber etc.

- The semi evergreen forests are found in the less rainy parts of these regions. Such forests have a mixture of evergreen and moist deciduous trees.
- The forests are also important for the cultivation of spices.

### **Tropical Wet Deciduous Forests**

- These are also called as Monsoon forests. These forests are found in the parts of Chhattisgarh, Odisha, Bihar, Jharkhand, Andhra Pradesh, Karnataka, Kerala and Tamil Nadu.
- Moist Deciduous forests are found in the area with 100-200 cm of rainfall. The major regions include western slopes of Sahyadri, north-eastern parts of peninsular plateau, Bhabar and Terai Region along the foothills of Shiwaliks.
- The major vegetation of these forests includes Teak, Sal, Mango, Mahua, Bamboo, Shisham, Khair and sandal. All these are economically very important.
- Dry Deciduous forests are found in the regions with 70-100 cm of rainfall. These represent transition type as on the wetter side these give way to moist deciduous and on the drier side these become thorn forests.
- Trees of these forests have thick bark and are not very high (generally 6-9 m height).
- They are distributed in eastern Rajasthan, western Madhya Pradesh, south-western Uttar Pradesh, southern Punjab, Haryana and the rain shadow region of Western Ghats.
- Overgrazing is the most important problem in these forests. The vegetation of this region includes Mahua, Babool, Tendu, Khair, Peepal etc.

### **Tropical Thorn Forests**

- These forests are found in the areas with rainfall less than 75 cm, humidity less than 50% and high temperature around 25-30°C.
- These forests are also found in a crescent belt extending from Indore district of Madhya Pradesh to plateau regions of Kurnool district of Andhra Pradesh.
- The main species of these forests are Babool, Khair, Palm, Date, Cacti and Palas.

## Montane Forests

- Since climatic conditions change with increasing height, the change in vegetation cover at different heights in mountainous region is also observed.
- Here the vegetation ranges from tropical to alpine type. At an altitude of 1500 m deciduous forest are found while the altitude of coniferous forest varies from 1500-3000.
- The vegetation found here includes Deodar, Spruce, Silver fir, Chir etc whose leaves are conical.
- Broad leaf evergreen trees like Oak, Magnolia, Lawrell etc are found in the heavy rainfall regions of the eastern Himalayas.

## Littoral and Swamp Forests

- These forests are also called Tidal or Mangrove.
- The deltaic tracts of Ganga, Godavari, and Krishna etc are ideally suited for this type of forests.
- The best example of this type of forest is Sunderbans which is the largest mangrove forest of the world.

Van Mahotsav was launched in 1950 to make people aware of the importance of planting trees. Van Mahotsav is usually observed in the first week of July every year. The objective is to keep local people involved in plantation drives and spread environmental awareness.

- The United Nations General Assembly declared 21 March as the international day of Forests (IDF), in 2012.
- The theme for each International Day of Forests is chosen by the collaborative partnership on forests. The theme for 2021 is Forest Restoration: A path to Recovery and Well Being.

## 22. Forest conservation Act, 1980

Forest conservation Act, 1980 provides for the conservation of forests and related aspects. The act covers all types of forests such as reserved forests, protected forests and any forested land.

### Botanical Survey of India

The Botanical Survey of India (BSI) was established in 1890 under the Ministry of Environment, forest and Climate change, with the objective of exploring the plant resources of the country and identifying plant species with economic virtue.

Forest Cover [ISFR (2019)]	Area (Km. sq.)	% of Total Area
• Highly dense forest	99,278	3.02
• Moderately Dense Forest	3,08,427	9.38
• Open forest	3,04,499	9.26
• Total Forest Cover	7,12,249	21.67

#### States with Maximum Forest Cover (%)

States	Area
1. Lakshadweep	90.33%
2. Mizoram	86.41%
3. Andaman & Nicobar Islands	81.74%
4. Arunachal Pradesh	79.63%

#### Status of Forest Cover (Area)

States	Area
1. Madhya Pradesh	77,482 km. sq.
2. Arunachal Pradesh	66,688 km. sq.
3. Chhattisgarh	55,611 km. sq.

4. Maharashtra

50,778 km. sq.

**Status of Mangrove Forest (Area)**

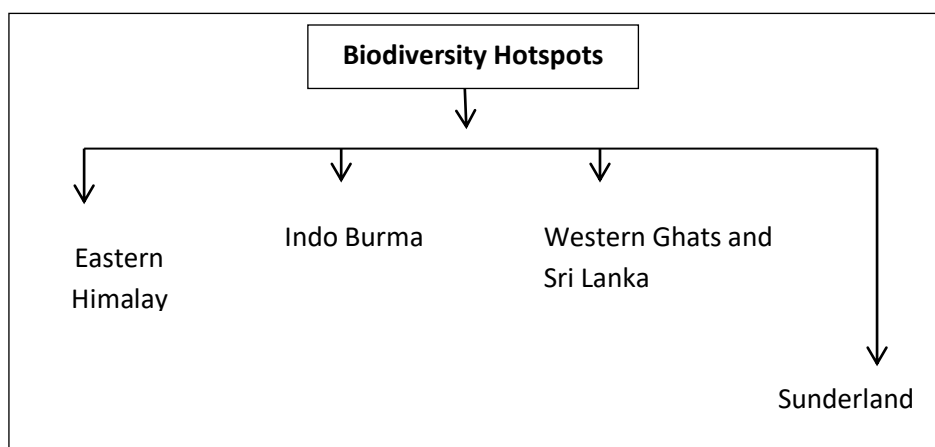
<b>States</b>	<b>Area</b>
1. West Bengal	2,112 km. sq.
2. Gujarat	1117 km. sq.
3. Andaman and Nicobar	616 km. sq.

National Bamboo Mission (NBM) was started as a Centrally Sponsored Scheme in the ear 2006-07 during the year 2014-15; the mission was included under the mission for Integrated Development of Horticulture (MIDH)

## 23. Biodiversity and Wildlife

- India is characterised as a megadiverse country which accounts for 2.4% of the total world's area, harbouring a rich diversity of geographical flora and fauna.
- The country's diverse physical features and climatic conditions have resulted in a variety of ecosystems such as forests, wetlands, grasslands, and deserts etc. which harbour and sustain a high level of biodiversity.
- According to Conservation International, 4 out of 35 globally identified biodiversity hotspots are found in India.

### Biodiversity Hotspots



The term Biodiversity Hotspot was coined by Norman Myers in 1988.

The term Biodiversity was first used by Wildlife Scientist Raymond F. Dasmann in 1968 in his book A Different Kind of country.

- Biodiversity means variety and variability of life on earth including terrestrial, marine and other aquatic ecosystem.

### Biome

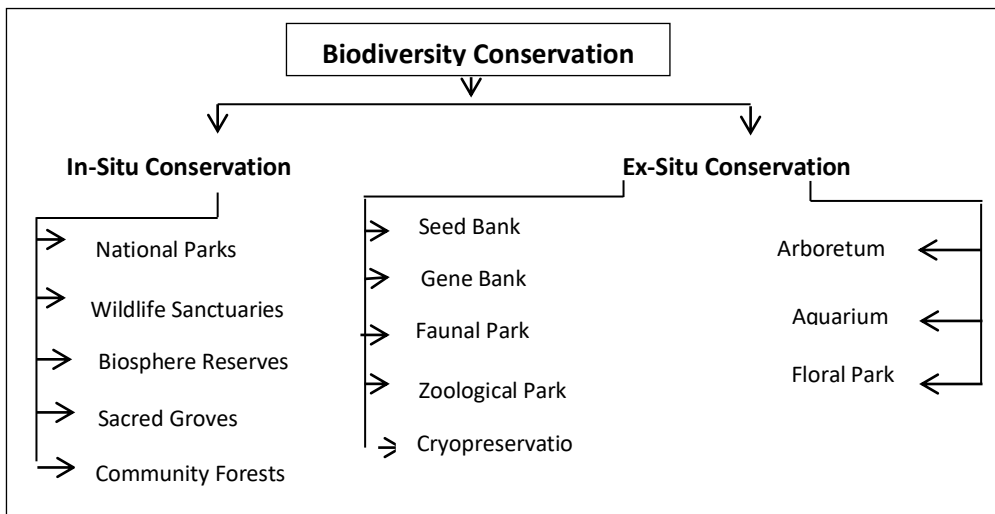
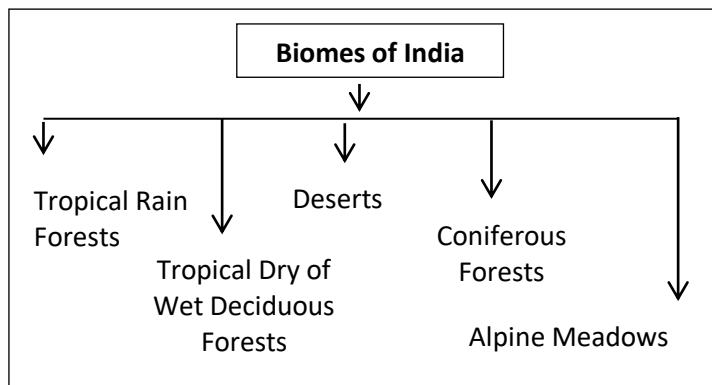
- Biome is a community of flora and fauna that have common characteristics for the environment in they exist and no two biomes are alike.
- There are 10 different bio-geographic zones and 25 bio-geographic provinces in India.

## Biogeographic Zones

1. Trans –Himalaya
2. Himalaya
3. Deserts
4. Semi-arid
5. Western Ghats
6. Deccan Peninsula
7. Gangetic Plain
8. Coasts
9. North East India
10. Islands

## Biogeographic Provinces

- Ladakh Mountains, Tibetan Plateau, Sikkim
- North-West Himalaya, West Himalaya, central Himalaya and East Himalaya
- Thar, Kutch
- Punjab Plains, Gujarat Rajputana
- Malabar plains, Mountains of Western Ghats
- Central Highlands, Chhotanagpur Plateau, Eastern highlands, Central Plateau, Deccan south
- Upper Gangetic Plains and Lower Gangetic Plains
- West coast, East Coast and Lakshadweep
- Brahmaputra Valley, North East Hills
- Andaman and Nicobar Islands





- Ex-Situ conservation is the technique of biodiversity conservation in which an endangered species, breed variety, plant or animal are conserved outside their natural habitats.
- In-Situ conservation is on-site conservation of plants and animals within their natural habitats or in protected areas.

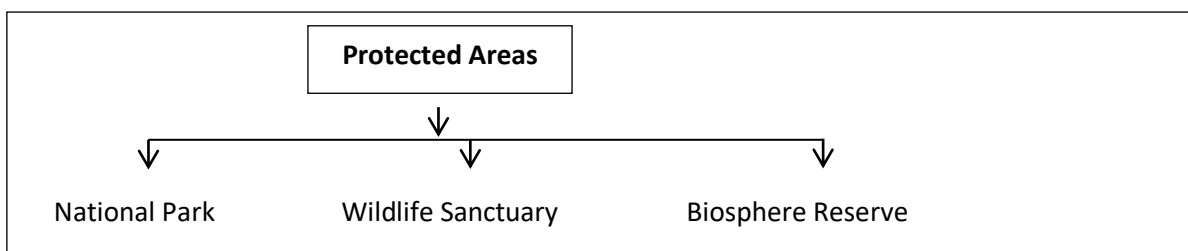
## 24. Protected Areas

India is one of the 17 mega diverse countries of the world. With only 2.4% of the world's land area, 16.7% of the world's human population and 18% livestock, it contributes about 8% of the known global biodiversity, however, putting enormous demands on our natural resources. India is home to world's largest wild tigers population and has got unique assemblage of globally important endangered species like Asiatic lion, Asian Elephant, One-horned Rhinoceros, Gangetic River Dolphin, Snow Leopard, Kashmir Stag, Dugong, Gharial, Great Indian Bustard, Lion Tailed Macaque etc.

### **Protected Area Network in India:**

A National Board for Wildlife (NBWL), chaired by the Prime Minister of India provides for policy framework for wildlife conservation in the country. The National Wildlife Action Plan (2002-2016) was adopted in 2002, emphasizing the people's participation and their support for wildlife conservation. India's conservation planning is based on the philosophy of identifying and protecting representative wild habitats across all the ecosystems. The Indian Constitution entails the subject of forests and wildlife in the Concurrent list. The Federal Ministry acts as a guiding torch dealing with the policies and planning on wildlife conservation, while the provincial Forest Departments are vested with the responsibility of implementation of national policies and plans.

A network of 668 Protected Areas (PAs) has been established, extending over 1,61,221.57 sq. kms. (4.90% of total geographic area), comprising 102 National Parks, 515 Wildlife Sanctuaries, 47 Conservation Reserves and 4 Community Reserves. The State/Union Territory wise details of PAs in the country with year of notification and area is given at Annexure-I. 39 Tiger Reserves (Annexure-II) and 28 Elephant Reserves (Annexure-III) have been designated for species specific management of tiger and elephant habitats. UNESCO has designated 5 Protected Areas as World Heritage Sites. As the ecosystems and species do not recognise political borders, the concept of Transboundary Protected Areas has been initiated for coordinated conservation of ecological units and corridors with bilateral and/or multilateral cooperation of the neighbouring nations. There are 4 categories of the Protected Areas viz, National Parks,



## National Park

**National Park** is an area having adequate ecological, faunal, floral, geomorphological, natural or zoological significance. The National Park is declared for the purpose of protecting, propagating or developing wildlife or its environment, like that of a Sanctuary. The difference between a Sanctuary and a National Park mainly lies in the vesting of rights of people living inside. Unlike a Sanctuary, where certain rights can be allowed, in a National Park, no rights are allowed. No grazing of any livestock shall also be permitted inside a National Park while in a Sanctuary, the Chief Wildlife Warden may regulate, control or prohibit it. In addition, while any removal or exploitation of wildlife or forest produce from a Sanctuary requires the recommendation of the State Board for Wildlife, removal etc., from a National Park requires recommendation of the National Board for Wildlife (However, as per orders of Hon'ble Supreme Court dated 9th May 2002 in Writ Petition (Civil) No. 337 of 1995, such removal/ exploitation from a Sanctuary also requires recommendation of the Standing Committee of National Board for Wildlife).

## Sanctuaries

**Sanctuaries**, Conservation Reserves and Community Reserves. Sanctuary is an area which is of adequate ecological, faunal, floral, geomorphological, natural or zoological significance. The Sanctuary is declared for the purpose of protecting, propagating or developing wildlife or its environment. Certain rights of people living inside the Sanctuary could be permitted. Further, during the settlement of claims, before finally notifying the Sanctuary, the Collector may, in consultation with the Chief Wildlife Warden, allow the continuation of any right of any person in or over any land within the limits of the Sanctuary.

## Conservation Reserves

**Conservation Reserves** can be declared by the State Governments in any area owned by the Government, particularly the areas adjacent to National Parks and Sanctuaries and those areas

which link one Protected Area with another. Such declaration should be made after having consultations with the local communities.

Conservation Reserves are declared for the purpose of protecting landscapes, seascapes, flora and fauna and their habitat. The rights of people living inside a Conservation Reserve are not affected. Community Reserves can be declared by the State Government in any private or community land, not comprised within a National Park, Sanctuary or a Conservation Reserve, where an individual or a community has volunteered to conserve wildlife and its habitat. Community Reserves are declared for the purpose of protecting fauna, flora and traditional or cultural conservation values and practices. As in the case of a Conservation Reserve, the rights of people living inside a Community Reserve are not affected.

### **Regulations/ laws relating to Protected Areas (PAs):**

The PAs are constituted and governed under the provisions of the Wild Life (Protection) Act, 1972, which has been amended from time to time, with the changing ground realities concerning wildlife crime control and PAs management. Implementation of this Act is further complemented by other Acts viz. Indian Forest Act, 1927, Forest (Conservation) Act, 1980, Environment (Protection) Act, 1986 and Biological Diversity Act, 2002 and the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006. The Wildlife Crime Control Bureau of the Central Government supplements the efforts of provincial governments in wildlife crime control through enforcement of CITES and control of wildlife crimes having cross-border, interstate and international ramifications. In order to strengthen and synergise global wildlife conservation efforts, India is a party to major international conventions viz. Convention on International Trade in Endangered Species of wild fauna and flora (CITES), International Union for Conservation of Nature (IUCN), International Convention for the Regulation of Whaling, UNESCO-World Heritage Committee and Convention on Migratory Species (CMS).

### **Main issues concerning the management of Protected Areas:**

Wildlife conservation and management in India is currently facing a myriad of complex challenges that are both ecological and social in nature. Issues such as habitat loss/fragmentation, overuse of biomass resources in the context of biotic pressures, increasing human-wildlife conflicts, livelihood dependence on forests and wildlife resources, poaching and illegal trade in

wildlife parts and products, need for maintaining a broad base of public support for wildlife conservation exemplify and characterize the contemporary wildlife conservation scenario in India. The government and the civil society are taking several measures to address these issues. Improved synergies and better coordination amongst the wide array of stakeholders are needed to meet the challenges of conserving India's diverse wilderness resources. In 1972, Wildlife Protection Act was passed under which various wildlife sanctuaries and national parks have been set up.

- National Parks are habitat oriented, under which protection is given to all species living in a specific region.
- The largest National Park of India is located in Leh (Ladakh) known as Hemis National Park.
- The Smallest National Park in India is in South Button Island in Andaman and Nicobar Islands (0.03 sq. km.)

- |  |
|--|
| <ul style="list-style-type: none"> <li>• Galathea Bay Wildlife Sanctuary (Great Nicobar Island) is one of the most important coastal and marine biodiversity areas and Marine Turtle Habitat in India.</li> <li>• India's first national park was maximum number of national parks (10) followed by Andaman and Nicobar (9).</li> <li>• As of 2021, there are 544 W</li> </ul> |
|--|

- Wildlife Protection Act, 1972 provides for the protection of wild animals, birds and plants. The act contains seven schedules which gives varying degree of protection.
- Schedule I and Part 2 of Schedule II provide absolute protection.
- Madhav Gadgil Committee (2011) and Kasturirangan committee (2013) have recommendation on Eco-Sensitive Zones in Western Ghats.
- Wildlife Crime Control Bureau is a statutory multidisciplinary body established by the government of India under the Ministry of Environment and Forrester to combat organised wildlife crime in the country.
- The Bureau has its headquarter New Delhi and five regional offices at Delhi, Kolkata, Mumbai, Chennai and Jabalpur.
- It was created on 6 June, 2007 by amending the Wildlife Protection Act, 1972.
- The Wildlife Institute of India (WII) is an autonomous institution under the Ministry of Environment, Forest and Climate Change, established in 1982 at Chandrabani, Dehradun in Uttarakhand.

## 25. Biosphere Reserves

'Biosphere Reserves' - was initiated under UNESCO's 'Man & Biosphere' (MAB) programme in 1971. The purpose of its formation is to conserve in situ all forms of life, along with its support system, in its totality, so that it could serve as a referral system for monitoring and evaluating changes in natural ecosystems. The first biosphere reserve of the world was established in 1979; since then, the network of biosphere reserves has increased to 564 in 109 countries across the world (MAB, 2010). Presently, there are 18 existing biosphere reserves in India. Some of the famous biosphere reserves are Sunderbans in West Bengal, Khangchendzonga mountain ranges in Sikkim, Nandnadevi mountain ranges in Uttarakhand, Gulf of Mannar, Rann of Kutch in Gujarat etc.

Thus, the protected area network plays a significant role in conservation, and regardless of the country - India or others, where the common aim is to preserve the ecological wealth by continuing conservation efforts.

### Conserving Protected Areas

- Reduce forest-based dependence of locals/tribals living on the forest fringes, by providing them alternate livelihood options.
- Increased vigilance and patrolling to counter poaching and other crimes
- Increased awareness amongst people and sensitivity towards the last strongholds of our country that support wildlife.
- Biosphere reserves are terrestrial and coastal/marine ecosystem made to conserve the biodiversity. These are the sites recognized under UNESCO'S Man and Biosphere (MAB) programme to promote sustainable development based on local community efforts. Biosphere Reserves was initiated by UNESCO in 1971.

**Core Zone:** It contains suitable habitat for numerous plants and animal species including higher order predators. Core Zone should be kept free from human interference. This is strictly prohibited area.

**Buffer Zone:** The buffer zone surrounds or adjoins the core areas, and is used for activities compatible with sound ecological practices which can reinforce scientific research, monitoring, training and education.

**Transition Zone:** The transition area is the part of the reserve where his greatest activity is allowed, fostering economic and human development that is socio-culturally and ecologically sustainable.

India has 18 Biosphere Reserves and with the inclusion of Panna Biosphere Reserve (MP), in 2020, the number of UNESCO designated World Natural Biosphere Reserves under MAB has raised to 12.

#### **Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)**

It is the only global convention specializing in conservation of migratory species, their habitats and migration routes. It came into force in 1983.

## **Difference between National Park, Wildlife Sanctuary and Biosphere Reserve**

<b>National Park</b>	<b>Sanctuary</b>	<b>Biosphere Reserve</b>
Habitat oriented, protection is given to all species of that region.	Generally species-oriented such as citrus, pitcher plant etc.	Ecosystem-oriented i.e. all forms of life.
Boundaries fixed by legislation.	Boundaries are not sacrosanct / fixed.	Boundaries fixed by legislation.
Tourism permissible.	Tourism permissible.	Tourism generally not permissible.
Lack of research and Scientific management.	Lack of Research and Scientific management.	Research and scientific management is encouraged.
Comes under WPA, 1972.	Come under WPA, 1972.	Come under UNESCO-MAB program.

#### **International Day for Biological Diversity:**

- International Biodiversity Day is observed every year on 22 May to generate awareness for biodiversity issues.

## 26. The International Union for Conservation of Nature

**International Union for Conservation of Nature (IUCN)**, in full **International Union for Conservation of Nature and Natural Resources**, formerly called **World Conservation Union**, network of environmental organizations founded as the International Union for the Protection of Nature in October 1948 in Fontainebleau, France, to promote nature conservation and the ecologically sustainable use of natural resources. It changed its name to the International Union for Conservation of Nature and Natural Resources (IUCN) in 1956 and was also known as the World Conservation Union (IUCN) from 1990 to 2008. The IUCN is the world's oldest global environmental organization. Its headquarters are in Gland, Switz.

Through its member organizations, the IUCN supports and participates in environmental scientific research; promotes and helps implement national conservation legislation, policies, and practices; and operates or manages thousands of field projects worldwide. The IUCN's activities are organized into several theme-based programs ranging from business and biodiversity to forest preservation to water and wetlands conservation. In addition, a smaller number of special initiatives draw upon the work of different programs to address specific issues, such as climate change, conservation, and poverty reduction. The volunteer work of more than 10,000 scientists and other experts is coordinated through special commissions on education and communication; environmental, economic, and social policy; environmental law; ecosystem management; species survival; and protected areas. All of the IUCN's work is guided by a global program, which is adopted by member organizations every four years at the IUCN World Conservation Congress.

The IUCN maintains the IUCN Red List of Threatened Species, a comprehensive assessment of the current risk of extinction of thousands of plant and animal species. The organization also publishes or coauthors hundreds of books, reports, and other documents each year. The IUCN has been granted observer status at the United Nations General Assembly.

The IUCN's membership includes more than 1,000 governmental and nongovernmental organizations from more than 140 countries. It is governed by a democratically elected council,



which is chosen by member organizations at each World Conservation Congress. The IUCN's funding comes from a number of governments, agencies, foundations, member organizations, and corporations.

India became a state member of IUCN in 1969 and IUCN office was established in New Delhi (2007).

- The World Wide Fund for Nature is an international non-governmental organization founded on 24 April, 1961, working in the field of Wildlife Preservation and the reduction of human impact on the environment.
- Its headquarter is located in Gland, Switzerland.
- The Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an international agreement between the governments, administered through United Nation Environment Program (UNEP).

#### **International Decades (United Nations)**

- International Decade on Ecosystem Restoration -**2021-30**
- Water for Sustainable Development -**2018-28**
- International Decade on Biodiversity -**2011-2020**

## **27. Conservation Efforts of Forest and Wildlife in India**

Conservation in the background of rapid decline in wildlife population and forestry has become essential. But why do we need to conserve our forests and wildlife? Conservation preserves the ecological diversity and our life support systems – water, air and soil. It also preserves the genetic diversity of plants and animals for better growth of species and breeding. For example, in agriculture, we are still dependent on traditional crop varieties. Fisheries too are heavily dependent on the maintenance of aquatic biodiversity. In the 1960s and 1970s, conservationists demanded a national wildlife protection programme. The Indian Wildlife (Protection) Act was implemented in 1972, with various provisions for protecting habitats. An all-India list of protected species was also published. The thrust of the programme was towards protecting the remaining population of certain endangered species by banning hunting, giving legal protection to their habitats, and restricting trade in wildlife.

Subsequently, central and many state governments established national parks and wildlife sanctuaries about which you have already studied. The central government also announced several projects for protecting specific animals, which were gravely threatened, including the tiger, the one horned rhinoceros, the Kashmir stag or hangul, three types of crocodiles – fresh water crocodile, saltwater crocodile and the Gharial, the Asiatic lion, and others. Most recently, the Indian elephant, black buck (chinkara), the great Indian bustard (godawan) and the snow leopard, etc. have been given full or partial legal protection against hunting and trade throughout India.

The conservation projects are now focusing on biodiversity rather than on a few of its components. There is now a more intensive search for different conservation measures. Increasingly, even insects are beginning to find a place in conservation planning. In the notification under Wildlife Act of 1980 and 1986, several hundred butterflies, moths, beetles, and one dragonfly have been added to the list of protected species. In 1991, for the first time plants were also added to the list, starting with six species.

## **Types and Distribution of Forest and Wildlife Resources:**

Even if we want to conserve our vast forest and wildlife resources, it is rather difficult to manage, control and regulate them. In India much of its forest and wildlife resources are either owned or managed by the government through the Forest Department or other government departments.

These are classified under the following categories.

- (i) **Reserved Forests:** More than half of the total forest land has been declared reserved forests. Reserved forests are regarded as the most valuable as far as the conservation of forest and wildlife resources are concerned.
- (ii) **Protected Forests:** Almost one-third of the total forest area is protected forest, as declared by the Forest Department. This forest land are protected from any further depletion.
- (iii) **Unclassed Forests:** These are other forests and wastelands belonging to both government and private individuals and communities. Reserved and protected forests are also referred to as permanent forest estates maintained for the purpose of producing timber and other forest produce, and for protective reasons.

Madhya Pradesh has the largest area under permanent forests, constituting 75 per cent of its total forest area. Jammu and Kashmir, Andhra Pradesh, Uttarakhand, Kerala, Tamil Nadu, West Bengal, and Maharashtra have large percentages of reserved forests of its total forest area whereas Bihar, Haryana, Punjab, Himachal Pradesh, Odisha and Rajasthan have a bulk of it under protected forests. All North-eastern states and parts of Gujarat have a very high percentage of their forests as unclassified forests managed by local communities.

## **The Institutional Framework for Wildlife Conservation in India**

### **State Government Institutions:**

State governments exercise complete administrative control over all statutorily recognized forests and other government-owned lands in the country. The state government's power to constitute reserved forests, national parks and wildlife sanctuaries is absolute but it has to seek prior approval of the Central Government for de-reservation, de-notification, diversion, logging, or leasing of forests for non-forestry activities.

## Statutory Bodies

Several statutory bodies require to be constituted at the federal and state levels with varying mandates to enforce, advise, and monitor a wide range of issues concerning forests, wildlife and environment. Some of the key bodies include the following:

*(a) The National Board for Wildlife (NBWL)* (formerly known as the Indian Board for Wildlife) is constituted under the Wildlife Protection Act, 1972, and chaired by the Prime Minister with the Minister of Environment and Forests as the vice-chair. Apart from a number of government functionaries drawn from both the Central and State governments, five non-governmental organizations and ten conservationists/ecologists are nominated to the NBWL. The board advises the federal and state governments in matters concerning wildlife conservation policy, illegal trade and poaching, management of national parks and sanctuaries, impact assessments of projects on wildlife, and other related issues. The tenure of each board is 3 years, after which a new one is constituted.

(The NBWL is ordinarily expected to meet at least once a year, but this does not always happen. However, a Standing Committee of the NBWL, comprising of a few government and non-government members of the NBWL, meets every three months under the chairmanship of the Union Minister of Environment and Forests, primarily to examine proposals for non-forestry use of forestland within National Parks and Wildlife Sanctuaries, and issue or deny permissions. These include, among others, proposals for highways, dams, industries and mining. The minutes of every Standing Committee meeting are put up on the website of the MoEF).

*(b) State Boards for Wildlife* at the state level similarly advise the state governments in selection and management of protected areas and other matters connected with the protection of wildlife. The SBWL is headed by Chief Minister, with the Forest Minister of the State as the Vice Chair.

(In many states, the SBWL is either totally defunct or simply a rubber stamp. Very often, retired government officials and ‘nature enthusiasts’ with questionable knowledge and credentials make up the board, thus making it fairly ineffective).

*(c) The Biodiversity Act, 2002* mandates the constitution of a National Biodiversity Authority which, among other responsibilities, advises the Union and State governments on matters

relating to biodiversity conservation, equitable sharing of benefits arising out of biological resource utilization; regulating access to biodiversity and initiating measures to oppose the granting of Intellectual Property Rights on any biological resource obtained from India.

*(d) Central and State Pollution Control Boards* have been constituted under the Environment Protection Act (EPA), 1986 with wide-ranging powers to regulate the setting up of industries in Ecologically Sensitive Areas (ESAs) and to inspect and prosecute individuals or industries who violate specified pollution control norms.

*(e) The Central Empowered Committee (CEC):* initially constituted under the Environment Protection Act, 1986 for a period of five years, starting in September 2002, it functions as a Committee of the Supreme Court to assist and monitor compliance of the orders of the Supreme Court in the major public interest litigation (Writ Petition (Civil) 202/1995 – Godavarman Tirumalpad v/s Union of India & others) concerning protection of forests, wildlife, and related issues.

*(f) National Green Tribunal (2009):* The National Green Tribunal (NGT) is a institution that is empowered to adjudicate environmental disputes. The tribunal has jurisdiction over all civil cases where a substantial question relating to the environment – arising out of the implementation of the Environment Protection Act, Forest Conservation Act, Biodiversity Act, Water (Prevention and control of pollution) Act, and related laws – is involved. The National Green Tribunal is intended to drive effective and expeditious disposal of cases relating to environmental protection and conservation of forests and other natural resources, including enforcement of any legal right relating to environment, and giving relief and compensation for damages to persons and property and for matters connected therewith or incidental thereto.

*(g) Forest Advisory Committee (FAC):* Is a statutory committee constituted under Section 3 of the Forest Conservation Act to consider proposals for diversion of forestland (other than in National Parks or Sanctuaries) for non-forestry purposes, and render advice to the Central Government.

# Project Tiger

- Government of India has taken a pioneer initiative for conserving the tiger by launching the Project Tiger in 1973. IUCN has specified tiger as an endangered species.

<b>India established Jim Corbett National Park as the first Tiger Reserve on 1<sup>st</sup> April, 1973</b>
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- From 9 tiger reserves since its formative year, the Project, spreading in 18 tiger range states in India.

## Important International Days

• World Wetlands Day	2 <sup>nd</sup> February
• International Polar Bear Day	27 <sup>th</sup> February
• International Day of Action of Rivers	14 <sup>th</sup> March
• World Wildlife Day	3 <sup>rd</sup> March
• World Sparrow Day	20 <sup>th</sup> March
• International Day of forest	21 <sup>st</sup> March
• World Water and Sanitation Day	22 <sup>nd</sup> March
• World Earth Day	22 <sup>nd</sup> April
• World Migratory Bird Day	2 <sup>nd</sup> Sat. in May
• International Day for Biological Diversity	22 <sup>nd</sup> May
• World Turtle Day	23 <sup>rd</sup> May
• World Environment Day	5 <sup>th</sup> June
• World Oceans Day	8 <sup>th</sup> June
• World Day to combat Desertification and Drought	17 <sup>th</sup> June
• World Population Day	11 <sup>th</sup> July
• International Tiger Day	29 <sup>th</sup> July
• World Lion Day	10 <sup>th</sup> August

- World Elephant Day 12<sup>th</sup> August
- World Orangutan Day 19<sup>th</sup> August
- International Day for the Preservation of Ozone Layer 16<sup>th</sup> September
- World Water Monitoring Day 18<sup>th</sup> September
- Zero Emissions Day 21<sup>st</sup> September
- World Rhino Day 22<sup>nd</sup> September

## T x 2 Programme

- It was launched by World Wildlife Fund (WWF) in 2010 at St Petersburg Tiger Summit held Russia. Under it, 13 tiger range countries had agreed to double the world tiger population by 2022. 13 Tiger Range countries are India, Laos, Cambodia, Vietnam, Thailand, Malaysia, Myanmar, Bangladesh, Bhutan, China, Nepal, Russia and Indonesia.
- Pilibhit Tiger Reserve (Uttar Pradesh) in November 2020 bagged first ever Tx2 international award for doubling the number of Tigers in 4 years (25 in 2014 to 665 in 2018) against a target of 10 years.

## National Tiger Conservation Authority

- It is a statutory body under Ministry of Environment, Forest and Climate Change constituted under the enabling provision of the Wildlife (Protection) Act, 1972 as amended in 2006.
- Its aim is to decide standards for tiger reserves, planning for tiger protection and to present annual report in parliament.

## Tiger Census

According to Tiger Census, 2018 (fourth Tiger Census) released on International Tiger Day (29<sup>th</sup> July 2019) the total count of Tiger has risen to 2,967 from 2,226 in 2014.

### Census data of all the 4 Tiger Census

Year	Tiger Count
2006	1411
2010	1706
2014	2226

2018

2967

### **Highest Number of Tigers**

<b>State</b>	<b>Tiger Count</b>
Madhya Pradesh	526
Karnataka	524
Uttarakhand	442
Maharashtra	312
Tamil Nadu	264

India's first specialized hospital for elephants has been formally opened in Mathura, Uttar Pradesh in November 2018.

## **Crocodile Conservation Project**

- Crocodile Conservation Project was launched in 1975 with support from UNDP and FAO to protect the remaining population of crocodiles in their natural habitat by creating sanctuaries, promoting captive breeding and rearing and to take up research to in order improve management.
- An Olive Ridley sea turtle has been designated in the list of Ramsar Wetland of International Importance in 2002.

**Odisha's Bhitarkanika National Park is home to world's largest white crocodile park in Kendrapara district.**

- For the conservation of Critically Endangered Gharial the National Chambal Gharial Wildlife Sanctuary was created in 1979.
- Other Projects include Baula Project at Dangamal (Odisha), Mugger Project at Ramatirtha (Odisha), Gharial Project at Tikar Pada (Odisha).



## Major Alligator and Crocodile Reserves

1. Guindy National Park	Tamil Nadu
2. Chambal Wildlife Sanctuary	Rajasthan, UP, MP
3. Bhitarkanika Wildlife Sanctuary	Odisha
4. Nandankanan Wildlife Sanctuary	Odisha
5. Satkosia Gorge Wildlife Sanctuary	Odisha

## Conservation of Musk Deer

- Himalayan Musk Deer are found in parts of northern Afghanistan, Pakistan, Tibet, Nepal, and Bhutan and in northern parts of India (Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim and Arunachal Pradesh).
- The species is endangered due to a high volume of illegal wildlife trade within its range.
- Kedarnath Wildlife Sanctuary in Uttarakhand was established in 1970 to conserve musk deer in their natural habitat. Also Askot Musk Deer Sanctuary, Uttarakhand has been setup primarily with objective of conserving musk deer.

## Blackbuck Conservation Reserve

India's first wildlife conservation reserve dedicated exclusively to the blackbuck has been approved by Uttar Pradesh government in Allahabad under Wildlife Protection Act, 1972.

Bishnoi community is known as Protectors of Blackbuck.

## Conservation of Red Panda

- The Red Panda (*Ailurus fulgens*), also called the lesser panda, the red bear-cat and the red cat-bear is a mammal native to eastern Himalayas and south western Chin. The Red Panda has been classified as Endangered by the IUCN.
- Red Pandas were introduced in Singalila National Park, Darjeeling from its captive breeding centre at Padmaja Naidu Himalayan Zoological Park, Darjeeling.

## Project Hangul

- The critically endangered Hangul also known as Kashmir Stag is on the verge of extinction, largely because of human intrusions and domestic livestock grazing.
- Hangul has been listed as Critically Endangered species in Red Data Book of IUCN.
- Hangul has been listed under the Schedule – 1 of Wildlife (Protection) Act, 1978.
- In 2009, the project was rechristened as Save Kashmir's Red Deer Hangul.

## Vulture Conservation

- Nine species of vulture are found in India, but most of them are now in danger of extinction after a rapid and major population collapse in recent decades.

Out of these 9 types, White-Backed Vulture, Slender Billed vulture and Indian Vulture were listed by IUCN as Critically Endangered because of the drastic decline in their number. Ramadevara Betta is India's only vulture sanctuary in Karnataka.

Jatayu Conservation Breeding Centre, Pinjore (Haryana) was established in September 2001 by Bombay Natural History society (BNHS).

Vulture Safety Zones of Uttarakhand and Uttar Pradesh and Vulture Restaurants of Punjab and Maharashtra are some vulture's conservation efforts.

## India Rhino Vision (IRV) 2020

- IRV 2020 was launched by Assam Forest Department in partnership with WWF-India and US Fish And Wildlife Service in 2005, which was also supported by Bodoland Territorial council and other organisations.

- Its goal is to have a wild population of at least 3,000 greater one- horned rhinos in the Indian state of Assam spreading over seven protected areas by the year 2020. IRV 2020 is an ambitious rhino range and population expansion programme.
- Rhino is classified as vulnerable under IUCN Red Data Book as compared to endangered till 2008.
- There are approximately 3,333 Great One-horned Rhinoceros left in the world (as of 31 December 2012), about 82% of those found in India, mainly concentrated in the state of Assam.

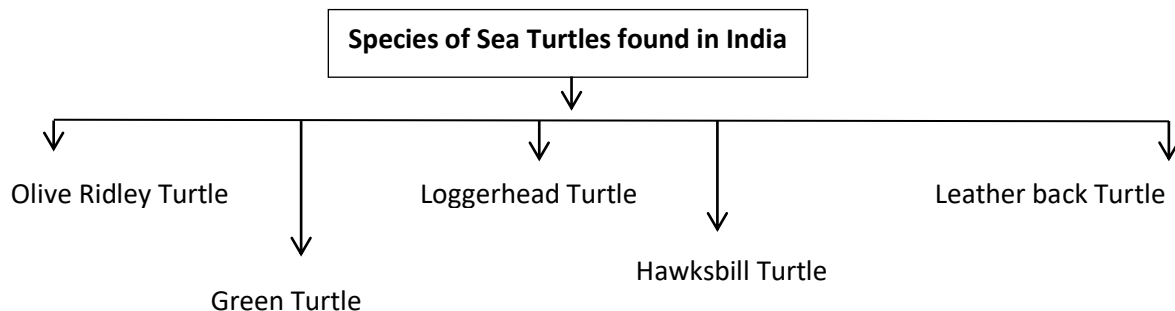
## Snow Leopard Project

- Project Snow Leopard was launched on 20<sup>th</sup> January, 2009 strengthen wildlife conservation in the Himalayan high altitudes, covering Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Arunachal Pradesh, Uttarakhand, Arunachal Pradesh and Sikkim. Leopard is listed under Schedule I of WPA, 1972.

The IUCN has downgraded its conservation status of Snow Leopard from endangered too vulnerable in 2017.

### Sea Turtles

- In India they are mostly visible in Lakshadweep and Andaman and Nicobar Islands.



MoEF & CC in January 2021 released National Marine Turtle Action Plan.

- The Odisha coast in India is the Largest Mass Nesting Site for the olive ridley turtles, followed by the coasts of Mexico and Costa Rica.

Olive Ridley Sea Turtle are the smallest species of India and has been listed on Schedule-I of wildlife Production Act, 1972 and Vulnerable under IUCN.

## Project Godawan

Rajasthan Government has taken up an initiative called Project Godawan for the protection of Great Indian Bustard in 2013 on World Environment Day. This project was started in Jaisalmer. Rajasthan is the first state to launch this campaign.

World's largest number of Great India Bustard is found in Rajasthan. This species is considered as Critically Endangered by IUCN Red Data list.

- On 5<sup>th</sup> October, 2009 Government of India declared Dolphin (*Platanista gangetica*) as the National Aquatic Animal. It represents the health of the rivers.

Ganges River dolphin has been placed under Endangered category of IUCN Red list and therefore, has been included under the Schedule I of the Wildlife Protection Act, 1972.

- This species inhabit parts of the Ganges, Meghna and Brahmaputra, and the Karnaphuli River in India and Bangladesh.

In October 2015 the West Bengal government decided to establish India's First Dolphin Community Reserve in the state at Hugli River between Malda and Sundarbans.

- The Vikramshila Gangetic Dolphin Sanctuary (Bhagalpur, Bihar) is the only safe habitat for this endangered river dolphin in Asia. 5<sup>th</sup> October is observed as world Dolphin day.
- The Gangetic Dolphin has been declared as the official mascot of Guwahati.

National Park	State	Animal /Bird
• Little Rann of Kutch	Gujarat	Wild Ass
• Kaziranga	Assam	One horned rhinoceros
• Jaldapara	Assam	One horned rhinoceros
• Dachigam	J & K	Hangul
• Gir	Gujarat	Asiatic Lion
• Van Vihar	Madhya Pradesh	White Tiger
• Desert	Rajasthan	Great Indian Bustard

- Keoladeo Ghana

Rajasthan

Siberian Crane

## Bird Sanctuaries

- Keoladeo Ghana (Bharatpur) Rajasthan
- Vedanthangal Tamil Nadu
- Ranganathittu Karnataka
- Salim Ali Tamil Nadu

## The Forest Survey of India

- A Centre for Biodiversity Policy and Law (CEBPOL) is established at Chennai in
  - The Forest Survey of India was established in 1981 at Dehradun.
  - Under Ministry of Environment (MoEF&CC) its four regional centres are situated at Bengaluru, Kolkata, Nagpur and Shimla.
  - India's first private Biodiversity Park (Nilgiri Biosphere Nature Park) has been opened at Anaikatti in Coimbatore district of Tamil Nadu.
  - Sirajbagh also known as Indira Gandhi Memorial Tulip Garden located near Dal Lake in Jammu and Kashmir is Asia's Largest Tulip Park.
- collaboration with Government of Norway.

## Zoological Survey of India (ZSI)

The Zoological Survey of India is a premier Indian organization in zoological research and studies. It was established on 1 July 1916 to promote the Survey, Exploration and Research of the fauna in the region. The headquarter of ZSI is at Kolkata. ZSI publishes Red Data book on Indian Animals.

## **Various Research Institutes**

- Indira Gandhi Forest Academy, Dehradun
- Central Arid Zone Research institute, Jodhpur
- Indian Institute of Forest Management, Bhopal
- Tropical Forest Research Institute, Jabalpur
- Institute of Wood Science and Technology, Bengaluru
- Institute of Forest Genetic and Tree Breeding, Coimbatore
- Salim Ali Centre for Ornithology and Natural History, Anaikatti, Coimbatore.

## 28. Wetlands and Ramsar Conservation

Wetlands are defined as area of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide should not exceed six metres.

### Wetlands in India

Globally, wetlands cover 6.4 per cent of the geographical area of the world. In India, according to the National Wetland Inventory and Assessment compiled by the Indian Space Research Organisation (ISRO), wetlands are spread over 1,52,600 square kilometres (sq km) which is 4.63 per cent of the total geographical area of the country. Of the 1,52,600 sq km, inland-natural wetlands account for 43.4% and coastal-natural wetlands 24.3%. Rivers/streams occupy 52,600 sq km, reservoirs/barrages 24,800 sq km, inter-tidal mudflats 24,100 sq km, tanks/ponds 13,100 sq km and lake/ponds 7300 sq km. India has 19 types of wetlands. In state-wise distribution of wetlands, Gujarat is at the top with 34,700 sq km (17.56 percent of total geographical area of the state), or 22.7 percent of total wetlands areas of the country thanks to a long coastline. It is followed by Andhra Pradesh (14,500 sq km), Uttar Pradesh (12,400 sq km) and West Bengal (11,100 sq km).

In India, peatlands have been recorded in Kerala, Arunachal Pradesh, Himachal Pradesh, and north Sikkim. Some parts of the Western Ghats have peat too. A lot of our deltas and mangroves have the propensity to develop into peat

### Types of Wetlands

- **Coastal Wetlands:** Coastal wetlands are found in the areas between land and open sea that are not influenced by rivers such as shorelines, beaches, mangroves and coral reefs.
- A good example is the mangrove swamps found in sheltered tropical coastal areas.
- **Shallow lakes and ponds:** These wetlands are areas of permanent or semi-permanent water with little flow. They include vernal ponds, spring pools, salt lakes and volcanic crater lakes.

- **Marshes:** These are periodically saturated, flooded, or ponded with water and characterized by herbaceous (non-woody) vegetation adapted to wet soil conditions. Marshes are further characterized as **tidal marshes** and **non-tidal marshes**.
- **Swamps:** These are fed primarily by surface water inputs and are dominated by trees and shrubs. Swamps occur in either freshwater or saltwater floodplains.
- **Bogs:** Bogs are waterlogged peatlands in old lake basins or depressions in the landscape. Almost all water in bogs comes from rainfall.
- **Estuaries:** The area where rivers meet the sea and water changes from fresh to salt can offer an extremely rich mix of biodiversity. These wetlands include **deltas, tidal mudflats** and **salt marshes**.

## Why are wetlands important?

Wetlands are vital not only for the ecosystems but our climate, providing essential services such as water regulation, flood control, and water purification. Wetland biodiversity is significant for ensuring good health, food supply, picturesque views facilitating tourism and thus related jobs.

Wetlands are also capable of absorbing carbon dioxide, therefore reducing global heating and pollution, and are often referred to as the “Kidneys of the Earth”.

Wetlands provide a wide range of important resources and ecosystem services such as food, water, fibre, groundwater recharge, water purification, flood moderation, erosion control, and climate regulation. They are a major source of water and the main supply of fresh water comes from an array of wetlands which help soak rainfall and recharge groundwater.

Wetlands are also important for the survival of floral and fauna. Several threatened migratory birds come to Indian wetlands. It provides wintering ground to migratory waterbirds such as the endangered Pallas’s fish-Eagle, the vulnerable Common Pochard, and the near-threatened Dalmatian Pelican, Grey-headed Fish-eagle, and Ferruginous Duck.

## The Wetland Project

The Wetlands of India portal has been developed under a technical cooperation project “Wetlands Management for Biodiversity and Climate Protection” (Wetlands Project) of the



Ministry of Environment, Forest and Climate Change (MoEFCC) in partnership with Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.

Similarly, India has been taking several wetland conservation projects to restore and protect the important wetlands in India that are the basis of living for many.

4-pronged rejuvenation of wetlands projects: The Ministry of Environment, forests, and climate undertook the restoration and rejuvenation of 130 wetlands under a four-pronged strategy, in which the nodal officers of these wetlands were trained in preparing focused management plans and in working out the health of the wetland. For the first time in the country, wetlands were graded between A to E as per their health.

## Ramsar Conservation

It is an intergovernmental treaty that provides a framework for national and international conservation efforts for the wetlands and their resources.

- It was adopted in Ramsar, a city in Iran in 1971 and came into existence in 1975. Today, it has total 170 contracting parties.
- India became a party to this convention in 1981.
- India has 46 designated Wetlands under Ramsar Convention. World Wetlands Day is observed on 2<sup>nd</sup> February every year.

S.N.	Wetland Site (Area- km <sup>2</sup> )	State/UTs	S.N.	Wetland Site (Area- km <sup>2</sup> )	State/UTs
1.	Asthmudi Wetland (1860)	Kerala	24.	Vembanand Wetland (4583)	Kerala
2.	Bhitarkanika Mangroves (525)	Odisha	25.	Upper Ganga Stretch (265.90)	UP
3.	Bhoj Wetlands (31)	MP	26.	Wular Lake (173)	J&K
4.	Chandertal Wetland(38.56)	Himachal P.	27.	Nandur Madhameshwar (14.37)	Maharashtra
5.	Chilika Lake (1140)	Odisha	28.	Keshopur-Miani (3.44)	Punjab
6.	Deepor Beel (4.14)	Assam	29.	Beas Conservation Res.(64.29)	Punjab
7.	East Kolkata Wetlands (378)	West Bengal	30.	Nangal (1.16)	UP

8.	Harike Lake(86)	Punjab	31.	Nawabganj (2.25)	UP
9.	Hokera Wetland (13.75)	J & K	32.	Parvati Arga (7.22)	UP
10.	Kanjli Lake (14.84)	Punjab	33.	Saman (5.26)	UP
11.	Keoladeo Ghana Nat. Park (28.73)	Rajasthan	34.	Samaspur (7.99)	UP
12.	Kolleru Lake (673)	Andhra P.	35.	Sandi (3.09)	UP
13.	Loktak Lake (945)	Manipur	36.	Sarsai Nawar (1.61)	UP
14.	Nalsarovar Bird Sanctuary (120)	Gujarat	37.	Sundarban (4230)	West Bengal
15.	Point Calimere(17.26)	Tamil Nadu	38.	Kabrtal/Kanwar Jheel (26.2)	Bihar
16.	Pong Dam Lake (307.29)	Himachal P.	39.	Asan Conservation Res.(4.44)	Uttarakhand
17.	Renuka Wetland (4.02)	Himachal P.	40.	Soor Sarovar (4.31)	UP
18.	Ropar Lake (41.36)	Punjab	41.	Lonar Lake (4.27)	Maharashtra
19.	Rudrasagar Lake(2.40)	Tripura	42.	Tso Kar (22)	Ladakh
20.	Sambhar Lake (736)	Rajasthan	43.	Thol Lake (7.9)	Gujarat
21.	Sasthamkotta	Kerala	44.	Wadhvana (25)	Gujarat
22.	Lake(11.3)	J & K			
	Surinsar-Mansar Lakes (3.50)				
23.	Tso Moriri Lake (120)	J & K	45.	Sultanpur Biosphere Reserve (1.4)	Haryana
			46.	Bhindawas (4.1)	Haryana

Under Ramsar Convention, a list of wetland sites has been prepared as Wetlands of International Importance under Montreux Record. Two Wetland sites of India in this record are Keoladeo National Park, Rajasthan and Loktak Lake, Manipur.

## 30. Coral reefs

Coral reefs are some of the most diverse ecosystems in the world. **Coral polyps**, the animals primarily responsible for building reefs, can take many forms: large reef building colonies, graceful flowing fans, and even small, solitary organisms. Thousands of species of corals have been discovered; some live in warm, shallow, tropical seas and others in the cold, dark depths of the ocean.

Each individual coral is referred to as a polyp. Coral polyps live on the calcium carbonate exoskeletons of their ancestors, adding their own exoskeleton to the existing coral structure. As the centuries pass, the coral reef gradually grows, one tiny exoskeleton at a time, until they become massive features of the marine environment.

Corals are found all over the world's oceans, from the Aleutian Islands off the coast of Alaska to the warm tropical waters of the Caribbean Sea. The biggest coral reefs are found in the clear, shallow waters of the tropics and subtropics. The largest of these coral reef systems, the Great Barrier Reef in Australia, is more than 1,500 miles long (2,400 kilometers).

### Types of coral reefs

Coral reefs take four principal forms.

- Fringing reefs consist of flat reef areas that directly skirt a nonreef island, often volcanic, or a mainland mass.
- Barrier reefs are also close to a nonreef landmass but lie several kilometres offshore, separated from the landmass by a lagoon or channel often about 50 metres (160 feet) deep. Some barrier reefs are more or less circular, surrounding an island, but larger barrier reefs, such as those along the Red Sea coast and Australia's Great Barrier Reef, are complex linear features consisting of chains of reef patches, some of them elongated into ribbon reefs.
- Atolls are like circular barrier reefs but without their central landmass.
- Finally, there are platform, or patch, reefs, which have irregular table like or pinnacle features. Smaller patches occur inside atoll lagoons. Larger patches occur as

isolated parts of larger developments of any of the other three reef categories. They sometimes occur completely separate from other kinds of reefs.

## Threats to coral reef ecosystems

Unfortunately, coral reef ecosystems are severely threatened. Some threats are natural, such as diseases, predators, and storms. Other threats are caused by people, including pollution, sedimentation, unsustainable fishing practices, and climate change, which is raising ocean temperatures and causing ocean acidification. Many of these threats can stress corals, leading to coral bleaching and possible death, while others cause physical damage to these delicate ecosystems. During the 2014-2017 coral bleaching event, unusually warm waters (partially associated with a strong El Niño) affected 70% of coral reef ecosystems worldwide. Some areas were hit particularly hard, like the Great Barrier Reef in Australia, where hundreds of miles of coral were bleached.

Corals are able to recover from bleaching events if conditions improve before they die, though it can take many years for the ecosystems to fully heal. Scientists are also testing new ways to help coral reef ecosystems, such as growing coral in a nursery and then transplanting it to damaged areas.

## Coral Reefs in India

- Coral reefs are found in the Gulf of Mannar, Palk Bay and Andaman Sea. Coastal Coral reefs are found in the Gulf of Kutch and Atolls are found in Lakshadweep. Coral reefs are listed under Schedule I of Wildlife (Protection) Act, 1972.
- Four regions of coral reefs have been recognized for the purpose of management and conservation in India. These are Gulf Mannar, Andaman and Nicobar Island, Lakshadweep and Gulf of Kutch.

The year 2008 was observed as the world Coral Reef Year. On this occasion, a workshop was convened by the Lakshadweep Government and National Community Institute of Goa in Kadmat Island (Lakshadweep).

IIPA2022

# Indian Geography: Social & Economic Geography

Short Answers

PKP-03 by Dr Amit Kumar Singh



22

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# 1. Mineral Resources

A mineral is a natural substance of organic or inorganic origin with definite chemical and physical properties. India is endowed with a rich variety of mineral resources due to its varied geological structure. The mineral resources provide the country with the necessary base for industrial development. The country is particularly rich in metallic minerals of ferrous group.

Indian mining is characterised by a large number of small mines, dominated by the public sector, which accounts for 75% of the total value of mineral production. Mining policy is pushing the industry to move toward privately owned, large-scale, mechanised mines. Minor minerals, mainly sand, gravel, brick, earth and stone, are also important contributors (about 10% of the value of minerals produced in the country, although data is difficult to come by. Non-metallic minerals are minor players in the Indian minerals sector in terms of value, though they are big both in terms of area under mining and volume of minerals produced.

Metallic minerals are the sources of metals. Iron ore, copper, gold produce metal and are included in this category. Metallic minerals are further divided into ferrous and non-ferrous metallic minerals. Ferrous, as you know, refers to iron. All those minerals which have iron content are ferrous such as iron ore itself and those which do not have iron content are non-ferrous such as copper, bauxite, etc. Non-metallic minerals are either organic in origin such as fossil fuels also known as mineral fuels which are derived from the buried animal and plant life such as coal and petroleum. Other type of non-metallic minerals are inorganic in origin such as mica, limestone and graphite, etc. Some new petroleum reserves are also found in the Krishna-Godavari and Kaveri basins (shown in the image given above).

## Distribution of Minerals

- Minerals are unevenly distributed on the earth's surface.
- All minerals are exhaustible in nature, i.e., will exhaust after a certain time.
- However, these minerals take long time to form, but they cannot be replenished immediately at the time of need.
- More than 97% of coal reserves occur in the valleys of Damodar, Sone, Mahanadi, and Godavari rivers.

- Petroleum reserves in India are located in the sedimentary basins of Assam, Gujarat, and Mumbai High (i.e. off-shore region in the Arabian Sea – shown in the map given below).

## **Mineral Belts in India**

- Further, there are three major mineral belts in India namely –
  - The North-Eastern Plateau Region,
  - The South-Western Plateau Region, and
  - The North-Western Region.

### **North-Eastern Plateau Region**

- The major areas of north-eastern plateau region are Chhotanagpur (Jharkhand), Odisha, West Bengal, and parts of Chhattisgarh.
- Iron ore, coal, manganese, bauxite, and mica are the major minerals of the north-eastern plateau region.

### **South-Western Plateau Region**

- The south-western plateau region covers major parts of Karnataka, Goa, and contiguous Tamil Nadu uplands and Kerala.
- Major mineral resources of south-western plateau region are iron ore, manganese, and limestone.
- Kerala has deposits of monazite and thorium, and bauxite clay and Goa has deposits of iron ore.

### **North-Western Region**

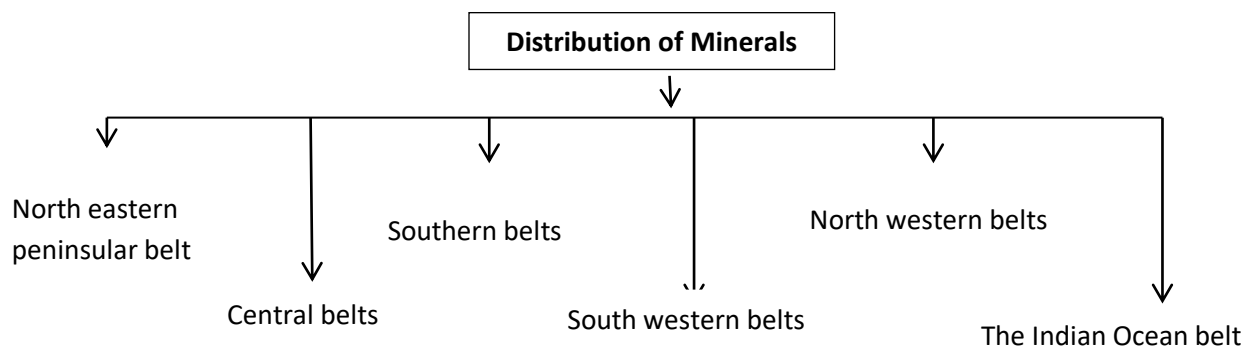
- The north-western region covers the areas of Aravalli in Rajasthan and parts of Gujarat.
- Major minerals of north-western regions are copper and zinc; other significant minerals include sandstone, granite, and marble, along with Gypsum and Fuller's earth deposits.
- In addition, Gujarat and Rajasthan, both have rich sources of salt.
- The Himalayan belt is also an important mineral belt, as it has rich deposits of copper, lead, zinc, cobalt, and tungsten.

## 2. Classification of Minerals

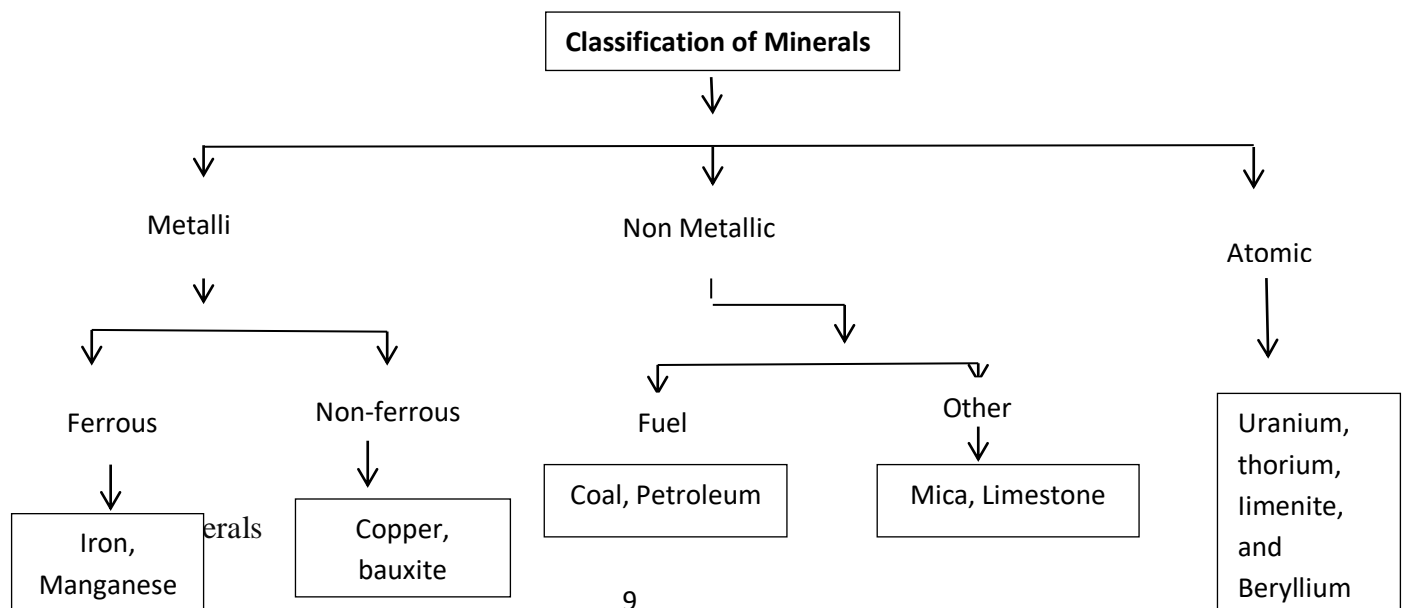
### Types of Minerals

- On the basis of chemical and physical properties, minerals are grouped as –
  - **Metallic** minerals and
  - **Non-metallic** minerals.
- Major examples of metallic minerals are iron ore, copper, gold, etc.
- Minerals are valuable natural resources. They constitute the vital raw material for many basic industries and are major resources for development.

### Distribution of Minerals



### Classification of Minerals



## Ferrous Minerals

### Iron Ore

- Iron ore is the backbone of industrial development. It is the most important mineral which provides raw material for Iron and Steel industry. Iron ore is extracted from igneous rocks of Cudappah and Dharwar.

Ore	Iron Content	Use
Magnetite	72%	Electronic Industries
Hematite	60-70%	Iron and Steel Industries
Limonite	40-60%	Pigment for paints
Siderite	40-50%	Source of Manganese

### Iron Ore Production

States	Production (in %)
1. Odisha	28.72
2. Chhattisgarh	102.17
3. Karnataka	28.72

- About 95% to total reserves of iron are located in the states of Odisha, Jharkhand, Chhattisgarh, Karnataka, Goa, Telangana, Andhra Pradesh and Tamil Nadu.
- At present, India is the 4thlargest (201 million Tonnes) iron-ore producing country in the world.

### Manganese

- Manganese is not found as a free element in nature. It is often found in combination with iron to produce Steel, which is also known as Ferromanganese.

- This is one of the major raw materials used in Iron and Steel industry. It is found in the Sedimentary Rocks of Dharwar System.

### Leading Manganese Producing States

States	Production (in %)
4. Madhya Pradesh	27.08%
5. Maharashtra	25.25%
6. Odisha	55%

**Nickel**

- Nickel is largely used in ornaments, aircrafts, and automobiles production.
- Cuttack and Mayurbhanj districts of Odisha have major deposits of Nickel. Jharkhand is the leading Nickel producing state in the country.

## Non-Ferrous Minerals

### Copper

- Copper is found in the veins of all three kinds of rocks i.e. Igneous, Sedimentary and Metamorphic.
- Its major ores are Sulphide ore (Cuprite), and Carbonate ores (Malachite and Azurite).

### Copper ore Reserves and Production

Reserves (TOP 3 States)	Producers (Top 3 State)
1. Rajasthan	1. Madhya Pradesh
2. Jharkhand	2. Rajasthan
3. Madhya Pradesh	3. Jharkhand

### Bauxite

- Bauxite is primarily used to produce alumina through the Bayer's process. It is mainly found in Tertiary Deposits and is associated with laterite rocks found extensively either on the plateau or hill ranges of peninsular India.

- The major bauxite producing regions in India are Ranchi and Palamu Jharkhand, Kheda in Gujarat, Shahdol and Balaghat in Madhya Pradesh, Durg and Surguja in Chhattisgarh; Kolhapur, Thane and Ratanagiri in Maharashtra; Belgaum and Bababudan Hills in Karnataka; and Palni, Javadi and Shevaroy hills regions in Tamil Nadu.

### **Bauxite**

#### **Top 4 Producer**

1. Odisha
2. Gujarat
3. Jharkhand
4. Chhattisgarh

#### **Top 4 Reserves**

- Odisha
- Andhra Pradesh
- Gujarat
- Jharkhand

### **Silver**

- In nature, silver mostly occurs as sulphide. It rarely occurs in pure form. It is often found mixed with Zinc. Blende, Galena (lead) and Copper pyrites.
- Zawar mine in Udaipur (Rajasthan) is the largest producers of silver. It is an important currency metal. Silver is also mined from Kolar Gold Fields and Hutti Gold Mines (Raichur) in Karnataka during gold refining.
- Chhattisgarh (Rajasthan) and Bharuch (Karnataka) are the largest Silver producing regions in the country. Rajasthan, Gujarat and Jharkhand are at first, second and third position respectively in country.

### **Silver Ore Reserve(%): Top States**

- |                   |     |
|-------------------|-----|
| 1. Rajasthan      | 87% |
| 2. Jharkhand      | 5%  |
| 3. Andhra Pradesh | 4%  |
| 4. Karnataka      | 2%  |

### **Chromite**

- Chromite is an oxide of Iron and Chromium and used in refractory works, metallurgical and chemical industries. It is used for producing stainless steel.



- The largest producer of chromite in the country is Odisha (95%). Keonjhar and Cuttack districts are centres of Chromite production.

### Chromite Reserves and Production

Reserves (Top States)	Production (in Thousand Tonnes)	
• Odisha	• Odisha	37,26,994
• Jharkhand	• Karnataka	782
• Chhattisgarh	• Maharashtra	1
• West Bengal	• India	32,27,777
		• Almost all tin

deposits in India are confined in Bastar district of Chhattisgarh which is also the only tin producing region of India. Cassiterite is the primary ore of tin.

### Gold

- Gold is known as an international currency and it is found in the veins of metamorphic and the igneous rocks.
- About 99% Gold Production in the country is done from the mines in Karnataka i.e. Kolar Gold Field and Hutti Gold Field. Some gold is also extracted from the mines of Ramgiri Gold Field in Andhra Pradesh.
- Shirpur gold refinery is India's first and Asia's largest gold refinery with headquarters in Mumbai. It is a Greenfield precious metal refinery located in Shirpur, Dhule in Maharashtra with installed capacity to refine 217 MT p.a. of gold and silver respectively.

### Lead

- India is largely dependent on import of lead because of its lower deposits and production.
- At the commercial level, the major lead mine is located at Zawar in Rajasthan where Hindustan Zinc Limited is involved in the mining of Lead.
- Lead is also extracted from Rajpura- Dariba mines at Udaipur district in Rajasthan by Hindustan Zinc Limited.

## Deposits of Lead and Zinc (Top States)

Lead	Zinc
1. Rajasthan	1. Rajasthan
2. Andhra Pradesh	2. Maharashtra
3. Gujarat	3. Madhya Pradesh

### Zinc

- Zinc is found in association with lead and silver. It is extracted from Zinc Sulphide, Calamine, Zincite, Willemite and Hemimorphite.
- The only commercial mine in India is in Zawar, Rajasthan which is operated by the Hindustan Zinc Limited. The Largest Zinc Reserves in India is found in Rajasthan.

## Non-metallic Minerals

### Diamond

- The world famous Kohinoor diamond was extracted from the Golconda Mines in Andhra Pradesh is the major state in diamond production. Here, the major diamond mines are located in Panna and Satna districts.
- The diamond found in veins of fossil less Vindhyan rocks of Pre-Cambrian period is considered as the most valuable.
- Mumbai is the largest market of diamond. Diamond cutting and polishing are also done here.

### Mica

There are three types of mica

- (i) **Muscovite:** This is also known as Rubi Mica. It is white in colour and of best quality.
  - (ii) **Phlogopite:** This is called Yellow Mica.
  - (iii) **Biotite:** This is called Black Mica.
- India is the largest producer of mica in the world.
  - Jharkhand, Andhra Pradesh, Telangana and Rajasthan respectively are the major mica producing states. Jharkhand alone produces about 50% of the total mica production in the country.

### Gypsum

- Gypsum is hydrated Calcium Sulphate.
- It is used in the production of fertilizer, cement, Sulphur etc. its largest producer is Rajasthan (99%).

- Gypsum deposits are found in Bikaner, Jodhpur, Nagpur and Jaisalmer districts of Rajasthan.
- It is also produced in Doda (Jammu & Kashmir) and Kutch (Gujarat). The other regions that are important from the point of view of gypsum mining are Coimbatore, Tirunelveli and Chengalpattu in Tamil Nadu.

### Graphite

- It is a natural form of crystalline carbon also known as Black Lead or Plumbago.
- The major Graphite producing states are Jharkhand, Odisha (Kalahandi) and Tamil Nadu.

### Deposits of Graphite

States Production		States Production	
1. Arunachal Pradesh	37%	2. J & K	32%
3. Odisha	10%	4. Jharkhand	9%

### Atomic Minerals

- They are found in the slate rocks of the Pre-Cambrian and Dharwar periods in India.
- In India, nuclear energy is produced from Uranium and Thorium.

### Thorium

- Thorium is mainly extracted from Monazite and Ilmenite sands found in the beaches along the coasts of Kerala and Tamil Nadu.
- World's Riches Monazite Deposits are found in Palakkad and Kollam districts of Kerala; near Visakhapatnam in Andhra Pradesh and Mahanadi river delta in Odisha.

### Uranium

- Its major ores are Pitchblende, Samarskite and Thorianite.
- In India, Uranium is found in the rocks of Dharwar and Archean series, Pegmatites, Monazite sands and Cheralite.
- The most important region for uranium mining is the Jadugoda region in Singhbhum (Jharkhand).

### 3. Energy Resources

Energy resources are required for all activities. Mineral fuels are essential for generation of power, required by agriculture, industry, transport and other sectors of the economy. It is needed to cook, to provide light and heat, to propel vehicles and to drive machinery in industries. Mineral fuels like coal, petroleum and natural gas (known as fossil fuels), nuclear energy minerals, are the conventional sources of energy. These conventional sources are exhaustible resources

Energy exists in several forms such as heat, kinetic or mechanical energy, light, potential energy, electrical, or other forms. Energy is the ability to do work. Energy sources could be classified as Renewable and Non-renewable.

Energy is one of the major inputs for the economic development of any country. In the case of the developing countries, the energy sector assumes a critical importance in view of the ever increasing energy needs requiring huge investments to meet them. Energy can be classified into several types based on the following criteria:

- Primary and Secondary energy
- Commercial and Non commercial energy
- Renewable and Non-Renewable energy

#### **Primary and Secondary Energy:**

Primary energy sources are those that are either found or stored in nature. Common primary energy sources are coal, oil, natural gas, and biomass (such as wood). Other primary energy sources available include nuclear energy from radioactive substances, thermal energy stored in earth's interior, and potential energy due to earth's gravity. The major primary and secondary energy sources are shown in Figure 1.1 Primary energy sources are mostly converted in industrial utilities into secondary energy sources; for example coal, oil or gas converted into steam and electricity. Primary energy can also be used directly. Some energy sources have non-energy uses, for example coal or natural gas can be used as a feedstock in fertiliser plants.

# Commercial Energy and Non Commercial Energy:

## Commercial Energy

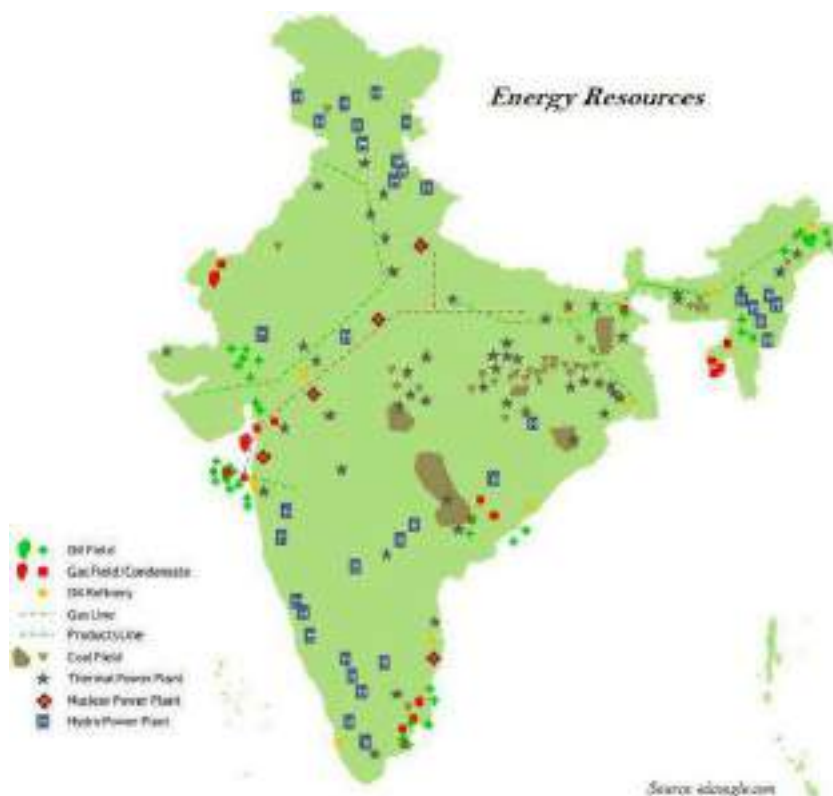
The energy sources that are available in the market for a definite price are known as commercial energy. By far the most important forms of commercial energy are electricity, coal and refined petroleum products. Commercial energy forms the basis of industrial, agricultural, transport and commercial development in the modern world. In the industrialized countries, commercialized fuels are predominant source not only for economic production, but also for many household tasks of general population. Examples: Electricity, lignite, coal, oil, natural gas etc.

## Non-Commercial Energy

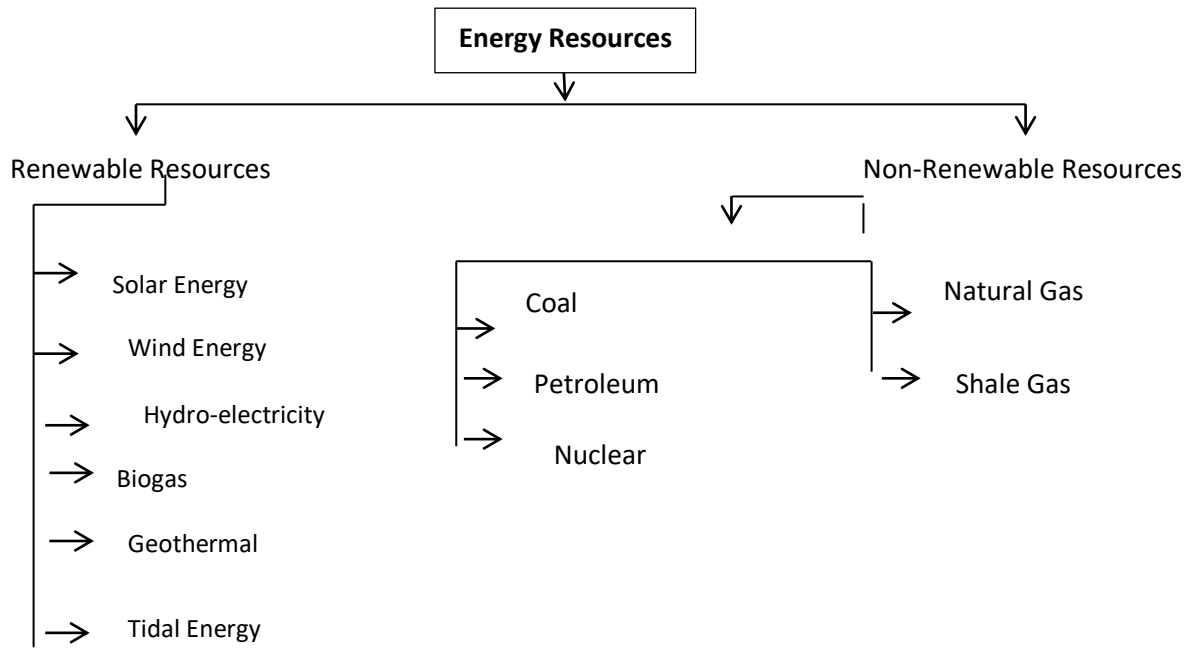
The energy sources that are not available in the commercial market for a price are classified as non-commercial energy. Non-commercial energy sources include fuels such as firewood, cattle dung and agricultural wastes, which are traditionally gathered, and not bought at a price used especially in rural households. These are also called traditional fuels. Non-commercial energy is often ignored in energy accounting. Example: Firewood, agro waste in rural areas; solar energy for water heating, electricity generation, for drying grain, fish and fruits; animal power for transport, threshing, lifting water for irrigation, crushing sugarcane; wind energy for lifting water and electricity generation.

## Renewable and Non-Renewable Energy

Renewable energy is energy obtained from sources that are essentially inexhaustible. Examples of renewable resources include wind power, solar power,



geothermal energy, tidal power and hydroelectric power (See Figure 1.2). The most important feature of renewable energy is that it can be harnessed without the release of harmful pollutants. Non-renewable energy is the conventional fossil fuels such as coal, oil and gas, which are likely to deplete with time.



## 4. Coal Production in India

- Coal is one of the important minerals which is mainly used in the generation of thermal power and smelting of iron ore. Coal occurs in rock sequences mainly of two geological ages, namely Gondwana and tertiary deposits.
- India has 4<sup>th</sup> largest reserves of coal and holds about 315 billion tons of world's proven reserves. India is the third largest coal producer in the world after China and USA.
- On the basis of proportion of carbon content, various types of coal are Anthracite (80-95%), Bituminous (55-65%), Lignite (45-55%) and Peat (35-5%).
- About 80% of the coal deposits in India is of bituminous type and is of non coking grade.
- The most important *Gondwana* coal fields of India are located in Damodar Valley region.
- About 80 per cent of the coal deposits in India is of bituminous type and is of non-coking grade. The most important Gondwana coal fields of India are located in Damodar Valley. They lie in Jharkhand-Bengal coal belt and the important coal fields in this region are Raniganj, Jharia, Bokaro, Giridih, Karanpura.
- Raniganj, Jharia, Bokaro, Giridih, and Karanpura are major coalfields of Jharkhand-Bengal coal belt.
- Jharia is the largest coal field followed by Raniganj.
- Other important coal mines are Singrauli (partially in Madhya Pradesh and partially in Uttar Pradesh); Korba in Chhattisgarh; Talcher and Rampur in Odisha; Chanda–Wardha, Kamptee, and Bander in Maharashtra; Singareni in Telangana; and Pandur in Andhra Pradesh.
- Tertiary coalfields are largely located in Darangiri, Cherrapunji, Mewlong, and Langrin in Meghalaya; Makum, Jaipur, and Nazira in upper Assam; Namchik – Namphuk in Arunachal Pradesh; and Kalakot in Jammu and Kashmir.
- The brown coal or lignite are found in the coastal areas of Tamil Nadu, Pondicherry, Gujarat, and Jammu and Kashmir.

## Coal Production

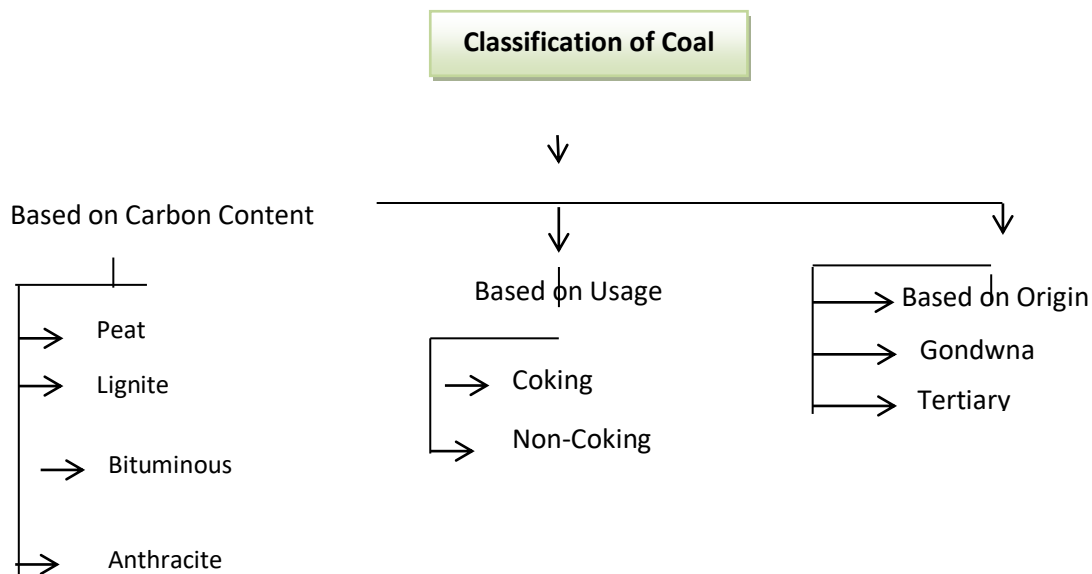
- Through sustained programme of investment and greater thrust on application of modern technologies, it has been possible to raise the All India production of coal at 730.354 million tonnes in 2018-19 (Provisional) with a positive growth of 7.9%.
- Coal India Limited has set up Regional Sales Offices and Sub-Sales Offices at selected places in the country to cater to the needs of the consuming sectors in various regions.
- As per the present import policy, **coal can be freely imported** (under Open General Licence) by the consumers themselves considering their needs based on their commercial prudence.
- Coking Coal is being imported by Steel Authority of India Limited (SAIL) and other Steel manufacturing units mainly to bridge the gap between the requirement and indigenous availability and to improve the quality of production.
- Coal based power plants, cement plants, captive power plants, sponge iron plants, industrial consumers and coal traders are importing non-coking coal.
- Coke is imported mainly by pig-Iron manufacturers and Iron & Steel sector consumers using mini-blast furnace.
- Details of import of coal and products i.e. coke during the last six years is as under:

(Million tonnes)						
*Import upto February, 2019						
Coal	2013-14	2014-15	2015-16	2016-17	2017-18(Prov.)	2018-19*
Coking Coal	36.87	43.72	44.56	41.64	47.00	47.57
Non-Coking Coal	129.99	174.07	159.39	149.31	161.27	166.13
<b>Total Coal Import</b>	<b>166.86</b>	<b>217.78</b>	<b>203.95</b>	<b>190.95</b>	<b>208.27</b>	<b>213.70</b>
Coke	4.17	3.29	3.07	4.35	4.58	4.69



## Coal Reserves

- As a result of exploration carried out up to the maximum depth of 1200 m, a cumulative total of 319.02 Billion tonnes of Geological Resources of Coal have so far been estimated in the country till April, 2018.
- Hard coal deposit spread over 27 major coalfields, are mainly confined to eastern and south central parts of the country. The lignite reserves stand at a level around 36 billion tonnes, of which 90% occur in the southern State of Tamil Nadu.
- Top 5 States in terms of total coal reserves in India are: Jharkhand > Odisha > Chhattisgarh > West Bengal > Madhya Pradesh.



## Classification of Coal

- Coal is originated from organic matter wood. When large tracts of forests are buried under sediments, wood is burnt and decomposed due to heat from below and pressure from above. The phenomenon makes coal but takes centuries to complete.
- **Classification of Coal can be done on the basis of carbon content and time period.**

- On the basis of carbon content it can be classified into following three types:
  - **Anthracite:** It is the best quality of coal with **highest calorific value** and carries **80 to 95% carbon content**. It ignites slowly with a blue flame and found in small quantities in Jammu and Kashmir.
  - **Bituminous:** It has a low level of moisture content with **60 to 80% of carbon content** and has a high calorific value. **Jharkhand, West Bengal, Odisha, Chhattisgarh** and **Madhya Pradesh** have deposits of Bituminous.
  - **Lignite** carries **40 to 55% carbon content** and is often brown in colour with high moisture content thus, gives smoke when burnt. **Rajasthan, Lakhimpur (Assam)** and **Tamil Nadu** has deposits of Lignite.
  - **Peat** is the first stage of transformation from wood to coal with **low calorific value and less than 40% carbon content**.

## Top State with Coal Reserves & Production

### Top State with Coal Reserves & Production

Reserves (%)	Production (%)
1. Jharkhand (26.03)	1. Chattisgarh (22.2%)
2. Odisha (24.85)	2. Odisha (19.8%)
3. Chhattisgarh (17.93%)	3. Jharkhand (18.5%)

## 5. Petroleum Production in India

The word Petroleum has a Latin origin (Petra „,rock” + Oleum “oil”). Petroleum is also known as Black Gold. It is oil obtained from rocks; particularly sedimentary rocks of the earth. Therefore, it is also called mineral oil. Petroleum is a mixture of many different hydrocarbons (90 to 95 per cent Hydrocarbons) of varying specific gravity, ranging from thick viscous liquids and dissolved waxy solids through lighter oils to gaseous compounds (5-10 % organic compounds containing oxygen, nitrogen, sulphur and traces of organometallic compounds). The quality of petroleum depends chiefly on the relative proportions of the different hydrocarbons and the amount of impurities like sulphur. Light oils have low percentage of carbon and high percentage of hydrocarbon. Petroleum varies in color from light straw to almost black, some kinds are greenish, amber (yellowish brown) colored and even rich wine red.

### Origin and Occurrence of Petroleum:

Petroleum has an organic origin and is found in sedimentary basins, shallow depressions and in the seas. Oil and natural gas originates from animal or vegetable matter contained in shallow marine sediments. Conditions for oil formation were favorable in lower and middle tertiary period (dense forest and sea organism), found in pore spaces of rocks where structure gave rise to traps in which the minute droplets accumulated and were prevented from escaping by impervious cap rock. Anticlines are the best known structures favorable for petroleum accumulation. Normally, oil is associated with water, being lighter than water (specific gravity 0.8-0.98) it collects in the anticlines above the surface of water. Gas is still lighter and occurs above oil.

### Distribution of Petroleum and Mineral Oil in India

- Process began in tertiary period, about 3 million years ago.
- Most of the oil reserves in India are associated with anticlines and fault traps in the sedimentary rock formations of tertiary times.
- In tertiary period, aquatic life was abundant in various forms, especially the minor microscopic forms of flora and fauna.

## **Extent of Oil bearing Strata in India**

- 1 lakh sq. km or 42 per cent of India covered with sedimentary rocks.
- 10 lakh sq. km form marine basins of Mesozoic and Tertiary times.
- Total continental shelf of probable oil bearing rocks amounts to 2 lakh sq. km.
- The total sedimentary area including both on shore and offshore comprises 27 basins.
- Mumbai High, the Gulf of Khambhat and the Assam are the most productive areas.

## **On- shore Oil Production**

- Brahmaputra valley of north-east India.
- Barmer area of Rajasthan. • Gujarat coast in western India.
- Cauvery on-shore basin in Tamil Nadu. • Andhra Pradesh has both on-shore and offshore oil reserves. 3 Assam
- Oldest oil producing state in India (The Digboi Field, the Naharkatiya and MoranHugrijan Field) most of the refineries located at Digboi, Guwahati, Bongaigaon, Brauni (refinery) Gujarati
- Ankleshwar, Khambhat or Lunej, Ahmedabad and Kalol, Nawgam, Kosamba, Kathana, Barkol, Mahesana and Sanand are important oilfields of this region.
- Ankleshwar: Oil from this field is sent to refineries at Trombay and Koyali. Rajasthan
- One of the largest inland oil discoveries was made in Banner district of Rajasthan.
- Other important discoveries Mangala oil field, Sarswati and Rajeshwari. Rajasthan is the largest on shore oil producing state of India.

## **Off-Shore Production in India Western Coast**

- Bombay High, Bassein and Aliabet.
- Mumbai High: 1974; rock strata of Miocene age.
- SagarSamrat, Bassein: south of Mumbai High.
- Aliabet: Aliabetisland in the Gulf of Khambhat. Eastern Coast
- The basin and delta regions of the Godawari, the Krishna and the Cauvery rivers hold great potential for oil and gas production.
- The Rawa field in Krishna-Godawari off-shore basin is an important one.
- The Narimanam and Kovilappal oilfields in the Cauvery on-shore basin are also important

### Leading Regions of Petroleum Production

• Coastal Regions	51.15%
• Rajasthan	22.67%
• Gujarat	12.79%
• Assam	11.67%

## Petroleum Products

Kerosene, Diesel, Petrol, Airline fuel, Artificial Rubber, Artificial fibre, Thermoplastic, Polyester, Detergent, Aromatic element, Gasoline, Dye (Colour), Pigments, Explosives, ink for Printing, Photography film, Cosmetics, Paint, Lubricant Oil, Paraffin and Wax.

## Components of Natural Gas

Natural gas primarily consists of Methane and small amount of Propane, Butane, Pentane and hexane.

### Leading Producers of Natural Gas

• Coastal Regions	70.17%	• Assam	9.44%
• Gujarat	4.92%	• Tripura	4.63%
• Rajasthan	3.93%	• Tamil Nadu	3.13%

### Natural Gas Compared to Petroleum Advantages

- Cheaper
- Does not require extensive refining
- Burns clean

### Disadvantages

- Storage and distribution is difficult
- With the help of pipelines, the gas can be transported to the consuming centers, but the construction of pipeline and its security and maintenance is expensive. Hence export is problematic
- Once the pipeline is laid- its size/capacity cannot be increased
- Leakage detection is difficult in case of underground pipelines

- If market/buyers are not found, then gas is wasted by burning (flaring)
- Therefore it is economical only to mine gas near market areas/ only if pipeline is established

## Oil Refineries in India

Plant	State	Estb. Year	Plant	State	Estb. Year
• Digboi (IOC)	Assam	1901	• Chennai (CPCL)	Tamil Nadu	1965
• Trombay (Mumbai) (HPCL)	Maharashtra	1954	• Nagapattinam (CPCL)	Tamil Nadu	1993
• Trombay (Mumbai) (BPCL)	Maharashtra	1955	• Mathura (IOC)	Uttar Pradesh	1982
• Visakhapatnam(HPCL)	Andhra Pradesh	1957	• Mangalore (MRPL)	Karnataka	1998
• Noonmati (Guwahati) (IOC)	Assam	1962	• Panipat-Karnal (IOC)	Haryana	1998
• Barauni (IOC)	Bihar	1964	• Numaligarh( NRL)	Assam	1999
• Koyali (ICO)	Gujarat	1965	• Jamnagar (RPL)	Gujarat	1999
• Cochin (KRL)	Kerala	1966	• Tatipaka (ONGC)	Andhra Pradesh	2001
• Manali	Tamil Nadu	1969	• Vadinar (ESSAR)	Gujarat	2006
• Haldia (IOC)	West Bengal	1975	• Bhatinda (HPCL)	Punjab	2008
• Bongaigaon (BRPL)	Assam	1979	• Bina (BPCL)	Madhya Pradesh	2009
			• Paradip (IOC)	Odisha	2010

## 6. Generation of Thermal Power in India

In India, power is generated from conventional (Thermal, Nuclear & Hydro) and renewable sources (Wind, Solar, Biomass etc.). However, Major production of Electricity is achieved through coal a thermal power plant which is around 75% of the total power generation. India's total power generation in Dec 2020 stood at 103.66 billion units, according to data realised by the Central Electricity Authority.

### Types of Thermal Power Plants

As the name suggests, thermal power plants generate electricity by using heat from a fuel source. The heat usually generates steam in a boiler which is then used to run a steam turbine connected to a generator. They are classified according to the heat source as follows:

- Coal-Fired
- Gas
- Diesel or Liquid fuel
- Geothermal
- Biomass
- Waste Material

### NTPC Power Plants

NTPC Power Plants	
Project	State
Existing Stations	
A. Coal Based	
• Singrauli	Uttar Pradesh
• Korba	Chhatisgarh
• Ramagundam	Andhra Pradesh

• Farakka	West Bengal
• Vindhyachal	Madhya Pradesh
• Rihand	Uttar Pradesh
• Kahalgaon	Bihar
• Dadri	Uttar Pradesh
• Talcher	Odisha
• Tanda	Uttar Pradesh
• Simhadri	Andhra Pradesh
• Badarpur	Delhi
• Sipat-II	Chhattisgarh

#### **B. Gas Based**

• Anta	Rajasthan
• Auraiya	Uttar Pradesh
• Kawas	Gujarat
• Dadri	Uttar Pradesh
• Jhanor-Gandhar	Gujarat
• Kayamkulam	Kerala
• Faridabad	Haryana

#### **C. Joint Venture**

• Rourkela	Odisha
• Durgapur	West Bengal
• Bhilai	Chhattisgarh
• Ratnagiri	Maharashtra



### **Project Under Construction**

• Kahalgao-II	Bihar
• Sipat-I	Chhattisgarh
• Barh	Bihar
• Bhilai (J V Project)	Chhattisgarh
• Korba-III	Chhattisgarh
• Dadri-II	Uttar Pradesh
• Farakka-II	West Bengal
• Simhadri-II	Andhra Pradesh
• Indira Gandhi STPP	Haryana
• Vallur (J V Project)	Tamil Nadu
• Koldam Hydro	Himachal Pradesh
• Loharinag Pala	Uttarakhand
• Tapovan Vishnugarh	Uttarakhand
• Nabinagar (J V Project)	Bihar
• Bongaigaon	Assam
• Mauda	Maharashtra
• Barh-II	Bihar

### **Quick facts**

- Thermal Energy is generated by using fossil fuels like coal, petroleum and natural gas. It is influenced by the availability of the fuel.
- With the establishment of National thermal Power Corporation (NTPC) in 1975, thermal energy has i.e. installed capacity and actual generation than its hydro and nuclear counterparts.

- More than 65% of India's electricity generation capacity comes from thermal power plants, with about 85% of the countries thermal power generation being coal based.
- Indian electricity sector consumes about 72% of the coal produced in country.

Despatch of coal to Thermal Power and Coal Consumption/Off-Take during last ten years

(Quantity of Million Tonnes)

Year	Coal Despatch				Total Offtake/ Consumption	Growth %
	Power (Utility)	Growth %	Power (Captive)	Growth %		
2009-10	341.373		49.203		514.555	
2010-11	353.918	3.67%	41.918	-14.81%	524.086	1.85%
2011-12	367.761	3.91%	42.607	1.64%	535.881	2.29%
2012-13	387.766	5.44%	58.998	39.47%	567.604	5.92%
2013-14	394.529	1.74%	54.423	-7.75%	572.485	0.86%
2014-15	435.438	10.37%	62.263	14.41%	604.348	5.57%
2015-16	483.124	10.95%	34.645	-44.36%	632.778	4.70%
2016-17	490.987	1.63%	44.057	27.17%	646.267	2.13%
2017-18	519.582	5.82%	65.906	49.59%	690.246	6.81%
2018-19	567.645	9.25%	76.78	16.50%	733.014	6.20%
2019-20	534.256	-5.88%	77.153	0.45%	707.387	-3.50%
2020-21 provisional	510.265	-4.49%	70.293	-8.89%	681.084	-2.30%

## Power Sector at a Glance ALL INDIA

<b>Updated on 11-02-2022</b> <b>Source: OM SECTION</b>		
<b>1.Total Installed Capacity (As on 31.01.2022) - Source : Central Electricity Authority (CEA)</b>		
<b>INSTALLED GENERATION CAPACITY (SECTOR WISE) AS ON 31.01.2022</b>		
<b>Sector</b>	<b>MW</b>	<b>% of Total</b>
Central Sector	98,327	24.9%
State Sector	1,05,314	26.7%
Private Sector	1,91,434	48.5%
<b>Total</b>	<b>3,95,075</b>	<b>100.0%</b>

<b>Installed GENERATION CAPACITY(FUELWISE) AS ON 31.01.2022</b>		
<b>CATAGORY</b>	<b>INSTALLED GENERATION CAPACITY(MW)</b>	<b>% of SHARE IN Total</b>
<b>Fossil Fuel</b>		
Coal	2,03,900	51.6%
Lignite	6,620	1.7%
Gas	24,900	6.3%
Diesel	510	0.1%
<b>Total Fossil Fuel</b>	<b>2,35,929</b>	<b>59.7%</b>
<b>Non-Fossil Fuel</b>		
<b>RES (Incl. Hydro)</b>	<b>1,52,366</b>	<b>38.5%</b>
Hydro	<b>46,512</b>	<b>11.8 %</b>
Wind, Solar & Other RE	1,05,854	26.8 %
Wind	40,101	10.2 %
Solar	50,304	12.7 %
BM Power/Cogen	10,176	2.6 %
Waste to Energy	434	0.1 %
Small Hydro Power	4,840	1.2 %
<b>Nuclear</b>	<b>6,780</b>	<b>1.7%</b>
<b>Total Non-Fossil Fuel</b>	<b>1,59,146</b>	<b>40.3%</b>
<b>Total Installed Capacity (Fossil Fuel &amp; Non-Fossil Fuel)</b>	<b>3,95,075</b>	<b>100%</b>

#### **Policy Initiatives / Decision Taken**

**Electricity Act 2003** has been enacted and came into force from 15.06.2003. The objective is to introduce competition, protect consumer's interests and provide power for all. The Act provides for National Electricity Policy, Rural Electrification, Open access in transmission, phased open access in distribution, mandatory SERCs, license free generation and distribution, power trading, mandatory metering and stringent penalties for theft of electricity.

It is a comprehensive legislation replacing Electricity Act 1910, Electricity Supply Act 1948 and Electricity Regulatory Commission Act 1998. The Electricity Act, 2003 has been amended on two occasions by the Electricity (Amendment) Act, 2003 and the Electricity (Amendment) Act, 2007. The aim is to push the sector onto a trajectory of sound commercial growth and to enable the States and the Centre to move in harmony and coordination.

## Performance of Generation from All Sources

### PERFORMANCE OF GENERATION FROM THERMAL, HYDRO, NUCLEAR & BHUTAN IMPORT

The electricity generation target of thermal, hydro, nuclear & Bhutan import for the year 2021-22 has been fixed as 1356 Billion Unit (BU). i.e. growth of around 9.83% over actual generation of 1234.608 BU for the previous year (2020-21). The generation from above categories during 2020-21 was 1234.608 BU as compared to 1250.784 BU generated during 2019-20, representing a negative growth of about 1.29%.

#### 1.2 Total Generation and growth over previous year in the country during 2009-10 to 2021-22 :

Year	Total Generation (Including Renewable Sources) (BU)	% of growth
2009-10	808.498	7.56
2010-11	850.387	5.59
2011-12	928.113	9.14
2012-13	969.506	4.46
2013-14	1,020.200	5.23
2014-15	1,110.392	8.84
2015-16	1,173.603	5.69
2016-17	1,241.689	5.80
2017-18	1,308.146	5.35
2018-19	1,376.095	5.19
2019-20	1,389.102	0.95
2020-21	1,381.827	-2.49
2021-22 *	1,234.298	8.48

\* Upto January 2022 (Provisional), Source : CEA

## 7. Nuclear Power in India

Nuclear energy has emerged as a viable source in recent times. Important minerals used for the generation of nuclear energy are uranium and thorium. Uranium deposits occur in the Dharwar rocks. Geographically, uranium ores are known to occur in several locations along the Singbhum Copper belt. It is also found in Udaipur, Alwar and Jhunjhunu districts of Rajasthan, Durg district of Chhattisgarh, Bhandara district of Maharashtra and Kullu district of Himachal Pradesh. Thorium is mainly obtained from monazite and ilmenite in the beach sands along the coast of Kerala and Tamil Nadu. World's richest monazite deposits occur in Palakkad and Kollam districts of Kerala, near Vishakhapatnam in Andhra Pradesh and Mahanadi river delta in Odisha.

- Nuclear energy has emerged as a viable source of clean energy in recent times. In a process called nuclear fission, the nucleus of a heavy atom (such as Uranium, Thorium or Plutonium), when bombarded with low energy neutrons, can be split apart into lighter nuclei and as a result tremendous amount of energy is released.
- The Atomic Energy Commission was established in 1948 by the efforts of Dr. Homi Jehangir Bhabha, the father of Atomic Energy Research in India.
- The atomic energy Department was established in 1954. It is the apex body regarding of nuclear energy.
- India's First Atomic Research Reactor, Apsara was established at Trombay near Mumbai. India's first Nuclear Power Reactor was established at Tarapur in 1969.
- The production of nuclear energy requires Uranium, Thorium and Heavy Water. Uranium is found in Jharkhand, Rajasthan and Meghalaya.
- The atomic Energy department has decided to achieve the target of electricity production of 20 Gigawatt by 2020.
- As of March 2018, India has 22 nuclear reactors in operation in 7 nuclear power plants, with total installed capacity of 6,780 MW.

# Major Atomic Centres

## Major Atomic Centres

Major Centre	Location	Characteristics
Tarapur	Mumbai (Maharashtra)	<ol style="list-style-type: none"> <li>1. First atomic power plant in India</li> <li>2. The largest atomic power plant in Asia</li> </ol>
Rawatbhata (Rana Pratap Sagar)	Kota (Rajasthan)	<ol style="list-style-type: none"> <li>1. Established with the cooperation Canada</li> <li>2. Natural Uranium Oxide is used as fuel</li> </ol>
Kalpakkam	Chennai (Tamil Nadu)	<ol style="list-style-type: none"> <li>1. First project to use state-of-art technology</li> <li>2. 485m long ocean tunnel</li> </ol>
Narora Kumharia	Bulandshahr (Uttar Pradesh) Fatehabad (Haryana)	<ol style="list-style-type: none"> <li>1. New Design evolved, suitable for seismic sites</li> <li>2. 2800 MW capacity (Proposed)</li> </ol>
Kakrapara	Surat (Gujarat)	<ol style="list-style-type: none"> <li>1. 220 MW Capacity (Unit-I)</li> </ol>
Kaiga	Karnataka	<ol style="list-style-type: none"> <li>1. Third largest nuclear plant of the country</li> </ol>
Kudankulam	Tamil Nadu	<ol style="list-style-type: none"> <li>1. Cooperation of Russia</li> <li>2. Ordinary water cooling technology</li> </ol>

## 8. Ultra Mega Power Project (UMPP)

- Ministry of Power has launched an initiative of Ultra Mega Power Project (UMPPs) to install 4,000 MW of super thermal power projects.
- The objective is to develop large capacity power Finance Corporation Ltd (PFC) has been appointed as the nodal agency to facilitate the development of these projects.
- Initially, 9 UMPPs were proposed and request for installation of 7 additional UMPPs have come up.
- These are as follows:
  1. Sasan Ultra Mega Power Project, Madhya Pradesh
  2. Mundra Ultra Mega Power Project, Gujarat
  3. Krishnapatnam UMPP, Andhra Pradesh
  4. UMPP in Jharkhand
  5. UMPP in Chhattisgarh
  6. UMPP in Odisha
  7. UMPP in Tamil Nadu
  8. UMPP in Maharashtra
  9. UMPP in Karnataka

Ministry of Petroleum and Natural Gas released the Hydrocarbon Vision 2030 for North East India on 9<sup>th</sup> January 2016, outlining steps to leverage the Hydrocarbon sector for development of the region in Guwahati. States covered in the union are Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura.

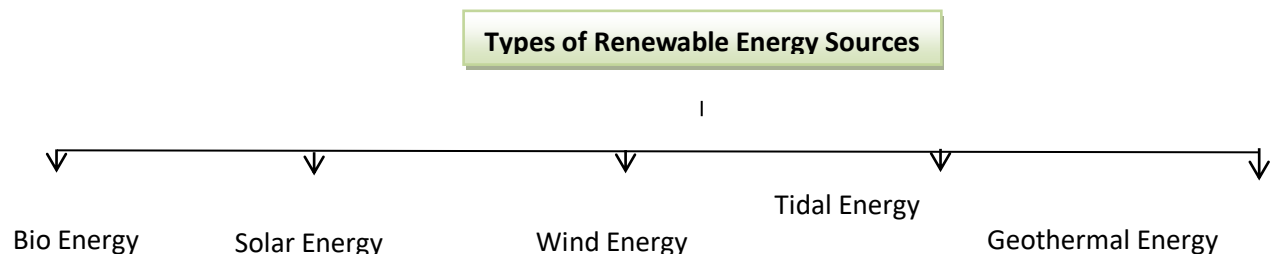
## 9. Renewable Energy (RE) Resources

As we know that Fossil fuel sources, such as coal, petroleum, natural gas and nuclear energy use exhaustible raw materials. Renewable energy is energy obtained from sources that are essentially inexhaustible. Therefore, renewable energy sources are only the Sustainable energy resources in the world the like solar, wind, hydrogeothermal and biomass. These energy sources are more equitably distributed and environment-friendly. The non-conventional energy sources will provide more sustained, eco-friendly cheaper energy after the initial cost is taken care of.

### Renewable Energy (RE) Capacity of India:

- The country's installed Renewable Energy (RE) capacity stands at 150.54 GW (solar: 48.55 GW, wind: 40.03 GW, Small hydro Power: 4.83, Bio-power: 10.62, Large Hydro: 46.51 GW) as on 30th Nov. 2021 while its nuclear energy based installed electricity capacity stands at 6.78 GW.
- India has the **4<sup>th</sup> largest wind power capacity in the world.**
- This brings the **total non-fossil based installed energy capacity** to 157.32 GW which is 40.1% of the total installed electricity capacity of 392.01 GW.
- At the **COP26** India is committed to achieving **500 GW of installed electricity capacity from non-fossil fuel sources by the year 2030.**

### Types of Renewable Energy Sources





## Installed Capacity

Sector	Installed Capacity	Under Implementation	Tendered (GW)	Total Pipeline (GW)
Solar Power	36.32	37.10	21.21	94.63
Wind Power	38.26	8.99	0.00	47.25
Bio Energy	10.31	0.00	0.00	10.31
Small Hydro	4.74	0.46	0.00	5.20
Wind Solar Hybrid	0	1.44	1.20	2.64
Round the Clock (RTC) Power	0	1.60	5.00	6.60
<b>Total</b>	<b>89.63</b>	<b>49.59</b>	<b>27.41</b>	<b>1.66.63</b>

India ranked 74<sup>th</sup> in Energy Transition Index (ETI), 2020 given by World Economic Forum (WEF). Sweden ranked first in this Index.

India ranks 4<sup>th</sup> and 6<sup>th</sup> position globally, in wind and solar power deployment respectively.

### National Solar Mission

- The National Solar Mission was launched on 11<sup>th</sup> January, 2010 with the aim of development and deployment of 20 GW solar powers by 2022. The capacity has now been updated to achieve 100 GW by 2030.

### International Solar Alliance (ISA)

- The International Solar Alliance was unveiled by Indian Prime Minister and French President at the U.N. Climate Change Conference in Paris on 30<sup>th</sup> November, 2015.
- ISA has set a target of 1 TW of solar energy by 2030, which would require USD1 trillion to achieve.
- The ISA is the first international body that will have a Secretariat in India, with a target to produce 100 GW of solar energy by 2022 that would account for one-tenth of ISA's goal.

India hosted First ISA Summit in March, 2018 in New Delhi. International Solar Alliance is headquartered at Gurugram, India.

## Wind Energy

- India is the fourth largest wind power producer in the world after China, USA and Germany.
- India's wind power potential at hub height of 120 meters is 695 GW/

## National Offshore wind Energy Policy, 2015

- The Union Cabinet on 9<sup>th</sup> September, 2015 gave its approval to the first National Offshore Wind Energy Policy. The focus of the policy is to harness offshore wind energy potential in India's Exclusive Economic Zone (EEZ).

## Geothermal Energy

- Geothermal energy is the energy received from the heat stored in the earth crust upto the depth of 3-4 km.
- A geothermal plant has been set up at Manikaran in Himachal Pradesh. A Geothermal Energy Center for Green House will be set up at Puga Valley in Ladakh. Tata Pani in Surguja district of Chhattisgarh is also being set up for Geothermal Energy.

**Union Ministry of New & Renewable Energy has approved proposal in August, 2019 to declare Ocean Energy as Renewable Energy along with tidal, wave and ocean thermal energy conversion.**

## Tidal Energy

- Tidal energy is a form of hydropower which converts the energy obtained from the tides into useful forms of power, mainly electricity.
- There is a high potential of the tidal energy generation in India at Gulf of Khambhat, Gulf of Kutch and Sundarbans.
- It is proposed to set up a Tidal Energy Producing Plant at Kandla in Gulf of Kutch, which will be the first of its kind in Asia. The efforts are also being made in the same direction in the Durgaduani Creek in Sundarbans.

## Wave Energy

- Wave energy, also known as Ocean Wave Energy, is another type of ocean based renewable energy source that uses the power of the waves to generate electricity.
- The ideal place for the generation of ocean wave energy is the Trade Wind Power Plant in India has been set up at Vizhinjam (Kerala).

## Hydrogen Energy

- Hydrogen is a clean and efficient energy carrier with potential to substitute liquid and gaseous fossil fuels especially for automobiles.
- Hydrogen Energy Centre at BHU, Varanasi is involved in research for the development of hydrogen energy.

## Biomass

- Biomass is an important source of energy in rural India. There are two major sources of biomass:
  1. The residue of agriculture and forest produce
  2. The garbage of Municipality.
- As on 31<sup>st</sup> October 2020, installed capacity of grid connected biomass power projects stood at about 10.15 GW, waste to energy projects capacity was 168.64 MW (grid connected) and 204.73 MWeq (off grid), and about 4.74 GW small hydro power capacity from 1,133 small hydro power projects was operational.

## Bio-Diesel

- Bio-diesel is an alternative fuel similar to conventional fossil diesel. It can be produced from vegetable oil, animal fats and waste cooking oil.
- An emphasis is laid in the production of *Jatropha curcas* (Rattan Jot). The first bio-diesel plant has been set up in Kakinada in Andhra Pradesh.

### **Pradhan Mantri JI-VAN Yojana**

Pradhan Mantri JI-VAN Yojana 2019 aims to create an ecosystem for setting up commercial projects and to boost research and development in the 2G Ethanol Sector.

### **Energy Conservation Day**

- It is organised every year on 14<sup>th</sup> December by Bureau of Energy Efficiency (BEE), under Ministry of Power.
- The Honorable President of India presented National Energy Conservation Awards to industries.

## 10. Agriculture

Agriculture plays a vital role in the Indian economy. Over 70 per cent of the rural households depend on agriculture. Agriculture is an important sector of Indian economy as it contributes about 17% to the total GDP and provides employment to around 58% of the population.

Over the past few decades, the manufacturing and services sectors have increasingly contributed to the growth of the economy, while the agriculture sector's contribution has decreased from more than 50% of GDP in the 1950s to 15.4% in 2015-16 (at constant prices).

Sustainable agriculture, in terms of food security rural employment, environmentally sustainable technologies such as soil conservation, sustainable nature resource management and biodiversity protection are essential for holistic rural development. On the recommendations of National Commission on Farmers, agriculture has been shifted to State list from Union list.

India has been divided into 15 Agro Climate Zones on the basis of geographical features and agricultural practices.

### Salient features of Indian Agriculture

- **Subsistence agriculture:** The type of agriculture in India is mostly Subsistence agriculture. In Subsistence agriculture the agricultural produce is for self-consumption only, there is no surplus production to sell in the market.
- **Commercial agriculture:** Large-scale commercial agriculture is also practiced in India, such as tea plantation in Assam, coffee in Karnataka, coconut in Kerala, etc. Commercial Agriculture is the agricultural practice where large agricultural produce is sold in the market by the firms for making profits.
  - Since the land resource in India is limited the pressure of increasing population on agriculture is increasing day by day.
- **Mechanization:** After Green Revolution, there has been an increasing trend in the use of machines in farm operations. This has led to the mechanization of Indian agriculture. Punjab, Haryana, Western Uttar Pradesh, River valleys of Andhra, and Tamil Nadu are major agriculturally mechanized areas in India.

- **Monsoon dependent:** Due to lack of irrigation facilities Two-third of Indian agriculture is dependent on monsoon rains.
- **Variety of crops:** Due to the presence of different types of topography, diverse soil (like alluvial, red, black cotton soil, etc), and different types of climate, India is blessed with the production of different varieties of crops in different regions. For eg., hilly areas are suitable for tea cultivation, plains for rice cultivation
- **Predominance of food crops:** In order to feed a large population and predominance of subsistence agriculture, food crops are mainly grown in order to keep with the food security demands of the huge Indian population.
- Arable Land – Both net sown area and fallow lands are included under this category.
- Fallow Land - It is that type of land in which no crop has been grown for one to five years.
- Barren Land – The type of land which is not suitable for cultivation. Sometimes, an arable land becomes barren because of unscientific cultivation.

#### Land Holdings (10<sup>th</sup> Agricultural Census 2015-15)

Classification	Range(ha)	2010-11 (mn)	2015-16 (mn)	% Change
• Small	<1	117.25	125.86	(+7.34%)
• Medium	1-4	19.72	19.3	(-2.13%)
• Large	4-10	0.98	0.83	(-15.31%)
Cropping Intensity=				
• Percentage of women landholders	12.79% (2010-11), 13.87% (2015-16)	<u>Gross cropped Area</u> x100		
• Small and Marginal holding (<2 hectares),	86.21%	Neta sown Area		
Average size of land holding , Highest – Nagaland (5 ha)				
Lowest – Kerala (0.18 ha)				

Uttar Pradesh has the largest number of landholder.

- Agriculture Census is held in every 5 year, the first being conducted in 1970-71.

There are three distinct crop seasons in the northern and interior parts of the country, namely Kharif, rabi, and Zaid.

- **The Kharif season:** The crops which are grown in the Kharif season require a good amount of water, thus the sowing of Kharif crops largely coincides with the onset of the Southwest Monsoon.
- **The Rabi season:** The sowing of rabi crops begins with the onset of winter in October-November and the harvesting is done in March-April. The celebration of the festival Holi can be related to a good harvest in the month of March- April.
- **The Zaid season:** It is a short duration summer cropping season beginning after harvesting of rabi crops, the cultivation of watermelons, cucumbers, vegetables, and fodder crops during this season is done on irrigated lands.

## Classification of Crops

Type	Months	Crops
1. Rabi Crops	Oct-Nov to Mar-Apr	Wheat, Barley, Gram, Peas, Mustard, Potato etc.
2. Kharif Crops	June-July to Oct-Nov	Rice, Jowar, Bajra, Maize, Groundnut, Cotton, Ragi, Soyabean, Oilseeds
3. Zaid Crops	Mar-Apr to June-July	Water melon, Musk melon, Cucumber, Bitter gourd, ladyfinger and other vegetables.

## 11. Agro Climate Zones in India

The Agricultural regions in India are fully controlled by a set of inter-related geographic factors. They are: a) Climatic factors b) Soil properties and c) Physiographic settings ( topography & drainage). This identification of agro-climatic zones for the purpose of developing location specific research and development strategies for increasing agricultural production has been given the due impetus recently. In order to plan agricultural activities more accurately each region into sub regions based on soil, climate (temperature), rainfall and other agro meteorological characteristics.

Planning Commission has demarcated the geographical area of India into 15 agro-climatic regions. These are further divided into more homogeneous 72 sub-zones.

The main objectives of agro-climatic regions are:

- (i) to optimise agricultural production;
- (ii) to increase farm income;
- (iii) to generate more rural employment;
- (iv) to make a judicious use of the available irrigation water;
- (v) to reduce the regional inequalities in the development of agriculture.

### The 15 agro-climatic zones

Zone 1- Western Himalayan Region: Jammu and Kashmir, Uttar Pradesh

Zone 2 - Eastern Himalayan Region: Assam, Sikkim, West Bengal and all North-Eastern states

Zone 3 - Lower Gangetic Plains Region: West Bengal

Zone 4 - Middle Gangetic Plains Region: Uttar Pradesh, Bihar

Zone 5 - Upper Gangetic Plains Region: Uttar Pradesh

Zone 6 - Trans-Gangetic Plains Region: Punjab, Haryana, Delhi and Rajasthan

Zone 7 - Eastern Plateau and Hills Region: Maharastra, Uttar Pradesh, Orissa and West Bengal

Zone 8 - Central Plateau and Hills Region: MP, Rajasthan, Uttar Pradesh

Zone 9 - Western Plateau and Hills Region: Maharastra, Madhya Pradesh and Rajasthan

Zone 10 - Southern Plateau and Hills Region: Andhra Pradesh, Karnataka, Tamil Nadu

Zone 11 - East Coast Plains and Hills Region: Orissa, Andhra Pradesh, Tamil Nadu and Pondicherry

Zone 12 - West Coast Plains and Ghat Region: Tamil Nadu, Kerala, Goa, Karnataka, Maharashtra Zone

13 - Gujarat Plains and Hills Region: Gujarat Zone

14 - Western Dry Region: Rajasthan Zone

15 - The Islands Region: Andaman and Nicobar, Lakshadweep. (Given Below Table)

## Agro Climate Zones in India

Region	Areas Covered	Characteristics
1. Western Himalayan Region	Ladakh, Kashmir, Punjab, Jammu	Brown soil and silty loam, steep slopes.
2. Eastern Himalayan Region	Arunachal Pradesh, Sikkim, Darjeeling, Manipur	High rainfall, high forest cover, red-brown soil, heavy soil erosion, shifting agriculture.
3. Lower Gangetic Plains Region	West Bengal, Eastern Bihar	Soil mostly alluvial and prone to floods.
4. Middle Gangetic Plains Region	Bihar, Uttar Pradesh	High rainfall, 39% irrigation.
5. Upper Gangetic Plains Region	North region of Uttar Pradesh	Irrigated by canal and tube wells, sub-humid continental climate, moderate rainfall.
6. Trans Gangetic Plains Region	Punjab, Haryana, Delhi	Alluvial soil, semi-arid climate, highest sown area, highly irrigated area.
7. Eastern Plateau and Hills	Chotanagpur plateau, Garhjat hills, Madhya Pradesh, Western Bagelkhnad plateau, Odisha	Fertile soils, shallow to medium slope, undulating irrigation tank and tube wells.
8. Central Plateau and Hills	Madhya Pradesh, South-Western Rajasthan	Semi-arid climate, moderate rainfall, mixed soil (red, yellow, black).
9. Western Plateau and Hills	Sahyadri, Malwa Plateau	Semi-arid climate with 25 to 75 cm rainfall, sown area (65%), forest (11%), irrigation (12.4%).
10. Southern Plateau and Hills	Tamil Nadu, Andhra Pradesh, Karnataka	Typically Semi-arid zone, dry land farming 81%, cropping intensity 11%.
11. Eastern coastal Plains and Hills	Tamil Nadu, Andhra Pradesh, Odisha	Mainly alluvial soil and coastal sand, high rainfall.
12. Western coastal Plains and Hills	Saurashtra, Maharashtra Goa, Karnataka, Tamil Nadu	Hot humid climate with variety of cropping pattern, rainfall and soil types.



<b>13. Gujarat plains and Hills</b>	Gujarat	Arid region with (hot sandy desert), very low rainfall with high evaporation, scanty vegetation.
<b>14. Western Dry Region</b>	Rajasthan	Arid region with (hot sandy desert), very low rainfall with high evaporation, scanty vegetation.
<b>15. Island Region</b>	Eastern Andaman & Nicobar, Western Lakshadweep	Typical equatorial climate, rainfall 300 cm, forest zone, sandy to clayey loam.

### **India's Major Crops divided into four categories**

**1. Food grains:** Rice, Wheat, Maize, Millets, Jowar, Bajra, Ragi, Pulses- Gram, Tur.

**2. Cash Crops:** Cotton, Jute Sugarcane, Tobacco, Oil seeds, Groundnut, Linseed, Sesame, castor seed, Rapeseed, Mustard.

**3. Plantation Crops:** Tea, Coffee; **Spices-** Cardamom, Chillies, Turmeric, Coconut, Arecanut and Rubber.

**4. Horticulture crops:** Apple, Peach, Pear, Apricot, Almond, Strawberry, Walnut, Mango, Banana, Citrus fruits, Vegetables.

### **Zone 1- Western Himalayan Region:**

It includes Jammu and Kashmir, Himachal Pradesh and Kumaun-Garhwal areas of Uttaranchal. It shows great variation in relief. Summer season is mild (July average temperature 5°C-30°C) but the winter season experiences severe cold conditions (January temperature 0°C to -4°C). The amount of average annual rainfall is 150 cms. Zonal arrangement in vegetation is found with varying height along the hill slopes. Valleys and duns have thick layers of alluvium while hill slopes have thin brown hilly soils. The region is gifted with a number of perennial streams due to high rainfall and snowcovered mountain peaks of which Ganga, Yamuna, Jhelum, Chenab, Satluj and Beas etc. are worthy of mention. These provide irrigation water to canals and cheap hydel power for agriculture and industries. In recent years the increasing human interference has led to the deterioration of the ecological system. Rapid construction activities in the form of buildings and transport routes and unscrupulous mining have led to the depletion of vegetal cover making the area prone to landslides, pollution, receding glaciers and water scarcity. Rice is the main crop of this region which is cultivated in terraced fields along the hill slopes. Maize, wheat, potato, barley are other important crops. Temperate fruits like apple and pear etc. are produced in some parts of Jammu and Kashmir and Himachal Pradesh. Similarly tea plantations have started in some areas of Garhwal-Kumaun hills. The horticulture of the region is obsessed with the problems of financial crisis, long gestation period, lack of improved varieties of plants and high post-harvest losses (about 20% in packing, storage, marketing and processing). This needs improvement in old unproductive orchards using the recent technique of grafting, introduction of new fast growing varieties of plants and development of infrastructural facilities. Environmental conditions of this region are well suited for the development of garden and plantation crops. A more rational land use planning is required for the region. Land suitable for agriculture, horticulture, pasture, forestry respectively should be demarcated on the following basis: (a) agriculture on land of up to 30 per cent slopes; (b) land having 30-50 per cent slopes for horticulture/fodder development; and (c) all lands above 50 per cent slopes under tree cover. Better quality planting material should be made available to fruit growers. The region has favourable climatic conditions for growing temperate vegetables, flowers, and crops like ginger and saffron.

### **Zone 2 - Eastern Himalayan Region:**

The Eastern Himalayan region consists of Sikkim, Darjeeling area (West Bengal), Arunachal Pradesh, Assam hills, Nagaland, Meghalaya, Manipur, Mizoram and Tripura. It is

characterised by rugged topography, thick forest cover and sub-humid climate (rainfall over 200 cm; temperature July 25°C-33°C, January 11°C-24°C). The soil is brownish, thick layered and less fertile. Shifting cultivation (Jhum) is practised in nearly 1/3 of the cultivated area and food crops are raised mainly for sustenance. Rice, potato, maize, tea and fruits (orange, pine-apple, lime, lichi etc.) are the main crops. The ecological system of the region is problematic. The region needs marked improvement in infrastructural facilities to accelerate the pace of development. Soil degradation should be arrested by controlling deforestation and by terracing in hills. The run-off should be checked and water conserved should be utilised in minor irrigation. Shifting cultivation should be controlled by encouraging permanent settlement. A programme to grow fruits above 30% slopes in the hills needs to be framed. Supporting activities of sericulture, handicrafts poultry, and piggery etc. should be promoted. A long term quality seed production plan should be implemented to assure adequate supply of quality seeds to the farmers

### **Zone 3 - Lower Gangetic Plains Region:**

This region spreads over eastern Bihar, West Bengal and Assam valley. Here average amount of annual rainfall lies between 100 cm-200 cm. Temperature for July month varies from 26°C-41°C and for January month 9°C-24°C. The region has adequate storage of ground water with high water table. Wells and canals are the main source of irrigation. The problem of water logging and marshy lands is acute in some parts of the region. Rice is the main crop which at times yields three successive crops (Aman, Aus and Boro) in a year. Jute, maize, potato, and pulses are other important crops. Planning strategies include improvement in rice farming, horticulture (banana, mango and citrus fruits), pisciculture, poultry, livestock, forage production and seed supply. An export processing zone for marine and sea foods needs to be established which should be equipped with modern facilities of freezing, canning, dehydration, and quality control. Organisational set-up for implementation should include: (a) a committee at the State level to guide and monitor implementation; (b) the Zila Parishads at the district level; and (c) a village level committee under the aegis of the Panchayat backed by trained staff (Wadia, 1996, p. 96).

### **Zone 4 - Middle Gangetic Plains Region:**

It incorporates eastern Uttar Pradesh and Bihar (except Chotanagpur plateau). It is a fertile alluvial plain drained by Ganga River and its tributaries. The average temperature of July month varies from 26°C- 41°C and that of January month 9°C-24°C. The amount of annual rainfall lies between 100 cm and 200 cm. The region has vast potential of ground water and

surface runoff in the form of perennial rivers which is utilised for irrigation through tube wells, canals and wells. Rice, maize, millets in, kharif, wheat, gram, barley, peas, mustard and potato in rabi are important crops. The agricultural strategy included introduction of modern market oriented agriculture in place of the traditional one. Efforts should be made to improve and stabilise yield of kharif paddy which accounts for over 40 per cent of gross cropped area in the region. Similarly increasing maize production, replacing upland paddy and millets with fruits, vegetables and kharif pulses (Arahar), encouraging pre-kharif paddy (January to June) or maize in low lands, improving low land cultivation through water harvesting structures and alternative farming systems, and utilising chaur lands for pisciculture are some other suggested measures to boost up agricultural production. The strategy also includes reclamation of 5.5 lakh ha of usar lands, 25.4 lakh ha of wastelands, and 16.5 lakh ha of fallow lands for agriculture and allied activities (agroforestry, silviculture, floriculture etc.). Supplementary measures should include input delivery system, demonstration of recommended package of practices, particularly for kharif paddy, diversification of crops like vegetables and fruits, and provisions of processing and marketing facilities, poultry, dairying and inland riverine fishery.

### **Zone 5 - Upper Gangetic Plains Region:**

This region encompasses central and western parts of Uttar Pradesh. The climate is subhumid continental with July month's temperature between 26°-41°C, January month's temperature between 7°- 23°C and average annual rainfall between 75 cm- 150 cm. The soil is sandy loam. It has 131 per cent irrigation intensity and 144 per cent cropping intensity. Canal, tube well and wells are the main source of irrigation. This is an intensive agricultural region where in wheat, rice, sugarcane, millets, maize, gram, barley, oilseeds, pulses and cotton are the main crops. Besides modernising traditional agriculture the region needs special focus on dairy development and horticulture. Strategies should include developing multiple mixed cropping patterns like rice-potato- wheat-moong and sugarcane , sunflower, and potato + mustard; improving irrigation system and water management such as lining of canals to check seepage; reclaiming saline/alkaline soils; raising fruit trees on Diara areas; devoting uplands to horticulture; improving cattle breed and bringing more areas to fodder crops.

### **Zone 6 - Trans-Gangetic Plains Region:**

The Trans Ganga Plain consists of Punjab, Haryana, Delhi, Chandigarh and Ganganagar district of Rajasthan. The climate has semiarid characteristics with July month's temperature

between 26°C and 42°C, January temperature ranging from 7°C to 22°C and average annual rainfall between 70 cm and 125 cm. Private tube wells and canals provide principal means of irrigation. Important crops include wheat, sugarcane, cotton, rice, gram, maize, millets, pulses and oilseeds etc. The region has the credit of introducing Green Revolution in the country and has adopted modern methods of farming with greater degree of mechanisation. The region is also facing the menacing problem of water logging, salinity, alkalinity, soil erosion and falling water table. The suggested strategies include: (a) diversion of 5 per cent of rice-wheat area to other crops like maize, pulses, oilseeds and fodder, (b) development of genotypes of rice, maize and wheat with inbuilt resistance to pests and diseases, (c) promotion of horticulture besides pulses like tur and peas in upland conditions, (d) cultivation of vegetables in the vicinity of industrial clusters, (e) supply of quality seeds of vegetables and planting material for horticulture crops, (f) development of infrastructure of transit godowns and processing to handle additional fruit and vegetable production, (g) implementation of policy and programmes to increase productivity of milk and wool, and (h) development of high quality fodder crops and animal feed by stepping up area under fodder production by 10 percent (Wadia 1996, p. 100).

### **Zone 7 - Eastern Plateau and Hills Region:**

It comprises the Chotanagpur plateau Rajmahal hills, Chhattisgarh plains and Dandakaranya. The region enjoys 26°C-34°C of temperature in July, 10°C-27° C in January and 80 cm-150 cm of annual rainfall. Soils are red and yellow with occasional patches of laterites and alluviums. The region is deficient in water resources due to plateau structure and non-perennial streams. Rainfed agriculture is practised growing crops like rice, millets, maize, oilseeds, ragi, gram and potato. The region requires planning to maximise use of rainwater, increase in ground water potential, change cropping pattern to achieve a balanced crop production and strengthen input and services delivery systems, Suggested strategies include: (a) coverage of large areas with quality seeds of HYV, (b) cultivation of high value crops of pulses like tur, groundnut and soyabean etc. on upland rained areas, (c) growing crops like urad, castor, and groundnut in kharif and mustard and vegetables in irrigated areas, (d) improvement of indigenous breeds of cattle and buffaloes, (e) rehabilitation of 30 per cent of degraded forest lands, (f) extension of fruit plantations, (g) renovation including desalting of existing tanks and excavation of new tanks, (h) reclamation of 95.32 lakh ha of acidic lands through lime treatment, (i) development of inland fisheries in permanent water bodies, and (j) adopting integrated watershed development approach to conserve soil and rain water.

### **Zone 8 - Central Plateau and Hills Region:**

This region spreads over Bundelkhand, Baghelkhand, Bhander plateau, Malwa plateau and Vindhya hills. The climate is semi-arid in western part to sub-humid in eastern part with temperature in July month 26°C-40°C, in January month 7°C-24°C and average annual rainfall from 50 cm- 100 cm. Soils are mixed red, yellow and black growing crops like millets, gram, barley, wheat, cotton, sunflower, etc. The region has dearth of water resources. The suggested measures should include water conservation through water saving devices like sprinklers and drip system; dry farming popularisation; dairy development, crop diversification, ground water development, diversion of 16 lakh ha of low value crops to high value crops, reclamation of ravine lands and improvement in indigenous breed cattle.

### **Zone 9 - Western Plateau and Hills Region:**

This comprises southern part of Malwa plateau and Deccan plateau (Maharashtra). This is a region of the regar soil with July temperature between 24°C-41 °C, January temperature between 6°C- 23°C and average annual rainfall of 25 cm-75 cm. Net sown areas is 65 per cent and forests occupy only 11 per cent. Only 12.4 per cent area is irrigated. Jowar, cotton, sugarcane, rice, bajra, wheat, gram, pulses, potato, groundnut and oilseeds are the principal crops. The area is known for its oranges, grapes and bananas. Since the region is deficient in water resources attention be paid to increasing water efficiency by popularizing water saving devices like sprinklers and drip system. The lower value crops of jowar, bajra and rainfed wheat should give way to high value oilseeds like sunflower, safflower and mustard. Five per cent area under rainfed cotton and jowar could be substituted with fruits like ber, pomegranate, mango and guava, appropriate marketing, storage and processing infrastructure to handle added fruit production should be developed. Improvement of milk production of cattle and buffalo through cross-breeding along with poultry development should be taken care of.

### **Zone 10 - Southern Plateau and Hills Region:**

It incorporates southern Maharashtra, Karnataka, western Andhra Pradesh and northern Tamil Nadu. The temperature of July month lies between 26°C to 42°C, that of January month between 13°C-21°C with annual rainfall between 50 cm-100 cm. The climate is semi-arid with only 50 per cent of area cultivated, 81 per cent of dry land farming, and low cropping intensity of 111 per cent. Low value cereals and minor millets predominate. Coffee, tea, cardamom and spices are grown along the hilly slopes of Karnataka plateau. Suggested strategies include: (a) diversion of 20 per cent of area under jowar/bajra/ragi to

groundnut/sesamum/sunflower, (b) cultivation of soyabean/ safflower on residual moisture after rice, (c) development of horticulture, (d) restoration of tank irrigation by taking appropriate measures of deepening, embanking etc., (e) use of water saving devices like sprinklers and drip system, (f) development of location specific dry land farming technology, viz. early fertilizer responsive varieties of jowar and rice, and (g) implementation of programmes for poultry farming and dairy development.

### **Zone 11 - East Coast Plains and Hills Region:**

This region includes the Coromandel and Northern Circar coasts. Here climate is sub-humid maritime with May and January temperatures ranging from 26°C-32°C and 20°C-29°C respectively and annual rainfall of 75 cm-150 cm. The soils are alluvial, loam and clay facing the menacing problem of alkalinity. The region accounts for 20.33 per cent of rice and 17.05 per cent of groundnut production of the country. Main crops include rice, jute, tobacco, sugarcane, maize, millets, groundnut and oilseeds. Main agricultural strategies include improvement in the cultivation of spices (pepper and cardamom) and development of fisheries. These involve increasing cropping intensity using water-efficient crops on residual moisture, discouraging growing of rice on marginal lands and bring such lands under alternate crops like oilseeds and pulses; diversifying cropping and avoiding mono-cropping; developing horticulture in upland areas; increasing marine, brackish water and inland fisheries; upgrading genetic potential of existing animals; improving tank irrigation by desalting and embanking existing tanks and improving field channels and structures; and providing solutions to the problems of water logging and alkalinity.

### **Zone 12 - West Coast Plains and Ghats Region:**

This region extends over the Malabar and Konkan coasts and the Sahyadris and is covered by laterite and coastal alluvials. This is a humid region with annual rainfall above 200 cm and average temperatures of 26°C-32°C in July and 19°C-28°C in January. Rice, coconut, oilseeds, sugarcane, millets, pulses and cotton are the main crops. The region is also famous for plantation crops and spices which are raised along the hill slopes of the Ghats. The strategies include development of high value crops and fisheries, protection of land from salinity ingress and provision of drainage improvement. A programme to sink about 5 lakh dug wells and shallow wells should be undertaken on priority basis. The approach of homestead system of reclaiming and using Khar lands be accepted, planned and implemented. Low productivity areas of paddy and millets under rained conditions should be diverted to horticultural crops like mango, banana, coconut etc. to cover about 0.5 lakh ha.

Appropriate infrastructure for fruit marketing and processing should be developed. Increasing mechanised fishing boats for deep sea fishing, strengthening of cold storage, processing, and transport infrastructure in corporate/cooperative sector, and providing incentives for prawn culture in brackish water should be taken up.

### **Zone 13 - Gujarat Plains and Hills Region:**

This region includes Kathiawar and fertile valleys of Mahi and Sabarmati rivers. It is an arid to semi-arid region with average annual rainfall between 50 cm-100 cm, and monthly temperature between 26°C-42°C in July and 13°C-29°C in January. Soils are regur in the plateau region, alluvium in the coastal plains, and red and yellow soils in Jamnagar. Groundnut, cotton, rice, millets, oilseeds, wheat and tobacco are the main crops. It is an important oilseed producing region. The major thrust of development in the region should be on canal and ground water management, rain water harvesting and management, dry land farming, agro-forestry development, wasteland development and developing marine fishing and brackish/back-water aquaculture in coastal zones and river deltas.

### **Zone 14 - Western Dry Region:**

It comprises western Rajasthan west of the Aravallis. It is characterised by hot sandy desert, erratic rainfall (annual average less than 25 cm), high evaporation, contrasting temperature (June 28°C- 45°C, and January 5°C-22°C), absence of perennial rivers, and scanty vegetation. Ground water is very deep and often brackish. Famine and drought are common features. Land-man ratio is high. Forest area is only 1.2 per cent. Land under pastures is also low (4.3 per cent). Cultivable waste and fallow lands account for nearly 42 per cent of the geographical area. Net irrigated area is only 6.3 per cent of net sown area which is 44.4 per cent of the geographical area. Bajra, jowar, and moth are main crops of kharif and wheat and gram in rabi. Livestock contributes greatly in desert ecology. Agricultural development strategies include completion of on-going irrigation projects; making research on the use of saline water; popularising bajra varieties giving higher biomass; promoting use of fertilisers; making improved seeds available to farmers, constructing moisture (rain water) conservation structures; increasing yield level of fruits like date palm, water-melon and guava; adopting high quality germ-plasm in cattle to improve their breed; and adopting silvi-pastoral system over wastelands through aerial and manual seeding.



## Zone 15 - The Islands Region:

The island region includes Andaman-Nicobar and Lakshadweep which have typically equatorial climate (annual rainfall less than 300 cm the mean July and January temperature of Port Blair being 30°C and 25°C respectively). The soils vary from sandy along the coast to clayey loam in valleys and lower slopes. The main crops are rice, maize, millets, pulses, areca nut, turmeric and cassava. Nearly half of the area is under coconut. The area is covered with thick forests and agriculture is a backward stage. The main thrust in development should be on crop improvement, water management and fisheries. Improved variety of rice seeds should be popularised so as to enable farmers to take two crops of rice in place of one. For fisheries development multi-purpose fishing vessels for deep sea fishing should be

### Land Holding (2011)

Type of land holding	Size of land holding	%
• Marginal land holding	Less than one hectare	67.10
• Small land holding	1-2 hectares	17.91
• Semi medium	2-4 hectares	10.40
• Medium land holding	4-10 hectares	4.25
• Large land holding	More than 10 hectares	0.7

introduced, suitable infrastructure for storage and processing of fish should be built up, and brackish water prawn culture should be promoted in the coastal area.

### Suitability of different soils for different crops

Soil	Crops
1. Alluvial soils	Wheat, maize, barley, gram, oilseeds, pulses, sugarcane
2. Clayey loams, fine and heavy soils	Rice, Jute etc.
3. Volcanic black soils or regur	Cotton, Wheat, Oilseeds.
4. Sandy loams and sandy soils	Jowar, bajra, groundnut, guar, pulses (green gram, red gram, black gram etc.)
5. Red and yellow soils	Jowar, groundnut, sugarcane.

## 12. Allied Sectors of Agriculture

The economic sector that depends on the agricultural activity in various ways and which affects the outcome of the agricultural sector is referred to as allied sector. The sector which deals with the crops production and livestock of natural resources is the agricultural department.

The important allied sectors of agriculture consider include Horticulture, Animal husbandry, Fishery, Soil and water conservation, Poultry, dairy farming, Agriculture Marketing, Milk-fed financial institute and Social forestry.

### Allied Sectors of Agriculture

- **Silviculture:** It is the growing and cultivation of trees.
- **Sericulture:** It is about the rearing of silkworms for the production of raw silk for industry.
- **Horticulture:** It is the production of fruits, vegetables and flowers.
- **Pisciculture:** It is the farming of fish, oysters, prawns and crabs.
- **Apiculture:** It is the maintenance of honey bee colonies in man-made hives managed by humans.
- **Olericulture:** It deals with growing of non-woody plants as vegetable for food.
- **Viticulture:** It is the production and study of grapes.
- **Floriculture:** It is concerned with the cultivation of ornamental and flowering plants for gardens.
- **Arboriculture:** It is a discipline for the cultivation and study of individual trees, shrubs and storage of fruits.
- **Aeroponics:** It is the process of growing plants in air/mist environment without the use of soil or an aggregate medium.
- **Hydroponics:** It is the growing of plants using minerals nutrient solutions in water without soil.
- **Geoponic:** It refers to the growing of plants in the normal soil.

## 13. Major Crops Grown in India

Agriculture is the backbone of our country. Since India is geographically a vast country so it has various food and non-food crops which are cultivated in three main cropping seasons. The Indian cropping season is classified into three main seasons-(i) **Kharif** (ii) **Rabi** and (iii) **Zaid** based on the monsoon. The kharif cropping season is from July –October during the south-west monsoon and the Rabi cropping season is from October-March (winter). The crops grown between March and June are summer crops.

### Rice

- Rice (paddy) is one of the major food crops of India.
- This is the staple food of the people living in the eastern and southern parts of the country.
- UN General Assembly declared 2004 as the International Year of Rice (IYR)

### Suitable Conditions of Growth

- It is grown in the region between 8° to 30° N latitude.
- It is a tropical plant and requires high heat and humidity.
- Temperature: 20° - 22° C at the time of sowing, 23°-25° C at the time of growth and 25° - 30° C at the time of harvest/
- Rainfall: 150 cm (100-200cm)
- Field must be flooded with 10-12 cm water at time of sowing. It is labour intensive cultivation.
- About 40% of rice cultivation in India is under irrigation.

### Production

- India is the second largest producer and consumer of rice in the world after China. China produces 21% of total rice.
- It accounts for 17.95% of world's total rice production.
- The Major varieties of rice are Ratna, IR-8, Jamuna, Krishna, Padma, Jaya.

### Leading Rice Producing States (2018-19)

Production	Area
1. West Bengal (16.05%)	1. Uttar Pradesh (13.28%)
2. Uttar Pradesh (15.54%)	2. West Bengal (12.61%)
3. Punjab (12.82%)	3. Odisha (8.47%)

## **Wheat**

### **Suitable Conditions for Growth**

- As a Rabi crop, it is sown in the beginning of winter and harvested in beginning of summer.
- The time of sowing of wheat crop is different in different regions due to climatic variation.
- Wheat is a primarily a crop of mid-latitude grasslands and requires a cool climate with moderate rainfall.
- Temperature: 10°-15° C (winter) and 21° - 26° C (summer)
- Sudden rise in temperature at the time of maturity is harmful.
- Rainfall: It requires 50-75 cm of annual rainfall for cultivation.
- Soil: loamy clay is the best soil for wheat cultivation. It also grows well in the black soil of the Deccan Plateau.
- Major varieties of Wheat: Kalyan, Sona, Sonalika, Lerma, Roso, Heera, Shera, Sonara-64.

### **Leading Producers of Wheat (2018-19)**

<b>Production</b>		<b>Area</b>	
1.	Uttar Pradesh (37.75%)	1.	Uttar Pradesh (32%)
2.	Punjab (18.24%)	2.	Madhya Pradesh (19%)
3.	Madhya Pradesh (15.47%)	3.	Punjab (11.9%)

## **Maize**

### **Suitable Conditions for Growth**

- Maize is mainly a raised kharif crop.
- It is sown just before the onset of monsoon and is harvested after retreat of the monsoon. (In Tamil Nadu, it is rabi crop and is sown a few weeks before the onset of winter rainy season in September and October.
- Rainfall 50-100 cm
- Sunshine after rain shower is very useful for maize.

- Cool and dry weather helps in ripening of the grain.
- Temperature: 21°C-27°C
- Frost is injurious to maize.
- Soil: Maize can be grown successfully in variety of soils ranging from loamy sand to clayey loam with good organic matter content having high water retention capacity.
- The cultivation of maize in India is characterised by interculture i.e. along with pulses, vegetable and oil seeds.

#### **Leading Producers of States (2018-19)**

<b>Production</b>	<b>Area</b>
1. Karnataka (13.69%)	1. Karnataka (14.62%)
2. Madhya Pradesh (13.52%)	2. Madhya Pradesh (14.37%)
3. Bihar (11.10%)	3. Maharashtra (10.33%)

#### **Millets**

- Coarse food grains like jowar, bajra and ragi are called millets. India is the largest producer of millets in the world. These are called Nutria-Millets/Nutria-Cereals, due to their high nutrition value.
- Millets are short durational (3-4 months) warm weather grasses, grown on less fertile and sandy soils.
- Jowar, bajra, ragi, korra, kodo kotki sanwam haraka, varagu and rajgira are important millets grown in India.

India celebrated the year 2018 as National Year of Millets and also Food and Agriculture Organisation has agreed to celebrate the next International Year of Millets in 2023

#### **Jowar (Sorghum)**

##### **Suitable Conditions for Growth**

- Jowar is major food crop cultivated in semi-arid areas of India.
- It is a Kharif crop in north India and it is sown as both Kharif and Rabi in southern India.
- Temperature 26°C to 33°C

- The rabi crop can be grown in areas, where the mean monthly temperature does not falls below 16°C.
- Rainfall: 30-60 cm (Jowar is rainfed crop of dry farming areas where irrigation is not used.)
- Both excessive moisture and prolonged dryness are harmful for its proper growth.
- Soil: loamy and sandy soils, clayey deep regur and alluvial are the best suited for its cultivation.

### **Distribution**

- It is mainly confined to the states of Maharashtra, Karnataka, Madhya Pradesh, Andhra Pradesh, Rajasthan, Tamil Nadu, south-west parts of Uttar Pradesh and Gujarat.

#### **Leading Producers of Jowar (2018-19)**

<b>Production</b>	<b>Area</b>
1. Karnataka (24.11%)	1. Maharashtra (36.35%)
2. Maharashtra (22.9%)	2. Karnataka (22.53%)
3. Tamil Nadu (12.97%)	3. Rajasthan (14.70%)

#### **Bajra (Bull Rush Millet)**

### **Suitable Conditions for Growth**

- Bajra is a crop of dry and warm climate
- Rainfall: 40-50 cm (It is rainfed crop).
- Temperature: IT ranges between 25°-35°C.
- Moderate sunlight after little rainfall is very useful in early stage of its growth.
- Soil: Sandy soil, black and red soils and upland gravelly soils are ideal for its growth.
- It mainly confirmed to the states of Rajasthan, Uttar Pradesh, Gujarat and Haryana.

#### **Leading Producers of Bajra (2018-19)**

<b>Production</b>	<b>Area</b>
1. Rajasthan (44.22%)	1. Rajasthan (60.32%)
2. Uttar Pradesh (20.66%)	2. Uttar Pradesh (12.65%)
3. Haryana (10.2%)	3. Maharashtra (7.27%)

## **Ragi**

- Ragi is another important millet mainly grown in drier parts of south India and some parts of north India.

### **Suitable Conditions for Growth**

- Temperature: It ranges between 20°C-30°C.
- Rainfall: 50-100 cm as it is a rainfed crop.
- Soil: Red, light black and sandy loams and well drained alluvial loams ideal for the growth.

### **Distribution**

- It is mainly confined to states of Karnataka, Uttarakhand, Maharashtra and Andhra Pradesh.

## **Barley**

- It is used for manufacturing beer and whiskey.
- It is a Rabi crop.

### **Suitable Conditions for Growth**

- It cannot tolerate high heat and humidity.
- Temperature: It ranges between 10°-15° C.
- Rainfall: 75-100 cm
- Soil: Light clay and alluvial soil.

### **Distribution**

- It is mainly confined to the states of Rajasthan, Uttar Pradesh, Madhya Pradesh and Chhattisgarh.

## **Pulses**

- Pulses include number of crops which are mostly leguminous and provide much needed vegetable protein to the largely vegetarian population of India.
- The largest producers of pulses in India are Madhya Pradesh, followed by Rajasthan, Uttar Pradesh and Maharashtra.
- Though gram and tur (arhar) are the most important pulses, other pulses such as urad (black gram), moong (green gram), masur (lentil), kulthi (horse gram), matar, khesar and moth are also grown in India.
- India ranks first in the production as well as consumption of pulses in the world.

## **Gram**

### **Suitable Conditions for Growth**

- Temperature: It ranges between 20°-25°C.
- Rainfall: 40-50 cm
- Soil: Loamy Soils
- It is cultivated in single strand or mixed with wheat, barley, linseed or mustard.

### **Distribution**

- The grams are mainly confined to the states of Madhya Pradesh, Rajasthan, Maharashtra, Andhra Pradesh and Uttar Pradesh.

### **International Year of Pulses 2016**

United Nations General Assembly announced 2016 as International Year of Pulse and programs were launched in this regard by the United Nations Food and Agriculture Organization on 10<sup>th</sup> November, 2016. The theme for the year was Fixed Nutrition Seeds for a Sustainable Future. Crop water requirement is the product of the water required by a crop and the harvested area to calculate water consumption.

### **Oilseeds**

- The oil extracted from oilseeds from an important segment of our diet and is used as raw material for manufacturing large number of items like paints, varnishes, hydrogenated oil, soaps, perfumes, lubricants etc.
- Oil cake, which is the residue after the oil is extracted from the oilseeds, forms an important cattle feed and manure.
- India has the largest area under production of oilseed.
- The eight major oilseeds are groundnut, sesame, rapeseed, mustard, linseed, castor seed, sunflower and soybean.
- The leading producers of Oilseeds are Madhya Pradesh, followed by Maharashtra and Rajasthan.

### **Groundnut**

- It is the most important oilseed of India accounting for a little less than ½ of the major oilseeds.
- It is rich in vitamins, proteins and has a high calorific value.
- It contains 40-50% oil.
- It grows best in tropical climate.
- Temperature: It ranges between 20°C-30°C.
- Rainfall: 50-75 cm



- Soil: Sandy loam, loamy red, yellow and black cotton soils.

### **Linseed**

- Linseed is a rabi crop which contains 35-47% oil.
- The oil has unique drying property and is used for manufacturing paints, printing ink, waterproof fabrics. India produces 10% of total production of linseed in the world. India is the third largest producer after Russia and Canada.
- Madhya Pradesh, Bihar, Uttar Pradesh, Chhattisgarh and Maharashtra are the main producers.

### **Castor Seeds**

- It is used for various purposes such as lubricant, hair oil, leather tanning etc.
- India is second largest producer of castor seed after Brazil and produces 1/5<sup>th</sup> of total world production.
- The crop is mainly confined to Gujarat, Rajasthan and Telangana.

### **Soybean**

- Soybean is a great source of protein and food oil. Madhya Pradesh has the maximum area (52.30%) under cultivation of Soybean.
- The most important arrears of soybean production are western Madhya Pradesh, eastern Rajasthan and north-east Maharashtra.

### **Rapessed and Mustard**

- India is the largest mustard producing country of the world. Both are Subtropical crops sown in the central and north-western part of India as a rabi crop.

<b>Top Three Oilseeds Producing States</b>		
<b>Groundnut</b>	Gujarat	2.36
	Rajasthan	1.06
	Tamil Nadu	0.88
<b>Repeseed and Mustard</b>	Rajasthan	3.27
	Haryana	0.81
	Madhya Pradesh	0.70

<b>Soybean</b>	Madhya Pradesh	4.91
	Maharashtra	2.10
	Rajasthan	1.00
<b>Sunflower</b>	Karnataka	0.17
	Haryana	0.04
	Andhra Pradesh	0.02
<b>Total Oilseeds</b>	Madhya Pradesh	6.24
	Rajasthan	5.71
	Gujarat	4.10

- The most of production of Rapeseed and Mustard comes from Rajasthan, Haryana, West Bengal and Madhya Pradesh.
- The main
- Varieties of mustard are Varuna, Pusa Bold, Pusa Jai Kisan, Pitambari etc.

### **Cash Crops**

- The crops, which have high commercial value and mainly grown for the purpose of earning profits, is known as cash crops. These crops play a significant role in Indian economy.

### **Sugarcane**

- Sugarcane belongs to bamboo family of plants and is indigenous to India. It is a water-intensive crop.
- It is the main source of sugar, gur and khandsari.
- The First Sugar Factory was established in 1903, in Pratarppur of Deoria district in Uttar Pradesh.
- Indian Institute of Sugar Technology is in Kanpur.
- Shakkar Nagar is the main reproductive centre of sugar. It is located in Telangana. Uttar Pradesh is called the Sugar Bowl of India.
- Crop requires 10 to 15 or even 18 months to mature.
- It requires hot and humid climate.

- Temperature: It ranges between 21°C – 27°C.
- Rainfall: 75 cm – 100cm
- Absence of rainfall at the time of maturity is required as heavy rainfall lower the sugar content.
- Soil: loam, clayey loam, black cotton soils, brown or reddish loam and laterite soil.

### **Production**

- India has the second largest area (India 50.70 lakh.) under cultivation India also ranks second in terms of its production after Brazil.

#### **Leading Sugarcane Producing States**

<b>States (%)</b>	<b>Area Wise (%)</b>
1. Uttar Pradesh (44.91%)	1. Uttar Pradesh (43.49%)
2. Maharashtra (23.10%)	2. Maharashtra (22.74%)
3. Karnataka (10.50%)	3. Karnataka (9.90%)

### **Tobacco**

- Tobacco is mainly used for smoking in the form of cigarette, bidi, cigar, cheroot and hookah and is chewed also. Tobacco is also used to manufacture insecticides.
- Central Tobacco Research Institute-Rajahmundry (Andhra Pradesh).

#### **Leading Tobacco Producing States (2018-19)**

<b>States (%)</b>	<b>Area Wise (Mill.h.)</b>
1. Andhra Pradesh	1. Gujarat (174)
2. Gujarat	2. Karnataka (95)
3. Karnataka	3. Andhra Pradesh (83)

### **Cotton**

- Cotton is the crop of tropical and sub-tropical areas.
- It requires 6-8 months to mature; its time of sowing and harvesting differs in different part of country depending upon climatic conditions.

- Soil: Deep black soil (regur) of the Deccan plateau and the Malwa plateau. Cotton also grows well in alluvial soil. Red and laterite soil of the peninsular region is very useful for its cultivation.
- India has the largest area under cotton cultivation in the world, but is the second largest producer of cotton after China and USA.

#### **Leading Cotton Producing States (2018-19)**

<b>States (%)</b>	<b>Area Wise (%)</b>
1. Maharashtra (24.83%)	1. Maharashtra (33.61%)
2. Gujarat (21.22%)	2. Gujarat (21.01%)
3. Telangana (14.26%)	3. Telangana (14.43%)

#### **Jute**

- Jute is one of the most affordable natural fibres in existence. They are composed primarily of cellulose and lignin.
- It is used in the manufacturing of gunny bags, hessian, ropes, string, carpets, rugs and clothes.
- It is a crop of hot and humid climate
  - Temperature: It ranges between 20° C to 40° C.
  - Rainfall: 120 to 150 cm
  - Humidity : 80-90%
  - Soil: It needs alluvial soil and standing water.

#### **Leading Cotton Producing States (2018-19)**

<b>States (%)</b>	<b>Area Wise (%)</b>
1. West Bengal (78.71%)	1. West Bengal (72.31%)
2. Bihar (10.45%)	2. Bihar (11.63%)
3. Assam (8.80%)	3. Assam (10.52%)

#### **Production of different crops**

<b>Crop</b>	<b>Leading State</b>
• Rice	West Bengal
• Wheat	Uttar Pradesh

• Bajra	Rajasthan
• Maize	Andhra Pradesh
• Gram	Maharashtra
• Gram	Maharashtra
• Groundnut	Gujarat
• Mustard	Rajasthan
• Soyabean	Madhya Pradesh
• Sunflower	Madhya Pradesh
• Cotton	Gujarat
• Jute	West Bengal
• Sugarcane	Uttar Pradesh

### **Plantation Crops**

- Plantation crops are not like other annually grown crops. It takes 3-5 years to bear returns after they are sown, but when they start bearing fruit, they continue to do so for 35-40 years.
- Tea, coffee, rubber and spices are the principle plantation crops in India.
- The Central Plantation Crops Research Institute (CPCRI) is situated in Kasaragod (Kerala).

### **Tea**

- Tea is believed to be indigenous to China.
- It is produced in tropical humid and subtropical humid climate.
- Tea bush grows is tropical and sub-tropical plant which thrives well in hot and humid climate.
- The first commercial tea plantation was established in the Brahmaputra Valley of Assam, with tea seeds imported from China.

### **Leading Tea Producing States**

<b>Production</b>	<b>Area</b>
1. Assam (51.1%)	1. Assam (55%)
2. West Bengal (23.17%)	2. West Bengal (24%)
3. Tamil Nadu (16.7%)	3. Tamil Nadu (12.5%)
4. Kerala (7.22%)	4. Kerala (5.1%)

## Coffee

- Coffee is second most important beverage crop. It is indigenous to Abyssinian plateau (Ethiopia).
- India is the only country that grows all varieties of coffee under shades.
- India is 7th largest (3.5%) coffee producer in the world. Thus, India is an insignificant producer of coffee as compared to Brazil (25%), Colombia (15%) and Indonesia (7%), Ethiopia and Mexico.
- The major coffee producing states are Karnataka, Kerala and Tamil Nadu.
- The Central Coffee Research Institute (CCRI) is located in Balehonnur (Karnataka).

### Leading Tea Producing States

Production	Area
1. Karnataka (71%)	1. Karnataka
2. Kerala (21%)	2. Kerala
3. Tamil Nadu (5%)	3. Andhra Pradesh

## Rubber

- Rubber is coherent elastic solid obtained from latex of a number of tropical trees of which *Hevea Brasiliensis* is the important.
- The first rubber plantations in India was set up in 1895 on the hills of Kerala. India is the fourth largest natural rubber producing country of the world after Thailand, Indonesia and Malaysia.
- It produces 9% of total rubber in the world.

### Leading Tea Producing States

1. Kerala	1. Tamil Nadu
2. Karnataka	2. Andaman and Nicobar

## **Spices**

- Pepper, cardamom, chillies, turmeric and ginger are some of the important spices produced in India.
- The Indian Institute of Spice Research (IISR) is located in Kozhikode (Kerala)

## **Pepper**

- It is a tropical plant which requires a minimum of 10°C and maximum of 30°C temperature.
- Rainfall: It ranges between 200-300 cm.
- Soil: loamy, lateritic and red soil are suitable for its growth.
- India is the second largest producer of pepper in the world after Indonesia.
- It is mainly confined to Kerala, Karnataka and Tamil Nadu.
- Kerala is the largest producer of pepper (93%)

## **Cardamom**

- Cardamom is known as Queen of Aromatic Spices. It is mainly used for flavouring and it also has medicinal properties.
- The Indian Cardamom Research Institute (ICRI) is in Myladumpara, Idukki, Kerala.
- The entire production comes from 3 states mainly situated Kerala (53%), Karnataka (42%) and Tamil Nadu (5%).

## **Chillies**

- The major chilly producing states are Andhra Pradesh, Telangana, Maharashtra and Odisha.
- Top 3 producers of green chillies: Karnataka, Madhya Pradesh, Bihar.
- Top 3 producers of dry chillies: Andhra Pradesh, Telangana, Madhya Pradesh.

## **Ginger**

- India is the largest producer (about 80%) of ginger in the world.
- States producing ginger are Meghalaya, Andhra Pradesh, Kerala, Sikkim, Odisha, Mizoram and Karnataka.
- Top 3 producers: Meghalaya, Arunachal Pradesh, Sikkim.

## **Turmeric**

- It grows well in tropical climate. It is used in day medicines.
- Andhra Pradesh, Karnataka and Tamil Nadu are the major producers and other producer are Gujarat, Odisha, West Bengal, Maharashtra, Bihar, Assam and Tripura.

### **Largest Spices Producing States in India**

<b>Spices</b>	<b>Largest Producing State</b>
• Saffron	Jammu and Kashmir
• Black Pepper	Kerala, Karnataka, Tamil Nadu
• Cardamom	Kerala, Karnataka, Tamil Nadu
• Ginger	Meghalaya, Arunachal Pradesh, Sikkim
• Cumin	Rajasthan, Kerala
• Clove	Tamil Nadu, Kerala
• Chilly	Andhra Pradesh, Karnataka, Tamil Nadu

### **Major Agricultural Boards and Headquarters**

<b>Board</b>	<b>Headquarters</b>
• Coffee Boar	Bengaluru (Karnataka)
• Rubber Board	Kottayam (Kerala)
• Tea Board	Kolkata (West Bengal)
• Tobacco Board	Guntur (Andhra Pradesh)
• Spices Board	Cochin (Kerala)
• National Meat and Poultry Processing Board	New Delhi
• Indian Grapes Processing Board	Pune (Maharashtra)
• Board of National Meat and Chicken Processing	New Delhi



## **Coconut**

- Coconut is a tropical crop. India is the third largest coconut producing country after Indonesia and Philippines.
- Kerala, Tamil nadu, Karnataka, Andhra Pradesh, West Bengal, Odisha, Maharashtra, Goa, Assam, Andaman and Nicobar, Lakshadweep and Puducherry are the major coconut producing states.

## **Horticulture**

- Horticulture is the science and art of the development, sustainable production, marketing and use of high value, intensively cultivated food and ornamental plants.
- It includes fruits, vegetables, spices, floriculture and coconut. It contributes 30% to agriculture economy.

### **Mango**

- The Top 3 producers: Uttar Pradesh, Andhra Pradesh, Telangana.
- The main varieties are Dashari, Langda, Chausa, Sapheda, Fajli, Malda, Mohanbhog, Alphonso and Shahpasand.
- The States of Uttar Pradesh, Bihar, Andhra Pradesh, West Bengal, Odisha, Kerala, Tamil Nadu, Maharashtra, Gujarat and Karnataka are the major producers.

### **Apple**

- It is a temperature fruit crop.
- Hail storms, frost, low temperature, rain, fog and cloudy weather hampers its growth.
- Kullu and Shimla (Himachal Pradesh) and Kashmir valley and hilly areas of Uttarakhand are suitable regions for the production.
- Top 3 producers: Jammu and Kashmir, Himachal Pradesh, Uttarakhand.

### **Banana**

- It is grown in both tropical and sub-tropical climate.
- India is the largest producer of banana in the world.
- Tamil Nadu, Maharashtra, Gujarat, Karnataka, Kerala, Andhra Pradesh and Assam are main producing states.
- Top 3 producers: Andhra Pradesh, Tamil Nadu, Gujarat

### **Orange**

- Orange is the most important citrus fruit widely grown in north and south India.
- Maharashtra, Punjab, Andhra Pradesh, Rajasthan, Assam and Karnataka are the main producing arrears.
- India is the third largest producer in the world.
- Coorg Orange (Karnataka), Nagpur orange (Maharashtra) and Arunachal wakro orange have been given GI tag.

### **Grape**

- It is a sub-tropical plant which requires long summer, short winter and moderately fertile well drained soil.
- Uttarakhand, Andhra Pradesh, Jammu & Kashmir, Punjab, Maharashtra, Andhra Pradesh, Tamil Nadu and Karnataka are the major producers of grapes.
- Top 3 producers: Maharashtra, Karnataka, Tamil Nadu.

#### **Peach**

- Peach requires temperate climate. The main areas are Himachal Pradesh, Uttarakhand and Kashmir valley.
- Top 3 producers: Uttarakhand, Punjab, Himachal Pradesh.

#### **Pear**

- It is a temperate fruit; Kashmir, Uttarakhand and Himachal Pradesh are main producing regions.
- Top 3 producers: Jammu and Kashmir, Uttarakhand, Punjab.

#### **Apricot**

- It is a temperate Fruit.
- It's mainly grown in Kashmir valley, Himachal Pradesh and Kumaon region Uttarakhand.

#### **Strawberry**

- It requires 16°C temperature and lots of water.
- Strawberry fields are submerged under 10 cm of fresh and slowly moving water for at least 3 months.
- States: Jammu and Kashmir, Himachal Pradesh, Uttarakhand.

<b>Plant Diseases/ Crops</b>		
<b>Disease/Indicators</b>		<b>Crops</b>
• Sesame leaf spot or brown leaf spot	Rice	
• Red rot	Sugarcane	
• Ergot	Bajra	
• Green ear disease	Bajra	
• Smut	Bajra	
• Tikka disease	Groundnut	
• Blast	Rice	
• Late blight	Potato	
• Downy mildew	Grapes, Bajra, Crucifers	
• White rust	Radish, Cabbage	
• Powdery mildew	Wheat	
• Karnal bunt	Wheat	
• Wilt	Pigeon pea, Cotton	
• Footrot	Paddy, Papaya	
• Loose smut	Barley	
• Bunchy top	Banana	
• Tundu	Wheat	
• Crown gall	Cherry, Apple, Almond	
• Ring rot	Potato	
• Ear-cockle	Wheat	
• Stem borer	Rice	
• Spotted/ Pink bollworm	Cotton	
• Gundhi bug	Paddy	

- |                 |           |
|-----------------|-----------|
| • Panama dry    | Banana    |
| • Black arm     | Cotton    |
| • White blister | Mustard   |
| • Canker        | Citrus    |
| • Koyliya       | Mango     |
| • Phyllody      | Sesamum   |
| • Downy Mildew  | Grapes    |
| • Buckeye rot   | Tomato    |
| • Grassy shoot  | Sugarcane |

### **Slash and Burn Farming in India**

- |                      |   |
|----------------------|---|
| • Jhumming           | Assam , Meghalaya, Mizoram and Nagaland             |
| • Pamlou             | Manipur   |
| • Dipa               | Bastar (Chhattisgarh) and Andaman & Nicobar Islands |
| • Bewar or Dahiya    | Madhya Pradesh                                      |
| • Podu or Penda      | Andhra Pradesh                                      |
| • Pama Dabi or Koman | Odisha  |
| • Kumara             | Western Ghats                                       |
| • Valre or Waltre    | South-eastern Rajasthan                             |
| • Khi                | Himalayan belt                                      |
| • Kuruwa             | Jharkhand   |

## 14. Major Revolutions in Agriculture

Agricultural revolution can be referred to the significant changes in agriculture when certain inventions, discoveries or new technologies implemented time to time in India. These revolutions change the ways of production and increase the production rate.

There have been many agricultural revolutions in India to focus on certain specific agricultural produce. These agricultural revolutions helped Indian agriculture grow exponentially and created new opportunities.

Major Revolutions in Agriculture	
Revolution	Production
• Black Revolution	Petroleum Production
• Blue Revolution	Fish Production
• Brown Revolution	Leather/Cocoa production
• Golden Fibre Revolution	Jute Production
• Golden Revolution	Overall Horticulture development/Honey Production
• Pink Revolution	Onion Production/Pharmaceutical/Prawn Production
• Grey Revolution	Fertilizer Revolution
• Red Revolution	Meat and Tomato Production
• Round Revolution	Potato Production
• Silver Fibre Revolution	Cotton Production
• Silver Revolution	Egg and Polutry Production
• White Revolution	Milk and Dairy Production
• Yellow Revolution	Oil Seeds Production
• Green Gold Revoltuion	Bamboo

### Green Revolution

- The Green Revolution refers to measures introduced worldwide from the 1950s onward. These had the goal of increasing harvests and ending large-scale hunger. Green Revolution owes its origin in the finding of new dwarf variety of wheat seed by Dr. Norman Earnest Borlaug.
- The initial years of the post-independence period saw the Indian agricultural system at its worst. Lack of funds, low yielding raw material, a dearth of machinery and technology; were some of the main problems at that time.

- Understanding the deteriorating condition of the agriculture sector, the Indian Government launched the *Green Revolution* through which the use of *High Yielding Variety (HYV)* seeds was adopted in the country. Along with this, took place the up-gradation in irrigation facilities as well as the use of more effective fertilizers. All this together led to the mass production of high-quality crops in India. To find an optimum solution for these issues, in the year 1965 under the guidance of M.S. Swaminathan, the Indian government launched the Green Revolution that lasted from 1967- 1978.
- The states which benefitted from green revolution include Punjab, Haryana and western Uttar Pradesh and Ganganagar district of Rajasthan.

### **Features of Green Revolution**

Given below are the features of the Green Revolution:

- The most effective feature of all was the introduction of HYV seeds in Indian agriculture. The seeds proved out to be highly effective in the regions with fluent irrigation facilities, thus, the first stage was focused on Punjab and Tamil Nadu.
- In the second stage of the scheme, other states were included too and seeds for various crops other than wheat were used.
- This Revolution initiated the use of an inland irrigation system as the country cannot depend only on monsoon for their water needs.
- The plan majorly focused on the production of food grains like wheat, rice, etc and commercial crops like jute, cotton, oilseeds etc. were prohibited from the plan.
- It promoted the use of fertilizers and manures whereas limiting the use of pesticides and weedicides in order to avoid any sort of crop damage
- The use of technologically advanced machinery like tractors, drills, harvesters, etc was implemented

### **Impact of Green Revolution in India**

Green Revolution in India has impacted and benefitted millions of people in the country through the following points:

- **Enhancing the Agricultural Production:** There was a great boom in the production of grains especially wheat as it increased from 11 million tonnes in 1960 to 55 million tonnes in 1990.

- **Increase in per Acre Yield:** The major impact of this Revolution can be seen whilst measuring the per acre production of crops that recorded a jaw-dropping spike of 850 kg/hectare to 2281 kg/hectare.
- **Independency in Terms of Import:** With the hike in production, adequate stocks were assembled for emergencies. This led to exemption of import and India began exporting.
- **Employment:** As the scheme involved transportation, irrigation, food processing, marketing and various other opportunities; Green Revolution helped people combat unemployment.
- **Relief to the Farmers:** The miserable conditions of farmers due to depletion of the agricultural sector was no longer the same. Farmers not only experienced a hike in their income but also started earning luxuries.

### **Drawbacks of Green Revolution**

Even after being recognized as one of the most significant developments in the agricultural sector across the globe, Green Revolution too had some drawbacks. Mentioned below are the drawbacks of this Revolution in India.

- The major imbalance was seen amongst the food grains. Auto greens like wheat, rice, bajra, jowar and maize would be a part of the plan but it mainly empowered wheat.
- HYV seeds for crops like pulses, oilseeds, cereals, etc are not developed yet or they are not highly efficient.
- Regional disparities begin to ignite with the widespread Green Revolution. As it only benefited areas like Punjab, Haryana, Western UP, Tamil Nadu; the entire Eastern region- West Bengal, Orissa, Assam, etc are completely untouched.
- This revolution also has a severe impact on the soil as repetitive production of the same crop on the same soil results in soil depletion.

### **Protein Revolution**

- **Related Higher Production also Known as Technology driven 2nd Green revolution** coined by P.M Narendra Modi and Finance Minister Arun Jetley.

- A price Stabilization fund of Rs. 500 crore to help farmers deal with volatility also a TV Channel has been set up to provide Information to the Farmers about Water Conservation, Organic Farming and other New Techniques

## **Ever Green Revolution**

- Mainly Concentrates on Overall Production of Agriculture, Started in 11<sup>th</sup> 5 year Plan.
- M.S Swaminathan has Renowned as Father of Ever Green Revolution in India emphasized to Improve Productivity perpetuity with out harming ecologically or Socially.

## **Green Revolution**

- In this Period Advanced technologies has been Implemented and Productivity in Agriculture has Been Increased Globally. Father of Green revolution is Dr. Norman Borlaug
- The Main Purpose of this Revolution was to save a billion people from starvation

## **White Revolution**

- Concentrates mainly on Milk and Dairy Products, Verghese Kurien Known as Milk Man of India.
- White Revolution is the Success Story of Dairy Co-Operative Movement in the country
- Operation Flood Program launched by government of India with international cooperation.

## **Yellow Revolution**

- Oilseed Production (Especially Mustard and Sunflower), Sam Pitroda father of Yellow Revolution.
- The main contributors to this factor are- the oil seeds production technology, price and market intervention support policy, expansion in area under oilseed, and the institutional support.

## **Brown Revolution**

- Leather / Cocoa / Non-Conventional Products.

- It's happened in the tribal Areas of Vishakapatnam
- Refers to Educating tribal People in growing environment-friendly and socially responsible coffee meet the demands

## **Golden Revolution**

- Fruits, Honey Production and Horticulture development
- Nirpakh Tutej, Known as father of Golden Revolution
- A Period Between 1993-2003 is Reffered as golden Revolution, Because of the Huge Increase in the Production of Fruits, Honey Production and Horticulture Products.

## **Pink Revolution**

- Father of Pink Revolution, Durgesh Patel
- Concentrates on Increasing the Pharmaceutical, Onion and prawn production in India.



## 15. Livestock and Animal Husbandry

Animal husbandry is a branch of agriculture in which animal farming carried out. Livestock farming has a broad history, starting with the Neolithic revolution, animals were first domesticated. Around 13000 BC onwards, that time Sheep, Pigs, Egypt, cattle raised on farms.

India's livestock sector is one of the largest in the world. About 20.5 million people depend upon livestock for their livelihood. Livestock contributed 16% to the income of small farm households as against an average of 14% for all rural households. Livestock provides livelihood to two-third of rural community. It also provides employment to about 8.8 % of the population in India. India has vast livestock resources. Livestock sector contributes 4.11% GDP and 25.6% of total Agriculture GDP.

**Economic Survey 2020** noted that livestock sector has grown at a compound annual growth rate of **7.9 per cent** during last five years. As per the **Economic Survey-2021**, the contribution of Livestock in total agriculture and allied sector **Gross Value Added** (at Constant Prices) has increased from 24.32% (2014-15) to 28.63% (2018-19). Livestock income has become an important secondary source of income for rural families and has assumed an important role in achieving the goal of doubling farmers' income.

- India is the motherland of some important breeds of cattles such as Kankrej, Rathi, Sahiwaal, Gir etc.
- India was ranked second in the Global Animal Protection Index – 2020.

### 20<sup>th</sup> Livestock Census

- The livestock census is conducted periodically (every 5 years) across the country since 1919. 19 such census have been conducted so far and the 20<sup>th</sup> census was concluded in October 2018.

### States with Maximum Livestock Population

States	Population in million (2019)
• Uttar Pradesh	67.8
• Rajasthan	56.8
• Madhya Pradesh	40.6
• West Bengal	37.4
• Bihar	36.5
• Andhra Pradesh	34.0
• Maharashtra	33.0
• Telangana	32.6
• Karnataka	29.0
• Gujarat	26.9

### All India Livestock & Poultry Population

(in Million)

Category	As per 19 <sup>th</sup> Livestock Census-2019	As per 20 <sup>th</sup> Livestock Census-2012
Cattle	190.90	192.52
Buffaloes	108.70	109.52
Sheep	65.07	74.26
Goat	135.17	148.48
Pig	10.29	9.06
Mithun	0.30	0.38
Yak	0.08	0.06
Horse & Ponies	0.63	0.34
Mule	0.20	0.08
Donkeys	0.32	0.12
Camel	0.40	0.25
Total Livestock	512.06	535.82
Total Poultry	729.21	851.81

## Cattle

- Cattle constitute about 35.94% of livestock population in India. India has the second largest cattle population after Brazil (13.1%). The total number of cattle is 192.49 million as per census 2018.

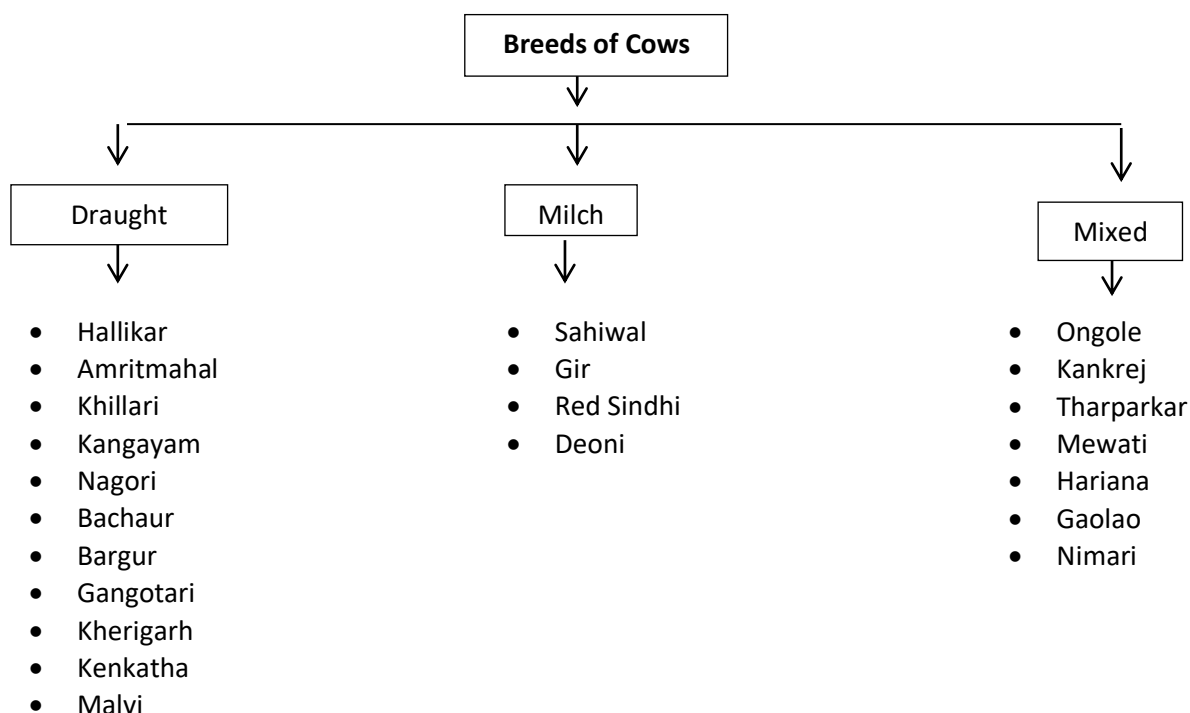
West Bengal observed the highest increase of 23% followed by Telangana (22%). The total number of cattle in the country has shown an increase of 0.8% Uttar Pradesh has observed a maximum decrease in cattle population.

### Cow Breeds in India:

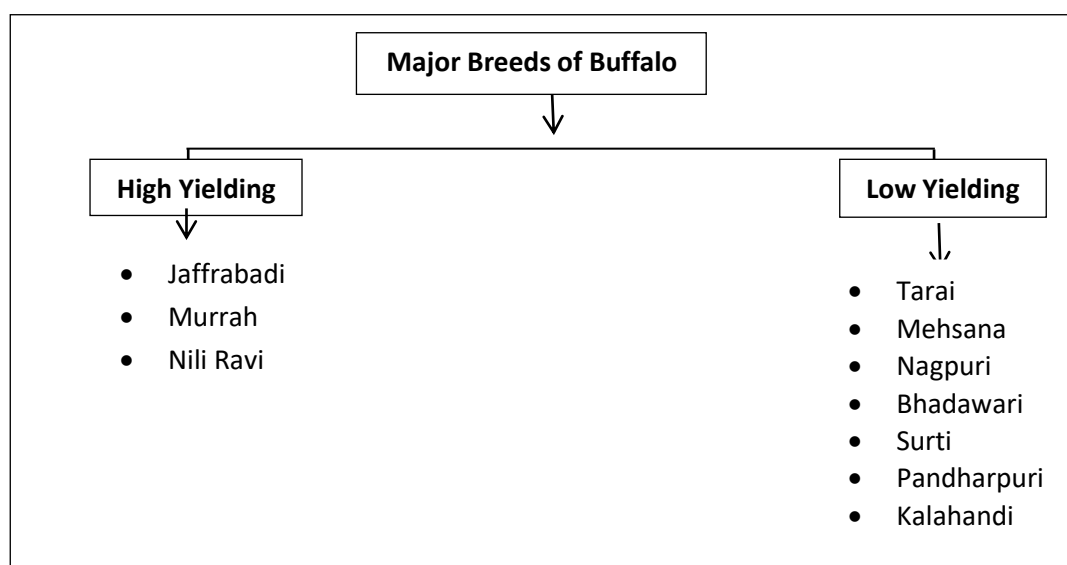
1. **Milch Breeds:** The Cows of milch breed yield higher quantity of milk but the bullocks are not good for agricultural works. For example Gir Red Sindhi, Sahiwal and Deoni.
  2. **Draught Breeds:** The cows of draught breed are poor milk producers of milk but the bullocks are excellent draught animals. For example Nagori, Bachaur, Athiawar, Malvi, Hallikar, Amritmahal, Kangayam, Khillari, Ponwar and Siri.
  3. **Mixed Breeds:** The cows of mixed breed are fairly good yielders of milk and the bullocks are good for draught purposes. For example Haryana, Ongole, Gaolao, Rath, Dangi, Nimari, Tharparkar and Kankre.
- Holstein Friesian cows are well known for the highest milk yielding capacity as compared to others.

### Population of Cattles in States

States	Population
West Bengal	19%
Uttar Pradesh	18.8%
Madhya Pradesh	18.7%



- The total number of buffaloes as per census 2010 is 109.85 million. The dairy industry in India is highly dependent on buffaloes. India has 55.9% buffaloes of the world.
- Uttar Pradesh has the highest number of buffaloes (33%) followed by Rajasthan, Gujarat, Madhya Pradesh, Bihar, Andhra Pradesh, Maharashtra, Haryana, Telangana and Punjab. These nine states together supply 89% of the buffaloes of the country.
- The main buffalo breeds include Murrah, Bhadawari, Jaffarabadi, Surti, Mehsana, Nagpuri, Rohtak, Nili Ravi and Deccan.



### Population of Buffaloes

States	Population	States	Population
• Uttar Pradesh	33%	• Rajasthan	13.7%
• Gujarat	10.5%	• M.P.	10.3%
• Bihar	7.7%		

Presently, India (109.85 million), Pakistan (31.7 million) and China (23.4 million) are at first, second and third position respectively in terms of buffalo population.

**Central Institute for Research** on Buffaloes has established in Hisar (Haryana)

Two National Kamdhenu Breeding Centers have been established in Madhya Pradesh and Andhra Pradesh for development and conservation of indigenous breeds.

## National Dairy Plan (NDP)

- National Dairy Plan aims to increase the production of milk, with an investment of 17,000 crores on 6<sup>th</sup> May, 2012.
- NDP was Started in 18 major milk producing states like Andhra Pradesh, Bihar, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal, Telangana, Uttarakhand, Jharkhand and Chhattisgarh.
- This is a six year project funded by World Bank and implemented by related agencies of states.

### Sheep Rearing

- Goat is also known as the poor man's cow. Goats are domesticated at very large scale in Bihar, Rajasthan, Uttar Pradesh and Madhya Pradesh.
- The major breeds of goats are Chamba and Guddi (Himachal Pradesh), Kashmiri and Pashmina (Kashmir), Bital (Punjab), Marwari, Moshan and Kathiawadi (Gujarat, Rajasthan and Madhya Pradesh) and Barani, Surati and Deccani (Peninsular India). Jamunapari (Uttar Pradesh) breed yields maximum goat milk.

### Poultry Farming

- Poultry farming is the raising of domesticated birds such as chickens, ducks, turkeys and geese for the purpose of meat or eggs production.
- The total poultry population in the country is 851.91 million in 2019.
- Chickens raised for eggs are usually called Layers, while chickens raised for meat are often called Broilers. World's highest egg yielding breed is Leghorn chicken.
- India ranks 5<sup>th</sup> in meat production. The best meat producing breeds are Cornish and New Hampshire.
- The Major local breeds of poultry in India include Asil (Uttar Pradesh and Andhra Pradesh), Chittagong (West Bengal) and Ghagus (Andhra Pradesh and Karnataka).
  - Camel, also known as the ship of the desert is found in tropical deserts of Bikaner and Jaisalmer,
  - National Research Centre on Camel is established in Bikaner, Rajasthan.
  - Kharai Breed of camel is found in Punjab and western Uttar Pradesh.
  - Kathiawari Horses are known for their strength and speed, while the Marwari horses are known for their loyalty and bravery.
  - India has 0.62 million horses and ponies. The Thoroughbred, Spiti and Manipuri are the famous breeds of horses.

Kadaknath Chicken from Jhabua district of Madhya Pradesh has received Geographical Indication (GI) tag from Chennai based Geographical Indication Registry and Intellectual Property India.

### Pig Rearing

- It provides cheap and protein rich meat. The pig population is about 1.69% of the total livestock.
- At present, there are 120 pig breeding farms in the country.
- India imported exotic pig breeds such as Duroc, Berkshires, Hampshire Large, White Yorkshire, Saddleback and Tamworth to augment the piggy production and overcome poor performance of indigenous pig germ plasm.

### India's World Ranking in Livestock

Rank	Livestock	Rank	Livestock
First	Buffalo	Fifth	Hen
Second	Cow-bull	Tenth	Camel
Second	Goat	Seventeenth	Horse
Third	Sheep	Eighteenth	Pig

#### Sericulture

- The production of silk originated in China. India is the second largest producer of silk after China.
- Sericulture is an agro-based industry.
- Sericulture includes the rearing of silk worm for silk production. Silkworm thrives on the leaves of mulberry, mahua, sal, ber and kusum trees.

Types of Silk		
<ul style="list-style-type: none"><li>Mulberry Silk</li></ul>	It accounts for 79.24% of India’s silk production. It is produced from mulberry tree fed silkworm.	
<ul style="list-style-type: none"><li>Tusar Silk</li></ul>	It has pale yellow colour. Silkworms are raised on mulberry, mahual, Sal, Ber and Kusum trees.	
<ul style="list-style-type: none"><li>Eri Silk</li></ul>	Eri is soft, less bright, rough and light brown coloured. The silkworms are raised on castor leaves.	
<ul style="list-style-type: none"><li>Muga Silk</li></ul>	It is golden-yellowish and silkworms are raised on mulberry leaves.	
Leading Producers of Silk		
Variety	State	Share
<ul style="list-style-type: none"><li>Tasar silk</li></ul>	Jharkhand	62.96%

• Eri silk	Assam	62.08%
• Muga silk	Assam	91.07%
• Mulberry silk	Karnataka	43.00%

#### Apiculture

- Apicultural is an important part of agriculture, which has immense potential for supplementing farmer's income and providing employment.
- Honey is rich in vitamins and nutrients and has high medicinal value.
- The Ram Krishan Dhan Centre at Almora and Gandhi Ashram Centre at Haldwani in Uttarakhand are catering the needs of apiculture in the state.

#### Lac Insect

- Lac is a natural larvae. Lac insect is mostly found in Indian Peninsula. India accounts for 80% of world lac production.
- Jharkhand is the largest producer of lac.
- India Lac Research Institute was established in Ranchi in 1925.
- Mirzapur district of Uttar Pradesh is the major centre of lac production.

#### Fishery (Pisciculture)

- India is the second largest fish producing country in the world after China. The per capita availability of fish is 9 kg per person.
- Although fishing is limited to the coastal regions yet the maximum portion of the total fish catching comes from the inland fishing.
- India ranks second in inland or fresh water fish production after China in the world.
- West Bengal is the largest producer of inland fish followed by Andhra Pradesh, Uttar Pradesh and Bihar.



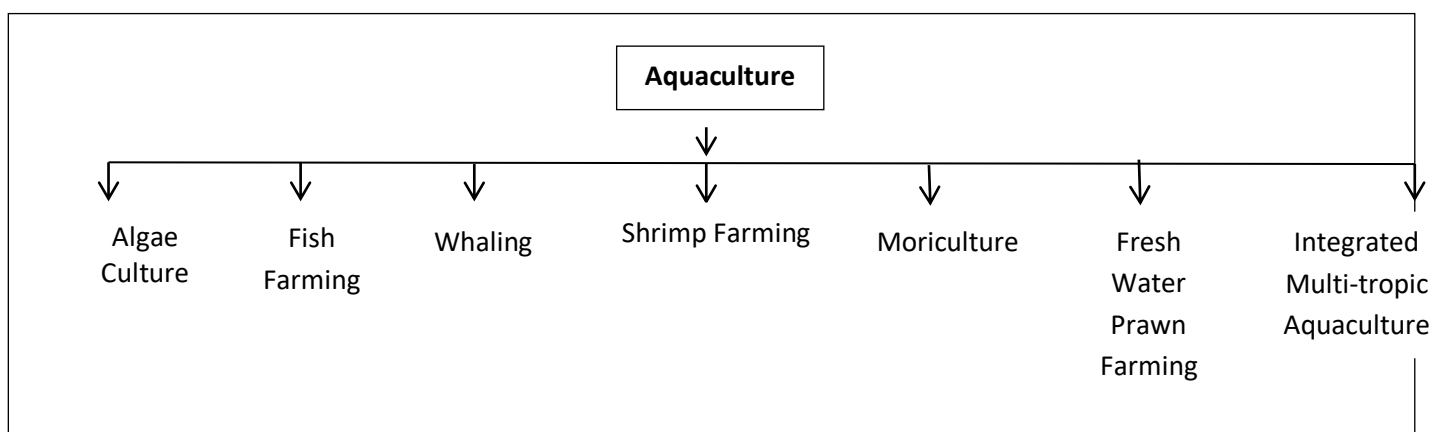
- The major fishing ports of India are Kochi, Chennai, Visakhapatnam, Raichak, Sasson Docks (Mumbai) and Paradip. West Bengal, Andhra Pradesh, Kerala and Tamil Nadu occupy the top four positions in India in terms of total production of fish.
- The Central Fishery Research Centre has been established at Mumbai.
- Livestock, fishing and Aquaculture account for nearly 32% of overall agricultural GDP and 5% of national GDP. Department of Animal Husbandry, Dairying and Fisheries was formed in February 1991, of which a separate Department fisheries was carved out in 2019.

### Blue Revolution

- The Government of India has restructured the Central Plan under an umbrella scheme of Blue Revolution. Realizing the immense scope for development of fisheries and aquaculture.
- It is being implemented to achieve economic prosperity of fishermen and to contribute towards food and nutritional security through optimum utilization of water resources for fisheries development in a sustainable manner.

### Aquaculture

- In India, two types of aquaculture are practised i.e. freshwater and brackish water aquaculture.
- The rearing and production of the entire aquatic animal and plant species namely fish, shrimp, crab, sambrook, palms, phytoplankton, algae and amphibian species is referred to as aquaculture.



## 16. Role of livestock in socio-economic life of India

The livestock plays an important role in the economy of farmers. The farmers in India maintain mixed farming system i.e. a combination of crop and livestock where the output of one enterprise becomes the input of another enterprise thereby realize the resource efficiency. The livestock serve the farmers in different ways.

- **Income:**

- Livestock is a source of subsidiary income for many families in India especially the resource poor who maintain few heads of animals.
- Cows and buffaloes if in milk will provide regular income to the livestock farmers through sale of milk.
- Animals like sheep and goat serve as sources of income during emergencies to meet exigencies like marriages, treatment of sick persons, children education, repair of houses etc.
- The animals also serve as moving banks and assets which provide economic security to the owners.

- **Employment:**

- A large number of people in India being less literate and unskilled depend upon agriculture for their livelihoods.
- But agriculture being seasonal in nature could provide employment for a maximum of 180 days in a year.
- The land less and less land people depend upon livestock for utilizing their labour during lean agricultural season.

- **Food:**

- The livestock products such as milk, meat and eggs are an important source of animal protein to the members of the livestock owners.
- The per capita availability of milk is around 355 g / day; eggs is 69 / annum;

- **Social security:**

- The animals offer social security to the owners in terms of their status in the society.
- The families especially the landless which own animals are better placed than those who do not.
- Gifting of animals during marriages is a very common phenomenon in different parts of the country.
- Rearing of animals is a part of the Indian culture. Animals are used for various socio religious functions.
- Cows for house warming ceremonies; rams, bucks and chicken for sacrifice during festive seasons;
- Bulls and Cows are worshipped during various religious functions. Many owners develop attachment to their animals.

- **Gender equity:**

- Animal husbandry promotes gender equity.
- More than three-fourth of the labour demand in livestock production is met by women.
- The share of women employment in livestock sector is around 90% in Punjab and Haryana where dairying is a prominent activity and animals are stall-fed.

- **Draft:**

- Bullocks are the back bone of Indian agriculture. Despite lot of advancements in the use of mechanical power in Indian agricultural operations, the Indian farmer especially in rural areas still depend upon bullocks for various agricultural operations.
- The bullocks are saving a lot on fuel which is a necessary input for using mechanical power like tractors, combine harvesters etc.
- Pack animals like camels, horses, donkeys, ponies, mules etc are being extensively used to transport goods in different parts of the country in addition to bullocks.

- In situations like hilly terrains mules and ponies serve as the only alternative to transport goods.
- Similarly, the army has to depend upon these animals to transport various items in high areas of high altitude.
- **Dung:**
  - In rural areas dung is used for several purposes which include fuel (dung cakes), fertilizer (farm yard manure), and plastering material (poor man's cement).

## **Contributions of Livestock Sector to Indian Economy**

- **Employment:**
  - According to NSSO's 68th Round Survey on Employment and Unemployment, 16.44 million workers were engaged in the activities of farming of animals, mixed farming, fishing and aquaculture.
- **Largest Milk Producer:**
  - India is the largest producer of milk in the world.
  - Milk production in the country was 188 million tonnes in 2018-19 with a yearly growth rate of 6.5 percent resulting in increased per capita availability to 394 grams per day.
- **Income:**
  - About 20.5 million people depend upon livestock for their livelihood. Livestock contributed **16% to the income of small farm households** as against an average of 14% for all rural households.
  - Livestock provides livelihood to two-third of rural community. As per the 70th round of NSSO, livestock rearing is a principal source of income to 3.7 per cent of the agricultural households.
  - Livestock sector contributes **11% GDP and 25.6% of total Agriculture GDP.**

- **Food:**

- The livestock products such as milk, meat and eggs are an important source of animal protein to the members of the livestock owners. The per capita availability of milk is around 375 g / day; eggs is 74 / annum during 2017-18.

- **Social security:**

- The animals offer social security to the owners in terms of their status in the society. The families especially the landless which own animals are better placed than those who do not.

## 17. Operation Flood

- Operation Flood in India was launched by National Dairy Development Board (NDDB) in 1970 for the promotion of milk trade.
- Verghese Kurien is known as the father of operation flood. Under this scheme, Anand Cooperative Samiti was established in Kheda district of Gujarat.

India is the largest milk producer of the world amounting to 20% of world milk production. In 2018-19 Milk production was 187.7 million tonnes. The per capita milk availability in India is 394 gms/day.

### Phases of Operation Flood

Phase	Duration
• Phase-I	July 1970 – March 1981
• Phase-II	April 1981 – March 1985
• Phase-III	April 1985 – March 1996
• Phase-IV	April 1996 – March 2000

## Rashtriya Gokul Mission

- Union Government of India launched the Rashtriya Gokul Mission on 28<sup>th</sup> July, 2014 to promote conservations and development of indigenous breeds of cows in a focused and scientific manner.
- The mission is a focused project under National Programme for Bovine Breeding and Dairy Development. Rashtriya Gokul Mission will be implemented through State Implementing Agency viz Livestock Development Boards (LDBs).
- India's first robotic dairy plant was opened in Virar, in sub-urban Mumbai by Amul Dairy. It started with a total investment of Rs. 1.8 billion.

# National Livestock Mission

- The National Livestock Mission (NLM) has been launched in 2014-15.
- The objectives of the mission are sustainable development of livestock sector, focusing on improving availability of quality feed and fodder, risk coverage, effective extension, skill development, improving flow of credit and organization of livestock reares.
- The National Livestock Mission is implemented through the following four submission:
  - (i) Sub-mission on Livestock Development
  - (ii) Sub-mission on Pig Development in North-Eastern Region
  - (iii) Sub-mission on Fodder and Feed Development
  - (iv) Sub-mission on Skill Development, Technology Transfer and Extension

## 18. Industrial Development in India

- Industrial sector is at the heart of a country's economy; it includes the manufacturing of goods, extraction of metals, and provision of services. All the products available for use in the market are finished products and are the result of some industries.
- Traditionally, India had six major industries. These were Iron and Steel, Textiles, Jute, Sugar, Cement, and Paper. Further, four new industries joined this list namely, Petrochemical, Automobile, Information Technology (IT), and Banking & Insurance. These industries are important for India's economy.
- The modern industrial sector based on an organized pattern started with the establishment of Cotton Textile Industry in Bombay in 1854 and Jute industry in 1855.
- The first paper mill was started at Ballygunge near Kolkata in 1870. Steel was first manufactured by modern methods at Kulti in 1874. Tata Iron and Steel Company was started at Jamshedpur in 1907.

### Factors Influencing the Location of Industries:

Many important geographical factors involved in the location of individual industries are of relative significance, e.g., availability of raw materials, power resources, water, labour, markets and the transport facilities.

But besides such purely geographical factors influencing industrial location, there are factors of historical, human, political and economic nature which are now tending to surpass the force of geographical advantages. Consequently, the factors influencing the location of industry can be divided into two broad categories i.e.

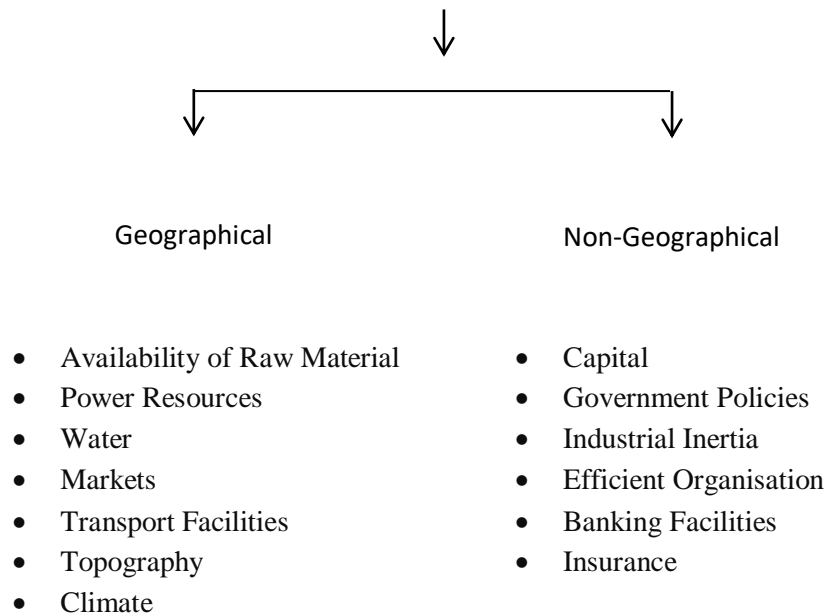
- (I) Geographical factors, and
- (II) Non-geographical factors

#### ***I. Geographical Factors:***

Following are the important geographical factors influencing the location of industries.



## Factors of Industrial Location



- 1. Raw Materials:** The significance of raw materials in manufacturing industry is so fundamental that it needs no emphasising. Indeed, the location of industrial enterprises is sometimes determined simply by location of the raw materials. Modern industry is so complex that a wide range of raw materials is necessary for its growth.

The jute mills in West Bengal, sugar mills in Uttar Pradesh, cotton textile mills in Maharashtra and Gujarat are concentrated close to the sources of raw materials for this very reason. Industries like iron and steel, which use very large quantities of coal and iron ore, losing lot of weight in the process of manufacture, are generally located near the sources of coal and iron ore.

- 2. Power:** Regular supply of power is a pre-requisite for the localisation of industries. Coal, mineral oil and hydro-electricity are the three important conventional sources of power. Most of the industries tend to concentrate at the source of power. Similarly, the location of large and heavy industries, quite often they are established at a point which has the best economic advantage in obtaining power and raw materials.

3. **Water:** Water is another important requirement for industries. Many industries are established near rivers, canals and lakes, because of this reason. Iron and steel industry, textile industries and chemical industries require large quantities of water, for their proper functioning.
4. **Labour:** No one can deny that the prior existence of a labour force is attractive to industry unless there are strong reasons to the contrary. Labour supply is important in two respects (a) workers in large numbers are often required; (b) people with skill or technical expertise are needed.
5. **Transport:** Transport by land or water is necessary for the assembly of raw materials and for the marketing of the finished products. The development of railways in India, connecting the port towns with hinterland determined the location of many industries around Kolkata, Mumbai and Chennai. As industrial development also furthers the improvement of transport facilities, it is difficult to estimate how much a particular industry owes to original transport facilities available in a particular area.
6. **Market:** The entire process of manufacturing is useless until the finished goods reach the market. Nearness to market is essential for quick disposal of manufactured goods. It helps in reducing the transport cost and enables the consumer to get things at cheaper rate
7. **Topography:** Site requirements for industrial development are of considerable significance. Sites, generally, should be flat and well served by adequate transport facilities. Large areas are required to build factories. Now, there is a tendency to set up industries in rural areas because the cost of land has shot up in urban centres.
8. **Climate:** Climate plays an important role in the establishment of industries at a place. Harsh climate is not much suitable for the establishment of industries. There can be no industrial development in extremely hot, humid, dry or cold climate.

## **II. Non-Geographical Factors:**

Now-a-days alternative raw materials are also being used because of modern scientific and technological developments. Availability of electric power supply over wider areas and the increasing mobility of labour have reduced the influence of geographical factors on the location of industries. The non-geographical factors are those including economic, political, historical and social factors. These factors influence our modern industries to a great extent. Following are some of the important non- geographical factors influencing the location of industries.

**1. Capital:** Modern industries are capital-intensive and require huge investments. Capitalists are available in urban centres. Big cities like Mumbai, Kolkata, Delhi, and Chennai are big industrial centres, because the big capitalists live in these cities.

**2. Government Policies:** Government activity in planning the future distribution of industries, for reducing regional disparities, elimination of pollution of air and water and for avoiding their heavy clustering in big cities, has become no less an important locational factor.

**3. Industrial Inertia:** Industries tend to develop at the place of their original establishment, though the original cause may have disappeared. This phenomenon is referred to as inertia, sometimes as geographical inertia and sometimes industrial inertia. The lock industry at Aligarh is such an example.

**4. Efficient Organisation:** Efficient and enterprising organisation and management is essential for running modern industry successfully. Bad management sometimes squanders away the capital and puts the industry in financial trouble leading to industrial ruin.

**5. Banking Facilities:** Establishment of industries involves daily exchange of crores of rupees which is possible through banking facilities only. So the areas with better banking facilities are better suited to the establishment of industries.

**6. Insurance:** There is a constant fear of damage to machine and man in industries for which insurance facilities are badly needed.

## 19. Major Industrial region of India

Industrial regions emerge when a number of industries locate close to each other and share the benefits of their closeness. They tend to concentrate on certain locations because of the favorable local factors. Several indices are used to identify the clustering of industries, important among them are:

- The number of industrial units
- Number of industrial workers.
- Quantum of power used for industrial purposes.
- Total industrial output.
- Value added by manufacturing, etc.

Following are the major industrial regions of India;

1. Mumbai-Pune Industrial Region
2. Hugli Industrial Region.
3. Bangalore-Tamil Nadu Industrial Region
4. Gujarat Industrial Region
5. Chotanagpur Industrial Region
6. Vishakhapatnam-Guntur Industrial Region
7. Gurgaon-Delhi-Meerut Industrial Region
8. Kolfam-Thiruvananthapuram Industrial Region.

### **1. Mumbai-Pune Industrial Region:**

This region extends from Thane to Pune and in adjoining districts of Nashik and Solapur. In addition, industries have grown at a rapid pace in Kolaba, Ahmednagar, Satara, Sangli and Jalgaon districts also. This region owes its origin to the British rule in India.

The seeds of its growth were sown in 1774 when the island-site was obtained for construction of Mumbai port. The opening of the first railway track of 34 kms between Mumbai and Thane in 1853, opening of the Bhore and Thane Ghats respectively to Pune and Nashik and that of Suez Canal in 1869 led to the development of Mumbai.

The growth of this industrial region is fully connected with the growth of cotton textile industry in India. As the coal was far removed, hydel power was developed in Western Ghats. Cotton was cultivated in the black cotton soil area of the Narmada and Tapi basins.

The partition of the country in 1947 adversely affected this region because 81% of the total irrigated cotton area growing long staple cotton went to Pakistan. Mumbai, the nucleus of this industrial region, is facing the current limitation of space for the expansion of the industry. Dispersal of industries is essential to bring about decongestion.

## **2. The Hugli Industrial Region:**

Located in West Bengal, this region extends as a narrow belt running along the river Hugli for a distance of about 100 km from Bansbaria and Naihati in the north to Birlanagar in the south. Industries have also developed in Midnapur district in the west. The river Hugli offered the best site for the development of an inland river port as nucleus for the development of Hugli industrial region.

The old trading centre of late 17th century has developed into the present industrial hub of Kolkata. Thus Kolkata-Haora forms the nucleus of this region. It is very well- connected by the Ganga and its tributaries with the rich hinterland of Ganga-Brahmaputra plains. Besides navigable rivers, roads and the railways provided subsequent links to the great benefit of Kolkata port.

The discovery of coal and iron ore in Chotanagpur plateau, tea plantations in Assam and northern parts of West Bengal and the processing of deltaic Bengal's jute led to the industrial development in this region. Cheap labour could be found easily from the thickly populated states of Orissa, Bihar, Jharkhand and eastern part of U.P. Kolkata, having been designated capital city of the British India (1773-1912) attracted large scale British investment of capital.

Establishment of first jute mill at Rishra in 1855 ushered in the era of modern industrial clustering in this region. A chain of jute mills and other factories could be established on either side of Hugli River with the help of Damodar valley coal. The port site was best-suited for export of raw materials to England and import of finished goods from that country.

Location of petroleum refinery at Haldia has facilitated the development of a variety of industries. The major centres of this industrial region are Kolkata, Haora, Haldia, Serampur,

Rishra, Shibpur, Naihati, Kakinara, Shamnagar, Titagarh, Sodepur, Budge Budge, Birlanagar, Bansbaria, Belgurriah, Triveni, Hugli, Belur, etc.

Alarming rate of silting of the Hugli River was a very serious problem. The depth of water in the channel from bay head to Kolkata docks must be kept at 9.2 metres for big ocean ships to come in. Dredging out of the silt rapidly filling up the water channel was very costly and not a permanent solution to save the life of Kolkata port.

The construction of Farakka barrage about 300 kms upstream on Ganga and flushing of the channel are the only possible answers. The construction of Haldia port in the lower reaches of Hugli to the south of Kolkata is another landmark in relieving the great pressure of cargo ships on the port of Kolkata.

### **3. Bangalore-Tamil Nadu Industrial Region:**

Spread in two states of Karnataka and Tamil Nadu, this region experienced the fastest industrial growth in the post-independence era. Till 1960, industries were confined to Bangalore district of Karnataka and Salem and Madurai districts of Tamil Nadu. But now they have spread over all the districts of Tamil Nadu except Viluppuram.

This region is a cotton-growing tract and is dominated by the cotton-textile industry. In fact cotton textile industry was the first to take roots in this region. But it has large number of silk-manufacturing units, sugar mills, leather industry, chemicals, rail wagons, diesel engines, radio, light engineering goods, rubber goods, medicines, aluminium, cement, glass, paper, cigarette, match box and machine tools, etc.

This region is away from the main coal-producing areas of the country but cheap hydroelectric power is available from Mettur, Sivasamudram, Papanasam, Pykara and Sharavati dams. Cheap skilled labour and proximity to vast local market as well as good climate have also favoured the concentration of industries in this region.

Madurai is known for its cotton textiles. Visvesvarayya Iron and Steel Works is located at Bhadravati. The other important centres of this region are Sivakasi, Tiruchirapalli, Madukottai, Mettur, Mysore and Mandya. Petroleum refinery at Chennai and Narimanam and iron and steel plant at Salem are recent developments.

#### **4. Gujarat Industrial Region:**

The nucleus of this region lies between Ahmedabad and Vadodara as a result of which it is also known as Ahmedabad-Vadodara industrial region. However, this region extends upto Valsad and Surat in the south and Jamnagar in the west. The region corresponds to the cotton growing tracts of the Gujarat plains and the development of this region is associated with the location of textile industry since 1860s.

This region became important textile region with the decline of cotton textile industry in Mumbai. Mumbai has the disadvantage of paying double freight charges for first bringing the raw cotton from the peninsular hinterland and then despatching the finished products to inland consuming points in India.

But Ahmedabad is nearer the sources of raw material as well as the marketing centres of the Ganga and Satluj plains. Availability of cheap land, cheap skilled labour and other advantages helped the cotton textile industry to develop. This major industrial region of the country, mainly consisting of cotton textile industry, is expanding at a much faster rate in providing a greater factory employment.

Besides textiles (cotton, silk and synthetic fibres) and petrochemical industries, other industries are heavy and basic chemicals, dyes, pesticides, engineering, diesel engines, textile machinery, pharmaceuticals, dairy products and food processing. The main industrial centres of this region are Ahmedabad, Vadodara, Bharuch, Koyali, Anand, Khera, Surendranagar, Surat, Jamnagar, Rajkot and Valsad. The region may become more important in the years to come.

#### **5. Chotanagpur Industrial Region:**

As its name indicates, this region is located on the Chotanagpur plateau and extends over Jharkhand, Northern Orissa and Western part of West Bengal. The birth and growth of this region is linked with the discovery of coal in Damodar Valley and iron ore in the Jharkhand-Orissa mineral belt. As both are found in close proximity, the region is known as the 'Ruhr of India'.

Besides raw materials, power is available from the dam sites in the Damodar Valley and the thermal power stations based on the local coal. This region is surrounded by highly populated states of Jharkhand, Bihar, Orissa and West Bengal which provide cheap labour.

Heavy engineering, machine tools, fertilizers, cement, paper, locomotives and heavy electricals are some of the other important industries in this region. Important nodal centres of this region are Ranchi, Dhanbad, Chaibasa, Sindri, Hazaribagh, Jamshedpur, Daltonganj, Garwa and Japla.

#### **6. Vishakhapatnam-Guntur Industrial Region:**

This industrial region extends from Vishakhapatnam district in the north-eastern part of Andhra Pradesh to Kurnool and Prakasham districts in the south-east and covers most of the coastal Andhra Pradesh. The industrial development of this region mainly depends upon Vishakhapatnam and Machilipatnam ports.

Developed agriculture and rich mineral resources in the hinterlands of these ports provide solid base to the industrial growth in this region. Coal fields of the Godavari basin are the main source of energy. Hindustan Shipyard Ltd. set up at Vishakhapatnam, set up in 1941 is the main focus.

Petroleum refinery at Vishakhapatnam facilitated the growth of several petrochemical industries. Vishakhapatnam has the most modern iron and steel plant which have the distinction of being the only plant in India having coastal location. It uses high quality iron ore from Bailadila in Chhattisgarh.

One lead-zinc smelter is functioning in Guntur district. The other industries of this region include sugar, textiles, paper, fertilizers, cement, aluminium and light engineering. The important industrial centres of this region are Vishakhapatnam, Vijaywada, Vijaynagar, Rajahmundry, Kurnool, Elum and Guntur. Recent discovery of natural gas in Krishna-Godavari basin is likely to provide much needed energy and help in accelerated growth of this industrial region.

#### **7. Gurgaon-Delhi-Meerut Industrial Region:**

This region developed after independence, but is one of the fastest growing regions of India. It consists of two industrial belts adjoining Delhi. One belt extends over Agra-Mathura-Meerut and Saharanpur in U.P. and the other between Faridabad-Gurgaon- Ambala in Haryana.

The region is located far away from the mineral and power resources, and therefore, the industries are light and market oriented. The region owes its development and growth to



hydro-electricity from Bhakra-Nangal complex and thermal power from Harduaganj, Faridabad and Panipat.

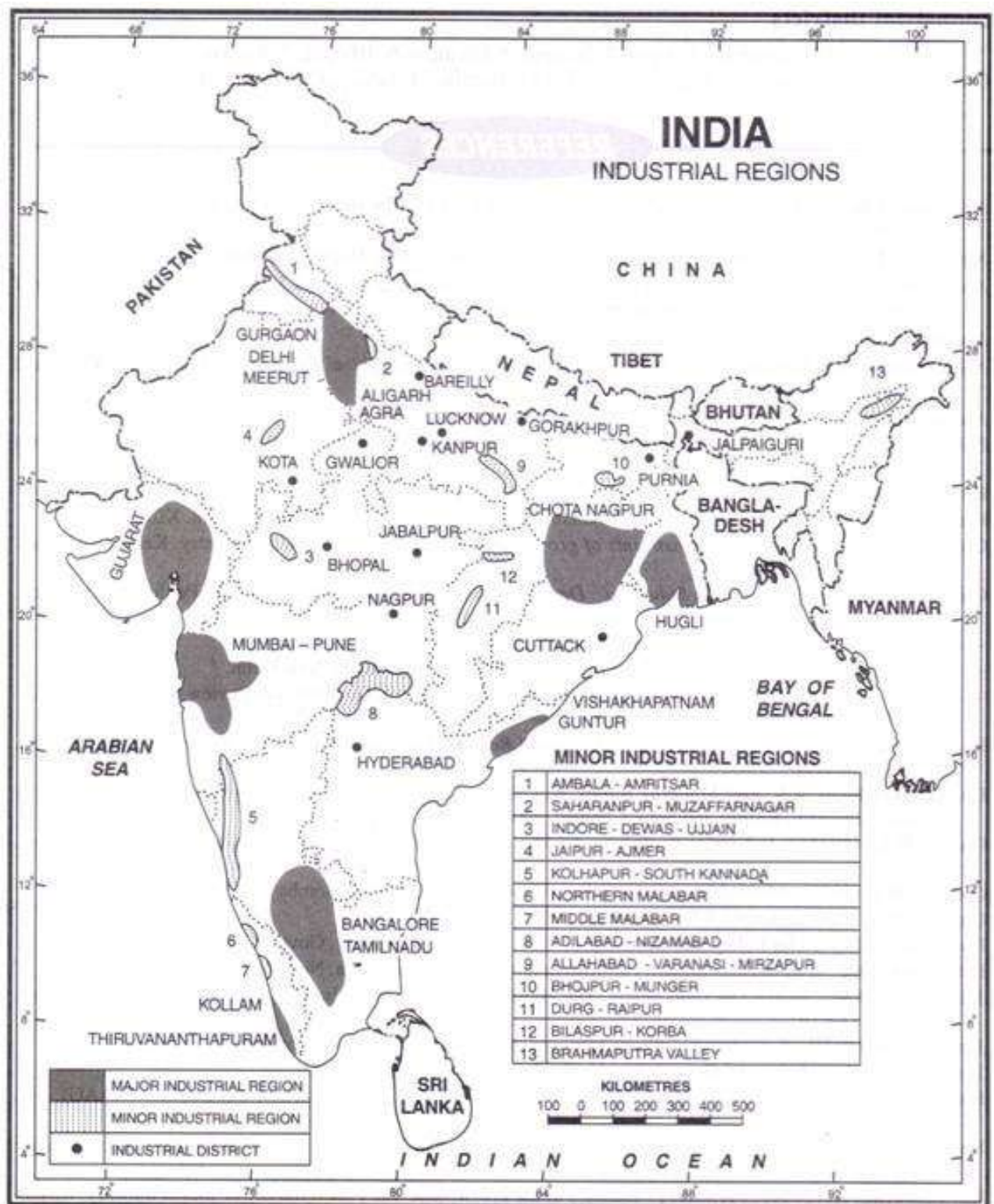
Sugar, agricultural implements, vanaspati, textile, glass, chemicals, engineering, paper, electronics and cycle are some of the important industries of this region. Software industry is a recent addition, Agra and its environs have glass industry. Mathura has an oil refinery with its petro-chemical complex. One oil refinery has been set up at Panipat also.

#### **8. Kollam-Thiruvananthapuram Industrial Region:**

This is comparatively small industrial region and spreads over Thiruvananthapuram, Kollam, Alwaye, Emakulam and Allapuzha districts of south Kerala. The region is located far away from the mineral belt of the country as a result of which the industrial scene here is dominated by agricultural products processing and market oriented light industries.

Plantation agriculture and hydroelectricity provide the industrial base to this region. The main industries are textiles, sugar, rubber, match box, glass, chemical fertilizers, food and fish processing, paper, coconut coir products, aluminium and cement. Oil refinery set up in 1966 at Kochi provides solid base to petrochemical industries. Important industrial centres are Kollam, Thiruvananthapuram, Alluva, Kochi, Alappuzha and Punalur.

Besides the above mentioned eight major industrial regions, India has 13 minor industrial regions and 15 industrial districts. Their names are mentioned below:



<https://www.yourarticlelibrary.com/industries/industrial-regions-8-major-industrial-regions-of-india/14159>

**Minor Industrial Regions:**

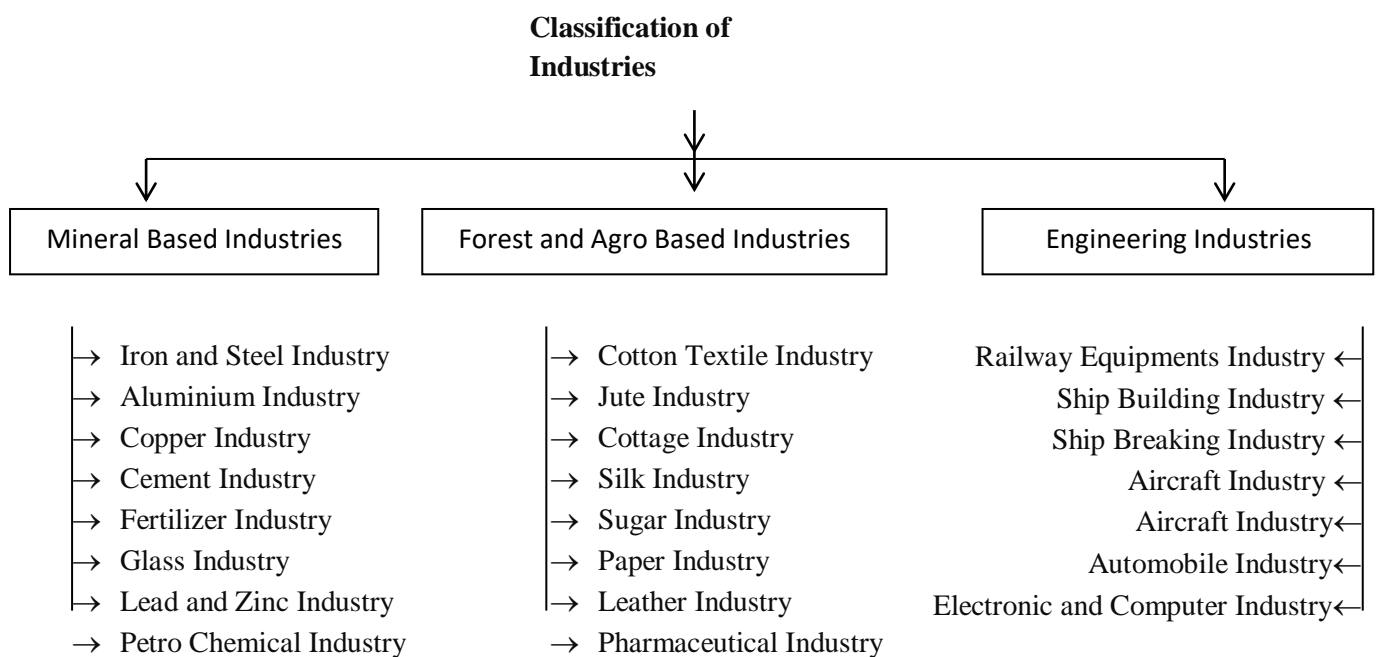
1. Ambala-Amritsar in Haryana-Punjab.
2. Saharanpur-Muzaffamagar-Bijnaur in Uttar Pradesh.
3. Indore-Dewas-Ujjain in Madhya Pradesh.
4. Jaipur-Ajmer in Rajasthan.
5. Kolhapur-South Kannada in Maharashtra-Karnataka.
6. Northern Malabar in Kerala.
7. Middle Malabar in Kerala.
8. Adilabad-Nizamabad in Andhra Pradesh.
9. Allahabad-Varanasi-Mirzapur in Uttar Pradesh.
10. Bhojpur-Munger in Bihar.
11. Durg-Raipur in Chhattisgarh.
12. Bilaspur-Korba in Chhattisgarh.
13. Brahmaputra Valley in Assam.

## 20. Classification of Industries

Industries are part of the secondary activity. Secondary activities or manufacturing converts raw materials into products of more value to people. The industry refers to economic activities concerned with the production of goods, extraction of services, and provision of services.

Industry classification or industry taxonomy is a type of economic taxonomy that classifies companies, organizations, and traders into industrial groupings based on similar production processes, similar products, or similar behavior in financial markets.

Industries can be classified into several groups but broadly they can be clubbed into three categories. The following table gives an understanding of them.



### 1. On the Basis of Raw-Material and Finished Goods

- **Heavy:** Industries that use heavy and bulky raw materials and produce products of the same category are called heavy industries. The iron and steel industry presents a good example of heavy industries.
- **Light:** The light industries use light raw materials and produce light finished products. Electric fans, sewing machines are light industries.

## **2. Forest and Agro Based Industries**

The agro-based industry includes industries related to textiles, sugar, paper and vegetable oil. These industries use agricultural products as their raw materials. Textile industry is the largest industry in the organized sector. It comprises of (i) cotton textiles, (ii) woollen textiles, (iii) silk textiles (iv) synthetic fibres and (v) jute textile industries. Textiles have been a major component of the industrial sector. It accounts for nearly a fifth of the industrial output and a third of the export earnings.

Forest-based Industry includes- the paper industry, match industry, silk industry, lac industry, sports goods industry and handicraft. India is a leading country in lac production. 60% of lac in the world is produced here. India is also the largest exporter of lac in the world.

## **3. The Engineering Industries:**

The Engineering Industry is the largest among all industrial sectors in India. It incorporates diverse segments of industry which can be broadly divided into two segments, namely, heavy engineering and light engineering. It is relatively less fragmented at the top, as the competencies required are high, while it is highly fragmented at the lower end (e.g. unbranded transformers for the retail segment) and is dominated by smaller players. The engineering industry in India manufactures a wide range of products, with heavy engineering goods accounting for bulk of the production. Most of the leading players are engaged in the production of heavy engineering goods and mainly produces high-value products using high-end technology.

Industries can also be classified into other groups. The following table gives some examples about them.

### **I. On the Basis of Strength of Labour:**

#### **1. Large Scale Industry:**

Industries which employ a large number of labourers in each unit are called large-scale industries. Cotton or jute textile industries are large scale industries.

#### **2. Medium Scale Industries:**

The industries which employ neither very large nor very small number of labourers are put in the category of medium scale industries. Cycle industry, radio and television industries are some examples of medium scale industries.

### **3. Small Scale Industries:**

Industries which are owned and run by individuals and which employ a small number of labourers are called small scale industries.

## **II. On the Basis of Raw-Material and Finished Goods:**

Industries classified on the basis of raw materials and finished goods are:

### **1. Heavy Industries:**

Industries which use heavy and bulky raw-materials and produce products of the same category are called heavy industries. Iron and steel industry presents a good example of heavy industries.

### **2. Light Industries:**

The light industries use light raw-materials and produce light finished products. Electric fans, sewing machines are light industries.

## **III. On the basis of Ownership:**

Since the start of the planned development of Indian economy in 1951, industries are divided in the following four classes:

### **1. Private Sector Industries:**

Industries owned by individuals or firms such as Bajaj Auto or TISCO situated at Jamshedpur are called private sector industries.

### **2. Public Sector Industries:**

Industries owned by the state and its agencies like Bharat Heavy Electricals Ltd., or Bhilai Steel Plant or Durgapur Steel Plant are public sector industries.

### **3. Joint Sector Industries:**

Industries owned jointly by the private firms and the state or its agencies such as Gujarat Alkalies Ltd., or Oil India Ltd. fall in the group of joint sector industries.

#### **4. Co-operative Sector Industries:**

Industries owned and run co-operatively by a group of people who are generally producers of raw materials of the given industry such as a sugar mill owned and run by farmers are called co-operative sector industries.

#### **IV. Miscellaneous Industries:**

Industries are also classified into the following miscellaneous categories.

##### **1. Village Industries:**

Village industries are located in villages and primarily cater to the needs of the rural people. They usually employ local machinery such as oil extraction, grain grinding and agricultural implements.

##### **2. Cottage Industries:**

Industries which artisans set up in their own houses, work with wood, cane, brass, stone, etc. are called cottage industries. Handloom, khadi and leather work at the artisans house fall in this category.

##### **3. Consumer Goods Industries:**

Consumer industries convert raw materials or primary products into commodities directly used by the people. Textiles, bakeries, sugar, etc. are some of the consumer goods industries.

##### **4. Ancillary Industries:**

The industries which manufacture parts and components to be used by big industries for manufacturing heavy articles like trucks, buses, railway engines, tractors, etc. are called ancillary industries.

##### **5. Basic Industries:**

Industries on which depend many other industries for their manufacturing processes are called basic industries. Iron and steel industry and power generating industry are included in this category.

## **6. Capital-Intensive Industries:**

Industries requiring huge investments are called capital-intensive industries. Iron and steel, cement and aluminium are outstanding examples of capital-intensive industries.

## **7. Labour-Intensive Industries:**

Industries which require huge labour force for running them are called labour-intensive industries. In these industries, labour is more important than capital. Shoe-making and bidi-manufacturing, etc. are included in these industries.



## 21. Iron and steel industry

Iron and Steel industries are famously known as the feeders of all the other industries- heavy, medium and light. The products of these industries are used as raw materials in other industries like engineering goods, construction materials, defence, vehicle, medical, scientific equipment and variety of consumer and industrial goods.. As we learned the industrial system, this industry comprises of various inputs, processes, and outputs. The input includes raw material such as iron ore, labor, capital, and other infrastructure. Iron ore is then converted into steel by various processes like smelting and refining.

Production and consumption of iron and steel is often regarded as the index of a country's development. Finally, the output is steel. Steel and iron can be called as the basic material needed in every other industry. No doubt, they are the backbone of the modern industry. In a developing country like India, Iron and Steel industry has taken the advantage of the cheap labor, raw material, and the ready market.

Iron and steel is a heavy industry because all the raw materials as well as finished goods are heavy. Iron ore, coking coal and limestone are required in the ratio of approximately 4 : 2 : 1 to make steel harder. Today with 91.46 million tons of total finished steel products and 9.7 million tons of raw pig iron, India ranks 3rd after Japan and China.

Chota-nagpur plateau region has the maximum concentration of iron and steel industries. All PSU market their steel through, Steel Authority of India Ltd. (SAIL) while TISCO markets its produce through Tata Steel. Liberalization and Foreign Direct Investment have given a boost to the iron & steel industry.

### Location of iron and steel industry

The iron and steel industry is a huge industry and requires lots of facilities before locating it in any place. These facilities are:-

- Raw materials like –iron ore, dolomite, aluminium, mica, silica etc.
- **Power resources** – coal or hydro-electric power
- **Capital**- it is a huge manufacturing industry therefore huge capital investment is required.

- **Cheap labour-** it is very labour intensive industries therefore cheap and abundant labour is needed
- **Market-** the final products are very heavy and there is a risk of rusting of the iron therefore the plant should be near to Market
- **Transportation.-** a good transport network is required for the raw material and finished goods to reach its destination.
- Apart from these Good Government policies, climatic condition, export-import facilities are also required.

## History of Iron and Steel Industry in India

The history of iron and steel began at least 6,000 years ago and in India steel-making can be traced back to 400 BC when the Greek emperors used to recruit Indian archers for their army who used arrows tipped with steel. The first notable attempt to revive steel industry in India was made in 1874 when the Bengal Iron Works (BIW) came into being at Kulti, in West Bengal. It produced 40,000 tons of pig iron in 1900 and continued to produce the metal until it was taken over by Indian Iron and Steel Company (IISCO) in 1936. But production on a large scale became noticeable with the establishment of a steel plant in Jamshedpur in Bihar in 1907.

### Iron and Steel Industries before Independence

S.	Place	State	Estd. Year	Characteristics
1.	Kulti/Barakar	West Bengal	1874	It was later changed into Bengal Iron and Steel Industry
2.	Sakchi	Jharkhand	1907	It was established by Jamshedji Tata. The modern Iron and Steel industry of India is supposed to have started from here (TISCO)
3.	Hirapur	West Bengal	1908	It was named as Indian Iron and Steel Co.
4.	Bhadravati	Karnataka	1923	Its earlier name was Mysore Iron and Steel Co. Later, its name was changed to Visvesvaraya Iron and Steel Co. It was the first PSU company.
5.	Burnpur	West Bengal	1937	It was established with the name Steel Corporation of Bengal. However, later on it was merged with Indian Iron and Steel

Company.

### **Major Iron and Steel Plants Established After Independence**

<b>Steel Plant Collaborating</b>	<b>Year of Establishment</b>	<b>Country</b>
• Rourkela (Odisha)	1955(2 <sup>nd</sup> FYP)	Germany
• Bhilai (Chhattisgarh)	1955(2 <sup>nd</sup> FYP)	USSR
• Durgapur (W.Bengal)	1955(2 <sup>nd</sup> FYP)	Britian
• Bokaro (Jharkhand)	1964(3 <sup>rd</sup> FYP)	USSR

#### **Types of Iron and Steel:**

**Pig iron** – these are the basic raw iron and it is called so because it is produced as chunky moulded blocks.

**Cast iron-** it is a ferrous alloy which is heated until it liquefies, and then moulded into different shapes of pipes and rods etc.

**Wrought iron-** the wrought iron is made when all the carbon is removed from the iron. Bit structurally it is very strong and soft used to make decorative items like grills, gate or furniture.

**Steel-** different types of steel are produced in an iron factory where all the carbon is removed. these steel are sturdy and lightweight therefore used in variety of products like pipes, utensils etc.

### **Steel Authority of India Limited**

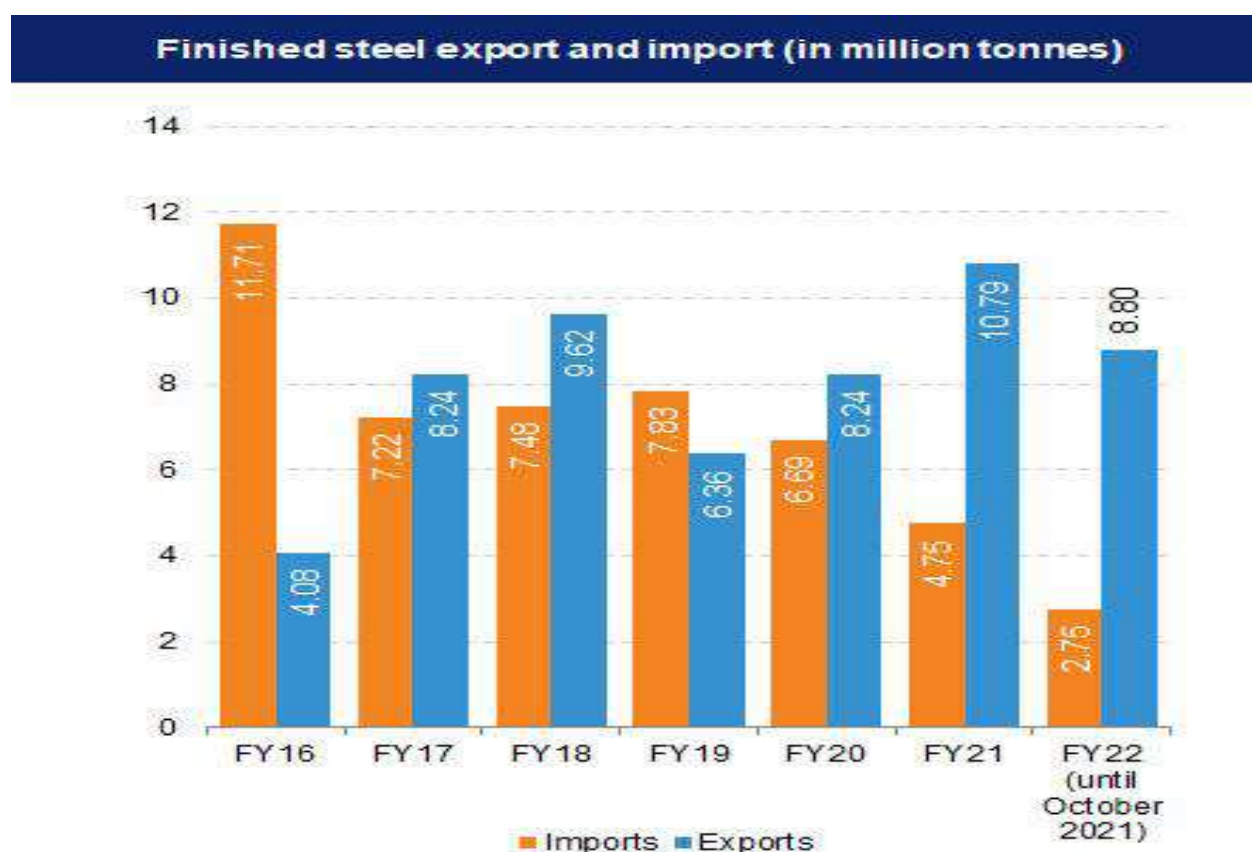
- On January 24, 1973, with the capital of Rs. 2000 crores, Steel Authority of India Limited took the responsibility of conducting joint operations with Bhilai, Durgapur, Bokaro, Rourkela, Burnpur, Salem and Visvesvaraya Iron and Steel plants.
- India has becoe the world's second largest steel producer after China in 2017. Also, India is the world's largest producer of the sponge iron in the world.

## Steel Production in India

The Indian steel industry is modern, with state-of-the-art steel mills. It has always strived for continuous modernisation of older plants and up-gradation to higher energy efficiency levels.

In FY22 (till January), the production of crude steel and finished steel stood at 98.39 MT and 92.82 MT, respectively. According to CARE Ratings, crude steel production is expected to reach 112-114 MT (million tonnes), an increase of 8-9% YoY in FY22. The consumption of finished steel stood at 86.3 MT in FY22 (till January). Between April 2021-January 2022, the consumption of finished steel stood at 86.3 MT. In January 2022, India's finished steel consumption stood at 9.65 MT.

In FY22 (until February 2022), exports and imports of finished steel stood at 12.2 MT and 4.3 MT, respectively. In April 2021, India's export rose by 121.6% YoY, compared with 2020. In FY21, India exported 9.49 MT of finished steel.



# Major Iron and Steel industries in India

## TISCO

- The Tata Iron and Steel plant lies very close to the Mumbai-Kolkata railway line and about 240 km away from Kolkata, which is the nearest port for the export of steel.
- The rivers Subamarekha and Kharkai provide water to the plant.
- The iron ore for the plant is obtained from Noamundi and Badam Pahar and coal is brought from Joda mines in Odisha. Coking coal comes from Jharia and west Bokaro coalfields.
- Before 1947, there was only one iron and steel plant in the country - Tata Iron and Steel Company Limited (TISCO). It was privately owned. After Independence, the government took the initiative and set up several iron and steel plants.
- TISCO was started in 1907 at Sakchi, near the confluence of the rivers Subamarekha and Kharkai in Jharkhand.
- Later on Sakchi was renamed as Jamshedpur. Geographically, Jamshedpur is the most conveniently situated iron and steel centre in the country.
- Sakchi was chosen to set up the steel plant for several reasons. This place was only 32 km away from Kalimati station on the Bengal-Nagpur railway line.
- It was close to the iron ore, coal and manganese deposits as well as to Kolkata, which provided a large market.
- TISCO, gets coal from Jharia coalfields, and iron ore, limestone, dolomite and manganese from Odisha and Chhattisgarh.
- The Kharkai and Subamarekha rivers ensured sufficient water supply. Government initiatives provided adequate capital for its later development.

## IISCO

- The Indian Iron and Steel Company (IISCO) set up its first factory at Hirapur and later on another at Kulti.
- In 1937, the Steel corporation of Bengal was constituted in association with IISCO and set up another iron and steel producing unit at Bumpiir (West Bengal).
- All the three plants under IISCO are located very close to Damodar valley coal fields (Raniganj, Jharia, and Ramgarh).
- Iron ore comes from Singhbhum in Jharkhand. Water is obtained from the Barakar River, a tributary of the Damodar.

- All the plants are located along the Kolkata-Asansol railway line. Unfortunately, steel production from IISCO fell considerably in 1972-73 and the plants were taken over by the government. Visvesvaraiya Iron and Steel Works Ltd. (VISL)
- The third integrated steel plant, the Visvesvaraiya Iron and Steel Works, initially called the Mysore Iron and Steel Works, is located close to an iron ore producing area of Kemangundi in the Bababudan hills.
- Limestone and manganese are also locally available. But this region has no coal. At the beginning, charcoal obtained by burning wood from nearby forests was used as fuel till 1951.
- Afterwards, electric furnaces were installed which use hydroelectricity from the Jog Falls hydel power project. The Bhadravati river supplies water to the plant. This plant produces specialised steels and alloys.
- After independence, during the Second Five Year Plan (1956-61), three new integrated steel plants were set up with foreign collaboration: Rourkela in Odisha, Bhilai in Chhattisgarh and Durgapur in West Bengal.
- These were public sector plants under Hindustan Steel Limited (HSL). In 1973, the Steel Authority of India Limited (SAIL) was created to manage these plants.

### **Rourkela Steel Plant**

- The Rourkela Steel plant was set up in 1959 in the Sundargarh district of Odisha in collaboration with Germany.
- The plant was located on the basis of proximity to raw materials, thus, minimising the cost of transporting weight losing raw material.
- This plant has a unique locational advantage, as it receives coal from Jharia (Jharkhand) and iron ore from Sundargarh and Kendujhar.
- The Hirakud project supplies power for the electric furnaces and water is obtained from the Koel and Sankh rivers. Bhilai Steel Plant
- The Bhilai Steel Plant was established with Russian collaboration in Durg District of Chhattisgarh and started production in 1959.
- The iron ore comes from Dalli-Rajhara mine, coal comes from Korba and Kargali coal fields.
- The water comes from the Tanduladam and the power from the Korba Thermal Power Station.
- This plant also lies on the Kolkata-Mumbai railway route.

- The bulk of the steel produced goes to the Hindustan Shipyard at Vishakhapatnam.

### **Durgapur Steel Plant**

- Durgapur Steel Plant, in West Bengal, was set up in collaboration with the government the United Kingdom and started production in 1962.
- This plant lies in Raniganj and Jharia coal belt and gets iron ore from Noamundi.
- Durgapur lies on the main Kolkata-Delhi railway route.
- Hydel power and water is obtained from the Damodar Valley Corporation (DVC).

### **Bokaro Steel Plant**

- This steel plant was set up in 1964 at Bokaro with Russian collaboration.
- This plant was set up on the principle of transportation cost minimisation by creating Bokaro-Rourkela combine.
- It receives iron ore from the Rourkela region and the wagons on return take coal to Rourkela.
- Other raw materials come to Bokaro from within a radius of about 350 km.
- Water and Hydel power is supplied by the Damodar Valley Corporation.

### **Other Steel Plants**

- New steel plants which were set up in the Fourth Plan period are away from the main raw material sources. All the three plants are located in South India.
- The Vizag Steel Plant, in Vishakhapatnam in Andhra Pradesh is the first port based plant which started operating in 1992. Its port location is of advantage.
- The Vijaynagar Steel Plant at Hosapete in Kamataka was developed using indigenous technology. This uses local iron ore and limestone. The Salem Steel Plant in Tamil Nadu was commissioned in 1982.

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## 22. Major Industries in India

### Aluminium Industry

- Aluminium Industry is the second most important metallurgical industry in India. Aluminium has gained popularity as a substitute of steel, copper, zinc and leads in a number of industries because it is light metal, resistant to corrosion, a good conductor of heat, malleable and becomes strong when it is mixed with other metals.
- India is the 2nd largest Aluminum Producer country in the world (in 2020).
- The plant for obtaining Alumina from bauxite ore for aluminium plants is located near the cheap sources of energy i.e., electricity & hydel power supply.
- It is also the fastest-growing metal which has grown by nearly 20 times in the last sixty years (compared to 6 to 7 times for other metals).
- The Aluminium industry comprises two basic segments: upstream and downstream.
  - The upstream sector produces primary Aluminium from raw materials via bauxite mining.
  - The downstream sector comprises of processing of Aluminium into semi-finished Aluminium goods such as rods, bars, castings, forging, etc.
- There are 8 aluminium smelting plants in the country located in Odisha (formerly Orissa) (Nalco and Balco), West Bengal, Kerala, Uttar Pradesh, Chhattisgarh, Maharashtra and Tamil Nadu.
- In 2004, India produced over 600 million tons of aluminium. Bauxite, the raw material used in the smelters is a very bulky, dark reddish coloured rock. The flow chart given below shows the process of manufacturing aluminium. Regular supply of electricity and an assured source of raw material at minimum cost are the two prime factors for location of the industry.

### Bauxite mining sites in India are:

- **Orissa:** Orissa is the largest bauxite producing state accounting for more than half of the total production of India. The total recoverable reserves in the state are estimated at 1,370.5 million tonnes. The main bauxite belt is in Kalahandi and Koraput districts and extends further into Andhra Pradesh.



- **Jharkhand:** The reserves of all grades of recoverable bauxite in Jharkhand have been estimated at 63.5 million tonnes. These reserves are found in extensive areas of Ranchi, Lohardaga, Palamu and Gumla districts. Some bauxite is also found in Dumka and Munger districts. High grade ore occurs in Lohardaga and adjoining areas.
- **Maharashtra:** Maharashtra accounts for about 10 per cent of the total bauxite produced in India. The total recoverable reserves in the state have been estimated to be of the order of 87.7 million tonnes. The largest deposits occur in Kolhapur district capping the plateau basalts. Udgeri, Dhangarwadi, Radhanagari and Inderganj in Kolhapur district contain rich deposits with alumina content 52 to 89 percent.
- **Chhattisgarh:** Chhattisgarh produces more than 6 per cent bauxite of India. The Maikala range in Bilaspur, Durg districts and the Amarkantak plateau regions of Surguja, Raigarh and Bilaspur are some of the areas having rich deposits of bauxite.
- **Madhya Pradesh:** Amarkantak plateau area, the Maikala range in Shahdol, Mandla and Balaghat districts and the Kotni area of Jabalpur district are the main producers.

### Major Aluminium Producing companies

Aluminium Company	Cooperating Country
• BALCOM	Former USSR (Russia)
• NALCO	France
• HINDALCO	USA
• INDALCO	Canada
• MALCO	Italy
• VEDANTA	Germany

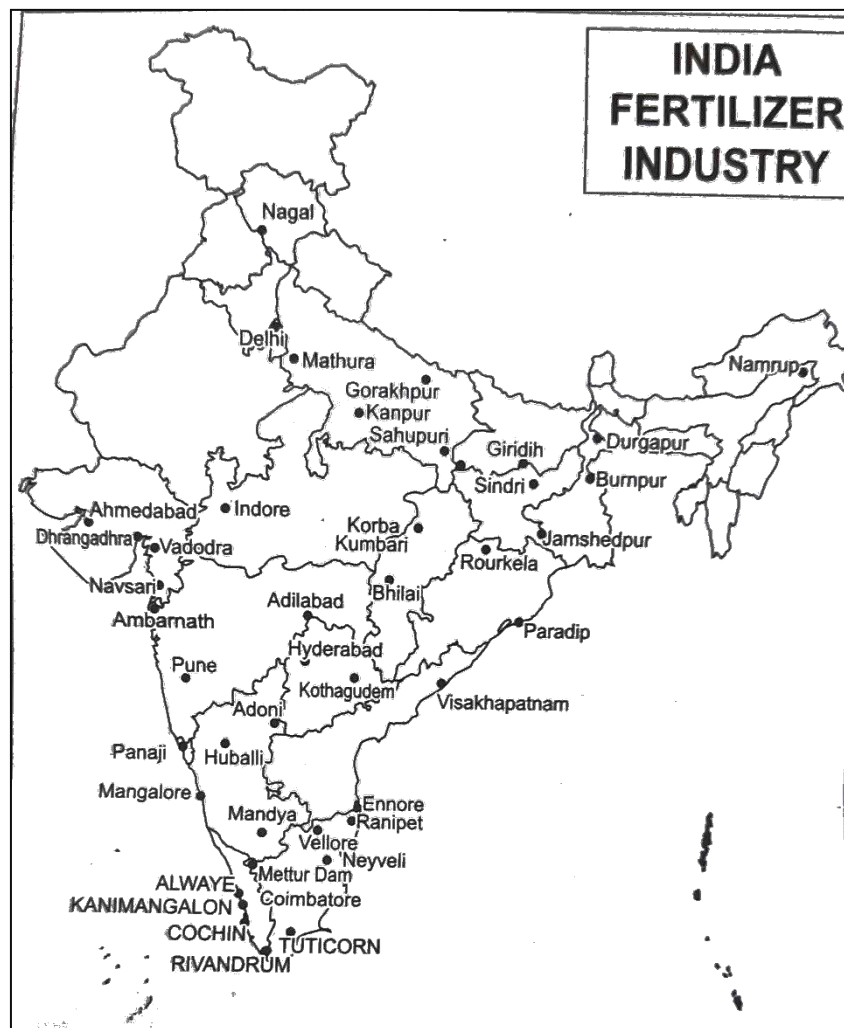
### Copper Industry

- In 1924, the Indian Copper Industry was established and at the same time, a smelting plant in Singhbhum district of Jharkhand was also established. Smelters at Singhbhum receive copper ores from Mosabani, Rakha, Dhobani Rajdah, Tamapahar and Turamdih.
- Hindustan Copper Ltd. is the sole producer of copper which was established in 1967.

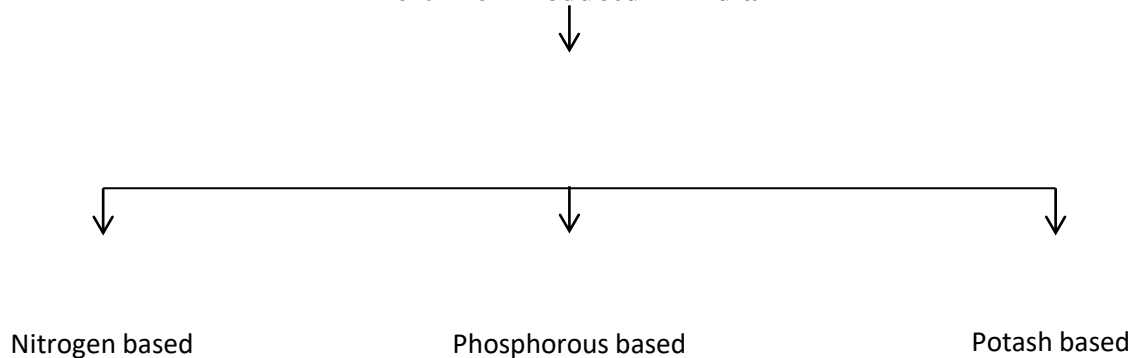
- The two big sites, that are the only producers of copper are Singhbhum (Jharkhand) and Khetri in Rajasthan. Khetri mines receive copper ores from Khetri, Kolihan, Chandmari and Dariba.
- Other major copper industries are Birla Copper Ltd, Dahej (Gujarat) and Swil Copper Ltd, Bharuch (Gujarat).
- Sludge is a residue of chemical fertilizer industry in which limestone is present. The cement industry based on sludge has been set up at Sindri (Jharkhand) and Talcher (Odisha).
- Slag is a residue of the iron and steel industry. The cement industry based on slag has been developed at Durgapur, Saraikela, Bhilai, Rourkela and Bhadravati.

### Fertilizer Industry

- The first fertilizer plant in India was established at Ranipet in 1906.
- The different raw materials needed for this industry are available in India. Consequently, India is third largest producer and consumer of chemical fertilizers in the world.



### **Fertilizer Produced in India**



- After independence in 1961, the process of decentralization began with the setting up of the Fertilizer Corporation of India.

### **Glass Industry**

- Glass is an inorganic product produced by melting a mixture of silica sand, soda ash, limestone with desired metallic oxides that serve as coloring agents.
- Silica sand constitutes 75% of basic material, and hence influences the location of the industry.
- The four main segments of glass industry are container glass, flat glass, fiber glass and specialty glass.
- China, Germany, USA and France are the biggest exporters of glass globally.
- The production of glass in India is predominantly found in the states of Uttar Pradesh followed by Maharashtra, Gujarat, Andhra Pradesh, Tamil Nadu and Karnataka.

### **Oil Refiner Industry**

- The oil and gas sector is among the eight core industries in India and plays a major role in influencing decision making for all other sectors of Indian economy.
- Oil extracted from well is crude oil and contains many impurities and cannot be used directly. It needs to be refined. Two types of refineries are: (a) Field based, eg- Digboi (b) Market based, eg- Barauni.
- India is the third largest consumer of oil in the world in 2017 with consumption of 4.69 mbpd of oil in 2017.

- India became the second largest oil refiner in Asia in May 2018.

### **Public Sector Oil Refineries**

- |                  |                                 |
|------------------|---------------------------------|
| • Assam          | Digboi, Nunamati,<br>Bongaigaon |
| • Bihar          | Barauni                         |
| • West Bengal    | Haldia                          |
| • Andhra Pradesh | Visakhapatnam                   |
| • Tamil Nadu     | Chennai                         |
| • Kerala         | Kochi                           |
| • Karnataka      | Manglore                        |
| • Maharashtra    | Trombay                         |
| • Gujarat        | Koyali                          |
| • Uttar Pradesh  | Mathura                         |
| • Haryana        | Karnal, Panipat                 |
| • Punjab         | Bhatinda                        |

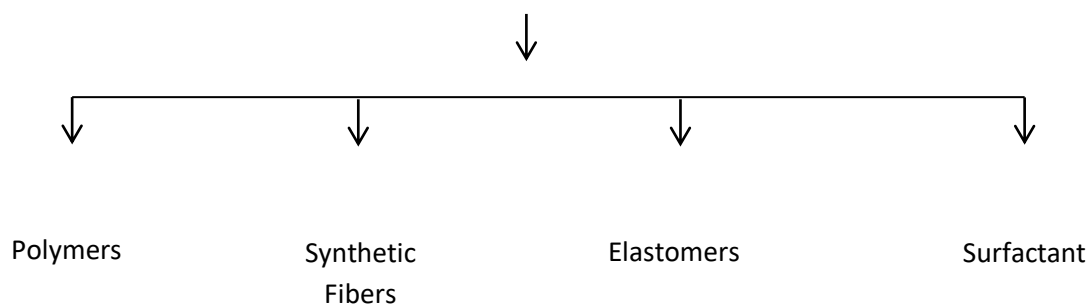
Bina, Bhatinda and Paradip Refineries are under construction.

The Navratna Company ONGC is planning to set up three new refineries. These will be established in Mangalore (Karnataka), Kakinada (Andhra Pradesh) and Barmer (Rajasthan).

### **Petrochemical Industry**

- The petrochemical industry is an industry branch that produces organic intermediate product such as refinery product, natural gas, rubber, plastic and fiber raw material.
- Petrochemical industry plays a vital role in economic growth and development of manufacturing sector.

### **Sub-groups of Petrochemical Industries**



### **Cotton Textile Industry**

- Indian is the World's Second Largest Manufacturer and Exporter of Textiles and Apparels, with a massive raw material and manufacturing base.
- It contributes about 10 percent to the manufacturing production, 2 percent to the GDP and 15 percent to the country's total export.
- In 1818, the first effort to establish this industry was made at Fort Gloster near Kolkata, which was unsuccessful. In 1856, its first successful effort was made by Kabas Ji Dabar Nanabhai in Mumbai.
- At present, the major centers of this industry are Mumbai, Ahmedabad, Coimbatore, Kanpur, Kolkata, Bangalore, Jaipur and Amritsar.

### **Jute Industry**

- Jute textile industry is one of the major industries in the eastern part of India, specifically in West Bengal.
- In 1855, the First Factory of Jute was established at Risra in West Bengal.
- At present, most of the jute industries are concentrated in the regions between Bansberia and Birlapur in the Hugli Industrial Belt.
- This industry is also located at Gorakhpur and Kanpur in Uttar Pradesh; Godavari basin and Visakhapatnam in Andhra Pradesh Guwahati in Assam; Dimapur in Nagaland and Agartala in Tripura.
- The Jute Corporation of India has been set up for its development and modernization.

- India is second largest exporter of Jute items and Bangladesh is the main competitor of India.

### **Cottage Industry**

- It is the traditional industry of India. It involves an investment of less than Rs. 5 lakh involving less than ten workers.
- It is associated with Community Development Programmes, Poverty Alleviation Programmes and Integrated Rural Development Program.

### **Major Cottage Industries**

<b>Industry</b>	<b>Centre</b>
<ul style="list-style-type: none"> <li>• Handloom</li> <li>• Malmal</li> <li>• Chhint</li> <li>• Durri</li> <li>• Khadi</li> </ul>	Meerut, Mathura, Madurai, Varanasi, Ambala, Machilipatnam, Agra, Jhansi, Aligarh, Ambala, Amroha, Calicut, Pune.
<ul style="list-style-type: none"> <li>• Silk Textiles</li> </ul>	Mysore, Kanchipura, Varanasi, Srinagar, Murshidabad, Amritsar, Nathnagar (Bhagalpur)
<ul style="list-style-type: none"> <li>• Woolen Textiles</li> </ul>	Amritsar, Dhariwal, Ludhiana, Machilipatnam, Srinagar, Warrangal
<ul style="list-style-type: none"> <li>• Leather</li> </ul>	Kanpur (Uttar Pradesh)
<ul style="list-style-type: none"> <li>• Gur and Khandsari</li> </ul>	Meerut (Uttar Pradesh)

### **Silk Industry**

- Silk industry occupies a unique position in India. Today, Indian subcontinent is the second largest silk manufacturer with 18% contribution in global raw silk production.
- Silk industry is mostly concentrated in Karnataka, Tamil Nadu, Assam, West Bengal and Andhra Pradesh, Karnataka accounts for more than 70% of the country's total silk production. It engages around 60 lakh workers and involves small and marginal farmers.
- **Central Silk Industry Research Institute** has been established at **Behrampur**

(Kolkata) for the purpose of silk related research.

- The major varieties of silk produced in India are **Mulberry, Tassar, Muga and Eri.**

### **Major Institutes for Cottage/Handicraft Industry**

- 1. Cottage Industry Board -1948**
- 2. Central Silk Board - 1949**
- 3. All India Handloom Board - 1950**
- 4. All India Handicrafts Board - 1953**
- 5. Khadi and Village Industries Board - 1954**
- 6. Small scale Industries Board - 1954**

**Union Textile Ministry** abolished five advisory boards in the Handloom Sector directed towards is systematic rationalization of Government bodies as under-

- All India Handloom Board (July 27, 2020)
- All India Handicraft Board (August 3, 2020)
- Cotton Advisory Board (August 3, 2020)
- All India Powerloom Board (August 4, 2020)
- Jute Advisory Board (August 4, 2020)

### **Sugar Industry**

- Sugar industry is the second largest agro-based industry in India after cotton textile. India is the world's largest producer of sugarcane and second largest producer of sugar after Cuba.
- It is mainly concentrated in the region of raw material because it is a weight losing industry. In 1840, the first sugar industry was set up in Betia (Bihar) but its actual production started from 1931 when protection of this industry was provided by the Central Government.
- Till 1960, Uttar Pradesh and Bihar were the leading sugar producers but later, the tendency of decentralization of this industry started and soon India became a favourable destination because of the favourable climate, black soils having high moisture retention capacity and development of tube well irrigation.

- At present, the major sugar producing states are Uttar Pradesh, Maharashtra, Andhra Pradesh, Tamil Nadu and Punjab.
- The Industrial Cluster Policy for Sugar and the Allied Industries was emphasized in the Industrial Policy of 1980.

### **Paper Industry**

- Indian paper industry is a delicensed sector and 100% FDI inflow is allowed on the automatic route.
- It is a weight loosing industry. Around 22 tonnes of raw materials are needed to produce one tonne paper. Therefore, this industry has been localized in the raw material regions.
- The requirement of raw materials is fulfilled by Bamboo (70%), Sabai Grass (15%), bagasse of sugarcane (7%), softwood (5%) and the rest 3% is fulfilled by the husks of rice, wheat, maize, degraded paper, clothes, eucalyptus and poplar plant.
- The first modernized industry of paper was established in 1832 at Serampore, West Bengal, Andhra Pradesh has the largest contribution in paper industry.
- The major centers of paper industry are Kagaznagar, Triupati and Rajahmundry in Andhra Pradesh; Mumbai and Kalyan in Maharashtra; Mysore and Bhadravati in Karnataka; Bhopal, Indore and Shahdol in Madhya Pradesh; Dalmianagar in Bihar, Yamunangar in Haryana.

### **Leather Industry**

- The growth in demand for leather is driven by the fashion industry, especially footwear.
- The leather industry has a place of prominence in the Indian economy due to substantial export earnings and growth and it accounts for around 12.93% of the world's leather production of hides/ skins.
- West Bengal and Tamil Nadu are the largest producers of cattle hides, Uttar Pradesh and West Bengal for goat skin whereas Rajasthan and Madhya Pradesh also produce substantial quality hides.
- The major footwear production centres in the country include Kanpur, Agra, Lucknow, Kolkata, Chennai, Mumbai, Bengaluru and Jaipur.



## **Pharmaceutical Industry**

- India is the largest provider of generic medicines globally, known as the Pharmacy capital of the World, occupying 20% share in global supplies by volume. The country is home to 3,000 pharma companies with a strong network of over 10,500 manufacturing facilities.
- The cost of production in India is around one-third of that in the US and almost half of that is Europe.
- In terms of value the pharmaceutical industry in India accounts for about 2.4% of the global pharmaceutical industrial production.
- In 1960, Indian Drugs and Pharmaceuticals Ltd. (IDPL) was established. Its main units are located in Rishikesh, Hyderabad, Chennai, Gurugram and Muzaffarpur.
- Ranbaxy is India's first multinational company. It is also doing R&D works for further progress in pharmaceutical sector. Ayurvedic and traditional health care companies like Dabur, Baidyanath, Unjha, Hamdard and Himalaya are doing concerted efforts for the development of new products.

### **Major Units of Heavy Engineering Industry**

- Heavy Engineering Corporation Ltd, Ranchi (1958)
- Mining and Allied Machinery Corporation Limited, Durgapur (1965).
- Bharat Heavy Plants and Vessels Limited, Visakhapatnam (1965)
- Triveni Strutrals Limited, Naini(Allahabad)
- Tungabhadra Steel Products Limited (a Joint undertaking of Karnataka and Andhra Pradesh)
- National Instruments Ltd, Jadavpur (Kolkata)
- Hindustan Machines Tools Ltd (HMT), Bangalore.

There are five factories working under HMT located in Bnegaluru, Pinore (Haryana), Kalamaserry (Kerala), Srinagar and Hyderabad.

## **Railway Equipments**

- The first industry based on railway equipments was established as Peninsular Locomotive Company at Singhbhum district of Jharkhand in 1921. Later, it was named as Tata Engineering and Locomotive Company (TELCO).
- The electric engine is built at Chittranjan Locomotive Works, diesel engine is built at Diesel Locomotive Work, Varanasi and the engine for meter gauge is built at TELCO. The Railway Wagons are produced in Perambur near Chennai, Tamil Nadu.
- The railway wagons are also made at Bharat Earth Movers Ltd (Bangalore), Jessup and Company Ltd (Kolkata), Railway Coach Factory, Kapurthala (Punjab). The new production unit of railway coach factory has been set up Raebareli (Uttar Pradesh) and Kanchrapara (West Bengal).
- Diesel Engine Factory is being set up in Marhowrah (Saran district of Bihar) and Electric Factory is being set up in Madhepura, Bihar.

Name of corridor				Name of Identified Industrial Nodes/cities	
1.	Delhi Mumbai	Industrial Corridor (DMIC)		i.	Ahmedabad-Dholera Invested Region; Gujarat
				ii.	Shendra-Bidkin Industrial Park, Aurangabad, Maharashtra
				iii.	Manesar-Bawal Investment Region, Haryana
				iv.	Khushkhhera-Bhiwadi-Neemrana Investment Region, Rajasthan
				v.	Jodhpur-Pali-Marwar Industrial Park, Rajasthan
				vi.	Pithampur-Dhar-Mhow Investment Region, Uttar Pradesh
				vii.	Dadri-Noida-Ghaziabad Investment Region, Uttar Pradesh
				viii.	Dighi Port Industrial Area, Maharashtra
2.	Chennai-Bengaluru	Industrial Corridor (CBIC)		Krishnapatnam (Andhra Pradesh), Tumkur (Karnataka) and Ponneri (Andhra Pradesh)	
3.	Vizag-Chennai	Industrial Corridor (VCIC)		Visakhapatnam and Srikalahasti-Yerpedu (Andhra Pradesh)	
4.	Bengaluru-Mumbai	Economic Corridor (BMEC)		Dharwad (Karnataka)	
5.	Amritsar-Kolkata	Industrial Corridor (AKIC)		Delhi, Varanasi, Patna, Dhanbad	

- **Rail Wheel Factory** is being set up in Chhapra. Two new factories with components of electric and diesel engine are being established at Danlimo/
- The first railway engine, Thompson, has been constructed by IIT Roorkee.

### **Ship-Building Industry**

- The first ship building factory of India was established at Visakhapatnam in 1941. It was later, nationalized by the Government of India in 1961 and was renamed as Hindustan Shipyard.
- The other major ship-building centers are located at Kolkata, Goa, Mumbai and Kochi. These are all Public Sector Undertakings. The Kochi Dockyard, developed in collaboration with Japan, is the largest and most recent dockyard of the country.
- The Mazagaon Dockyard (Mumbai) builds the naval ships for Indian Navy. A decision has been taken to develop two new international level shipyards under National Maritime Development Programme.

### **Ship Breaking Industry**

- Ship breaking is a green process, wherein a ship at end of its life cycle is being dismantled and each part is sent further for reuse.
- In India, full-fledged ship breaking practices started around 1980s in Mumbai and Kolkata. Later, Alang in Bhavnagar district, Gujarat was developed for ship breaking owing to its various advantages listed below and is considered the world's largest ship breaking facility.

### **Air Craft Industry**

- The first aircraft industry of India was set up under the name of Hindustan Aircraft Company at Bangalore in 1940.
- Today, it is known as Hindustan Aeronautics Limited (HAL).
- The aircraft industry has been set up in Bengaluru, Koraput, Nashik, Hyderabad, Korba, Barrackpore, Kanpur and Lucknow keeping in view the self-reliance in defence equipments.

### **Automobile Industry**

- Automotive industry is considered a sunrise sector of the economy, at present; all types of small and big vehicles are manufactured in the country.
- Companies like Hyundai and Daewoo set up their industrial units in India as well. In fact, automobile industry is a mixture of both manufacturing and assembling.

### **Industrial Corridors**

- It is a package of infrastructure spending allocated to a specific geographical area, with the intent to stimulate industrial development, and is observed along the main routes. Such corridors are constructed in areas that have pre-existing infrastructure such as Seaports, Highways and Railways.

### **Core Industries**

- Department of Industrial Policy and Promotion (DIPP) give the Index of Industrial production.
- The eight core industries have combined weight of 4.27 percent in IIP.
- These particular industries serve as backbone of all other industries in India.
- DIPP revised the base year of Index of eight core industries from 2004-05 to 2011-12

### Classification of Central Public Sector Enterprises

Criteria	Maharatna	Navratna	Miniratna Category-I	Miniratna Category-II
<b>Eligibility</b>	Three years with an average annual net profit of over Rs. 5,000 crore	A score of 60 or above (out of 100), based on six parameters which include net profit, net worth, total manpower cost, total cost of production, cost of services, PBDIT (Profit Before Depreciation, Interest and Taxes), Capital employed etc.	Have made profits continuously for the last three years or earned a net profit of Rs. 30 crore or more in one of the three years.	Have made profits continuously for the last three years and should have a positive net worth.
<b>Benefit for Investment Number</b>	OR Average annual net worth of Rs. 15,000 crore during the last years	OR A company must first to be a Miniratna and have a 4 independent direction on its board before it can be made up a Navratna.		
	Average annual turnover of Rs. 25,000 crore for 3 years Rs. 1,000 crore-Rs. 5,000 crore, or free to decide on investment up to 15% of their net worth in a project 10 Companies	Up to Rs. 1,000 crore of 15% of their net worth on a single project or 30% of their net worth in the whole year (not exceeding Rs. 1,000 crores).	Up to Rs. 500 crore or equal to their net worth, whichever is lower.	Up to Rs. 300 crore or up to 50% of their net worth, whichever is lower.
		14 Companies		

12 Companies

62 Companies

### Central Public Sector Enterprises

#### **Maharatna (Total-11)**

1. Bharat Heavy Electrical Limited
2. Coal India Limited
3. GAIL (India) Limited
4. Indian Oil Corporation Limited
5. NTPC Limited
6. Oil and Natural Gas Corporation Limited
7. Steel Authority of India Limited
8. Bharat Petroleum Corporation Limited
9. Hindustan Petroleum Corporation Limited
10. Power Grid Corporation Limited
11. Power Finance Corporation Limited

- Central Coalfields Limited
- Central Mine Planning & Design Institute Limited
- Chennai Petroleum Corporation Limited
- Cochin Shipyard Limited
- Dredging Corporation of India Limited
- Kamarajar Port Limited
- Garden Reach Shipbuilders and Engineers Limited
- Goa Shipyard Limited
- Hindustan Copper Limited
- HLL Lifecare Limited
- Hindustan Newsprint Limited
- Hindustan Paper Corporation Limited
- Housing and Urban Development Corporation Limited
- India Tourism Development Corporation Limited
- Indian Rare Earths Limited
- Indian Renewable Energy Development Agency

- Projects and Development India Limited
- Railtel Corporation of India Limited
- Rail Vikas Nigam Limited
- Rashtriya Chemicals and Fertilizers Limited
- RITES Limited
- SJVN Limited
- Security Printing and Minting Corporation of India Limited
- South Eastern Coalfields Limited
- State Trading Corporation of India Limited
- Telecommunications Consultants India Limited
- THDC India Limited
- Western Coalfields Limited
- WAPCOS Limited

### **Navratna (Total-13)**

1. Bharat Electronics Limited
2. Container Corporation of India Limited
3. Engineers India Limited
4. Hindustan Aeronautics Limited
5. Mahanagar Telephone Nigam Limited
6. National Aluminium Company Limited
7. National Buildings Construction Corporation Limited
8. NMDC Limited
9. Neyveli Lignite Corporation Limited
10. Oil India Limited
11. Rashtriya Ispat Nigam Limited
12. Rural Electrification Corporation Limited
13. Shipping Corporation of India Limited

### **Miniratna Category – I (Total – 61)**

- Limited
- Indian Trade Promotion Organization
- IRON International Limited
- KIOCL Limited
- Mazagaon Dock Ship builder Limited
- Mahanadi Coalfields Limited
- Manganese Ore India Limited
- Manglore Refinery and Petrochemical Limited
- Mishra Dhatu Nigam Limited
- MMTC Limited
- MSTC Limited
- National Fertilizers Limited
- National Seeds Corporation Limited
- NHPC Limited
- Northern Coalfields Limited
- North Eastern Electric Power Corporation Limited
- Numaligarh Refinery Limited
- ONGC Videsh Limited
- Pawan Hans Helicopter Limited

- HSCC (India) Limited
- Ed. CIL (India) Limited
- National Small Industries Corporation Limited
- Indian Railway Finance Corporation Limited
- Mineral Exploration Corporation Limited

### **Miniratna Category-II (Total-12)**

- Artificial Limbs Manufacturing Corporation of India
- Broadcast Engineering Consultants (I) Limited
- Central Railside Warehouse Company Limited
- Bharat Pumps and Compressors Limited
- Engineering Projects (India) Limited
- FCI Aravali Gypsum and Minerals India Limited
- Ferro Scrap Nigam Limited
- HMT (International) Limited
- Indian Medicines and Pharmaceuticals Corporation Limited

- Airports Authority of India
- Antrix Corporation Limited
- Balmer Lawrie and Co. Limited
- Bharat Coking Coal Limited
- Bharat Dynamics Limited
- BEML Limited
- Bharat Sanchar Nigam Limited
- Bridge and Roof Company (India) Limited
- Central Warehousing Corporation

- MECON Limited
- National Film Development Corporation Limited
- Rajasthan Electronics & Instruments Limited



## 23. Role of Transport

Transport system of a country refers to the different means which carry men and material from one place to the other. Transportation is the foundation stone of economic infrastructure. It helps in the development of trade, commerce and industry. Transportation removes the hindrance of place and facilitates the movement of goods from producers to consumers. It also helps in removing regional inequalities.

Importance of Transport has beautifully explained by Dr. Marshall, “**Most effective economic fact of our times is not the development of manufacturing industries but that of the transport services.**”

Transportation has assumed much importance in developing economy like ours for rapid economic growth. If agriculture and industries are supposed to be the body of the country, transportation may be said to be the nerves and veins of the economy. These days transportation is known as the symbol of civilization.

### I Advantages of Transport:

The advantages of transport can be realised from the social and economic progress of the nation which have been generated by this sector in India during the plan periods.

#### A. Economic Benefits:

##### (i) Better Production in both Agriculture and Industrial Sectors:

Transport system has helped in the growth in industrial and agricultural production. It has been transporting raw materials and labour to the places of production and by carrying the products produced by these sectors to different parts of the country and other countries of the world.

##### (ii) Reduction in Cost of Production:

The transportation network reduces the cost of manufactured goods and lowers the price in the markets.

##### (iii) Reduction in Scarcity:

It helps in solving the problem of scarcity of goods and factors in different regions of the country.

**(iv) Growth in Foreign Trade:**

It helps in promoting foreign trade of the country. A country's exports/imports cannot develop without good parts, shipping and cargo facilities. Thus, transportation system makes a network for transactions among different regions as well as with other countries.

**(v) Specialization of Labour and Mobilization of Resources:**

By the efficient and effective transportation system, the benefits of specialization of labour and proper mobilization can be achieved. Thus, an economic system makes the best use of resources through good transport system.

**(vi) Promotion of Tourism:**

An ideal transportation promotes tourism system or services all over the country.

**(vii) Expands the Market:**

Markets for both industrial and agricultural produce expand both on the domestic and international front with the expansion of transport network. For example, through the expansion of road, rail and water transport, it got good success making links between different parts of the country and with other countries of the world.

## **B. Social Benefits:**

**(i) More Employment Opportunities:**

Transport helps to create employment opportunities and thus, it provides employment through helping mobility of workers. About 18 lakhs people are employed in Indian railways. In the same way, lakhs of people are employed in roadways, shipping and air transport.

**(ii) Education Expansion:**

Developed means of transport helps in the expansion of education even in remote areas of the country. It provides mobility to teachers, students and teaching aids. Means of transport are the source of advertisement also. In this way, they also help in expanding education.

**(iii) Social and Cultural Spirit:**

Means of transport brings together persons living at different corners of the country. They exchange their views. They have the common problems, because of their living together. Consequently social and cultural unity emerges. Thus, developed means of transportation are also responsible for international brotherhood.

**(iv) Higher Standard of Living:**

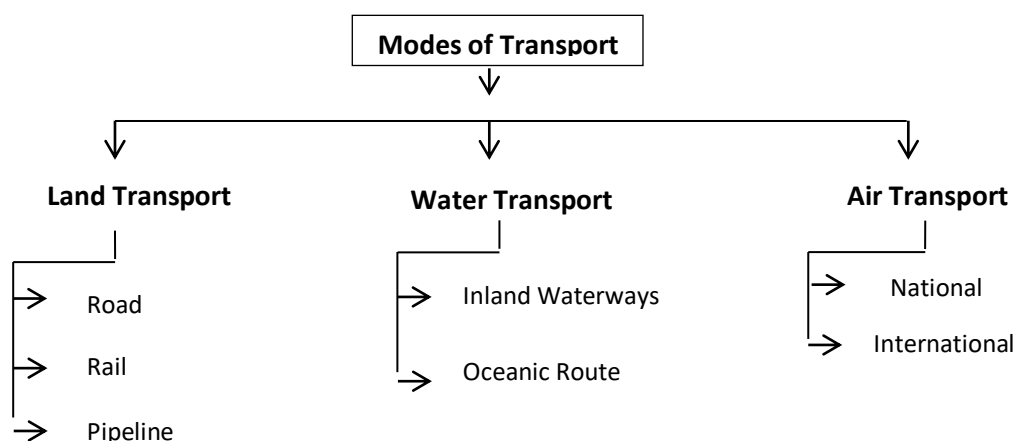
Transportation has reduced distance. As a result, we enjoy the position to use various varieties of things produced in different corners of the world. These standard commodities increase our standard living which depends upon goods and services, we consume.

**(v) Relationship between Villages and Cities:**

Means of transport has reduced distance between villages and cities. Men and materials move from villages to cities and from cities to villages. Villagers can now avail of the employment opportunities available in cities. Villages, in close contact of cities develop faster.

## Modes of Transportation

The main modes of transportation are land, water, air and pipelines. These are used for inter-regional and intra-regional transport, and each one (except pipelines) carries both passengers and goods. Several places (nodes) join together by a series of routes (links) to form a pattern is called transport network.

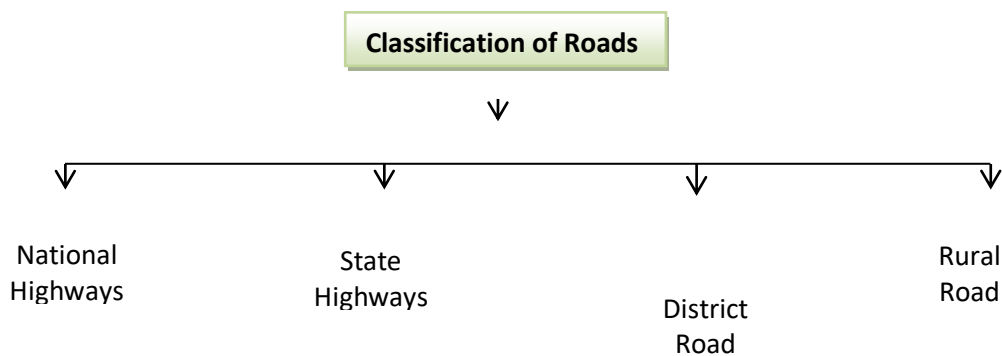


## Road Transport

- It is the easiest and cheapest medium to cover short and medium distances. India has the second largest road network across the world spanning over more than 62 lakh km<sup>2</sup>. This road network transports 69% of all goods in the country and 90% of India's total passenger traffic uses road network to commute.

### Length of Roads Annual Report (2020-2021)

• National Highways/Expressways	1,36,440 km
• State Highways	1,76,818 km
• Others	59,02,539
<b>Total</b>	<b>62,15,797</b>



### National Highways

- National Highways are the arterial roads of the country for inter-state movement of passengers and goods.
- Their construction and maintenance is the responsibility of the National Highways Authority of India (NHAI).

### State Highways

- These roads link all important centres of industry, trade and commerce of the state. .
- Maharashtra has maximum length of state highway followed by Gujarat, Madhya Pradesh, Rajasthan and Andhra Pradesh.

- State highways are constructed and maintained by the state Public Works Department (PWD).
- According to the Annual Report (2020-2021) of Ministry of Road Transport and Highways, total length of state highways is 1,76,818 km.

The Char Dham Mahamarg Vikas Pariyojana is an ambitious initiative to improve connectivity to the Char Dham Pilgrimage centres in the Himalayas.

### District Roads

- These roads mostly connect the towns and large village with one another and with the district headquarters and local railway station. The construction and maintenance of these roads lies within the jurisdiction of Zila Parishad and PWD.

### Golden Quadrilateral Project

This is a high speed four lane National Highway project connecting four major metropolitan cities - Delhi, Mumbai, Chennai and Kolkata. The total length of this project is 5,846 km.

### North-South & East-West Transport Corridors

The North-South Corridor is 4,000 km long highway, connecting Srinagar to Kanyakumari. The East-West Corridor is 3,300 km long highway, connecting Silchar in Assam to Porbandar in Gujarat. Its total length is 7,300 km.

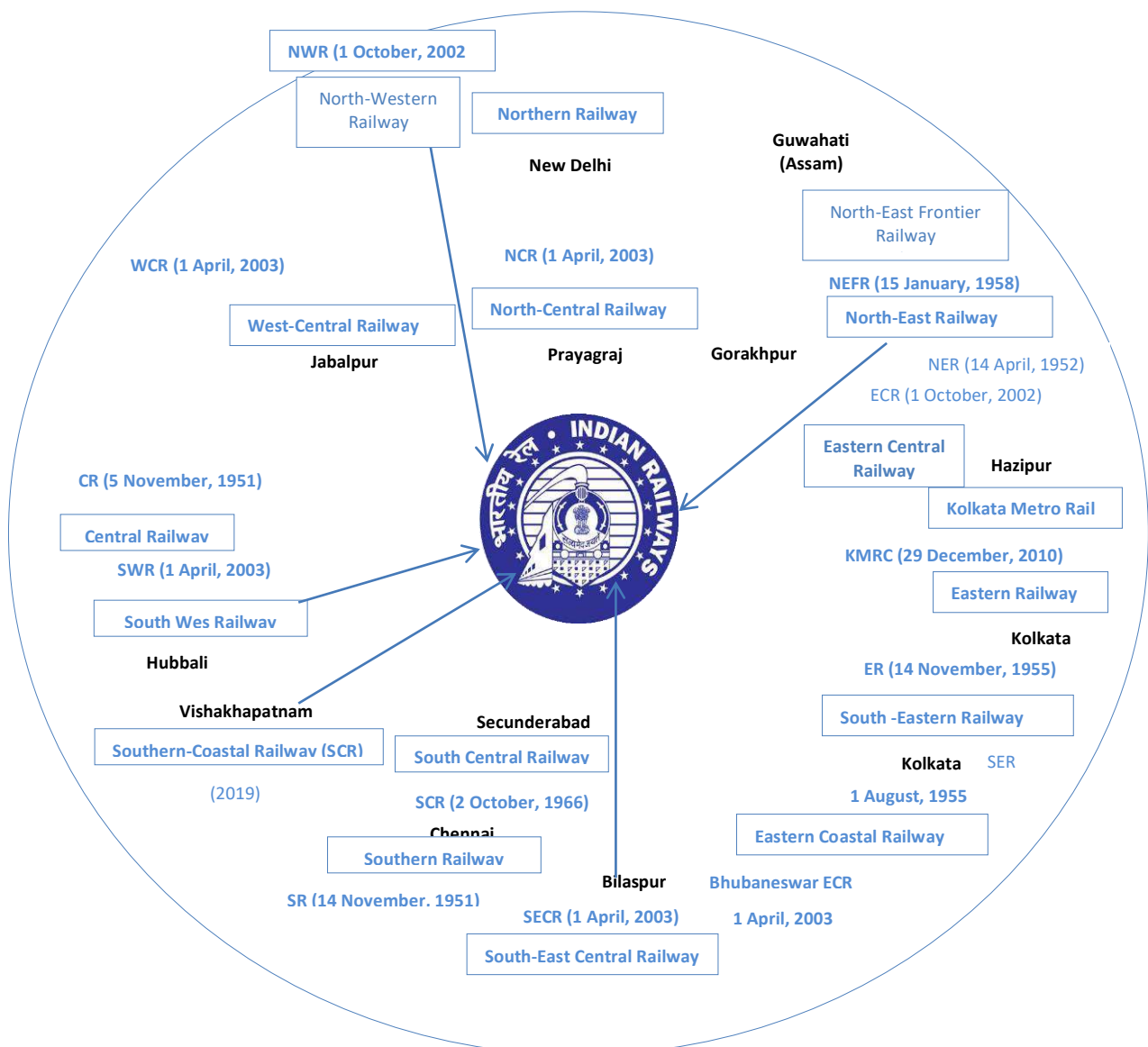
S.No.	Production Unit	Place	Product
1.	Chittaranjan Locomotive Works	Chittaranjan (WB)	Electric Locomotive
2.	Integral Coach Factory	Chennai (TN)	Coach
3.	Rail Coach Factory	Kapurthala (Punjab)	Coach
4.	Diesel Locomotive Works	Varanasi (UP)	Diesel Locomotive
5.	Diesel Loco Modernisation Works	Patiala (Punjab)	Locomotive Manufacturing rebuilding
6.	Rail Wheel Factory	Bengaluru (Karnataka)	Wheel, Axle
7.	Rail Wheel Plant	Saran (Bihar)	Wheel
8.	Electric Locomotive Factory	Madhepura (Bihar)	Electric Locomotive
9.	Diesel Locomotive Factory	Marhowra (Bihar)	Diesel Locomotive
10.	Modern Coach Factory	Raebareli (UP)	Coach

## 24. Rail Transport

Rail Transport network in India is one of the longest in the world. It facilitates the movement of both freight and passengers and contributes to the growth of economy. The first train steamed off from Mumbai to Thane, a distance of 34 km in 1853.

- The formal inauguration ceremony was performed on 16th April 1853, when 14 railway carriages carrying about 400 guests left Bori Bunder at 3.30 pm "amidst the loud applause of a vast multitude and to the salute of 21 guns." The first passenger train steamed out of Howrah station destined for Hooghly, a distance of 24 miles, on 15th August, 1854. Thus the first section of the East Indian Railway was opened to public traffic, inaugurating the beginning of railway transport on the Eastern side of the subcontinent.
- The Indian Railway Network (67,368 km) is the fourth largest network in the world after USA (2, 28,218 km), China (1,03,100 km) and Russia (85,266 km).

### INDIA: RAILWAY ZONE



- The total length of railway line is maximum in Uttar Pradesh (9077.45 km) followed by Rajasthan (5839.10 km), Maharashtra (5745.48 km), Gujarat (5258.49 km) and Madhya Pradesh (5000 km).
- Vivek Express is the longest rail route of the country, which covers the distance of 4,273 km from Dibrugarh to Kanyakumari. Before this, Himsagar Express was the longest rail route covering distance of 3,787 km from Jammu Tawi to Kanyakumari.
- Indian Railways is a multi-gauge, multi-traction system covering the following:

Track Kilometers	Broad Gauge (1676 mm)	Meter Gauge (1000 mm)	Narrow Gauge (762/610 mm)	Total
	86,526	18,529	3,651	108,706
Route Kilometers	Electrified	Total		
	16,001	63,028		

#### Other Interesting facts of Indian Railways

- Indian Railways runs around 11,000 trains everyday, of which 7,000 are passenger trains

7566 - locomotives	37,840 - Coaching vehicles	222,147 - Freight wagons	6853 - Stations
300 - Yards	2300 - Good sheds	700 - Repair shops	1.54 million - Work force

#### Types of Track / Gauge

Gauge	Network Coverage
• Board Gauge (1.676 m)	63,950 km
• Metre Gauge (1.0 m)	2,402 km
• Narrow Gauge (0.762 m)	1,604 km

#### Major Expressways

Expressway	Length (km)	State
• Purvanchal Expressway (Longest Exp. Way in India)	340.8	Uttar Pradesh
• Yamuna Expressway	165.00	Uttar Pradesh
• Mumbai-Nashik	150.00	Maharashtra
• Ahmedabad-Vadodra	93.00	Gujarat

• Mumbai-Pune	93.00	Maharashtra
• Jaipur-Kisangarh	90.00	Rajasthan
• Allahabad Bypass	86.00	Uttar Pradesh
• Durgapur Expressway	65.00	West Bengal
• Chennai Bypass	32.00	Tamil Nadu
• Delhi-Gurgaon	28.00	Delhi-Haryana
• Noida-Greater Noida	24.53	Delhi-Uttar Pradesh
• Delhi-Noida Flyaway	9.20	Delhi-Uttar Pradesh
• Hyderabad Elevated	11.60	Andhra Pradesh
• Hosin road Elevated	9.90	Karnataka
• Hyderabad outer ring road	58.00	Telangana
• Raipur-Bhilai-Durg	26.00	Chhattisgarh
• Agra-Lucknow Expressway	302	Uttar Pradesh
• Eastern Peripheral Exp. Way NE-2	135	Haryana – UP
• Bengaluru Elevated Tollway	9.9	Karnataka
• Delhi-Meerut Exp. Way NE-3	96	Delhi-UP

- Bairabi Sairang Railways: It was started on 29<sup>th</sup> November, 2014 which aimed to connect Bairabi to Sairang Railway Station (Mizoram).
- Jiribam Tubul Imphal Railways: This railway line will link capital of Manipur, Imphal with Jiribam using Broad Gauge network of the country.



## 25. Air Transport

- The air transport in India was started in February, 1911 when the world's first Aeroplane Postal Service was started between Allahabad and Naini.
- The Indian Airlines Corporation, headquartered in New Delhi, was established to facilitate the airway service within the country.

Indira Gandhi International Airport was the busiest airport in terms of international passengers during financial

### Timeline of Air India

- 1932: Tata Airlines was started by J.R.D. Tata
- 1946: Tata Airlines become Air India
- 1953: Indian Airlines Corporation was established and started its operation
- 1981: Vayudoot was founded as joint venture between Air India and Indian Airlines
- 1993: Vayudoot merged into Indian Airlines
- 1996: Alliance Air (now Air India Regional) was formed as a subsidiary of Indian Airlines
- 2005: Indian Airlines was rebranded as Indian
- 2011: Indian merged with Air India

### Major International Airports

1. Netaji Subhash Chandra Bose International Airport, Kolkata
2. Chennai International Airport, Chennai
3. Thiruvananthapuram International Airport
4. Sardar Vallabhbhai Patel International Airport, Ahmedabad
5. Guru Ram Dass Jee International Airport, Amritsar
6. Lokpriya Gopinath Bordoloi International Airport, Guwahati
7. Dabolin International Airport (Civil Enclave)
8. Srinagar International Airport, Srinagar (Civil Enclave)
9. Jaipur International Airport
10. Kozhikode Airport, Calicut
11. Veer Savarkar International Airport (Civil Enclave), Port Blair, Andaman and Nicobar Islands
12. Indira Gandhi International Airport, Delhi
13. Chhatrapati Shivaji International Airport, Mumbai

14. Rajeev Gandhi International Airport, Hyderabad
15. Kempegowda International Airport Bengaluru
16. Cochin International Airport, Kochi (Private)
17. Dr. B.R. Ambedkar International Airport, Nagpur
18. Vishakhapatnam International Airport
19. Vijaywada Airport, Vijaywada
20. Biju Patnaik International Airport, Bhubaneswar

## 26. Water Transport

Waterways are an important mode of transport for both passenger and cargo traffic in India. It is the cheapest means of transport and is most suitable for carrying heavy and bulky material. It is a fuel-efficient and eco-friendly mode of transport.

The water transport is of two types– (a) inland waterways, and (b) oceanic waterways:

### **Inland Waterways**

It was the chief mode of transport before the advent of railways. It, however, faced tough competition from road and railway transport. Moreover, diversion of river water for irrigation purposes made them non navigable in large parts of their courses. India has 14,500 km of navigable waterways, contributing about 1% to the country's transportation. It comprises rivers, canals, backwaters, creeks, etc. At present, 5,685 km of major rivers are navigable by mechanised flat bottom vessels.

### **Inland Waterway Authority of India**

It was established in 1986 for the purpose of development, maintenance and regulation of the inland waterways. Its headquarter is in Noida while the regional centres are located in Patna, Kolkata, Guwahati and Cochin.

In 2015-16, the Government of India declared 106 National Waterways under Inland Waterways Authority of India (IWAI). It reduces the cost of transportation and lowers the carbon footprints.

### **Oceanic Ways**

India has a vast coastline of approximately 7,517 km, including islands. Twelve major and 185 minor ports provide infrastructural support to these routes. Oceanic routes play an important role in the transport sector of India's economy. Approximately 95 per cent of India's foreign trade by volume and 70 per cent by value moves through ocean routes. Apart from international trade, these are also used for the purpose of transportation between the islands and the rest of the country.

# Sagarmala Project

- It is the flagship, strategic and customer oriented initiative of Union Government to achieve the broad objective of promoting port led economic development in India.
- The ambitious programme seeks to harness vast potential of India's 7,500 km long coastline and 14,500 km of potential navigable waterways following port connectivity enhancement, port linked industrialization and coastal community development. It involves phase wise implementation over the period of 2015-2035.

## National Waterways of India

waterways	Stretch	Specification	Declaration Date
NW 1	Prayagraj-Haldia 1,620 km	It is one of the most important waterways in India, which is navigable by mechanical boats and ordinary boats up to Haridwar.	27 Oct, 1986
NW 2	Sadiya-Dhubri 891 km	Brahmaputra is navigable by streamers up to Dibrugarh (1,384 km) which is shared by India and Bangladesh.	26 Oct, 1988
NW 3	Kottapuram Kollam 20 km	It includes 168 km of west coast canal along with Chamapkara canal (23 km) and Udyogmandal canal (14 km).	01 Feb, 1991
NW 4	Kakinada, Puducherry 1,995 km	Stretch of canal and Kalurelly Tank stretches along river Godavari and Krishna.	24 Nov, 2008
NW 5	Talcher, Dhamra 585 km	Stretch of river Brahmani, Geonkhali Cherbatia stretch of East coast canal. Stretch of Matai river alongwith Mahanadi delta river system	24 Nov, 2008
NW 6	Bhanga- Laxhipur	Laxhipur to Bhanga on Barak river	14 Aug, 2013

## 27. Oil and Gas Pipeline Network

- Oil and Gas Pipelines are the most convenient and efficient mode of transporting liquids and gases over long distances. Even solids can also be transported by pipelines after converting them into slurry.
- Oil India Limited (OIL) under the administrative set up of the Ministry of Petroleum and Natural Gas is engaged in the exploration, production and transportation of crude oil and natural gas. It was incorporated in 1959 as a company.
- Asia's first cross country pipeline covering a distance of 1,157 km was constructed by OIL from Naharkatiya oilfield in Assam to Barauni refinery in Bihar. It was further extended up to Kanpur in 1966. Another extensive network of pipelines has been constructed in the western region of India of which Ankleshwar-Koyali, Mumbai High-Koyali and Hazira-Vijaipur-Jagdishpur (HVJ) are most important.
- Recently, a 1256 km long pipeline connecting Salaya (Gujarat) with Mathura (U.P.) has been constructed. It supplies crude oil from Gujarat to Punjab (Jalandhar) via Mathura. OIL is in the process of constructing of 660 km long pipeline from Numaligarh to Siliguri.

### Major Oil/Natural Gas Pipelines

Pipelines	Length (in km)
1. Hazira-Vijaipur-jagdishpur	1,750
2. Salaya-Mathura-Panipat	1,870
3. Kandla-Bhatinda	1,331
4. Mumbai-Manmad	1,389
5. Duliajan-Bongaigaon-Barauni	1,405
6. Naharkatia-Nunmati-Barauni	1,167

7. Mundra-Panipat	1,174
8. Barauni-Haldia	943
9. Barauni-Patna-Kanpur	743
10. Chennai-Trichy-Madurai	683
11. Kochhi Mangluru	450

## 28. Postal System

- For more than 150 years, the Indian Postal Service has helped the country to engage in communication and social-economic development. It has succeeded in touching the lives of people across the country from delivering mails to accepting deposits and providing retail services like bill collection, sale of forms, etc.
- The establishment of the modern postal system in India can be traced back to the second half of the 18th century. For the facility of prepayment of postage on letters, 'Copper Tickets', pre-paid token stamps in 2 Annas value were introduced from Patna in 1774 by the East India Company during the period of Warren Hastings, the then Governor General of India.
- The postal system was thrown open to the public in 1837. The first postal stamp was issued in 1852 in Karachi. The Indian Post office was recognized as institution in 1854.
- Post independent, India's first postal stamp was issued on 21 November 1947. The independent India's first postal stamp depicted the picture of national flag of Indian. Mahatma Gandhi was the first person whose picture was depicted on free India's stamp (1948).
- India is divided into 23 postal circles. Each circles is divided into regions. These regions are further divided into divisions and subdivisions.
- Pin Code System was introduced in India on 15th August, 1972 by Shriram Bhikaji Velankar.

### **Indian Postal Service (IPoS) – Functions**

1. Monitoring and management of divisional postal services
2. Overall administration of Mail and Post offices in a division
3. Optimization and expansion planning of the postal network inside a division
4. Management of technology, finances and materials.
5. Marketing of India Post services and products such as Banking and Insurance
6. Handling Public Grievance Redressal System and customer relations
7. Coordinating with other government agencies such as Police, District Administration etc.
8. Management of personnel in the division.

## 29. Tele - Communication

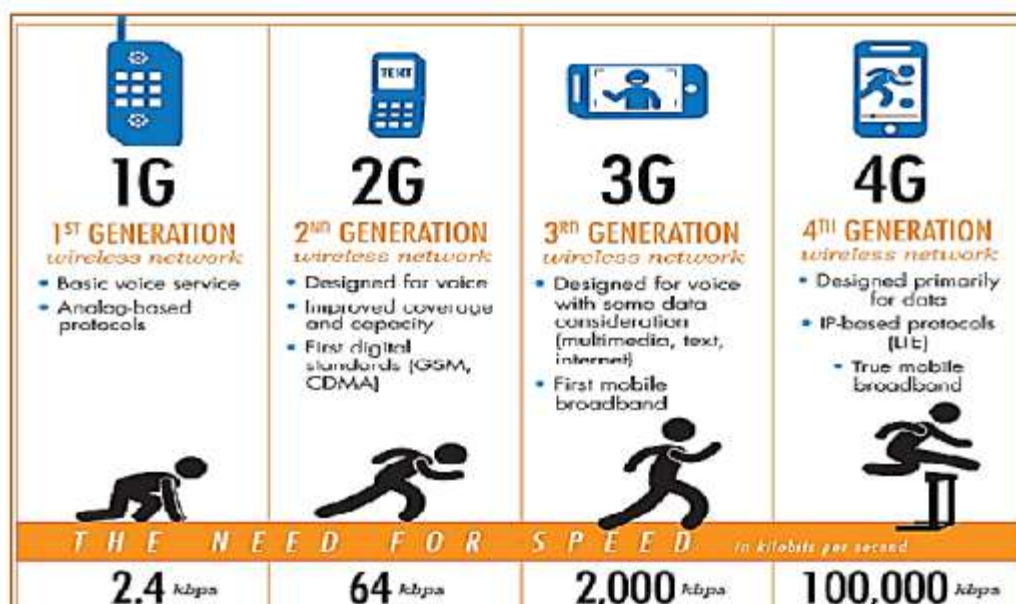
- Telephone Service was started in Kolkata in 1881-82 and the first automatic telephone exchange was commissioned at Shimla in 1913-14.
- India has the second largest telecom network in the world after China, whereas with 422.19 million internet subscribers India is the 3rd largest country in terms of total internet users. India is the 2nd largest smartphone market in the world.
- National Digital Communication Policy, 2018 envision India's transition to a digitally empowered society.
- In India, the total subscriber base stood at 1178.41 million in December 2021.
- Tele-density of rural subscribers reached 44.40% in December 2021. From around 4,200 petabytes in 2018, India's overall wireless internet data usage has increased by almost 7x to 32,397 petabytes in 2021.
- India is the world's second-largest telecommunications market. The total subscriber base, wireless subscriptions as well as wired broadband subscriptions have grown consistently. Tele-density stood at 85.91%, as of December 2021, total broadband subscriptions grew to 792.1 million until December 2021 and total subscriber base stood at 1.18 billion in December 2021.
- Gross revenue of the telecom sector stood at Rs. 64,801 crore (US\$ 8.74 billion) in the first quarter of FY22.
- The total wireless data usage in India grew 16.54% quarterly to reach 32,397 PB in the first quarter of FY22. The contribution of 3G and 4G data usage to the total volume of wireless data usage was 1.78% and 97.74%, respectively, in the third quarter of FY21. Share of 2G data usage stood at 0.48% in the same quarter.
- Over the next five years, rise in mobile-phone penetration and decline in data costs will add 500 million new internet users in India, creating opportunities for new businesses.
- By 2025, India will need ~22 million skilled workers in 5G-centric technologies such as Internet of Things (IoT), Artificial Intelligence (AI), robotics and cloud computing.



### Telecom Sector Gross Revenue (US\$ billion)



- Growth in the wireless sector (technology getting upgraded from 1G to 4G) has resulted in a significant boom in the data usability space, providing users with mobile broadband and fast speed data services.



### Achievements

Following are the achievements of the Government in the past four years:

- Department of Telecommunication launched 'Tarang Sanchar' - a web portal sharing information on mobile towers and EMF Emission Compliances.
- Payments on unified payments interface (UPI) hit an all-time high of 3.65 billion (by volume), with transactions worth ~Rs. 6.54 trillion (US\$ 87.11 billion) in September 2021.
- Over 75% increase in internet coverage from 251 million users to 446 million.

## 30. Concepts of Town

- Urban areas have been recognized as “engines of inclusive economic growth”. Of the 121 crore Indians, 83.3 crore live in rural areas while 37.7 crore stay in urban areas, i.e approx 32 % of the population. The census of India, 2011 defines urban settlement as :-
- In simple term Urbanization is defined as a process of developing a rural or semi-urban area into a fully functional and developed town, equipped with all the basic and modern amenities.
- Urbanization can also be defined as the increase in the proportion of population of country living in urban areas and increase in percentage of population engaged in non-agricultural activities.
- Urbanization is closely linked to modernization, industrialization and the social process of rationalization.

All the places which have municipality, corporation, cantonment board or notified town area committee

All the other places which satisfy following criteria :

- a. A minimum population of 5000 persons ;
- b. At least 75 % of male main working population engaged in non-agricultural pursuits ; and
- c. A density of population of at least 400 persons per square kilometer

**The first category** of urban units are known as Statutory town. These town are notified under law by respective State/UT government and have local bodies like municipal corporation, municipality, etc, irrespective of demographic characteristics. For example- Vadodara (Municipal corporation), Shimla (Municipal corporation)

**The second category** of towns is known as Census Town. These were identified on the basis of census 2001 data. Cities are urban areas with more than 100,000 population. Urban areas below 100,000 are called towns in India

**Similarly Census of India defines:-**

Urban Agglomeration (UA): An urban agglomeration is a continuous urban spread constituting a town and its adjoining outgrowths (OGs), or two or more physically contiguous towns together with or without outgrowths of such towns. An Urban

Agglomeration must consist of at least a statutory town and its total population (i.e. all the constituents put together) should not be less than 20,000 as per the 2001 Census. In varying local conditions, there were similar other combinations which have been treated as urban agglomerations satisfying the basic condition of contiguity. Examples: Greater Mumbai UA, Delhi UA, etc.

**Out Growths (OG):** An Out Growth (OG) is a viable unit such as a village or a hamlet or an enumeration block made up of such village or hamlet and clearly identifiable in terms of its boundaries and location. Some of the examples are railway colony, university campus, port area, military camps, etc., which have come up near a statutory town outside its statutory limits but within the revenue limits of a village or villages contiguous to the town.

While determining the outgrowth of a town, it has been ensured that it possesses the urban features in terms of infrastructure and amenities such as pucca roads, electricity, taps, drainage system for disposal of waste water etc. educational institutions, post offices, medical facilities, banks etc. and physically contiguous with the core town of the UA. Examples: Central Railway Colony (OG), Triveni Nagar (N.E.C.S.W.) (OG), etc.

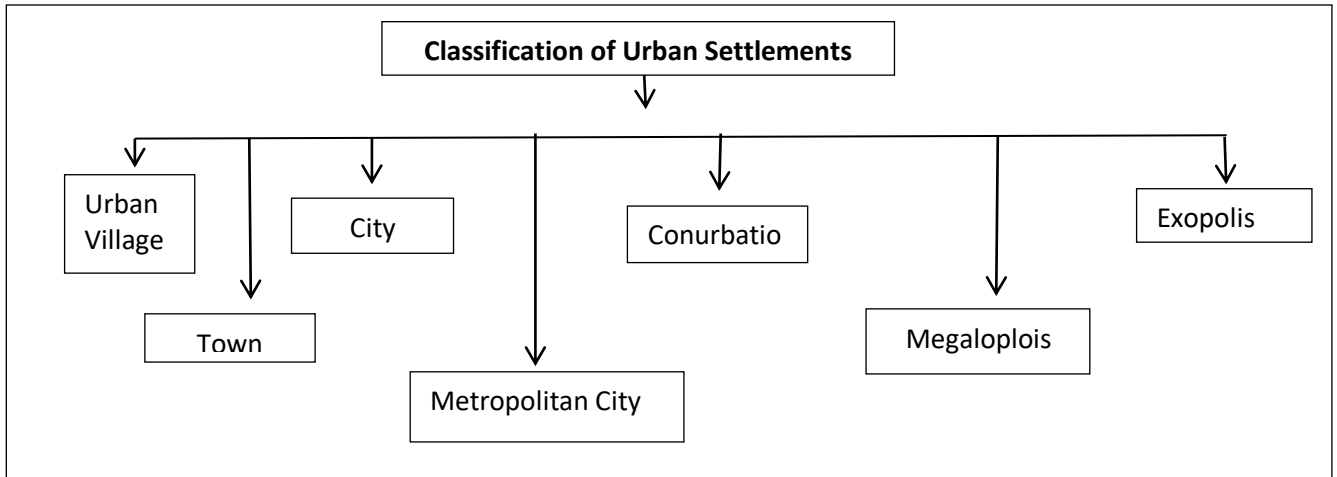
Each such town together with its outgrowth(s) is treated as an integrated urban area and is designated as an 'urban agglomeration'. Number of towns/UA/OG 2011, according to Census 2011 Census are :-

S. No.	Classification of Towns	No. of Towns
1	Statutory Towns	4,041
2	Census Towns	3,894
3	Urban Agglomerations	475
4	Out Growths	981

States with Maximum Urban Population			
State Population (in Million)		State Population (in %)	
1. Maharashtra	50.81	Goa	62.2
2. Uttar Pradesh	44.49	Mizoram	52.10
3. Tamil Nadu	34.91	Tamil Nadu	48.45
4. West Bengal	29.09	Kerala	47.72
States with Minimum Urban Population			
State Population (in Million)		State Population (in %)	
1. Sikkim	0.153	Himachal	10
2. Arunachal Pradesh	0.317	Bihar	11.3
3. Nagaland	0.570	Assam	14.1

## 31. Classification of Urban Settlements

- Urban settlement is a heavily populated area in which working population is involved in secondary (industry) and tertiary (service) sector.



- The definition of urban settlement is mainly based upon the population size, density, local government and economic activities of local government and economic activities of locals.

### Urban Village

- It is transitional zone of urban development in which both the rural and urban functions are observed.
- The working population in an urban village is engaged in non-agricultural activities. However, the land use is dominated by agricultural and allied activities. Thus, it is also termed as Rurban Centre, Market Town, Semi-Urban Town and Rural Town.

### City

- It is larger than town and has greater number of economic functions especially in term of secondary and tertiary activities having population between 10,000-99,999 is known as city.

### Metropolitan City

- According to the Census 2011, metropolitan cities are the cities of Urban Agglomeration having population of 1 million or more. Metropolitan cities are also known as million plus

cities. Metropolitan cities are also known as million plus cities. Metropolis is essentially the products of centralisation of administration politics and economic forces of nation.

- Mumbai, Chennai and Kolkata are major metropolis of India since British rule. These metropolis remain as a centre of economic affairs. Delhi was also included in this list after 1911 when it became the capital city of India.

### **Conurbation**

- The word Conurbation was first used by Patrick Geddes in 1915.
- It is used to describe coalescence of urban settlement which was separated by open space, through Ribbon Development, along the main inter-urban transport routes. Conurbations are seen near Delhi, Kolkata and Mumbai.
- A similar conurbation is developing in the north-western part of India in cities of Agra, Mathra, Hodal, Ballabhgarh, Faridabad, Gurugram, Delhi, Sonipat, Panipat, Karnal, Kurukshetra, Ambala, Chandigarh and Panchkula.

### **Megalopolis**

- Megalopolis is a Greek word, meaning Great City. This word was first used by Jean Gottmann in 1957. It is similar to conurbation and is formed when a large city sprawls and because of its functionality or occupational structure, brings into its fold nearby towns and cities. The population of a Megalopolis is more than 10million.
- Exopolis is a city that no longer conveys the traditional qualities of city. High growth of outer city and city edges can be observed that led to more urban life. The foremost example is Los Angeles and USA.

## 32. Functional Classification of Towns

The structure and functions of any towns varies the basis of various features, viz., population , geographical location , area etc. Some towns and cities specialise in certain functions and they are known for some specific activities, products or services. However, each town performs a number of functions.

The major functions which the town perform are, of course , non-agricultural or tertiary in nature. For instance, some towns perform administrative functions, some name industrial functions , some are cultural centre and so on.

In India, first attempt was made by Amrit Lal (1959). He used the Locational Quotient (L.Q.) method to determine the functional classification of the class I cities. According to Lal all the class I cities of India, except a few multifunctional in nature.

Qazi Ahmad (1965) used 62 variable to classify 102 Indian cities on the basis of their functions.  $\propto$  Ashok Mitra (1971,1973) used seven categories of workers as variables grouped into three major functional type i.e. manufacturing, trade & transport and services .

M. Aurousseau (1921) recognized six classes of towns according to their functions described as under:

### **Production Centres**

- These are associated with industrial production and are popularly known as industrial towns uh as Jamshedpur, Bokaro, Bhilai etc.

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- These are associated with industrial production and are popularly known as industrial towns uh as Jamshedpur, Bokaro, Bhilai etc.

### **Defence Towns**

- The aim of these towns is to provide security and arrangement for defence of the country. These towns are characterised by cantonments, barracks, military training centre, garrisons and naval headquarters

### **Administrative Town**

- The main function of these towns is to administer a given area under district, state of the county fucg as New Delhi, Gandhinagar, Aizawal, Chheani, Porta Blair etc. National Capital territory of Delhi is the largest administrative city in India.



### **Educational Towns**

- The towns which grow due to their educational facilities come under this category like Roorkee, Aligarh, Kota, Pilani etc.

### **Trading Centres**

- There are several cities and towns in the country that depend on trade for their growth. Mumbai, Chennai, Bengaluru, Kolkata are among the big trading centres of the country.

### **Mining Towns**

- These are developed due to the mining activities in towns of Jharia, Singbhum, Dhanbad, khetri etc.

### **Residential Towns**

- These towns are developed to provide residential accommodation to urban people such as Partapur near Meerut, Mohali near Chandigarh and Rajnagar near Ghaziabad etc.

### **Transport Centres**

- These towns are mostly found at the junction of two different type of transportation system (say where rail transport ends and road transport ends and road transport starts) such as Kathgodam, Mumbai, Visakhapatnam, Agra,etc.

### **Seaports**

- These are providing facilities of import and export. Some of the major seaports are Kandla, Mumbai, Paradip, Haldia and Tuticorin

### **Religious and Cultural towns**

- These towns are famous for their cultural, spiritual and religious attributes. Some of the important towns are Haridwar, Allahabad, Ajmer, Amritsar, Bodh Gaya, Rameswaram and Kedarnath.

### **Tourist and Resort Centres**

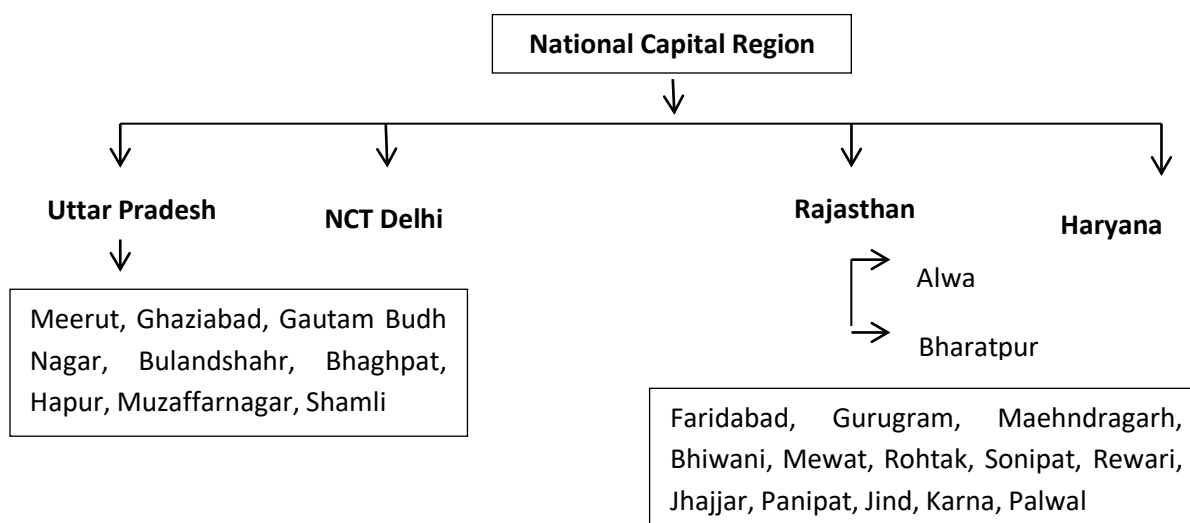
- These are famous for their healthy climate, natural or man-made beauty and facilities for fun and sports like Manali, Ooty, Darjeeling, Mussoorie, beaches of Goa and Chennai etc.

## 33. National Capital Regions of India

- In 1985, a broad plan for the development of Delhi and its surrounding areas i.e. NCR, was started. Its boundaries were determined by statistics cum experience.
- National Capital Region (NCR) is a unique example of inter-state regional planning and development for a region with NCT-Delhi as its core. The NCR as notified covers the whole of NCT-Delhi and certain districts of Haryana, Uttar Pradesh and Rajasthan, covering an area of about 55,083 sq. kms. The sub-region wise area details are as under

### Facts about the National Capital Region:

- Districts in three neighbouring states of Haryana, Uttar Pradesh and Rajasthan, along with whole of the National Capital Territory of Delhi constitute the National Capital Region (NCR) of India, as defined in National Capital Region Planning Board (NCRPB) Act, 1985
- **Delhi:** Delhi constitutes about 2.9 percent of the land area of the Region.
- **Areas under Uttar Pradesh:** Meerut, Ghaziabad, Gautam Budh Nagar, Bulandshahr, Baghpat, Hapur and Muzaffarnagar.
- **Areas under Haryana:** Faridabad, Gurgaon, Mewat, Rohtak, Sonipat, Rewari, Jhajjar, Panipat, Palwal, Mahendragarh, Bhiwani, Jind and Karnal.
- **Areas under Rajasthan:** Bharatpur and Alwar.
- 



## National Capital Region



## Functions of National Capital Region Planning Board

- To co-ordinate the **enforcement and implementation of the regional plan, functional plans**, sub-regional plans and project plans through the participating states and the NCT, Delhi
- To ensure proper and systematic programming by the participating states and the NCT Delhi in regard to project **formulation and phasing of development** of the National Capital Region in accordance with stages indicated in the regional plans.
- To arrange for, and oversee, the **financing of selected development projects in the NCR** through central and state plan, funds and other sources of revenue.

## 34. Slums in India

- The word “slum” is used to describe informal settlements within cities with inadequate housing and miserable living conditions. They are often overcrowded, with many people crammed into very small living spaces. Slums are not a new phenomenon as they have been a part of almost all cities, particularly during a time of urbanisation and industrialisation. Slums are generally the only type of settlement affordable and accessible to the poor in cities, where competition for land and profits is intense. The main reason for slum proliferation is rapid and non-inclusive patterns of urbanisation catalysed by increasing rural migration to urban areas.
- Slums manifest deprivation that transcends income poverty. Slum dwellers in India are characterised by acute over-crowding, insanitary, unhealthy and dehumanising living conditions. They are subject to insecure land tenure, lack of access to basic minimum civic services such as safe drinking water, sanitation, storm drainage, solid waste management, internal and approach roads, street lighting, education and health care, and poor quality of shelter.
- Many of these habitations are located in environmentally fragile and dangerous zones prone to landslides, floods and other disasters that make the poor residents highly vulnerable. A significant proportion of the slum dwellers also face social burdens and health problems worse than their non-slum and rural counterparts. Civic bodies do not provide the required municipal services in slums on the plea that these are located on ‘illegal’ space. Moreover, the problem’s scale is so colossal that it is beyond the means of Municipalities that lack a buoyant fiscal base.
- Under Section-3 of the Slum Area Improvement and Clearance Act, 1956, slums have been defined as mainly those residential areas where dwellings are in any respect unfit for human habitation by reasons of dilapidation, overcrowding, faulty arrangements and designs of such buildings, narrowness or faulty arrangement of streets, lack of ventilation, light, sanitation facilities or any combination of these factors which are detrimental to safety, health and morals.

- As per UN Habitat a slum is characterized by lack of durable housing, insufficient living area, lack of access to clean water, inadequate sanitation and insecure tenure. → The slum population in India has increased during 2001-11.

## Probable reasons for upcoming slums

- Urbanization
- Industrialization
- Higher productivity in the secondary/tertiary sector against primary sector makes cities and towns centres of economic growth and jobs
- Cities act as beacons for the rural population as they represent a higher standard of living and offer opportunities to people not available in rural areas. This results in large scale migration from rural to urban areas.
- Negative consequences of urban pull results in upcoming of slums characterized by housing shortage and critical inadequacies in public utilities, overcrowding, unhygienic conditions, etc.

## Definition and types of slums – Census 2011

Three types of slums have been defined in Census, namely, Notified, Recognized and Identified.

- (i) **Notified slums** : All notified areas in a town or city notified as ‘Slum’ by State, Union territories Administration or Local Government under any Act including a ‘Slum Act’ may be considered as Notified slums
- (ii) **Recognized slums**: All areas recognised as ‘Slum’ by State, Union territories Administration or Local Government, Housing and Slum Boards, which may have not been formally notified as slum under any act may be considered as Recognized slums
- (iii) **Identified slums**: A compact area of at least 300 population or about 60-70 households of poorly built congested tenements, in unhygienic environment usually with inadequate infrastructure and lacking in proper sanitary and drinking water facilities. Such areas should be identified personally by the Charge Officer and also inspected by an officer nominated by Directorate of

Census Operations. This fact must be duly recorded in the charge register.  
Such areas may be considered as Identified slums

## Slum and Urban population (slum reported towns) INDIA

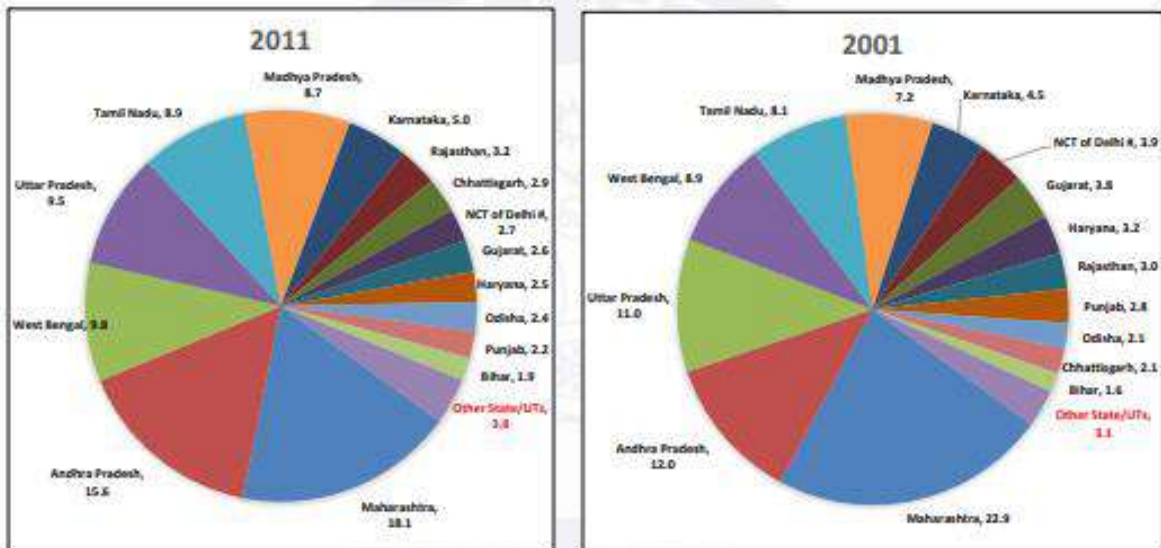
Indicator	Absolute		Absolute change 2001-11	Decadal Growth 2001-11	Slum Percentage	
	2001	2011			2001	2011
Slum						
Persons	5,23,71,589	6,54,94,604	1,31,23,015	25.1	23.5	22.4
Males	2,77,59,224	3,39,68,203	62,08,979	22.4	23.6	22.4
Females	2,46,12,365	3,15,26,401	69,14,036	28.1	23.3	22.5
Sex ratio	887	928	41			
Urban (slum reported towns)						
Persons	22,31,11,858	29,18,38,124	6,87,26,266	30.8	100.0	100.0
Males	11,76,10,448	15,16,66,671	3,40,56,223	29.0	100.0	100.0
Females	10,55,01,410	14,01,71,453	3,46,70,043	32.9	100.0	100.0
Sex ratio	897	924	27			

## Slum and Urban population (all towns) INDIA

Indicator	Absolute		Absolute change 2001-11	Decadal Growth 2001-11	Slum Percentage	
	2001	2011			2001	2011
Slum						
Persons	5,23,71,589	6,54,94,604	1,31,23,015	25.1	18.3	17.4
Males	2,77,59,224	3,39,68,203	62,08,979	22.4	18.4	17.4
Females	2,46,12,365	3,15,26,401	69,14,036	28.1	18.2	17.4
Sex ratio	887	928	41			
Urban (all towns)						
Persons	28,61,19,689	37,71,06,125	9,09,86,436	31.8	100.0	100.0
Males	15,05,54,098	19,54,89,200	4,49,35,102	29.8	100.0	100.0
Females	13,55,65,591	18,16,16,925	4,60,51,334	34.0	100.0	100.0
Sex ratio	900	929	29			



# STATE SHARE OF SLUM POPULATION TO TOTAL SLUM POPULATION OF INDIA



## Other States/UTs

### 1. Reported slum less than 1%

Jammu & Kashmir, Uttarakhand, Jharkhand, Assam, Kerala, Tripura, Tripura, Puducherry #, Himachal Pradesh, Chandigarh #, Nagaland, Mizoram, Nagaland, Mizoram, Meghalaya, Sikkim, Arunachal Pradesh, Goa and A & N Islands #

### 2. State/UTs not reported slum

Manipur, Daman & Diu #, D & N Haveli # and Lakshadweep #

## Other States/UTs includes :

### 1. Reported slum less than 1%

Jammu & Kashmir, Uttarakhand, Jharkhand, Chandigarh #, Meghalaya, Assam, Assam, Puducherry #, Tripura and Kerala

### 2. State/UTs not reported slum

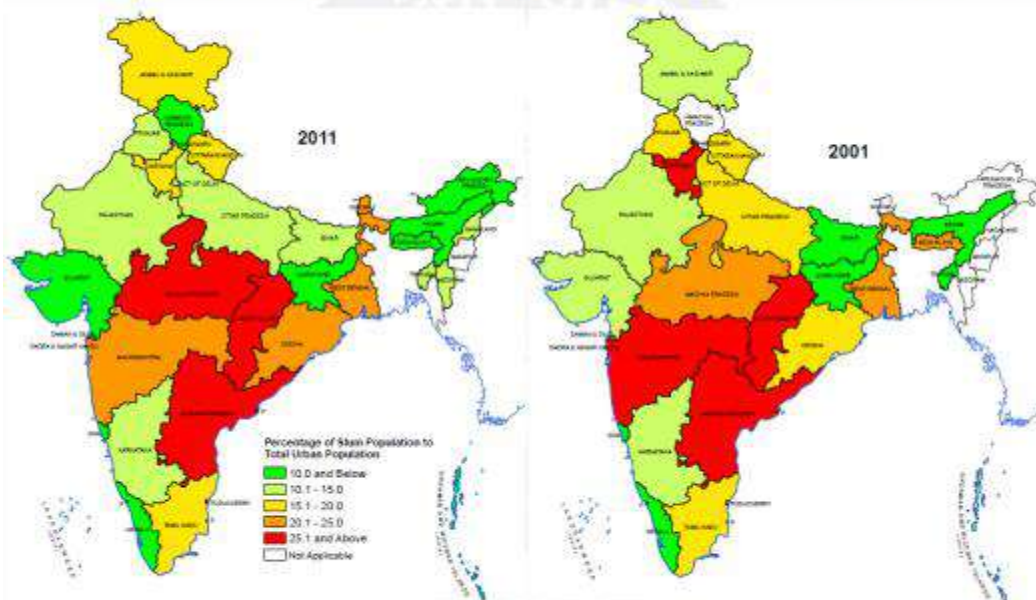
Himachal Pradesh, Sikkim, Arunachal Pradesh, Nagaland, Manipur, Mizoram, Daman & Diu #, D & N Haveli #, Lakshadweep # and A & N Islands #

Source: Primary Census Abstract for Slum, 2011

Office of the Registrar General & Census Commissioner, India

## Percentage of slum population

INDIA



Source: Primary Census Abstract for Slum, 2011  
Office of the Registrar General & Census Commissioner, India



## **35. Urban Mission Schemes**

Ministry of Urban Development, Govt. of India has launched Atal Mission for Rejuvenation and Urban Transformation (AMRUT) on 25th June, 2015 to provide the national priority basic services for e.g. water supply, sewerage, urban transport to households and build amenities in cities which will improve the quality of life for all, especially the poor and the disadvantaged. A set of Reforms and Capacity Building have also been included in the Mission. The Mission mandates a set of 11 Reforms which have to be implemented by all the States and 500 Mission cities within a period of 4 years.

### **Deen Dayal Antyodaya Yojna**

- National Urban Livelihood mission and National Rural Livelihood Mission and National Rural Livelihood Mission were merged under Deen Dayal Antyodaya Yojana in September, 2014.
- The objective of the scheme is to train 0.5 million people in urban areas per annum from 2016. In Rural areas, the objective is to train 1 million people by 2017. Further, in urban areas, services like SHG promotion, training centres, vendor markets and permanent shelters for homeless will be provided.
- This project will help in reducing the anxiety of urban street vendors. The nodal ministries are Ministry of Rural Development and Ministry of Housing and Urban Poverty Alleviation.

### **Pradhan Mantri Awas Yojana (PMAY)**

- Pradhan Mantri Awas Yojana (PMAY) has been launched on 25 June, 2015, by Government of India, in which affordable housing will be provided to the urban poor with a target of building 20 million affordable house by 31 March, 2022.

## **National Urban Health Mission**

- National Urban Health Mission was launched on 20 January, 2014 in Bangalore

## **Swatch Bharat Mission**

- Central Rural Sanitation Programme (1986) was one of the first schemes of the central government which focussed solely on rural sanitation, to construct household toilets, construct sanitary complexes for women, establish sanitary marts, and ensure solid and liquid waste management.
- A Total Sanitation Campaign was launched in 1999 which gave greater focus on Information, Education and Communication (IEC) activities in order to make the creation of sanitation facilities demand driven rather than supply driven.
- In 2012, Total Sanitation Campaign was replaced by the Nirmal Bharat Abhiyan (NBA), which focused on coverage for the whole community instead of focus on individual house.
- The financial support for the mission was provided by Asian Development Bank.
- Swachh Bharat Mission (SBM) was launched on 2<sup>nd</sup> October, 2014 with an aim of ensuring a clean India by 2<sup>nd</sup> October, 2019 as a fitting tribute to Mahatma Gandhi on his 150<sup>th</sup> Birth Anniversary.
- Swachh Bharat Mission (Urban) coordinated by Ministry of Housing and Urban Affairs seeks to achieve Open Defecation Free (ODF) urban India and 100% scientific management of municipal solid waste in 4,041 statutory towns in the country.
- Swachh Bharat Mission (Gramin/Rural) coordinated by Ministry of Jal Shakti seeks to bring about an improvement in the general quality of life in the rural areas, by promoting cleanliness, hygiene, and eliminating open defecation

### **Objective**

- It aims to improve the health care of the urban population particularly the poor and other disadvantaged sections of the society. It also aims to strengthen public health system.

### **Swachh Bharat Survey, 2021**

Indore was declared as India's Cleanest City for the fifth time followed by Surat and Vijay

wada. Varanasi was named India's cleanest town on banks of Ganga river. Touted as world's largest cleanliness survey by the government, Swachh Bharat Survekshan was started in 2016 (January) conducted by Ministry of Housing and Urban Affairs assesses and ranks the cities on the basis of cleanliness. Chhattisgarh has been awarded as the Cleanest State of India for the 3<sup>rd</sup> consecutive year (more than 100 Urban Local Bodies).

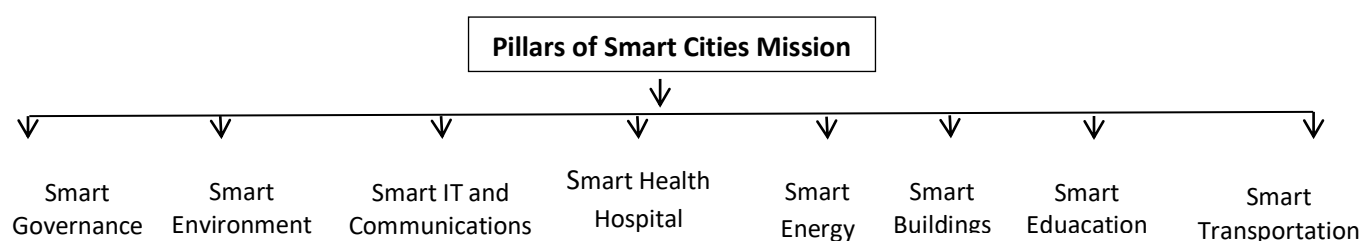
**Prerak Daaur Samman** – this is a new performance category introduced under Swachh Survekshan 2021, five cities –Indore, Surat, Navi Mumbai, New Delhi Municipal Council and Tripati were categorized as Divya (Platinum)

## Smart Cities Mission

- The Smart Cities Mission (SCM) is a holistic city rejuvenation programme for 100 cities in India launched on June 25, 2015. The SCM initially spanned for five years (2015-16 to 2019-20) and may be continued thereafter based on evaluation.

### Countries Associated in the Development of Smart Cities

Country	City
• Japan	Varanasi, Chennai and Ahmedabad
• Germany	Bhubaneswar, Kochi and Coimbatore
• USA	Visakhapatnam, Allahabad and Ajmer
• France	Chandigarh, Puducherry and Nagpur
• UK	Pune, Amravati and Indore



## Ease of Living Index 2020

- The Index is released by Ministry of Housing and Urban Affairs which ranks 111 cities with a population of more than a million and cities with less than one million populations under Smart Cities program.

One Million Plus Category Ranking	One Million Plus Ranking
1. Bengaluru	1. Shimla
2. Pune	2. Bhubaneswar
3. Ahmedabad	3. Silvassa

### Municipal Performance Index 2020 (ranks 111 municipalities)

1. Indore	1. New Delhi
2. Surat	2. Tirupati
3. Bhopal	3. Gandhinagar

## Atal mission for Rejuvenation and Urban Transformation (AMRUT)

- It is aimed at developing infrastructure in 500 cities and towns that are having a population of one lakh and above with an outlay of 50,000 crore rupees between 2015-16 and 2019-20
- The mission adopts a project based approach to ensure basic infrastructure services relating to water supply, sewerage, transport and development of green spaces among others.

## 36. Tribes of India

### Definition

The Constitution of India has recognized tribal communities in India under ‘Schedule 5’ of the constitution. Hence the tribes recognized by the Constitution are known as ‘ Scheduled Tribes’.

As per 1951 census, 5.6% of the total population of the country was tribal. According to Census-2011, the number of scheduled tribes in India is 10, 42, 81,034. It is 8.6% of the total population of India. A total of 9, 38, 19,162 people belonging to scheduled tribes reside in rural areas whereas 1, 04, 61,872 people in urban areas. The scheduled tribes are 11.3% of the total population of rural areas and 2.8% of urban areas. There are about 550 tribes in India.

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### Article 342

The President may, with respect to any State or Union territory, and where it is a state, after consultation with the Governor thereof by public notification, specify the tribes or tribal communities or parts of or groups within tribes or tribal communities which shall, for the purposes of this constitution, be deemed to be scheduled tribes in relation to that state or Union Territory, as the case may be.

Parliament may by law include in or exclude from the list of Scheduled tribes specified in a notification issued under clause(1) any tribe or tribal community or part of or group within any

tribe or tribal community, but save as aforesaid, a notification issued under the said clause shall not be varied by any subsequent notification.

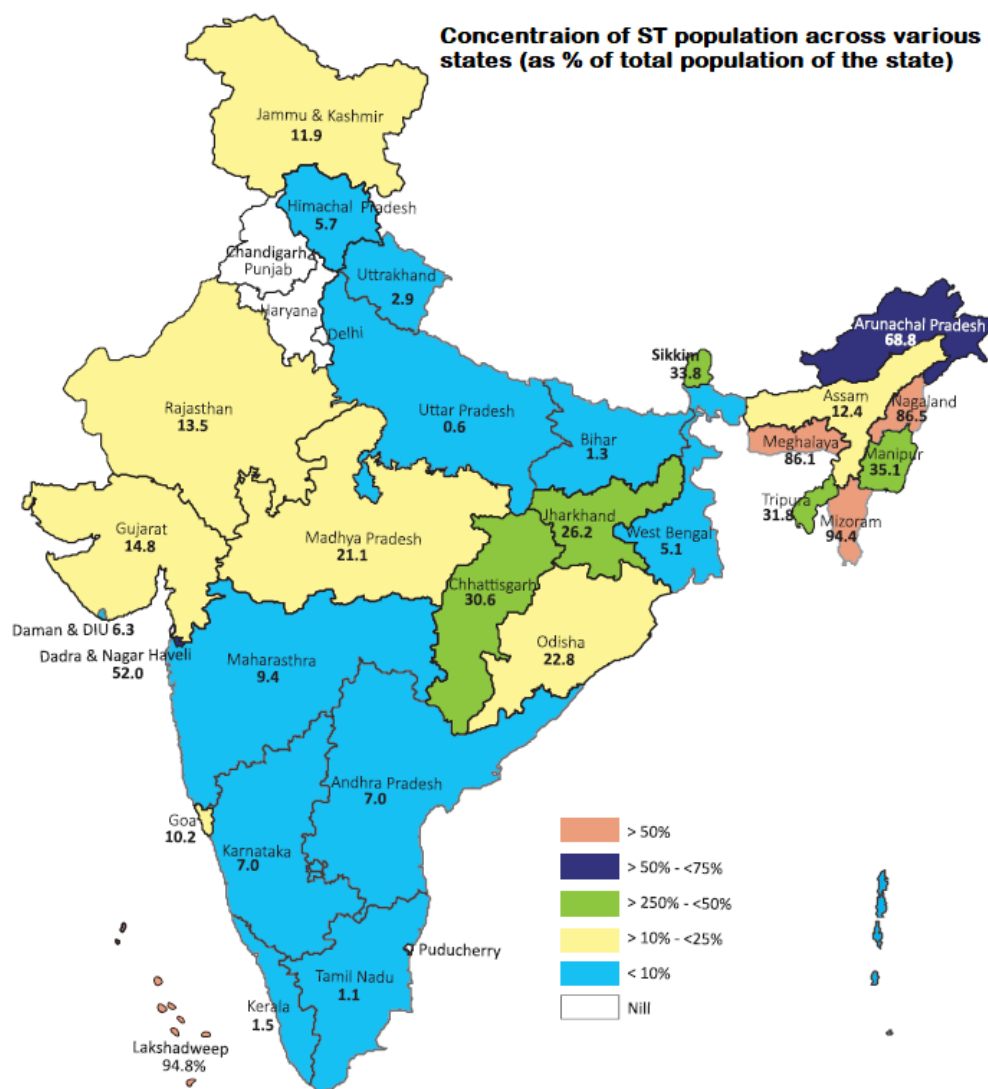
## **Distribution of Tribes in India**

The Scheduled Tribes are notified in 30 States/UTs and the number of individual ethnic groups, etc. notified as Scheduled Tribes is 705. The tribal population of the country, as per 2011 census, is 10.43 crore, constituting 8.6% of the total population. 89.97% of them live in rural areas and 10.03% in urban areas. The decadal population growth of the tribal's from Census 2001 to 2011 has been 23.66% against the 17.69% of the entire population. The sex ratio for the overall population is 940 females per 1000 males and that of Scheduled Tribes 990 females per thousand males.

Broadly the STs inhabit two distinct geographical area – the Central India and the North- Eastern Area. More than half of the Scheduled Tribe population is concentrated in Central India, i.e., Madhya Pradesh (14.69%), Chhattisgarh (7.5%), Jharkhand (8.29%), Andhra Pradesh (5.7%), Maharashtra (10.08%), Orissa (9.2%), Gujarat (8.55%) and Rajasthan (8.86%). The other distinct area is the North East (Assam, Nagaland, Mizoram, Manipur, Meghalaya, Tripura, Sikkim and Arunachal Pradesh).

More than two-third of the ST population is concentrated only in the seven States of the country, viz. Madhya Pradesh, Maharashtra, Orissa, Gujarat, Rajasthan, Jharkhand and Chhattisgarh. There is no ST population in 3 States (Delhi NCR, Punjab and Haryana) and 2 UTs (Puducherry and Chandigarh), as no Scheduled Tribe is notified.

States and union territories having maximum ratio of scheduled tribes, as per Census-2011 (in descending order)- Lakshadweep (94.8%) > Mizoram (94.4%) > Nagaland (86.5%) > Meghalaya (86.1%) > Arunachal Pradesh (68.8%).



### State wise list of Tribes in India

State	Tribes
1. Arunachal Pradesh	Apatanis, Dafla, Mishmis, Singhphos, Abor, Aka.
2. Andhra Pradesh	Chenchus, Yerukula, Bhagata, Lambada, Yanadi, Konda.
3. Assam	Chakma, Dimasa, Hojong, Gangte, Lalung
4. Bihar	Asur, Baiga, Birhr, Birjia, Bediya, Banjara
5. Chhattisgarh	Agariya, Kodaku, Dhanwar, Kamar, Kharia
6. Goa	Dhodia, Varli
7. Gujarat	Bhil, Banjara, Patelia, Barda, Barli, Khari, Dhodia, Kokna, Charan, koli.

8. Himachal Pradesh	Gaddis, Gujjars, Pangwala, Swangla, Kinnaur, Jad
9. Jammu & Kashmir	Bakarwal, Gujjar, Mon, Balti, Gaddi, Sippi, Changpa
10. Jharkhand	Santhal, Munda, Ho, Birhors, Oraon, Kharia, Asur Mal Paharia
11. Karnataka	Barda, Koraga, Patelia, Yerava, Siddi, Chenchu, Malsar, Maleru, Toda, Rathwa
12. Kerala	Mopalis, Adiyan, Kurumbas, Nayar, Arandan, Eravallan, Kurubas
13. Madhaya Pradesh	Baigaas, Bhils, Bhria, Kol, Murias, Agariya, Korku, Gond
14. Maharashtra	Madia, Katkari, Koli, Oraon, Warli, Bavacha, Bhunjia, Dhodia, Thoti
15. Manipur	Angami, Maram, Mishing, Phake, Kuki
16. Meghalaya	Chakma, Garo, Khasi, Jaintia, Mikir, Hajong, Lakher
17. Mizoram	Mizo, Chakma, Garo, Kuku, Hajong
18. Nagaland	Angami, Naga, Kuki, Mikir, Konyank, Garo Kachari
19. Odisha	Bagata, Kondha, Bhumij, Bondo, gondia, Kol, Korua, Koya
20. Rajasthan	Bhils, Meenas, Banjaras, Sahariya, Dhamaria
21. Sikkim	Bhotias, Lepchas, Shrpas
22. Tamil Nadu	Adiyna, Toda, Eravallun, Irular, Kotas, Paniyan
23. Telangana	Chenchus, Koyas, Yerukala, Pradhon
24. Tripura	Inshai, Bhil, Bhutia, Rieng, Jamatia, Chakma, Halam, Mag.
25. Uttarakhand	Tharus, Jaunsaris, Buxas, Bhuta, Boon Rajis
26. West Bengal	Santhl, Oraon, Munda, Bhumij, Kora, Bhutia, Bedia
27. Andaman and Nicobar	Oraons, Sentinelese, Onges, Shompen
28. Little Andaman Island	Jarawa
29. Daman and Diu	Dobla, Dhodia, Varli, Siddi
30. Dadra Nagar	Dhodia, Dubla, Kathodi, Kokua, Koli, Dhor, Naikda

### **Tribal Population In Island Groups**



• Onge	Negrito	Little Andaman
• Sentineless	Negrito	Sentinel Islands
• Jawara	Negrito	Middle & South Andaman
• Great Andamanese	Negrito	Strait Island
• Showmen	Mongoloid	Great Nicobar
• Nicobarese	Mongoloid	Great Nicobar

### Population of Largest and Smallest Tribe

Scheduled Tribe	Population (in lakh)
Bhil	74 (largest tribe)
Gond	55 (second largest tribe)
Santhal	42
Oraon	20
Onges	98
Sentinelese	0.80 (Primitive Vulnerable Tribes)
Great Andamanese	0.29 (Primitive Vulnerable Tribes)

## Particularly Vulnerable Tribal Groups

- In 1973, the Dhebar Commission created Primitive Tribal Groups (PTGs) as a separate category, who are less developed among the tribal groups. In 2006, Government of India renamed PTGs as PVTGs.
- In 1975, Government of India initiated to categorize the most vulnerable tribal groups as a separate category under PTGs declaring 52 groups as such, while in 1993, an additional 23 groups were added to it making it to 75 out of 705 Scheduled Tribes in India.

- Among the 75 listed PVTGs, the highest numbers are found in Odisha.

### **Particularly Vulnerable Tribal Groups**

<b>State</b>	<b>Tribal Groups</b>
• Tamil Nadu	Kota, Toda, Irular
• Sikkim	Lepcha
• Chhattisgarh	Kawardha
• Uttarakhand	Buxa, Raji
• Andaman and Nicobar	Onge, Jarawa, Shompen