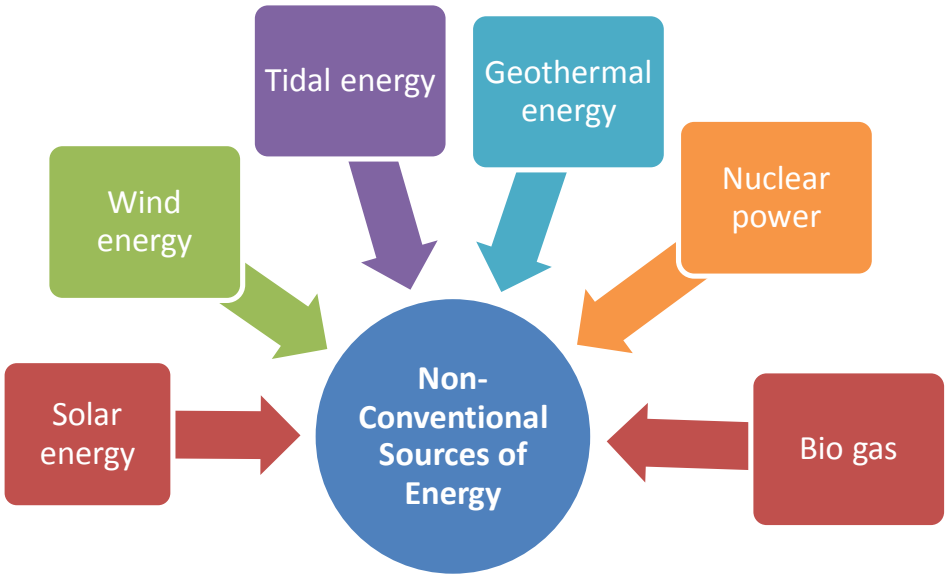
Non-Conventional Sources of Energy

Non-Conventional Sources of Energy

Non-conventional sources of energy are also known as renewable or alternative sources of energy. These resources have been developed in the recent past as an alternative to conventional or non-renewable sources of energy. Some examples are wind energy, solar energy, geothermal energy, tidal energy and bio gas. Non-conventional resources are known as energy resources of the future.



Solar Energy

India is a tropical country which gets adequate sunlight. Most parts of the country have 300 clear sunny days in a year.
In India, solar energy is generated in the following ways:

Solar cells

Also known as photovoltaic cells, the solar cells are made of thin wafers of semi-conductor materials from silicon and gallium. When sun's energy falls on them, electricity is generated.

- Solar cells are widely used in calculators, electronic watches, street lightening, traffic signals and water pumps.
- A group of solar cells joined together in a solar panel can give a large amount of solar energy.

Solar cells are joined together to form a solar panel for generating a large amount of solar energy.

Solar Cooker

- The solar cookers use solar heat by reflecting solar radiations with the help of a mirror on to a glass sheet which cover the black insulated box.

- The raw food is kept in the black insulated box in the solar cooker. The box is insulated from outside so that heat does not escapes.
- The heated box emits red radiation which is retained because of the opaque glass. As a result, the significant amount of the energy entering the oven is retained.
- Of late, spherical reflectors are being used instead of plane mirror because the former has more heating effect and has greater efficiency.

Solar Water Heater

- Water can be heated using solar energy. Sunlight is allowed to fall on flat plate collectors which are shallow rectangular trays filled with water.
- It consists of an insulated box painted black from inside with a glass lid to collect and store solar heat.
- In the box, there is black painted copper coil through which the cold water flows in. When the coil gets heated, the water too gets heated and flows into a storage tank.

Many housing societies have started installing solar panels on the top of their house for lightening lobbies and heating water.

Advantages of Solar Energy

- It is a cleaner and a renewable source of energy.
- It can be used for various purposes such as to produce electricity in areas which do not have an access to energy grid and to distill water in regions which have limited clean water supplies.
- Solar energy systems do not require a lot of maintenance.
- It saves fossil fuels such as coal and petroleum and also reduces energy bills.

Wind Energy

Wind is an inexpensive, reliable and a cleaner source of energy.

Generation of Wind Energy

- Windmills are used for generating electricity. The blades of the wind mill rotate due to the force of the wind. This rotational motion of the blades is used for driving a number of machines such as water pumps, flourmills and electric generators.
- Several windfarms are installed in a definite pattern in clusters called 'wind farms'. Wind farms are generally installed in coastal regions, open grasslands and hilly regions. The Indian wind programme is the fifth largest in the world.
- In India, largest wind farm cluster is located from

The largest wind farm in India is situated from Nagarcoil to Madurai in the state of Tamil Nadu

Nagarcoil to Madurai in Tamil Nadu. Important wind farms are also located in the states of Andhra Pradesh, Gujarat, Kerala, Lakshadweep and Maharashtra.

Advantages

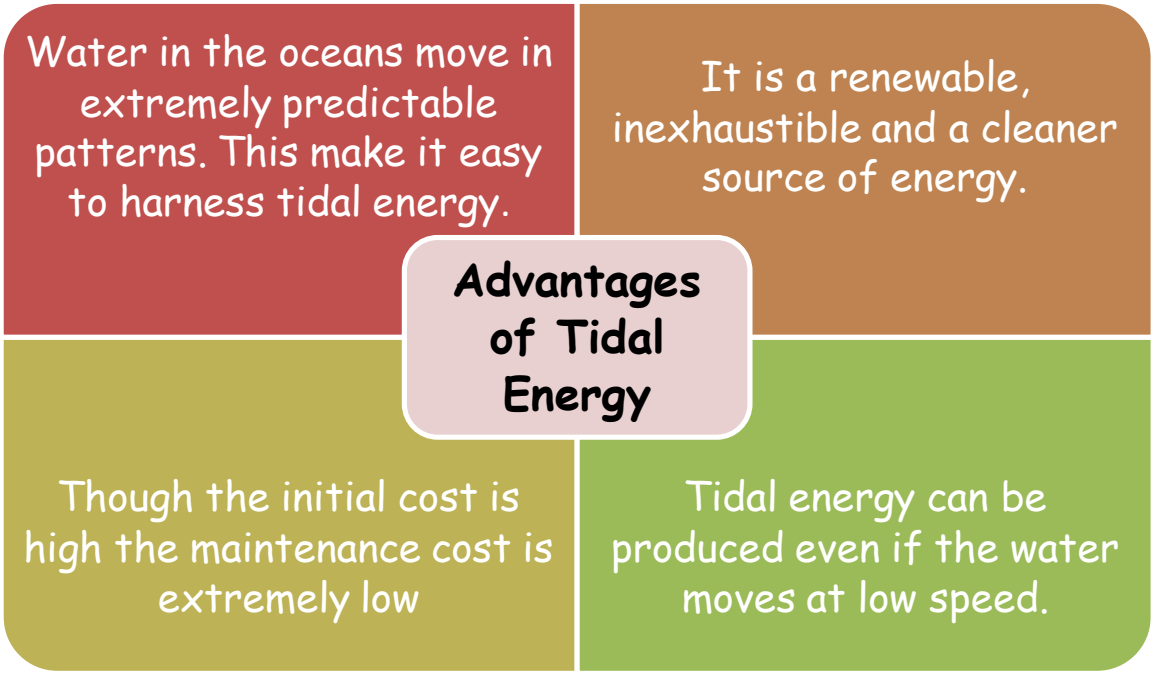
- It is a renewable source of energy.
- It does not produces pollution. Thus, it is a cleaner source of energy.
- It reduces our dependence on the fossil fuels.
- Wind turbines can be built on existing agricultural farms. This greatly benefits the economy in rural areas, where most of the best wind sites are found.
- Land owners can earn additional income by installing wind turbines on land that can be used for domestic consumption.

Tidal Energy

Tides are caused due to the periodic rise and fall of ocean waters produced by the attraction of the moon and the sun. This rise and fall of ocean waters produces a large amount of energy known as **tidal energy**.

Generation of Tidal Energy

- The tidal energy is harnessed by constructing a tidal barrage.
- During high tide, the sea water flows into the reservoir of the barrage and turns the turbine which in turn produces electricity by rotating generators.
- The reverse process takes place during the low tide. The sea water stored in a barrage reservoirs flows out into the sea. During this process, the flowing water turns the turbines.
- In India, the prospective site for exploiting tidal energy are Gulf of Kutch, Cambay and Sunderbans. Other suitable sites are located near Lakshadweep Islands and Andaman and Nicobar Islands.



Geothermal Energy

When the heat obtained from the earth is used for generating electricity, it is known as geothermal electricity. As the interiors of the Earth are hot, the heat energy may at times surface itself in the form of hot springs. This energy can be used for the generation of electricity.

Generation of Geothermal Energy

- The extremely high temperatures in the deeper geothermal reservoirs are used for the generation of electricity.
- Hot water is pumped from deep underground through a well under high pressure.
- When water reaches the surface, the pressure is dropped that causes the water to turn into steam. The steam spins the turbine which then rotates a generator and produces energy.
- The steam cools off in the cooling tower and condenses back to water. The cooled water is then pumped back again under the surface of the earth to begin the process again.

Advantages

- Because of its extensive distribution, geothermal energy is easily accessible.
- It is environment friendly because of the low sulphur emission, carbon dioxide and greenhouse gases.
- It is not influenced by weather and seasons.
- It is independent of external supply and demand effects and fluctuations of exchange rates.

Distribution

- India has a potential to produce about 12,000MW of geothermal energy.
- In India, geothermal plants are located in Manikaran in Himachal Pradesh and Puga valley in Ladakh. The hot springs have been grouped together and termed as different geothermal provinces.
- These regions are the Himalayan geothermal province, Naga-Lushai geothermal province, Andaman and Nicobar Islands geothermal province and Cambay graben, Son-Narmada-Tapti graben, West coast, Damodar Valley, Mahanadi Valley and Godavari Valley.

Nuclear Power

Nuclear power is obtained from energy stored in the nuclei of atoms of naturally occurring radioactive elements such as uranium, thorium and plutonium.

Generation of Nuclear Energy

- Nuclear fission is the process in which a large nucleus splits into two smaller nuclei with the release of energy.
- Nuclear fission produces heat which is then used for heating water and producing steam.
- The steam turns the turbine which in turn is used to run generators resulting in the production of electricity.

- Two main types of reactors used to generate electricity are the pressurised and boiling water reactors. In the former, because the water is pressurised, it does not boil.
- This heated water is circulated through tubes in generators which then turns the turbine.
- In boiling water reactor, the water is boiled due to the heat produced by nuclear reaction and turns into steam to turn the turbine.
- Water is reused in both systems.

Distribution

Nuclear power is the fourth largest source of electricity in India. India has 21 nuclear reactors. Uranium and thorium are used for generating nuclear power. The Monazite sands of Kerala are also rich in thorium.

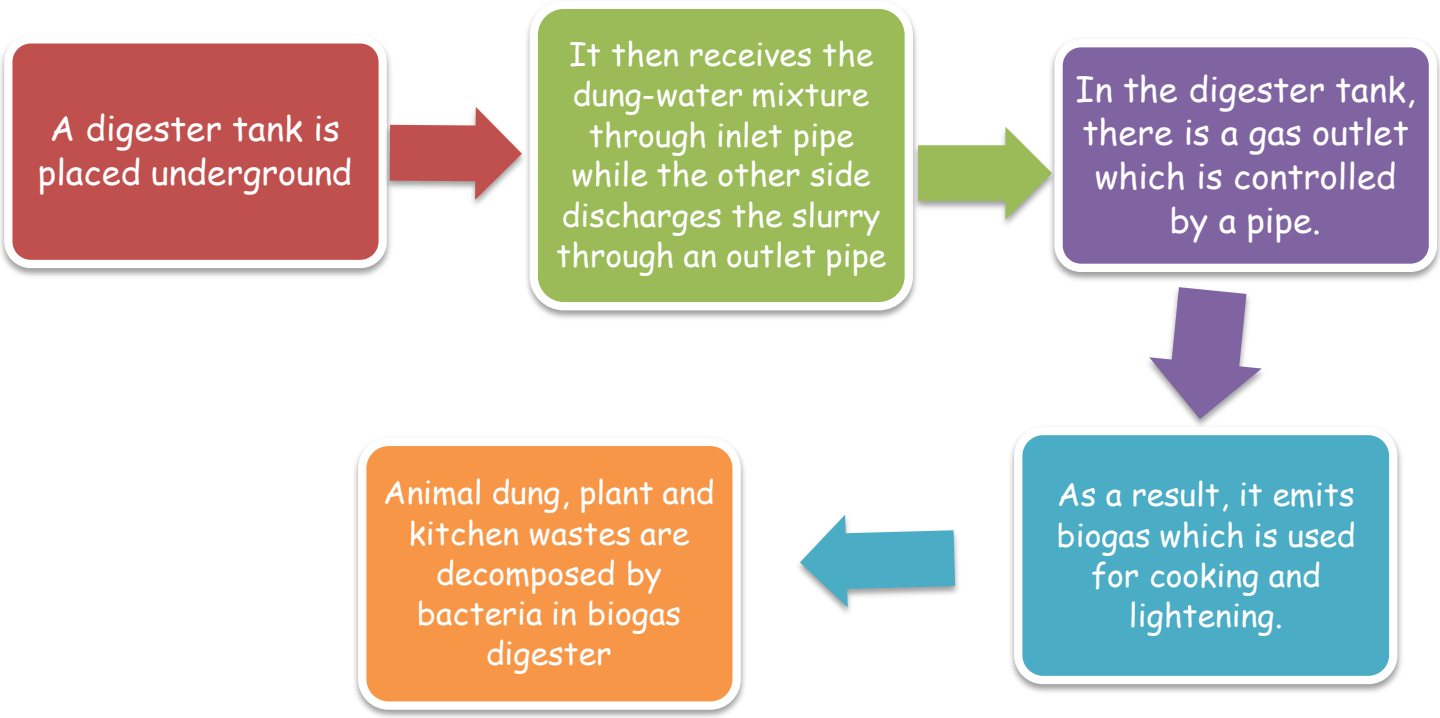
Advantages

- Nuclear energy is a renewable source of energy and it reduced the dependency on fossil fuels for the generation of energy.
- It saves on the cost of raw materials. Its transportation and handling cost is also minimal.
- It initiates a continuous process of energy production. A nuclear power plant generates electricity for almost 90% of annual time.
- It reduces price vitality of other fuels such as petrol.

Biogas

Biogas is a renewable source of energy which is generated by anaerobic degradation (breaking down of organic matter by bacteria in the absence of oxygen) of plant and animal wastes in presence of water. Biogas is composed of methane, carbon dioxide, hydrogen and hydrogen sulphide.

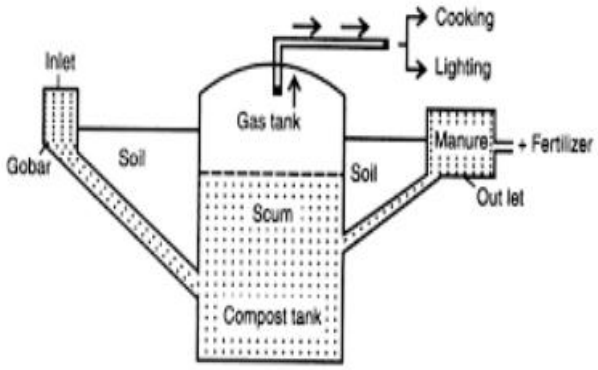
Generation of Biogas



Advantages

- Biogas is a clean, non-polluting and cheap source of energy.
- There is direct supply of gas from the plant, therefore, there is no storage problem.
- The sludge left behind is a rich fertiliser containing bacterial biomass.

The Ministry of Non-Conventional Energy Sources has been promoting the Biogas Pragramme in India. It has set up a number of bio gas plant across the country.



A diagram explaining the formation of bio gas

Soils in India

Soil

Soil is a renewable natural resource. It supports various living organisms and is a medium of plant growth. Topsoil is the uppermost layer of the Earth. It consists of humus. Factors such as variation of temperature, parent rock, decomposers and running water affect the formation of soil.
Fertile soil is essential for agricultural production. It has the following characteristics:

- It has enough moisture to supply essential nutrients to plants.
- It should have sufficient depth to enable the plants to grow their roots.
- It is rich in nutrients such as nitrogen, potassium and phosphorus.
- It contains organic matter.

The fertility of soil can be improved by adding fertilisers.

Classification of Soil

Based on its formation, soil can be classified into the following categories:
Sedimentary or Residual Soil: When soil is formed in its original position by fragmentation of the parent rock, it is called ***in situ*** or residual soil. This includes black soil, red soil, laterite soil and desert soil.
Transported Soil: These soils are formed after being transported and deposited by various agents of erosion such as water and wind. This includes alluvial soil.
Soil in India can be classified based on their texture, thickness, age, chemical and physical properties.

Map of India showing the regions of alluvial soil

Alluvial Soil

- It is formed by the deposition of sediments brought down by the rivers. Very fine particles of soil called alluvium are deposited by the rivers in plains.
- It is also called riverine soil because it is mainly found in the river basins. It consists of sand, clay and silt known as loam.
- It has been deposited by the three Himalayan river systems—the Ganga, the Indus and the Brahmaputra. It is also found in deltas formed by rivers Mahanadi, Godavari, Krishna and Kaveri.
- Alluvial soil is classified into two types—khadar and bhangar.

Characteristics of Alluvial Soil

- It is formed by the deposition of sediments by the rivers as it flows from its upper to its lower course.
- While in the upper plains of the river valleys, the soil is coarse; it has fine soil particles in the lower river valleys.
- While the alluvial soil is dry, porous, sandy and faint yellow in the lower Ganga Valley, it becomes compact, less coarse and moist in West Bengal and Bangladesh.
- It is fertile as it is rich in minerals such as lime and potash. It is suitable for the growth of kharif and rabi crops.

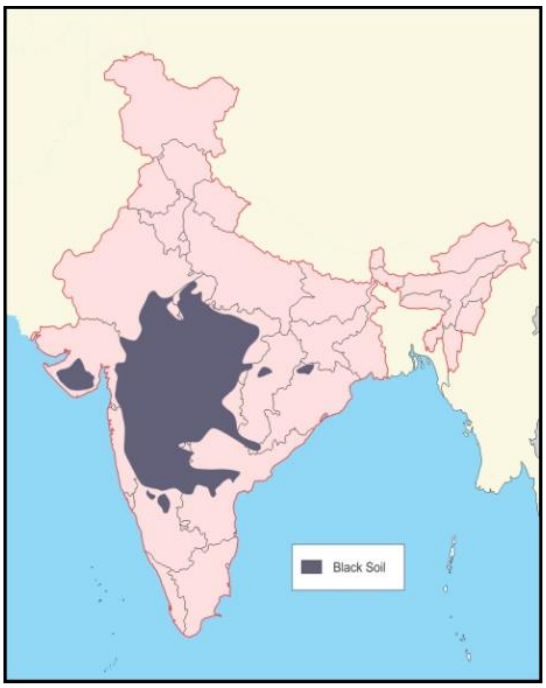
- It is however deficient in nitrogen and humus. Only the alluvial soil of the Ganga delta is rich in humus.
- The alluvial soil is alkaline in drier areas.

Differences between bangar and khadar soils

Bangar Soil	Khadar Soil
It is old alluvial soil.	It is new alluvial soil.
It has higher concentration of kankar nodules.	It has less concentration of kankar nodules.
It is comparatively less fertile.	It is more fertile as it is deposited every year during the monsoon floods.

Black Soil

This soil is also known as regur soil or black cotton soil (it is suitable for the growth of cotton). It is a residual soil as it is formed at the place of its origin.



Map of India showing the regions of black soil

Characteristics of Black Soil

- It is clayey and is finely textured soil.
- Because it is formed from weathered lava rocks, it is black.
- It has about 50% of clayey material and hence is highly water retentive.
- When the soil becomes wet, it expands making ploughing difficult. During the dry season, the black soil shrinks and develops cracks which help in air circulation.
- The soil is suitable for the cultivation of cotton, jowar, sugarcane, wheat, linseed and gram. Besides, it is suitable for the growth of oilseeds, pulses, cereals, tobacco and vegetables.
- Its subsoil has moisture content even during rainy season.

Red Soil

Ancient crystalline and metamorphic rocks of the Peninsular Plateau fragmented to form the red soil. This soil differs from place to place on the basis of the parental rocks. They are red as they contain large amounts of iron oxide. It looks yellow when it occurs in a hydrated form.

Characteristics of Red Soil

- It is porous and contains large quantities of iron oxide.
- It is shallow, loose and aerated.
- It is deficit in nitrogen, phosphorus, potassium and organic matter. Small quantities of soluble salt are present in it.
- Because it is not very fertile, fertilisers are added to it.
- The soil requires irrigation.
- Red soil is suitable for the cultivation of rice, ragi, tobacco, groundnut and potatoes.

Laterite Soil

- It is formed because of the atmospheric weathering of rocks caused by high temperature and high rainfall. This residual soil is formed by leaching because of tropical rains.
- Leaching is a process in which the nutrients of the soil percolate down into the soil because of heavy rainfall. This makes the topsoil infertile. This is also called desilication.
- There are two types of laterite soils—upland laterites and lowland laterites. The former are formed over hills and uplands. When these soils are transported by streams of rivers to lowlands, it is called lowland laterites.

Characteristics of Laterite Soil

- It is red because of the presence of iron oxide formed during leaching.
- It has a coarse texture and is porous.
- It is deficient in lime, magnesium and nitrogen.
- It is not fertile as it does not retain moisture.
- It is acidic because of the leaching of alkalis.

Mountain Soil

The mountain soil is found in the hilly mountainous regions. This includes peat, meadow, forest and hill soils.

Desert soil: It is sandy soil. It is formed because of weathering of rocks in the desert regions.

Saline and alkaline soils: It has large amount of salts and alkalis. It is formed when the tidal water accumulates in areas located near the coasts because of poor drainage.

Marshy soil: This soil is found in waterlogged areas, especially in coastal regions or near the deltas. It contains iron and organic matter.

Distribution of soils in India

Alluvial soil	Inland Alluvium: Plains of Indus, the Ganga and Brahmaputra rivers. It extends from Punjab to Bangladesh and Assam. It is also found in Haryana, Uttarakhand, Uttar Pradesh, Bihar, West Bengal and some parts of Gujarat and Rajasthan.
	Deltaic Alluvium: Deltas of Rivers Ganga–Brahmaputra, Mahanadi, Godavari, Krishna and Kaveri.
	Coastal Alluvium: Coastal strips of Peninsular India and in the plains of Gujarat.
Black Soil	Deccan lava traps including parts of Maharashtra, Gujarat, Madhya Pradesh, Andhra Pradesh, Karnataka, Rajasthan, Uttar Pradesh and some parts of Tamil Nadu.
Red Soil	Parts of Tamil Nadu, Chhattisgarh, Jharkhand, Bundelkhand, Odisha, Meghalaya, Mizoram, Manipur and Nagaland. It is found in the Plateau regions of Peninsular India.
Laterite Soil	Highland areas of the Peninsular Plateau. It is found in some parts of Madhya Pradesh, Maharashtra, Odisha, West Bengal, Andhra Pradesh, Karnataka, Kerala and Tamil Nadu.

Soil Erosion

The wearing away (due to the action of winds) and washing down of soil cover (due to running water) is known as soil erosion.

Soil Erosion by Water

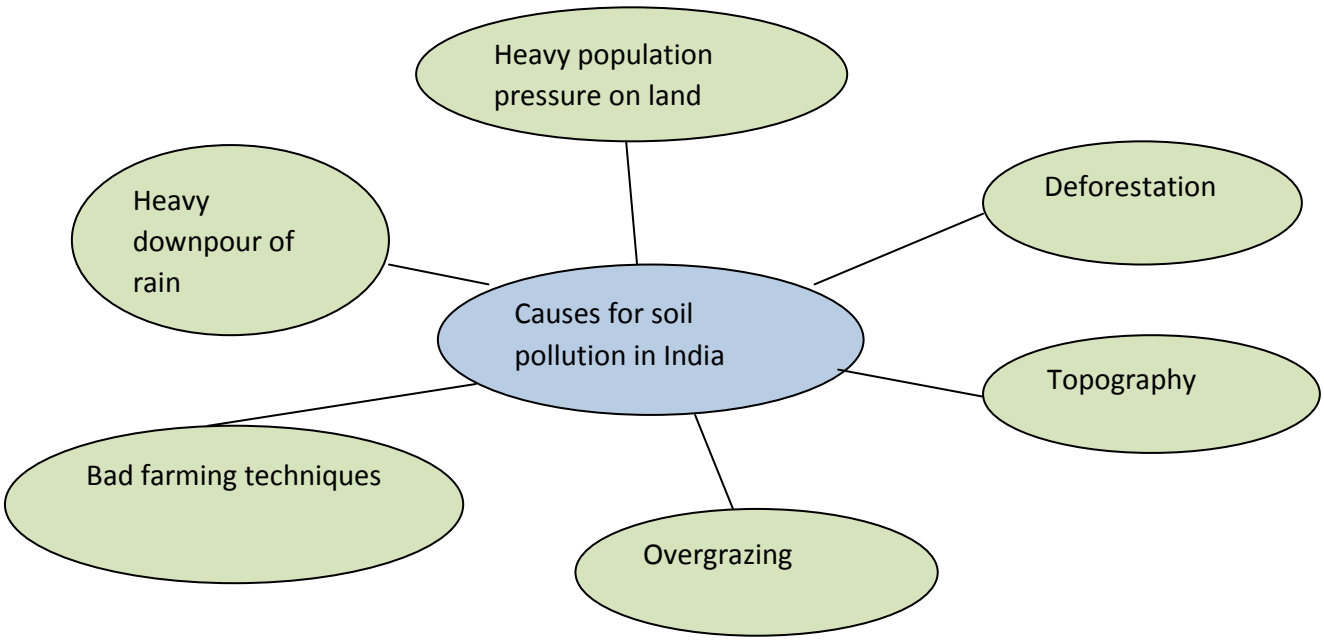
Gully Erosion: This occurs during heavy rainfall when running water cuts through the soil making deep channels. The land thus becomes unsuitable for cultivation and is known as **bad land**.
Rill Erosion: It occurs when runoff water forms small channels running down the slope. It is an intermediate stage between sheet and gully erosion.
Sheet Erosion: The washing away of the topsoil because of flowing of water as a sheet over large areas is known as sheet erosion.
Leaching: When soil is bare of any vegetation, nutrients present in the soil percolate below the soil because of heavy rainfall. It makes soil infertile.
Stream Bank Erosion: It occurs when streams of rivers change their course by cutting one bank and depositing the silt on the other bank of the river.
Sea or Shore Erosion: The powerful waves of the sea dash against the coast and break the cliff rocks. The fragmented material is then removed by the retreating sea waves. Eastern and western coasts have experienced this kind of soil erosion.

Soil Erosion Due to Human Action

- Deforestation has resulted in soil erosion. Absence of any vegetation on the land leads to washing away of the soil.
- Overgrazing by domestic animals also leads to soil erosion.

Soil Erosion by Winds

- When the wind blows away the topsoil, it is known as wind erosion.
- When a bare land is exposed to high speed winds, smaller soil particles are removed in bouncing and hopping manner along the surface of the ground. This is known as saltation.
- The rolling and sliding of larger soil particles along the ground surface is known as soil creep.



In India, the following regions are affected by soil erosion:

- Badlands of Chambal and Yamuna rivers
- Western Himalayan region
- Chotanagpur Plateau region
- Tapti Sabarmati valley region in Gujarat
- Regur soil area of Maharashtra
- Dry areas of Rajasthan, Gujarat and Haryana

Methods to Prevent Soil Erosion

Soil can be conserved in the following ways:

- **Contour Ploughing**: When one ploughs along the contour lines, it is called contour ploughing. It decreases the flow of water down the slopes and thus helps in soil conservation.
- **Terrace Farming**: When steps are cut out on the slopes of the hills making terraces, it reduces soil erosion.
- **Strip Cropping**: When strips of grass are grown between the strips of crops, they are known as strip cropping. It breaks down the speed of winds.
- **Shelter Belts**: When trees are planted in a row, it breaks the force of the winds. This method has proved very useful in the station of dunes in the deserts of western India.

Terrace farming

- **Plugging of Gullies**: The gullies made in the soil are plugged with deposition of silt during heavy rainfall.

  Soil conservation is required to prevent the loss of soil fertility and agricultural productivity. Soil erosion may also increase the risks of droughts and floods. Landslides also occur because of deforestation and soil erosion.

In India, many programmes have been undertaken to prevent soil erosion. These are

1. Integrated watershed management programme was launched during the Sixth Plan in flood-prone rivers. The programme enhances the ability of the catchment by absorbing rainwater and reducing erosion.
2. A scheme for reclamation and development of ravine area was launched in 1987–88 in Madhya Pradesh, Uttar Pradesh and Rajasthan. The scheme included afforestation and reclamation of ravines.
3. The scheme was also launched for controlling shifting cultivation in the states of Arunachal Pradesh, Mizoram, Nagaland, Tripura and Assam.
4. National Project on Development and Use of Biofertilisers and National Project on Quality Control were implemented during the Seventh Five Year Plan. It aimed at balancing the use of fertilisers.

Shelter Belt

Agriculture in India–Cash Crops

Cash Crops

Cash crops are agricultural crops which are grown primarily for direct sale in the markets. The main cash crops are categorised as
Beverages: Tea and coffee
Fibres: Cotton and jute
Oilseeds: Groundnut and mustard seeds
Others: Sugarcane, tobacco and rubber

Sugarcane

It grows mainly in the tropical regions with a hard thick stem growing up to the height of 3.5 m or more. India has the largest area under sugarcane in the world. It is used for manufacturing sugar, gur and khandsari. India is the second largest producer of sugarcane in the world after Brazil.

Climatic Conditions and Soil

- Sugarcane grows well in regions with temperatures between 20°C and 24°C. Dry winter is ideal for ripening and harvesting.
- Frost can severely damage the crop.
- Sugarcane grows well in tropical regions with rainfall of 100–150 cm distributed throughout the year.
- Dry sunny weather is essential during the ripening stage of the cane.
- Rich alluvial and lava soil are considered best for the growth of sugarcane.

Methods of Cultivation

- **Sowing**: Sugarcane is planted by the following methods:
  - **Sett method**: New canes are taken out from old plants. These cuttings of new plants known as ‘setts’ are planted and four to five stalks grow from each cutting.
  - **Ratooning method**: Sugarcane is harvested leaving a little stalk with the roots in the soil. Any crop obtained from the roots of the leftover crop is known as ratoon. Advantages of ratooning are that it saves labour as plants need not be planted again and it is a cheaper method as it does not involve any extra inputs.
  - Sugarcane is also planted by seeds, but this method of sowing is hardly used.
- **Harvesting**: It is harvested in northern India before the winters to save it from frost. The crop is cut by hand using a long carved knife. The stalk should be cut close to the ground as the greatest accumulation of sucrose is in the base of the stem.
- **Processing**: After harvesting, the sugarcane has to be taken to the mill at the earliest. It is because the sucrose content starts decreasing after 24 hours of harvesting. In the mills, canes are crushed and boiled with lime to make raw sugar. It is reprocessed to make brown and white sugar. Only one-third of the sugarcane grown in the country is used for making sugar. The remaining two-thirds are used for making gur and khandsari.
- **Distribution**: Three main areas of sugarcane distribution are
  - The Satluj Ganga Plain from Punjab to Bihar, regions of black soil from Maharashtra to Tamil Nadu and coastal Andhra Pradesh and the Krishna Valley.
  - Uttar Pradesh, Maharashtra, Tamil Nadu, Karnataka and Andhra Pradesh are leading producers of sugarcane in the world. Tamil Nadu is the largest producer of sugarcane in South India.

- Sugarcane has begun to be grown in South India as it has a favourable maritime climate free from the effects of summer loo and winter frost and has good irrigation facilities.

Oil Seeds

Groundnut, linseed, castor seed, sesame, soya bean, cotton seed, sunflower seed, rapeseed and mustard seed are some oil seeds which are grown in India. Groundnut is the leading oil seed in India.

Groundnut

Groundnut contains about 42% of oil which is extracted from nuts found in the roots of plants. It is mainly used for the manufacturing of hydrogenated oil. It is used for making margarine, medical emulsions and soaps. While the oil of groundnut is used for cooking, its oil cake is used as cattle feed. The nuts are also eaten raw, roasted, salted and sweetened.

Climatic Conditions

- Groundnut grows well in tropical and sub-tropical climate and can be damaged because of frost. While it is a rabi crop in Odisha and southern states, it is a kharif crop in the rest of India.
- It requires a temperature of 20°C to 25°C.
- The groundnut crop requires light to moderate rainfall of 50–100 cm which should be well distributed throughout the year.
- Continuous rains, stagnant water and frost harm the crop adversely.

Soil

Sandy loams and well-drained soils are considered suitable for groundnut cultivation.

Method of Cultivation

- Sowing: After ploughing, seeds are sowed by broadcasting and drilling methods. It is a flowering plant, and the crop takes about 4–5 months for harvesting.
- Harvesting: During harvesting, the entire plant is removed from the soil. Groundnuts are packed in sacks after drying. They are sent to mills or commercial establishments.

Distribution

India is the second largest producer of groundnut after China. It is mainly grown in Peninsular India. Gujarat is the leading producer of groundnut in India. Other groundnut-producing states are Maharashtra, Karnataka, Rajasthan, Madhya Pradesh, Uttar Pradesh and Punjab.

The table below gives details of the other oil seeds produced in India.

Name of Oil Seed	Temperature	Rainfall	Soil	Methods of Cultivation	Distribution
Mustard and Rape seeds	10–20°C	25–40 cm	Loamy soil	They are grown in rows along with wheat, gram and barley. Their growing period is from four to five months. The seeds are separated by trampling them under	Uttar Pradesh, Rajasthan, Punjab, Madhya Pradesh and Haryana are the main producing states. They are also grown in Assam, Bihar, Odisha, Gujarat and Jammu and Kashmir.

				bullocks' feet.	
Soya bean	13–24°C	40–60 cm	Friable loamy acidic soils	It is a rain fed crop which is harvested in the middle of October.	Madhya Pradesh is the leading producer of soya beans, followed by Rajasthan and Maharashtra.
Sunflower seed	26–30°C	Less than 50 cm	Well-drained loamy soil	It requires adequate moisture in soil in the first 45 days. Rainfall should not be heavy during its flowering stage.	Bihar, Maharashtra, Andhra Pradesh and Karnataka
Sesame	21°C It cannot withstand frost.	Moderate rainfall between 40 cm and 50 cm. Excessive rainfall ruins the crop.	Well-drained light loamy soil	It is grown as a kharif crop in the northern states and as a rabi crop in the southern states.	Uttar Pradesh, Rajasthan, Maharashtra, Madhya Pradesh, Odisha, Gujarat, Karnataka Andhra Pradesh and Tamil Nadu
Linseed	15–20°C	45–75 cm	It is grown during the rabi season and is harvested in march April.	Alluvial soils, clayey loamy soil and deep black soils.	Madhya Pradesh and Uttar Pradesh
Castor seed	20–25°C	50–75 cm	It is sown in June and July and harvested in November and December.	It grows on red sandy loamy soil.	Gujarat, Andhra Pradesh and Rajasthan are the leading producers. It is also grown in Odisha, Karnataka and Tamil Nadu.

Cotton

Cotton is an important cash crop which provides raw materials to Indian industries. It is a tropical crop grown in the kharif season.

Climatic Conditions

- The cotton plant requires a high temperature ranging between 21°C and 30°C. While during October, the temperature should be above 26°C to help in ripening and bursting of cotton balls, the minimum temperature should not fall below 20°C as it retards plant growth.
- A long growing period of at least 200 frost-free days is also necessary for the plant to mature.
- Moderate rainfall of 50–75 cm is required for the growth of the plant. Rainfall more than 85 cm can destroy the crop.

Soil

Well-drained clayey soil rich in lime and phosphate is suitable for the growth of cotton plant. The deep black soil of the plateau regions and Gujarat is also considered suitable for the growth of the cotton plant.

Methods of Cultivation

- **Sowing**: The seeds are sown by the drilling or broadcast methods generally before the beginning of rainfall.
- **Harvesting**: Harvesting is done in October when the cotton balls ripen and burst.
- **Processing**: After harvesting, the cotton crop passes through the following processes:
    - The cotton balls are ginned after harvesting. Ginning is a process of separating cotton fibres from cotton seeds.
    - The seeds are then crushed to produce oil; the residue is then used for feeding cattle.
    - The cotton fibre or the bale is then transported to the manufacturing regions.
    - After washing fibres, rope-like mass of fibre known as sliver is formed.
    - The sliver is then spun to make cotton yarn.

Varieties of Cotton

Five main varieties of cotton are grown in India. These are superior long staple, long staple, superior medium staple, medium staple and short staple.

Distribution

The chief cotton-growing regions of the country are

- The northwestern parts of the Deccan having fertile black soil
- The central and southern Deccan of Karnataka and Tamil Nadu
- The Upper Ganga Valley

Gujarat, Andhra Pradesh, Maharashtra and Punjab are the chief cotton-producing states in the country. Other cotton-producing states are Madhya Pradesh, Rajasthan, Haryana, Karnataka and Tami Nadu.

Jute

Jute is one of the most important fibres grown in India. White jute grows on lowlands and uplands. The tossa jute is grown only on uplands as it can be damaged by floods. Jute is used for manufacturing sacks and other packaging materials. Jute is also used for manufacturing many utility products such as carpets, rugs, twine and tarpaulins.

Mesta is an inferior substitute for jute.

Climatic Conditions

- The jute crop requires hot and humid climate with temperatures ranging between 24°C and 35°C.
- The crop requires an annual rainfall of more than 150 cm.
- Uninterrupted rains and prolonged droughts are harmful for the crop.

Soil

New alluvial soil is considered suitable for the growth of the jute crop.

Methods of Cultivation

Sowing: Seeds are sowed by broadcasting and drilling methods. They are sown in February on lowlands and in March and June on uplands.

Harvesting: The crop is harvested from July to September. The plants are cut after they attain the height of 2–4 m, and then they are put into a pond for retting. After peeling the bark, the fibre is rinsed, washed, dried and pressed into bales.
Processing: Jute is put into specialised tanks for retting. After obtaining fibres, they are dried, spun and woven into sacks and carpets.

Distribution
West Bengal is the leading producer of jute in the country. In Bengal, jute is grown in Nadia, Parganas, Jalpaiguri, Malda and Burdwan. It is also grown in Assam, Bihar, Odisha and Uttar Pradesh.

Tea

Tea is an important beverage in India.

Climatic Conditions
- The ideal maximum temperature for the growth of the tea plant is about 24–30°C. The tea plant grows well under shade.
- High humidity, heavy dew and morning fog are good for the development of young leaves.
- The tea plant grows well in humid climate. It needs adequate annual rainfall of about 150 cm distributed throughout the year.

Soil
- It grows well in regions of well-drained loamy soil or forest soil rich in humus.
- The soil should be gently rolled to prevent waterlogging.

Methods of Cultivation
Sowing
- One way of planting tea is that first high-quality seeds are sown in nurseries. The saplings are then transplanted within a year in a tea garden.
- Tea shrubs can also be grown in nurseries from the cutting of high-yielding varieties. This is known as the clonal planting method of propagating tea.
- Tea gardens are located on hillslopes as slopes prevent the soil from waterlogging. Standing water or waterlogging can seriously damage the crop.

Harvesting
- Bushes of the plant are pruned. In India, tea leaves are picked frequently.
- Tea picking is a skilful job and is mostly done by women.

Processing
There are four types of tea and each is processed differently.
Black Tea
- Withering: Tea leaves are dried under the Sun to extract moisture.
- Rolling: Leaves are then rolled mechanically between steel rollers to break the fibres.
- Fermentation: The leaves are fermented, reducing the amount of tannic acid in tea by half.
- Drying: Leaves are then dried over a fire or in an oven until they are black.
- Blending: Blenders then give blend grades of tea to give it a special aroma.

Green Tea
- The picked leaves are heated immediately by roasting them.
- There is no fermentation process and leaves remain green even when they are dried, graded and packed.

Oolong Tea

- This tea is prepared by partially drying and fermenting the leaves.
- Much of this tea is exported to the United States.

Brick Tea

- Inferior and coarser leaves and stems are compressed into rectangular blocks of brick tea.
- This tea is mostly consumed in Tibet and Russia.

Distribution

India is the fourth largest exporter of tea. Assam is the leading producer of tea in India, followed by West Bengal. Tea is also produced on a large scale in Tamil Nadu and Kerala. Other minor tea-producing regions are Ratnagiri and Satara in Maharashtra, Purnea in Bihar, Kangra Valley in Himachal Pradesh and Coorg and Shimoga in Karnataka.

Coffee

Three main species of coffee are grown in India. These are

Coffea robusta: It is grown in areas of lower elevation where Arabica is not usually grown and can survive in even arid conditions. It produces poor quality coffee.

Coffea liberica: It is a disease-resistant species of coffee which is generally grown on the lowlands. Both Robusta and Liberica are suitable for making 'instant' coffee and thus have become popular.

Coffea arabica: It is the finest quality of coffee, but it is prone to diseases. Its main varieties are Chicks, Blue Mountain and Bourbon Amarillo.

Climatic Conditions

- Coffee requires warm climate with a temperature of 15–28°C. It can neither withstand frost nor high temperature.
- The coffee plant is planted under the shade of trees (such as silver oak and jackfruit) as direct sunlight can damage the crop.
- The coffee plant requires rainfall between 150 and 200 cm. A prolonged drought may severely damage the crop.

Soil

Rich, well-drained friable loamy soil is suitable for the growth of coffee plant. Fertilisers are added to make the soil fertile.

Methods of Cultivation

Sowing

- Saplings of coffee plant are taken from the nursery and are then transplanted to the field.
- Plants are planted 3 m apart from each other. They are pruned. The height of the coffee plant is maintained at 1.5 to 2.5 m.
- Coffee plants are grown on slopes as stagnant water is harmful for the crop.
- Many trees such as oranges, cardamom and pepper vines are also planted to generate extra income.

Harvesting

- The coffee plant is harvested in the fourth or fifth year. Coffee is picked by hands by removing ripe berries from the stalk.

Processing

- The coffee berries are passed through the machine which removes their outer covering.
- The beans are then fermented by drying under the Sun. After being peeled, the beans are roasted at a temperature of 99°C and are then ground into coffee powder.

Distribution

Coffee is mainly produced in Karnataka (Coorg and Chikmagalur), Kerala (Kozhikode, Palakkad and Idukki) and Tamil Nadu (Nilgiri district, Madurai and Coimbatore).

Rubber

Rubber is obtained from latex—a milky juice obtained from various plants such as castile and *Hevea brasiliensis* (para rubber).

Climatic Conditions

- Para rubber is grown in India at an elevation of about 300 to 450 m on the slopes of the Western and Eastern Ghats.
- It grows well in hot and humid conditions. It is grown in regions where the temperature does not fall below 21°C. It grows well between 25°C and 35°C.
- The rubber plant requires evenly distributed high rainfall of 200–400 cm.

Soil

The plant requires rich, well-drained alluvial and laterite soils.

Methods of Cultivation

Sowing

- Rubber is cultivated either by propagating seeds or by bud grafting.
- In propagation of seeds, seeds are allowed to sprout in the river bed sand. After germination, they are planted in nurseries and are then transplanted in the fields.
- Bud grafting is carried out by selecting quick-growing buds. After the seedlings grow, the buds are grafted on the seedlings.
- Rubber plant needs proper caring and good manuring for growth and good yield.

Harvesting

- Latex is obtained from the rubber tree by the process of tapping. After cutting the bark of the rubber tree, latex is collected in containers placed below the plant.
- Tapping is not carried out in the rainy season as latex dilutes because of rainwater. It is also suspended during winter as its production is minimal at this time.

Processing

- Latex contains about 35% of dry rubber. After collecting, it is sent to a factory for processing.
- It is cleaned and mixed with acetic acid and is heated for about 24 hours.
- The spongy whitish mass is then obtained which is passed through the rollers to drain out water.
- They are then rolled into sheets and dried.

Distribution

India is the fourth largest producer of natural rubber in the world. Kerala produces about 95% of the total annual output. It is produced mainly in Kottayam, Kozhikode, Ernakulum and Kollam districts in Kerala. It is also grown in Tamil Nadu and Karnataka. Tripura, Assam, Goa and Andaman and Nicobar Islands also produce rubber in small quantities.

Transport

Transport

The economy of any nation depends on its infrastructure. One of the main components of infrastructure is the transport system. The transport system plays an important role in the Indian economy. These are

- It links the interior regions to the other parts of the country, thus helping in use of resources.
- It helps in industrialisation and urbanisation.
- It transports goods from one place to another.
- It minimises the effects of natural disasters.
- It enables easy movement of people across regions.

Roadways

India has one of the largest networks of roadways in the world. The length of road per 100 sq. km. of area is known as the density of roads. Kerala has the highest density of roads.
India has a large network of 41 lakh kilometres, making it the second largest road network in the world. This network of roads in India includes national highways, state highways, district roads and rural roads like border roads.

National Highways

Roads which run across the country and connect various cities and are maintained by the central government are known as national highways (NHs). Some facts about NHs:

- They handle about 40% of the total road traffic.
- The traffic on NHs is growing because of rapid industrialisation.
- The National Highways Authority of India (NHAI) was constituted in 1988. It is responsible for the construction of NHs and for implementing projects which are related to the improvement of NHs.
- Besides NHAI, the Public Works Department and Border Road Organisation carry out the development and maintenance of NHs.

Two major projects undertaken by NHAI are the Golden Quadrilateral and North–South and East–West Corridor.

Golden Quadrilateral

- It is the largest express highway project in India connecting the four metropolis cities of Delhi, Mumbai, Kolkata and Chennai.
- The Golden Quadrilateral has enabled the industrial growth of all small towns through which it passes and has provided an impetus to truck transport throughout India.

North–South and East–West Corridor

- The North–South and East–West Corridor is the largest ongoing highway project in India.
- It aims to connect Srinagar, Kanyakumari, Porbandar and Silchar.

Express Highways

Express highways are six-lane roads constructed to provide high-speed movement without any obstacles like speed breakers. Some major express highways in India are
Yamuna Expressway: It connects Greater Noida with Agra. It is a six-lane expressway. This expressway has reduced the travelling time between Delhi and Agra by over two hours and connects the main towns located on the eastern side of River Yamuna. It has helped farmers to transport their agricultural, horticultural and dairy products to major cities.
Ahmedabad–Vadodara Expressway: It was India's first four-lane expressway. It reduced the journey between Ahmedabad and Vadodara to less than 1 hour.
Mumbai–Pune Expressway: It is India's first six-lane high-speed tolled expressway. It has separate tunnels and complete fencing to prevent crossing by humans or animals.

Panipat Expressway: It has been constructed to decongest the traffic on the busy Delhi–Amritsar route. It is a 10-km elevated highway at Haryana.

State Highways

These are constructed and maintained by state governments. They link cities and towns within the state and connect the national highways.

Differences between national highways and state highways

National Highways	State Highways
National highways are constructed and maintained by the central government.	State highways are constructed and maintained by the state government.
They connect major cities, industrial centres and pilgrim places across the country.	These connect district headquarters, tourist centres, pilgrim towns and national highways within the state.

District Roads

These roads connect areas of production with markets in a district. They also connect talukas with district headquarters within the state.

Rural Roads

Rural roads constitute about 80% of total road length in the country. These roads facilitate the movement of agricultural produce and finished goods from production centres to market centres. Prime Minister's Rural Road Scheme was launched in December 2000 by the Government of India to provide connectivity to the rural areas.

Border Roads

The Border Road Organisation (BRO) was set up to strengthen the defence of the country. BRO has built the highest road in the world running from Manali to Leh.

Advantages of Roadways

- They provide door-to-door services.
- The cost of construction of roadways is much lower than that of railways.
- Roadways can be constructed in hilly regions.
- Roadways supplement the other modes of transport. For example, roadways connect railway stations and ports to the hinterland.

Disadvantages of Roadways

- The road network is inadequate to tackle India's large population.
- About half of the roads are unmetalled roads, and hence, their use is restricted during the rainy season.
- The number of NHs is also not enough keeping in mind the large population of the country.
- In cities, roads are highly congested. Sometimes, the encroachment of the road by hawkers and vegetable sellers also results in congestion.
- The passing of heavily loaded trucks which carry a load above the prescribed limit also damages the roads in the long run.

Railways

The first railway service ran from Mumbai to Thane in 1853. India has one of the largest and busiest rail networks in the world. India has both long distance and suburban rail networks. New Delhi, Mumbai, Kolkata and Chennai have their own metro networks. Indian Railways help not only in the movement of people but also in the transport of goods such as fertilisers, agricultural produce, and iron and steel products.

Railways have three kinds of tracks—broad gauge, metre gauge and narrow gauge.

Broad Gauge: Almost all major rail routes are broad gauge routes. The distance between the rails is 1.676 metres. Broad gauge connects major ports with interior towns and industrial centres. It handles 85% of the total goods traffic in tones-km. It is also called India gauge. The broad gauge railway line on the west coast is known as the Konkan Railway line which is an engineering feat.

Metre Gauge: The distance between the rails is one metre. It accounts for 11.22% of the total rail route.

Narrow Gauge: The distance between the rails is 0.610–0.762 m. Metre gauge is mainly confined to the hilly regions.

Advantages of Railways

- It transports raw materials to production units and finished products to the markets.
- Bulky goods can be easily transported over a long distance.
- Railways have brought villages closer to the cities.
- It facilitates easy movement of people, police and defence equipment.
- Railways help in reducing suffering during natural calamities.
- It provides for a comfortable journey even during the nights.

Disadvantages of Railways

- Railway tracks cannot be laid down in hilly and remote forested regions.
- Every industrial town does not have railway tracks.
- Trains cannot cross oceans. They are limited to land travel and cannot transport products from one continent to the other.
- Train travel is long and tedious as compared to air travel.

Air Transport

- Air transport in India made progress after Independence. India has both domestic and international airlines. The Airports Authority of India was set up on 1 April 1995 after the merger of National Airport Authority and International Airports Authority.
- The Airports Authority of India is responsible for providing safe and efficient air traffic services in the country.
- Air India is a government-owned carrier serving 50 domestic destinations and 39 international destinations. It is the 16th largest airline in Asia. Some private airlines operating in India are Jet Airways, GoAir and SpiceJet.
- The cargo airline companies in the country are Deccan Cargo and Express Logistics Pvt. Ltd. and Blue Aviation Pvt. Ltd.
- Pawan Hans Helicopters Ltd. (PHHL) was established with an aim to provide helicopter support services to the oil sector for offshore exploration.

Advantages of Airways

- It is the fastest means of transport.
- It is also a prestigious and comfortable means of transport.
- Regions which are covered with dense forests, deserts and high mountains have easily become accessible because of air travel.
- In case of a natural calamity like floods, when roads cannot be used, relief work is carried out with the help of helicopters.

Disadvantages of Airways

- It is the costliest means of transport and hence is out of the reach of common people.
- Unlike roads and railways, airways have still not been connected to the smallest cities.
- Petroleum which is used as fuel is a non-renewable source of energy.
- Freight charges are high.

Water Transport

Waterways are the most important means of transporting bulky and heavy goods. It is a fuel-efficient and environment-friendly means of transport. Water transport can be divided into inland waterways and oceanic waterways.

Inland Waterways

Inland waterways connect rivers, canals, backwaters and creeks within the country. These waterways should be free of barriers such as waterfalls and rapids. Inland Waterways Authority of India (IWAI) is in charge of the waterways in India. It has declared five inland waterways as national waterways. These are

Name of Inland Waterway	Features
National Waterway No. 1	Comprises the Ganga–Bhagirathi–Hooghly river system connecting Haldia–Kolkata–Farakka–Munger–Patna–Varanasi–Allahabad.
National Waterway No. 2	River Brahmaputra connects Dhubri–Pandu–Tezpur–Neamati–Dibrugarh–Sadiya.
National Waterway No. 3	Comprises the West Coast Canal along Champakaran and Udyogmandal. It was declared a national waterway in 1993.
National Waterway No. 4	Connects Andhra Pradesh, Tamil Nadu and Puducherry.
National Waterway No. 5	Comprises the Talcher–Dharma stretch of River Brahmi, the Goenkhali–Charbatia stretch of the East Coast Canal and the Charbatia Dharma stretch of Malti River along with the Mahanadi delta.

The following waterways have been declared as national waterways by the government:

- The River Ganga between Allahabad and Haldia
- The River Brahmaputra between Sadiya and Dhubri
- The West Coast Canal in Kerala

Apart from the Ganga and the Brahmaputra, Godavari, Krishna and Buckingham Canal and East–West Canal are important inland waterways.

Oceanic Waterways

India is a peninsular country with a long coastline of 7517 km. It has 12 major sea ports and 187 minor sea ports.

Sea ports handle over 80% of all cargo traffic. Some major sea ports in India are

- Mumbai Port is the largest port in the country. Jawaharlal Nehru Port was built to decongest the Mumbai Port. Apart from various other goods, Mumbai Port deals with mineral oil and dry cargo.
- Mormugao Port in Goa is an important iron ore-exporting port in the country. It is a natural harbour and occupies the fifth position in total traffic handled.
- Kolkata is an inland riverine port. Haldia Port was developed on the River Hooghly to reduce pressure on the Kolkata Port.
- Paradip Port is located on the coast of Odisha and handles iron ore and coal.
- Vishakhapatnam Port in Andhra Pradesh is the deepest landlocked port which handles crude oil and petroleum products.
- Chennai is one of the oldest artificial ports of the country. It is next to Mumbai in trading activities. It handles petroleum products, crude oil, fertilisers, iron ore and dry cargo.
- Tuticorin Port in Tamil Nadu has a natural harbour and mainly handles coal, salt, edible salt, dry cargo and petroleum products.
- Kandla Port is a tidal port located in Gujarat. It handles crude oil, petroleum products, edible oil, food grains, cotton and salt.
- New Mangalore in Karnataka exports iron ore of Kudremukh and imports petroleum products, fertilisers and edible oils.
- Kochi Port is located in the southwestern part of the country. It has been developed alongside a natural harbour. It handles the export of tea, coffee and spices and the imports of petroleum oil and fertilisers.

Differences between Oceanic Waterways and Inland Waterways

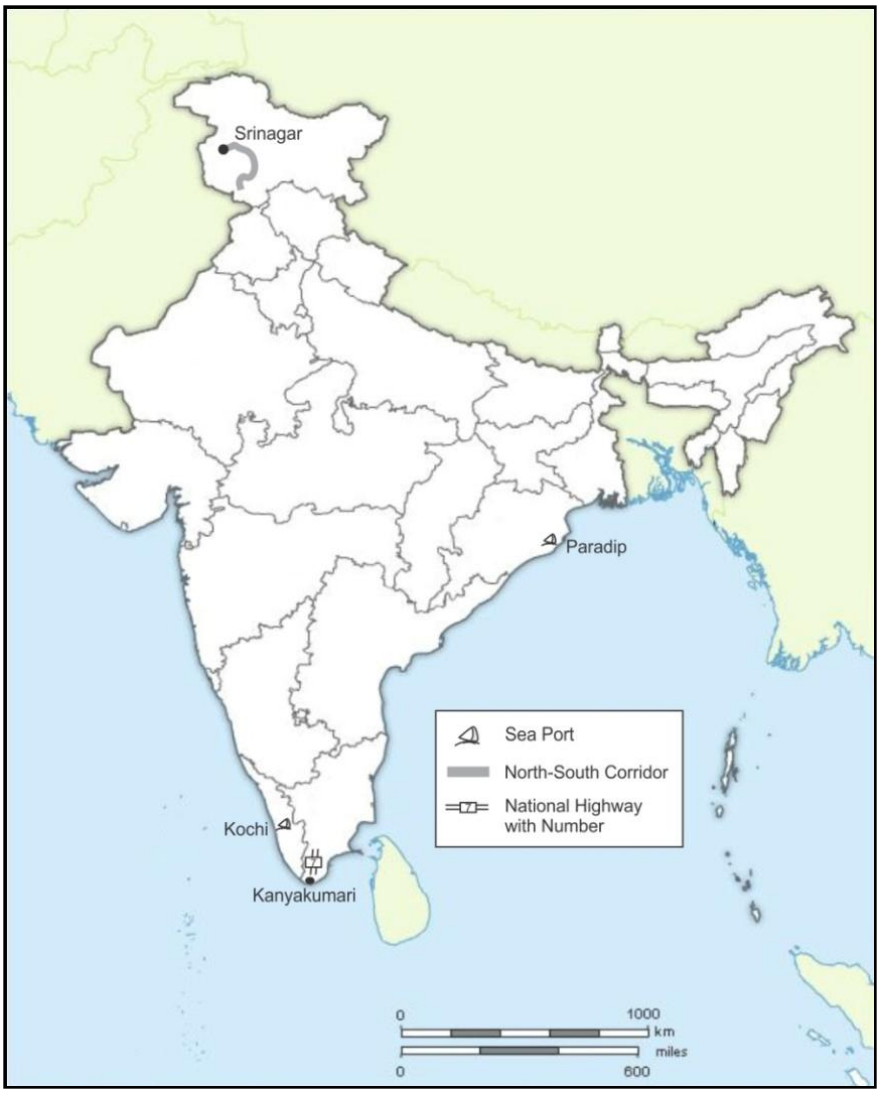
Oceanic waterways	Inland waterways
It includes transport along the coastline.	It includes transport through navigable rivers and canals.
Coastal and foreign trade usually takes place through oceanic waterways.	Domestic trade takes place through inland waterways.

Advantages of Waterways

- It is the cheapest means of transport.
- It is suitable for carrying heavy and bulky materials.
- It is a fuel-efficient and eco-friendly mode of transport.
- It is safe and has less traffic in comparison to road and air transport.

Disadvantages of Waterways

- It is dependent on the weather.
- It involves long hours of travel which cause sickness.
- It is limited to areas where rivers are navigable and where an oceanic route exists.



Map of India showing Paradip Sea Port, Kochi Sea Port, Northern terminal of the North South Corridor and the Southern Terminal of the National highway No. 7

Waste Management-II

Impact of Waste Accumulation

If wastes are allowed to accumulate and are not disposed carefully, then they will not only affect our environment but will also affect our health.

- When accumulated wastes are left opened and unattended, they begin to decompose. This results in the growth and multiplication of number of pathogenic bacteria, viruses and fungi which carry germs of various diseases to human settlements.
- Decomposition of wastes also produces various gases which pollute the air around us.
- During the rainy season, rainwater takes various decomposed wastes containing pathogens to water bodies causing water pollution.

Spoilage of Landscape

- Waste accumulation ruins the natural beauty of the landscape. Apart from this, it also becomes the thriving ground for rats and other disease-carrying germs.
- Burning of coal, fuel or wood produces sulphur and nitrogen which react with oxygen to form sulphur oxide and nitrogen oxide, respectively. When these gases react with water vapour, sulphuric acid and nitric acid are formed. Precipitation of water along with these acids forms acid rain.
- When monuments come into contact with acid rain, gypsum and calcium are washed away leading to their corrosion. Examples: The Parthenon of Athens, the Colosseum of Rome, the Taj Mahal of Agra

Pollution

- Pollution is caused by the introduction of harmful substance in the atmosphere. It is caused by the addition of waste toxic chemicals or gases into the atmosphere.
- Accumulation of waste leads to pollution. Industries, household activities, hospitals, restaurants and agricultural practices (such as the use of fertilisers) are the main sources of pollution.
- In open dumping, wastes are dumped in open spaces located far away from the limits of the city. This kind of waste disposal is not safe and has many limitations. The dumping of different types of wastes makes such dumping grounds the breeding ground of mosquitoes and flies. When these wastes are carried by rainwater to nearby lakes, rivers or ponds it results in water pollution.
- Industrial wastes contain harmful chemicals such as lead and mercury. These chemicals enter animal and human bodies by the food chain.

Eutrophication

It is a process in which oxygen begins to deplete from water bodies either naturally or because of human activities. Nutrients and chemicals are discharged into water bodies through sewage and effluents. Accumulation of these in water bodies results in the growth of phytoplankton and algae. This obstructs the penetration of oxygen and sunlight into water bodies which may result in the death of aquatic organisms.

Health Hazards

- Respiratory infections and irritation in the eyes, nose and throat. It causes headaches, nausea, dizziness and allergic reactions.
- Air pollution may also cause chronic respiratory diseases, lung cancer, cardiovascular diseases and even damages the nerves, kidneys and liver.

- Pathogens are disease-causing bacteria which are present in wastewater. When contaminated water is consumed, pathogens enter the human body. It may cause various water borne diseases such as typhoid, cholera, diarrhoea, dysentery and jaundice.
- Metals such as lead, mercury and cadmium dissolved in water may cause several diseases if they enter the human body. When water contaminated with cadmium was consumed by people in Japan, they were affected by a disease called Itai-Itai. Similarly, a disease known as Minamata affected the Japanese after they consumed fish which had large concentrations of mercury. Lead can affect the blood system and can lead to behavioural disorders.
- Radiations are extremely dangerous for human health as they produce harmful changes in the body cells and affect the genes.
- When people are exposed to radiations, their offspring may also be affected and gene mutations may be transmitted to future generations. This is known as genetic variations.
- When a person is exposed to radioactive pollution, damage may be caused to the body organs. It may result in lung cancer, brain cancer, thyroid cancer, sterility and reduced or defective eyesight.

Effects of Waste Accumulation on Terrestrial Life

Effects of waste accumulation on human health have already been discussed above.

Its effects on plants are

- Nitrogen dioxide leads to the premature falling of leaves. It also affects the growth of plants which result in low crop yields.
- Ozone enters the leaves of plants through stomata. It then dissolves with water within the plant and reacts with other chemicals damaging its leaves. Plants weakened by ozone may become more susceptible to various diseases, pests and droughts.
- Peroxyacetyl nitrate causes premature falling and discolouring of leafy vegetables.
- Sulphur dioxide has a bleaching effect on plants. It results in the loss of chlorophyll. Many leafy vegetables become yellow because of the effect of the gas.
- Radioactive pollution affects our environment. Radioactive wastes cannot be destroyed, and hence, they remain in our environment for a long period of time. They cause the discolouring of trees in the forests. After the Chernobyl nuclear accident, a pine forest cover near the power plant turned reddish brown.

Effects on Animals and Birds

- Animals may consume toxic materials or polythene bags from wastes. This results in the spread of diseases among them.
- The underground disposal of radioactive wastes may contaminate the drinking water which may be harmful for plants, animals and humans.
- Birds consuming agricultural wastes produce defective egg shells and show increased mortality.

Effects on Aquatic Life

When the quantities of harmful substances such as pesticides and insecticides increase in the food chain of marine and aquatic organisms who are then consumed by other living beings, it is known as the process of biomagnification. The phenomenon of concentrated toxic deposition at the higher trophic level in the food chain is known as **bioaccumulation**.

Minamata Tragedy

Minamata is a coastal town in Japan. It had a vinyl chloride factory which used to discharge effluents contaminated with methyl mercury into the sea. This was consumed by fish. When these fish were caught and consumed by the people, it caused Minamata disease. The disease affected the central nervous

system resulting in difficulty in walking and speaking among humans. Under extreme circumstances, the disease also resulted in death among people. Fishing in Minamata Bay was later banned by the Japanese authorities.

Safe Disposal of Wastes

It is important to safely dispose wastes. Wastes can be safely disposed in the following ways:

Segregation

This is a method in which wastes are segregated. Biodegradable and non-biodegradable wastes are segregated into different bins. Biodegradable wastes are then converted to useful products like biogas.

Open Dumping

In open dumping, wastes are dumped in open spaces located far away from the limits of the city. This kind of waste disposal is not safe and has many limitations. The dumping of different types of wastes makes such dumping grounds the breeding ground of mosquitoes and flies. Burning of these wastes also pollutes the air. The situation can become worse during the rains. Rainwater may carry these wastes to nearby lakes, rivers or ponds and pollute them.

Sanitary Landfills

In sanitary landfills, the wastes are disposed away from the city. The waste is first spread in layers and then is compacted tightly so that their volume is reduced. The waste is then covered by soil. The waste is then subjected to bacterial decomposition. Sanitary landfills are useful as the wastes are not attacked by rodents or insects. Sanitary landfills are planted with vegetation. It has to be taken care that the roots of plants which are grown should not penetrate more than 30 cm into the soil. Further, only those plants should be grown which have the ability to thrive on low nutrient soil.
One precaution which needs to be taken care is that landfills should not be located in areas which have high underground water level as it may get polluted.

Composting

In composting, household and municipal wastes are decomposed by the aerobic method. The wastes are decomposed by microorganisms.
This is a useful method of waste decomposition as wastes are decomposed by microorganisms into humus which adds fertility to the soil. Advantages of composting are

- Enhances soil nutrition and soil water retention capacity
- Checks soil erosion
- Increases the soil fertility by adding humus

Incineration

In the process of incineration, municipal wastes are burned at a very high temperature. Many materials like metal do not get completely burnt. These may be then recycled. This method however also pollutes the air with fly ash and sulphur dioxide.
It is also an expensive process as the installation of proper devices for controlling air pollution need to be installed. This method is useful because

- It kills pathogenic organisms and reduces the volume of wastes.
- It is useful for disposing petroleum and plastic wastes in chemical industries.

Management of Municipal Wastes

- Municipal authorities should collect solid wastes from each house.
- Horticultural and construction wastes should be collected separately and disposed of.
- Biomedical wastes and industrial wastes should not be mixed with municipal wastes.
- Municipal wastes should be carefully stored and segregated.

Drainage and Treatment of Effluents

Wastewater has to undergo three treatments during its purification. These are

Primary Treatment

- In the first stage of primary treatment, large particles such as rags and sticks are removed from water.
- To remove inorganic solids such as silt, egg shells along with bone chips and seeds, known as grit, the wastewater is made to enter a grit chamber where the speed of water is decreased. The grit then settles and is removed manually or mechanically from the grit chamber.
- Water then flows into a sedimentation tank. In the process of sedimentation, water is stored in large basins where sand particles, silt and other particles settle. The impurities or sludge are then removed.
- The process in which sedimented water is subjected to a chemical process is known as coagulation or flocculation.
- In the process of filtration, suspended impurities are removed by making water pass through a barrier of sand matrix.

Secondary Treatment of Water

- In this method, the organic matter which is present in water is biologically degraded by microorganisms. When water enters a tank, it comes into contact with microorganisms.
- Air is introduced into the tank through diffusers. Microorganisms in the presence of oxygen break the organic matter and the impurities then settle at the bottom of the tank which are later removed.
- Water is then treated with chlorine gas which then kills the rest of the harmful organisms.

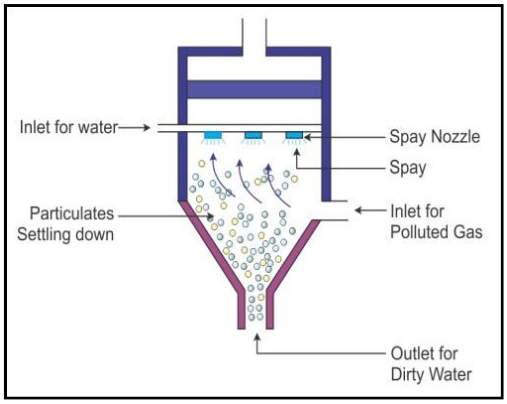
Tertiary Treatment

Tertiary treatment: In this method, nutrients such as nitrogen or phosphorus are removed. This water can be reused for industrial, agricultural and domestic purposes.

Pollution Control Devices and their Functioning

Scrubber

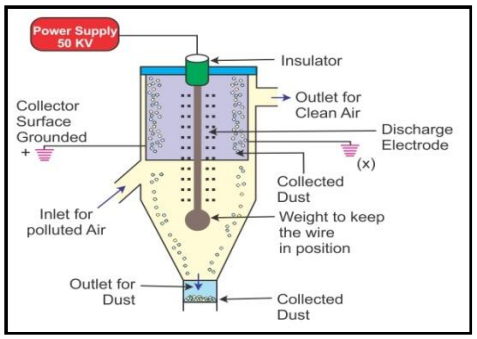
- Wet scrubber is a device which is used for trapping the emissions of water-soluble gases such as sulphur dioxide, nitrogen oxide and ammonia.
- In a wet scrubber, spray nozzles are fitted through which water is sprayed into the device in a way that it goes downwards.
- As polluted gases rise upwards, the particulate matter present in it collides with water drops. Because of the gravitational force, the water drops containing particulate matter settle at the bottom and the pollutants are segregated.



Scrubber

Electrostatic Precipitator

- This device is used for removing fly ash after combustion of coal or other materials. The process of its working is as follows:
- After combustion of coal and other materials, polluted gas or smoke enters the electrostatic precipitator.
- The devise is electronically charged. The polluted air and the impurities become negatively charged as they gain electrons on their surface.
- Negatively charged dust particles are then drawn towards the positive charged electrode plates and are deposited there.
- Impurities are then dislodged by mechanical rappers and get collected at the bottom of the unit in a hopper.
- An electrostatic precipitator is a very efficient device which removes more than 99% of impurities.
- The advantages of using this device are that they are economical to operate and have high efficiency. They also do not produce moisture plume.



Electronic Precipitator

Reduce, Reuse and Recycle

Wastes should be reduced, reused and recycled.

- Waste can be reduced by reducing the generation of waste from industries. Wastes should also be segregated.
- Wastes such as glass, rubber and metal pieces can be reused to produce new materials. Wastes such as fly ash produced by the paper industry can be used for making roads and filling up low-lying areas.
- Wastes can also be treated and recycled to make new products. Example: The paper industry uses recycled pieces of wood from the furniture industry. Paper can also be recycled.

Government Initiatives for Protecting the Environment

The Environment Protection Act (1986) empowers the central government to coordinate actions of the state governments and plan and execute a nationwide programme for the prevention, control and abatement of environmental pollution.

Environmental activists have been demanding that large and big dams should not be built, as construction of big dams submerges forested land, disrupts the ecosystem of rivers and destroys not only the aquatic life but also the terrestrial life around them. Building of large dams also displaces people in large numbers.

Social Initiatives

Many social initiatives are taken to protect the environment. Some of these are

- Air pollution can be minimised by using public transport by car pooling.
- People living in housing societies can initiate steps for waste management by making provisions for waste segregation and building compost pits.
- People should stress on making houses or residential buildings with solar panels and water recharging facilities.

Individual initiatives

- Use of plastic bags should be discarded, and bags made of jute or cloth should be encouraged
- Use eco-friendly objects
- Cut down on the use of chlorofluorocarbons (CFCs)
- Adopt and popularise renewable sources of energy
- Reuse and recycle wastes
- Use rechargeable batteries

Climate of India

Climate of India and Regional Variations

India has a tropical monsoon type of climate. This is because India lies in the tropical belt and its climate is influenced by the monsoon winds. Hot summers and dry winters are characteristic of the monsoon type of climate.
India has many relief features which affect its climate. For example, the Himalayas influence the climate of India in the following ways:

- It protects northern India from the cold winds which blow from central Asia. Without this range, the Indian plains would experience extremely cold climate.
- Northern India experiences continental type of climate because of the presence of the Himalayas. Main characteristics of this type of climate are hot summers, cold winters and little rainfall. The diurnal range (difference between maximum and minimum temperature) of temperature is also large.

Regional Variations

India has a vast latitudinal and longitudinal extent. Thus, it has vast regional variations. Some of these are

- While Barmer in Rajasthan experiences a temperature of 48–50°C in June, Pahalgam in Kashmir experiences 22°C in the same month.
- While Kerala enjoys tropical climate with warm and moist air, Punjab experiences continental type of climate with severe heat during summers and severe cold during winters.
- While the temperature in Kerala remains at about 20–22°C during winters, in Kargil, the temperature may drop below −40°C.
- While the difference between day and night temperatures in Kerala is hardly 7–8°C, the diurnal range of temperature is extremely high in the Thar desert. The difference between the day and night temperature is between 25°C and 30°C.
- Precipitation also differs in the country. While the precipitation is in the form of snowfall over the Himalayas, it rains over other parts of the country.
- While Mawsynram and Cherrapunji receive about 1100 cm of rainfall in Meghalaya, Jaisalmer in Rajasthan receives only about 9 cm of rainfall annually.
- Most parts of India receive rainfall during June to September, but the coastal areas of Tamil Nadu receive rainfall during winters.

Factors Affecting the Climate of India

The Himalayas

- The Himalayas protect the North Indian Plains from severe cold winds which blow from Central Asia during winter.
- The rain-bearing winds blowing from the Arabian Sea bring in rainfall over the northern plains after striking the Himalayas. Central Asia lies in the rain shadow area of the Himalayas and hence hardly receives any precipitation from these winds.

The Monsoon Winds

- The monsoon winds affect the climate of India. The southwest monsoon winds blowing from the Arabian Sea and the Bay of Bengal bring rainfall over the entire country during June, July and August.
- By the beginning of October, the winds start to retreat from central India. The northeast monsoon winds bring rain to Tamil Nadu in winters.

Latitude

- The tropic of Cancer divides the country into two parts. The northern part lies in the temperate zone, while the southern part lies in the tropical zone.
- While the northern part of the country lying in the temperate zone experiences hot summer and cool winters, the southern parts of the country located in the tropical zone experiences hot climate.

Varied Relief

- Relief features play an important role in shaping the climate of India. The areas located in the windward side of the Western Ghats receive heavy rainfall, while the Deccan region lying on the leeward or rain shadow area of the Western Ghats receives very little rainfall.
- The southwest monsoon winds blow parallel to the Aravalli Range. The latter is not able to stop the moisture-laden winds, making Rajasthan a dry state.
- Areas located in southern Assam receive heavy rainfall compared to the regions located to their north. This is because the hills in Southern Assam block the winds and force them to shed their moisture. By the time these winds arrive in northern Assam, they are comparatively dry.

Altitude

- Temperature decreases with higher altitude. There is a decrease of 1°C for every 166 m rise in height.
- Thus, the mountains are cooler than the plains. Thus, the temperature at Ooty is lower than that at Kochi as the former is located at a higher altitude.

Influence of the Surrounding Seas

- India—a peninsular country—is surrounded by seas and oceans on three sides.
- These water bodies affect the climate of the regions which lie close to the sea. These regions experience moderate, equable and maritime climate.

Western Disturbances

- Because of the shifting of pressure belts in central and west Asia, northern India comes under the influence of western disturbances.
- These western disturbances cause rainfall over the northern parts of the country and snowfall over Jammu and Kashmir.

Distance from the Sea

- The regions located far away from the Sea and in the interior of the continent experience a continental type of climate.
- The summers are extremely hot, and the winters are extremely cold.

Phenomena and Mechanism of the Monsoons

The monsoon winds are caused by the differential heating and cooling of the land and the sea. They are divided into two systems—summer monsoon and winter monsoon.

Summer Monsoon

- The land heats quickly during summers, and hence, low-pressure conditions develop over the land. As the sea is relatively cool, high pressure area develops over the sea.
- Because winds move from a high-pressure area to a low-pressure area, winds move from the sea to the land. This is called summer monsoon.
- In May, June and July, the plains of the Indian subcontinent receive vertical rays of the Sun. While a low-pressure area develops over the land, a high-pressure area develops over the sea.
- Thus, winds blow from the Indian Ocean northwards and northwestwards into Asia. Because they blow from the southwest, they are known as the southwest summer monsoon.

Winter Monsoon

- During the winter, oceans tend to become warm and the land cools down. A high pressure area develops over the land and a low-pressure area develops over the Indian Ocean.
- The winds move from a high-pressure area to a low-pressure area. Thus, the winds which blow from the land to the sea are dry and are devoid of any moisture. They bring cold weather and do not produce any rainfall.
- When these winds blow over adjoining oceans, they pick up moisture and bring rainfall over the southern Coromandel Coast (coastal Tamil Nadu) and over the southern tip of Andhra Pradesh.
- Because these winds blow from the northeastern parts of the country, they are also known as northeast monsoon winds.

Features of Rainfall in India

- Rainfall in India is mainly concentrated to the months of July, August and September.
- In India, the rainfall is mainly orographic in nature. The places located on the windward side receive more rainfall than the places located on the leeward side.
- Only a small amount of rainfall is received from cyclones and convectional rainfall.
- Monsoon in India is erratic, uneven and unpredictable. While there are floods in some regions, the other regions experience drought.

Seasons in India

The southern monsoon winds have distinct seasonal patterns. In the monsoon type of climate, a year is divided into four seasons.

Hot Dry Summer

- Summer in India begins from March and continues till May.
- The highest temperature is recorded in the northwestern parts where the highest temperature may reach up to 48°C. South India does not experience intense heat because it experiences moderating influence of the sea.
- During the summer, a local hot wind called loo blows in the northern parts of the country. Direct exposure to the wind may prove fatal.

- During this season, thunderstorms known as kalbaisakhi hit West Bengal. These are also known as Bardoli Chheerha. These thunderstorms are accompanied by heavy rainfall. It also rains in coastal Kerala and Karnataka. These showers are known as mango showers as they help in the early ripening of mangoes. They are also known as cherry blossoms in Karnataka.

Southwest Monsoon

- The southwest monsoon begins in June and lasts till September. During summers, a low-pressure area is created over the northwestern part of the Indian Ocean. This attracts the southeast trade winds. These winds get deflected to their right because of the Coriolis force after crossing the equator.
- They reach the west coast as the southwest monsoon. They bring heavy rainfall accompanied by violent thunder and lightning. This violent onset of the monsoon is termed the burst of the monsoon.
- The monsoon winds get divided into the Arabian Sea branch and the Bay of Bengal branch.

Map showing direction of South west monsoon winds in India

Arabian Sea Branch

- One branch of these winds causes heavy rainfall on the areas which lie on the windward side of the Western Ghats and the Western Coastal Plains. The areas located on the leeward side of the Western Ghats hardly receive any rainfall.
- The second branch of the Arabian Sea monsoon winds strikes the northern coast of Mumbai. It further moves along the river valleys of Narmada and Tapti and cause rainfall in central India. It then mingles with the Bay of Bengal branch after entering the Ganga plains.
- The third branch strikes the Saurashtra Peninsula and the Kachchh. It then travels to western Rajasthan and runs parallel to the Aravalli Range. Hence, western Rajasthan gets scanty rainfall.
- The Arabian Sea branch joins the Bay of Bengal branch causing rainfall in the western Himalayas.

Bay of Bengal Branch

- The Bay of Bengal branch approaches towards Myanmar and southeast Bangladesh. Because of the presence of the Arakan Hills, they are deflected towards the Indian subcontinent. The monsoon thus enters West Bengal from south and southeast instead of the southwesterly direction.
- This branch then divides into two—one running along the Ganga plains and the other along the Brahmaputra valley.
- These branches cause heavy rainfall in the Ganga plains, Brahmaputra valley and Garo and Khasi Hills of Meghalaya. Mawsynram and Cherrapunji, which are located on the southern part of the Khasi Range, receive the highest average rainfall in the world.

The rainfall received from the southwest monsoon winds are largely affected by topography. This can be borne by the following examples:

- Mahabaleshwar located on the windward side of the Western Ghats receives heavy rainfall (250 cm). Pune, on the other hand, located on the leeward side gets less than 70 cm of rainfall annually.
- It rains heavily in the northeastern parts of the country because of the presence of the mountain ranges.
- There is a decrease in rainfall as one goes from the east to the west because the winds become dry as they shed their moisture in the course of their journey. Thus, Kolkata receives 120 cm of rainfall, Patna receives 102 cm, Allahabad receives 91 cm and Delhi gets 56 cm of rainfall.
- The coast of Tamil Nadu does not get rainfall during this season. It is because this coast is parallel to the Bay of Bengal branch of the southwest monsoon winds. It also lies in the rain shadow area of the Arabian Sea branch of the southwest monsoon.

Retreating Monsoon

- During October and November, the southwest monsoon winds become weaker and start retreating.
- This season is marked by clear skies and an increased temperature in the northern plains.
- The retreat of monsoon is at a marked level. This increase in temperature is termed October heat.
- At this time, the low-pressure conditions shift to the Bay of Bengal giving rise to cyclonic depressions. These cyclonic depressions often result in the destruction of life and property generally on the eastern coast and the southern coast. Most of the rainfall of the Coromandel Coast is derived from depressions and cyclones.

Tropical Cyclones

- Tropical depressions originating in the Bay of Bengal are caused by local variation of heat and moisture. They result in tropical cyclones in November and December.
- They generally originate in the neighbourhood of the Andaman and Nicobar Islands between 12°N and 17°N and travel eastwards towards the Bay of Bengal. They result in heavy downpour and cause great loss of life and property.

October Heat

- The month of October is marked by clear cloudless sky, high temperature and high humidity. This is called October heat.
- The month is also a period of transition between the hot rainy season and the cold dry season.

Cold Season

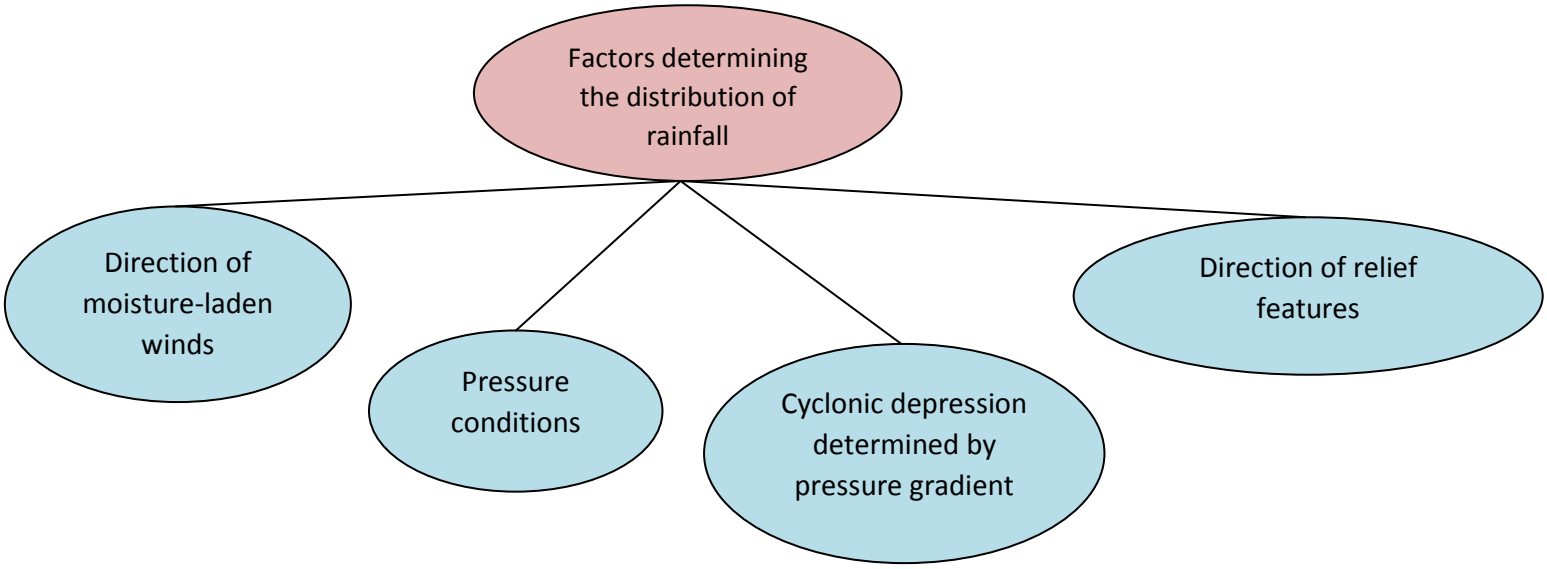
- The cold weather season in India begins during mid-November in northern India and stays till February. December and January are the coldest months.
- The temperature decreases from the south to the north. The places in the North Indian Plains experience cold climate. Thus, while the mean temperature during January at Thiruvananthapuram is as high as 31°C, it is only 16°C in Varanasi.
- The excessive cold in north India during the winter is due to the following reasons:
    - Cold winds blow from the Caspian Sea and Turkmenistan over the northwestern parts of India during February.
    - Places such as Punjab, Haryana and Rajasthan are far away from the moderating influence of the sea and hence experience continental type of climate.
    - The snowfall in the nearby Himalayan ranges creates a cold wave situation.
    - There are high-pressure conditions over the northwestern parts of the country.
    - The northeast trade winds blow from the land to the sea during this season, and hence, they are dry. They pick up moisture when they blow over the adjoining oceans and thus bring rainfall over the Coromandel Coast.
    - Western disturbances are experienced in the northern parts of the country during the cold season.

Rainfall

Most parts of the country do not receive rainfall during the winter. Some areas which receive rainfall during the winters are

- Central and northern parts of the country get occasional rainfall during winter.
- Weak temperate cyclones cause rainfall in Delhi, Haryana, Punjab and western Uttar Pradesh. This rainfall is beneficial for rabi crops.
- Northeastern parts of the country also receive winter rainfall.
- In October and November, northeast monsoon picks up moisture while blowing over the Bay of Bengal and cause torrential rainfall over the coast of Tamil Nadu and the southern tip of Andhra Pradesh.

Distribution of Rainfall



Distribution of Rainfall in India

Regions receiving heavy rainfall (more than 200 cm)

- Slopes of the Western Ghats and the Western Coastal Plains
- Meghalaya Hills (Garo, Khasi and Jaintia), the southern slopes of the Eastern Himalayas, Assam, Arunachal Pradesh and West Bengal

Regions receiving moderate rainfall (100–200 cm)

- The southern parts of Tamil Nadu and the northern parts of Andhra Pradesh
- Middle Ganga Valley, some parts of the Western Ghats, Eastern Maharashtra, Madhya Pradesh and Odisha

Regions receiving low rainfall (50–100 cm)

- Parts of the Deccan plateau comprising the regions of Karnataka, Andhra Pradesh and Tamil Nadu
- Eastern Rajasthan, Punjab, Haryana and Kashmir

Regions receiving scanty rainfall (100–200 cm)

- Northern parts of Kashmir, southern Punjab and western Rajasthan
- The rain shadow regions of the Western Ghats lying in the Deccan Plateau

Minerals in India

Minerals

Minerals are naturally occurring, homogeneous substances with definite chemical composition. Based on chemical and physical properties, minerals can be divided into metallic and non-metallic minerals. Differences between metallic and non-metallic minerals are

Metallic Minerals	Non-metallic Minerals
Metallic minerals contain metal in the raw form.	Non-metallic minerals do not contain metals.
These metals are generally associated with igneous rocks.	These metals are generally associated with sedimentary rocks.
They are usually hard and have a shine of their own.	They are not usually hard and have no shine of their own.
Examples: Iron, copper, bauxite, tin	Examples: Salt, coal, mica, clay

Characteristics of Minerals

Main characteristics of minerals are

- Minerals are not evenly distributed on the surface of the Earth.
- Minerals are exhaustible. Because they cannot be replenished immediately, they need to be conserved.
- All minerals do not have uniform properties. They have different chemical compositions.
- Minerals differ with each other in colour, lustre and texture.

Minerals in India

India is rich in many minerals because of its varied geological structure. Some commonly found minerals in India are coal, bauxite, mica, iron ore and manganese.

Coal

- Coal occurs in the sedimentary rocks. It was formed when plants and ferns were buried in the swamp forests. Heat and pressure exerted by many layers which were formed over these decayed plants resulted in many physical and chemical changes.
- Coal contains carbon, hydrogen, oxygen, nitrogen and small amounts of phosphorus and sulphur.
- Depending on the amount of carbon, moisture and volatile matter present, coal can be classified into four categories—anthracite, bituminous, lignite and peat.

Anthracite

- It is the hardest and highest quality coal as it has a carbon content of over 90% and burns slowly without smoke.
- It leaves very little ash behind and has a high heating value.

Bituminous

- Its carbon content varies from 50% to 80%.
- It is hard and black. It makes up about 80% of the total coal output in the world.
- It is widely used for household purposes.
- It is popularly used in various industries. High grade bituminous coal is used in blast furnaces for smelting iron.

Lignite

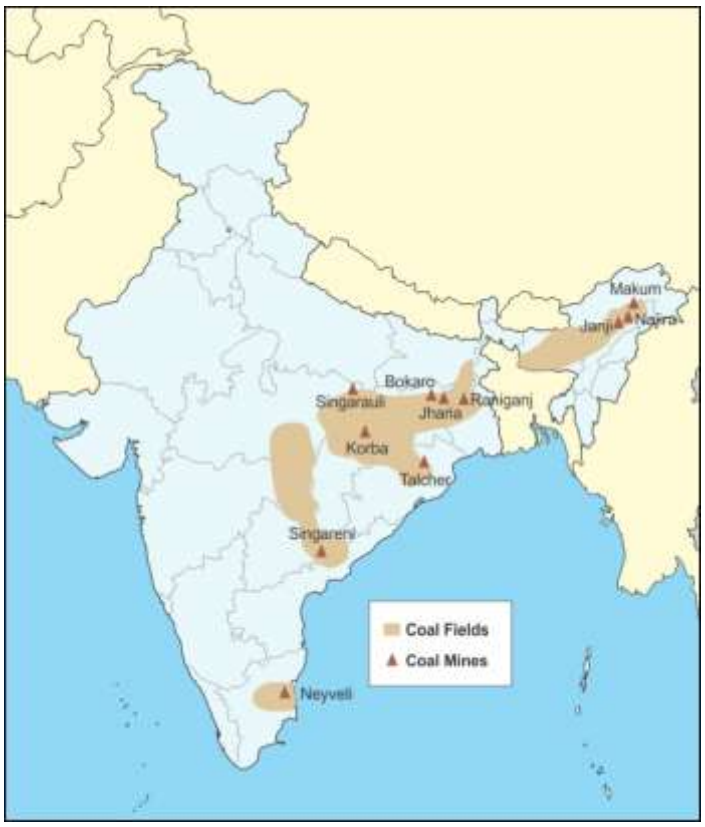
- It is a low grade coal also known as brown coal.
- It is soft with high moisture content.

Peat

- It has the least carbon content and is inferior to the other three varieties of coal.
- It represents the first stage of transformation of wood into coal.

Uses of Coal

- It is used in thermal power plants for generating electricity.
- It is used as a source of heat and energy for domestic purposes.
- It is used for manufacturing iron and steel. It is used as raw material in many industries.
- Chemicals such as ammonia and benzol are obtained as by-products from the gases which are released when the coal is burnt in a closed chamber to get metallurgical coke.



Map showing major coal fields and coal mines in India

Distribution

In India, coal is found in two main fields—Gondwana coalfields and tertiary coalfields. Bituminous coal is generally found in India.

Gondwana Coalfields

- It accounts for 98% of the total coal reserves in India. It is nearly free of moisture.
- It is found in the river valleys of Damodar, Mahanadi and Godavari.
- Gondwana coal deposits are found in West Bengal, Jharkhand, Odisha, Chhattisgarh, Madhya Pradesh, Uttar Pradesh and Andhra Pradesh.

Tertiary Coalfields

- The coal found in the tertiary coalfields has high moisture content.
- These fields are generally found in Assam, Arunachal Pradesh, Meghalaya and Nagaland.

Petroleum

Petroleum is a mixture of hydrocarbon compounds. It is found in underground reservoirs in sedimentary rock formations such as sandstone, shale and limestone. Petrol, diesel, tar, kerosene, LPG and paraffin wax are some products which are obtained during the refining process.

Uses of Petroleum

- It is used as a fuel and plays a major role in land, sea and air transport.
- After refining, petroleum is used in the production of various petrochemicals such as gasoline, lubricating oil and printing ink.
- It is used for power generation.

Distribution

- It is found in Mumbai High which is about 176 km off Mumbai in the Arabian Sea.
- Digboi oil field in Assam is the biggest oil field in India.
- Khambhat basin in Gujarat is the main oil field. Other important oil field reserves are Kalol, Koyali, Kosamba, Sanand, Kathana, Ankleshwar and Navgaon.

There are 21 oil refineries in India. The Reliance Petroleum Limited at Jamnagar in Gujarat was the first oil refinery in the private sector. The Digboi oil refinery is the oldest refinery in India.

Iron Ore

Names of iron ores and their characteristics:

Varieties of Iron Ore	Characteristics	Distribution
Hematite	It is known as 'red ore'. It contains 60–70% of pure iron.	Odisha, Jharkhand, Chhattisgarh, Karnataka and Maharashtra
Magnetite	It is known as 'black ore'. It is the best quality of iron ore as it contains more than 70% of iron. It possesses magnetic property and hence is called magnetite.	Tamil Nadu and Karnataka
Limonite	It is of inferior quality as it contains 35–50% of iron. It is yellow brown.	Garhwal in Uttarakhand, Mirzapur district in Uttar Pradesh and Kangra Valley in Himachal Pradesh

Distribution

Main iron ore deposits in India:

States	Regions	Utilisation
Chhattisgarh	Bailadilla in Dantewada and Durg district	Supply deposits to the Bhilai Iron and Steel Plant
Odisha	Keonjhar, Mayurbhanj, Sambalpur, Sundergarh, Cuttack, Koratpur	Supply deposits to steel plants located at Durgapur, Bokaro, Jamshedpur, Asansol and Rourkela
Karnataka	Bababudan Hills in Chikmaglur, Sandur, Bellary, Hospet, Shimoga and Chitradurga districts	Supply raw materials to Bhadravati iron works
Goa	North Goa	-
Andhra Pradesh	Anantapur, Khammam, Krishna, Kurnool, Kadapa and Nellore	-
Tamil Nadu	Salem, North Arcot, Tiruchirappalli, Coimbatore and	-

	Madurai	
Maharashtra	Ratnagiri and Chandrapur districts	-
Rajasthan	Moriza in Bhilwada and Udaipur districts	-

Manganese

It is a black, hard metal which is mainly used as a raw material for smelting iron ore and is used for manufacturing ferro alloys.

Uses of Manganese

- It is an important raw material in the iron and steel industry as it is used for hardening steel and prevents it from rusting.
- It is used in dry cell batteries.
- It is used in forming many alloys.
- It is used in chemical, glass and electrical industries.

Distribution

Main deposits of manganese in India are located in the following states:

States	Regions
Andhra Pradesh	Adilabad, Vishakhapatnam and Vizianagaram
Goa	Sanguem
Jharkhand	Singhbhum, Palamau and Chaibasa
Karnataka	Sandur, Shimoga, Chitradurga, Bellary, North Kanara, Tumkur, Belgaum and Davangere
Madhya Pradesh	Chhindwara, Balaghat, Mandla, Jabalpur
Maharashtra	Nagpur and Bhandara
Odisha	Keonjhar, Mayurbhanj, Talcher, Sundargarh, Bonai and Koratpur
Rajasthan	Banswara, Udaipur and Pali

Bauxite

It is an oxide of aluminium.

Uses of Bauxite

- Aluminium is extracted from bauxite. It is lightweight, strong and rust-resistant metal.
- Aluminium is used in aircraft, automobiles, shipping industry and household appliances.
- Because aluminium is a good conductor of electricity, it is used in the electrical industry.

Distribution

Main deposits of bauxite in India are located in the following states:

States	Regions
Goa	Mopa and Pernem
Odisha	Kalahandi and Sambalpur
Gujarat	Jamnagar, Kaira, Surat and Kachchh
Madhya Pradesh	Jabalpur, Balaghat, Shahdol, Mandla and Amarkantak Plateau
Chhattisgarh	Durg, Bilaspur, Raigarh
Jharkhand	Palamau, Ranchi

Maharashtra	Thane, Kolhapur, Ratnagiri, Satara
Karnataka	Belgaum, mainly at Karle Hills
Tamil Nadu	Salem, Nilgiri, Madurai, Coimbatore

The largest integrated aluminium plant is located at Renukoot in Uttar Pradesh. It gets its supply of bauxite from Amarkantak Plateau and Ranchi.

Limestone

It is a non-metallic mineral. It is formed by the deposition and hardening of skeletons, remains of animals and shells. It is found in almost every state of India.

Uses of Limestone

- It is used as a flux in the iron and steel industry.
- It is mainly used in the cement industry.
- It is used in manufacturing quicklime and slaked lime.
- It is used to suppress methane explosions in underground coal mines.
- It is used in the production of chemicals, paper, glass and fertilisers.

Industries in India

Mineral-Based Industries in India

Industries which use minerals as raw materials are known as mineral-based industries.

Iron and Steel Industry

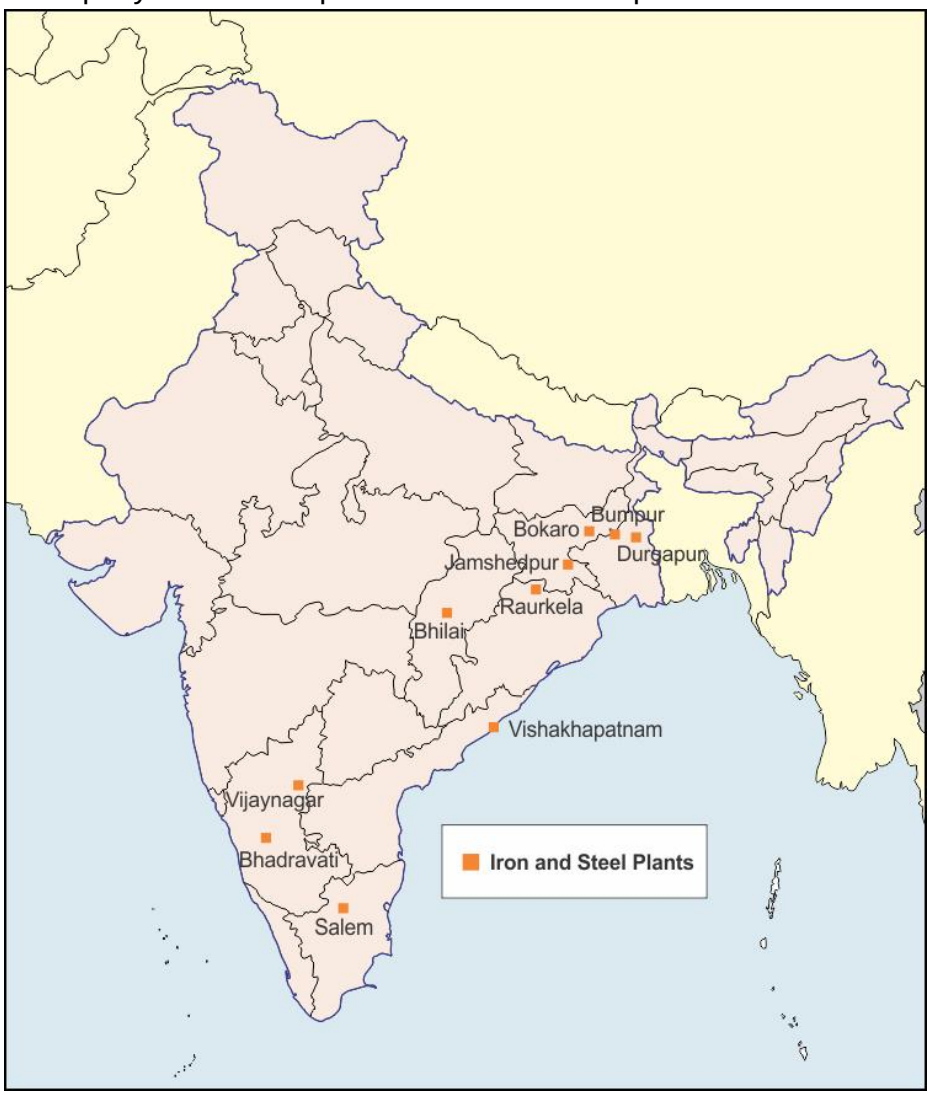
The opening of the Tata Iron and Steel Company in Jamshedpur in 1907 was an important event in the history of industrialisation in India. At present, India is the fifth largest producer of crude steel in the world.

Raw Materials

Iron ore, manganese, limestone, silica, feldspar, scrap iron and flux are important raw materials used in the iron and steel industry. Coking coal for the industry is obtained from Jharia, Raniganj, Bokaro, Giridha and Korba. Manganese is used for hardening the steel and for removing impurities.

Steel Making

Iron ore exists with impurities such as sulphur, silica and lime. These impurities have to be removed to obtain pure iron for manufacturing steel. The following process is used for converting iron ore to steel.



Map of India showing some major iron and steel plants in India

Ore Reduction

- The process of ore reduction is carried out in the blast furnace. Coke, limestone and dolomite are added to combine impurities in the ore.
- These impurities combine to form slag which floats on the molten iron and can be separated from it.
- Molten iron is then collected at the base of the furnace which is removed at regular intervals.
- This product is known as pig iron which can later be converted to wrought iron, steel and cast iron.

Steel Melting Furnace

- To convert pig iron into steel, impurities are removed by deoxidation.
- Hardening material such as carbon is then added.

Rolling Mills

- The steel is cast into ingots and rolled into different sizes.

Tata Iron and Steel Plant at Jamshedpur

Tata Iron and Steel Company (TISCO) is located at Jamshedpur about 240 km northwest of Kolkata.

Availability of Raw Materials

- The plant gets iron ore from the Gurumahisani mines in Mayurbhanj district of Odisha and from the Noamundi mines in Singbhum district of Jharkhand.
- The plant obtains manganese from Joda in Keonjhar district and limestone, dolomite and fire clay from the Sundargarh district of Odisha.
- Coal is received from Jharia and Bokaro coalfields which are located at a distance of about 177 km.

Power Supply: Coal, the main source of power supply, comes from Jharia and Bokaro coal fields.

Water Supply: Water from the rivers Kharkai and Subarnarekha is used in the plant.

Labour Force: Most labour force comes from the densely populated states of Bihar, West Bengal, Jharkhand, Chhattisgarh and Uttar Pradesh.

Markets: Kolkata is an important market of finished steel.

Transport Facilities: Jamshedpur is well-connected with roads and railways to the other parts of the country. It is connected with Eastern Railways and Kolkata Port for exporting steel.

Products: High-grade carbon steel and acid steel are used for making railway wheels, axles, bars and rods. The plant also produces special alloy steel.

Other Large Iron and Steel Plants

Name of the Plant	Location	Availability of Raw Materials	Power Supply	Water Supply	Products
Bokaro Steel Plant (set up in assistance with Russia)	Hazaribagh District	Coal: Bokaro and Jharia Iron ore: Kiriburu mines in Keonjhar (Odisha) Limestone: - Bhavantapura Dolomite: Palamau district of Jharkhand	Damodar Valley Corporation (DVC)	Reservoirs across River Damodar	Pig iron, crude steel and saleable steel. Its sludge and slag is used for making fertilisers at Sindri.
Durgapur Steel Plant (set up in assistance with UK)	Burdwan district of West Bengal	Iron ore: Singhbhum (Jharkhand) and Keonjhar (Odisha) Coal: Jharia (Jharkhand) and Raniganj (West Bengal)	Coal for power supply is obtained from Jharia coalfields and Damodar Valley Corporation	River Damodar	Alloy steel and railway items such as wheels. Also produces crude coal tar and crude benzol.
Bhilai Iron and Steel Plant (set up in assistance with Russia)	Durg district of Chhattisgarh	Iron ore: Dalli Rajhara mines (Chhattisgarh) Limestone: Nandini Manganese: Balaghat mines in Madhya Pradesh	Coal is obtained from Bokaro, Karagati and Jharia	Reservoir located at Tendula	Heavy rails, billets, rolled wires, structural beams and plates for the shipbuilding industry. It also

			coal fields in Jharkhand and Korba in Chhattisgarh		produces by-products such as ammonium sulphate, benzol, coal tar and sulphate acid.
Rourkela Steel Plant	Sundargarh district of Odisha	Iron ore: Sundargarh and Keonjhar (Odisha) Manganese: Barajmda Limestone: Bhirmitrapur Dolomite: Baradwar	Coal is obtained from Jharia, Talcher and Korba fields. Electricity is obtained from Hirakud Project.	Mandira dam across River Sankha and River Mahanadi	Hot rolled sheets, galvanised sheets and electrical steel plates. Also produces nitrogen which is used as fertiliser.
Indian Iron and Steel Company	Burnpur, Hirapur and Kulti near Asansol in northwest Kolkata	Iron ore: Singbhum and Mayurbhanj Limestone and dolomite: Sundargarh district in Odisha Manganese: Jharkhand	Coal: Jharia coal fields, Damodar Valley Corporation	River Damodar	Pig iron and iron and steel
Visvesvaraya Iron and Steel Limited	Bhadravati in Shimoga district in Karnataka	Iron ore: Kemmangundi mines (Chikmagalur district) Limestone: Bhudiguda Manganese: Shimoga and Chitradurga	Charcoal is obtained from nearby forests of Malnad area. Electricity is obtained from Shravati Power Project.	-	Alloy steel, ferro silicon, cement, mild steel and casting
Vijayanagar Steel Plant	Torangal near Hospet in Bellary in Karnataka	Iron ore: Hospet Limestone and dolomite: Gulbarga and Bijapur	Coal fields of the Kanhan Valley (MP) and Singareni coalfields (Andhra Pradesh)	Tungabhadra reservoir and Tungabhadra project	Ingot steel
Vishakhapatnam Steel Plant	Vishakhapatnam in Andhra Pradesh	Iron ore: Bailadila in Chhattisgarh Limestone, dolomite and manganese: Mines of Andhra Pradesh and Odisha	Coal fields of Damodar Valley		Liquid steel, saleable steel
Salem Steel Plant	Salem in Tamil Nadu	Iron ore: Salem, iron ore mines of Karnataka Coal: Neyveli			Stainless steel, electrical steel

Mini Steel Plants

Mini steel plants use ferrous scrap, pig iron or sponge as their raw materials. The government is encouraging the establishment of mini plants because they have the following advantages:

- These plants use scrap iron which is cheap and easily available.
- They use electric power and thus do not cause pollution.
- They do not require heavy investments.
- As these plants meet the demands of the local markets, they reduce the pressure on large plants.

Heavy Engineering Industries

Heavy engineering industries are important industries as they provide machinery for industries and equipment for the agriculture, transport, mining and construction sectors.
These industries require the following:

- Bulky raw materials
- Advanced technology and large capital resources
- Huge workforce

Iron and steel industries, shipbuilding industries and automobile industries are heavy industries.

Shipbuilding Industry

Factors favouring the development of the shipbuilding industry in India are

- Because the shipbuilding industry requires bulky raw materials, it is located near the source of raw materials.
- It requires skilled labour force.
- It is also located near deep waters which can be used for navigation.
- It needs large tract of level land.

Major Shipyards

Name of the Company	Features
Hindustan Shipyard Limited	Located in Vishakhapatnam, it was the first shipyard to obtain ISO-9001 accreditation. It builds cargo vessels, passenger vessels and small craft for ports and customs.
The Cochin Shipyard	Located in Kochi, it has large docks to construct and repair ships. It has repaired more than 1200 ships so far.
The Garden Reach Workshop	Located in Kolkata, it is one of the leading shipyards in India. It constructs ships, floating dry docks, passenger and other types of vessels, and fishing trawlers.
The Mazagaon Dock Limited	Located in Mumbai, it builds frigates, cruisers and other ships for the Indian navy. It also builds cargo ships, passenger vessels and dredgers.

Automobile Industry

Four requirements of the automobile industry are

- Raw materials such as iron, steel and paint
- Tools and machinery for running and maintaining factories
- Finished goods such as tyres, tubes and batteries
- Coal and hydropower

India has several automobile units. It is the sixth largest passenger car and commercial vehicle manufacturing country in the world.

Railway Locomotives

Railways are an important means of transport in the country. Units producing locomotives and coaches for the railways come under the Ministry of Railways. These are

The Chittaranjan Locomotive Works: it is located at Chittaranjan in West Bengal. It manufactures electric railway engines, broad gauge and metre gauge and diesel locomotives.

The Diesel Locomotive Works (DLW): It is located at Varanasi. It produces broad gauge and metre gauge diesel engines.

The Integral Coach Factory: Located at Perambur near Chennai, it manufactures fully furnished passenger coaches.

The Rail Coach Factory: It is located at Kapurthala in Punjab and produces high-speed lightweight railway coaches.

Other plants producing diesel electrical engines are located at Jamshedpur and Patiala.

Aircraft Industry

Hindustan Aeronautics Limited was set up in 1964 with its corporate office at Bengaluru. It was the first aircraft industry to be set up in India. Its main functions are

- To design, manufacture, repair and overhaul various types of aircraft, aero engines, avionics, instruments and accessories.
- Design and develop advanced light helicopters and light combat aircraft.

Heavy Electrical Industry

This industry consists of the equipment used for generation, transmission, distribution and use of power. It includes items such as generators, boilers, turbines and cables. Three main heavy electrical industries in India are

- The Heavy Electrical Limited at Bhopal in Madhya Pradesh
- The Bharat Heavy Electricals Limited at New Delhi
- The Hindustan Cables Factory at Rupnarainpur in West Bengal

Heavy Machinery and Tools

This industry provides machines to all sectors of the economy.

The Hindustan Machine Tools at Bengaluru: It is a major manufacturer of machine tools in the country. It also manufactures watches, tractors, printing machinery and lamp-making machinery. Some of its units are also located at Ajmer, Mohali, Ranibagh and Pinjore. Some other heavy industries are the **Heavy Machine Tools Plant** at Ranchi, **Machine Tool Corporation** of India and **National Instruments Factory**.

Iron Implements for Agriculture is an important industry which makes agricultural implements in India. Units of factory dealing with the manufacture of iron implements in India are set up at Ajmer, Pune, Satara and Bhiwandi.

Electronics

The electronic industry developed in India about 1950. It is the fastest growing industry.
The Indian Telephone Industry was set up at Bengaluru in 1950. It manufactures equipment to meet the requirements of post and telegraph departments, railways, defence and electricity boards. It also manufactures automatic telephone switching systems and teleprinter exchanges.
The Electronic Corporation of India at Hyderabad produces modular systems for nuclear applications and for use in medical, agricultural and industrial fields.
The Bharat Electronics Limited (BEL) at Bengaluru caters to the requirements of the defence sector, All India Radio and the Meteorological Department.

Space Technology

It is supported by the electronic industry. The Indian Space Research Organisation at Bengaluru, the Satellite Launching Station at Sriharikota and the National Remote Sensing Agency at Hyderabad are important industries dealing with space research and satellite launching. India has launched various indigenous satellites such as the Apple and INSAT series. ISRO has developed rockets for putting satellites into polar orbits. Recently, India has also undertaken a Mars orbital mission.

Software Industry

The software industry has emerged as one of the fastest growing industries in India. India has achieved the capability of designing super computers. Indian industries also provide their expert IT services to global markets. Bengaluru and Hyderabad are two leading centres of software industries.

Entertainment Products Industry

As a result of progress made by the electronic industry, the television and audio industries boomed in the 1990s. *BPL*, *Videocon*, *Onida* and *Philips* specialise in the sales of televisions. Many audio systems have also captured the vast Indian markets. Mumbai, Pune, Kolkata and Chennai are the main centres of production.

Petrochemical Industry

Petrochemical industries use raw materials which are generally the products of petroleum, LPG and coal. These industries are located near oil refineries which can supply the basic requirements of naphtha and benzene.
Petrochemical industries manufacture synthetic fibres, dyestuffs, synthetic rubber, plastics, drugs and pharmaceuticals. They also produce fertilisers and insecticides. They also manufacture adhesives and resins for industries.
Advantages of petrochemical products are that they are cheaper and can be produced on a large scale. Raw materials are easily available. Many traditional materials have been replaced by the products of petrochemical industries; for example, jute fibre has been replaced by synthetic fibre, steel pipes have been replaced by PVC and jute bags have been replaced by polythene bags.

Main Petrochemical Plants

Herdillia Chemicals Limited at Chennai manufactures acetone, phenol and diacetone alcohol.
National Organic Chemicals Industries Limited is located at Thane near Mumbai. It is the first plant which is based on latest technology. It produces ethylene, benzene and PVC.
Petrofils Cooperative Limited (PCL), a joint venture between the Weavers' Cooperative Societies and the Government of India, has plants located at Vadodara and Naldhari. It manufactures polyester filament, swim suits and yarn.
India Petrochemical Cooperation near Vadodara manufactures organic chemicals and fibres.
Reliance Industries is located at Hazira in Gujarat.
Indian Oil Corporation has set up one petrochemical plant in Gujarat and two at Panipat (Haryana).

Natural Vegetation of India

Natural Vegetation

Natural vegetation is vegetation which grows in the region all by itself without the interference of human activity. There is a thin line of difference between flora and forests.
Flora refers to the listed species of plants. Forest refers to a large tract of land covered with trees and shrubs.
Natural vegetation of a region is influenced by several factors such as temperature, rainfall and altitude.
India has a variety of forests and natural vegetation which differ from region to region.

Tropical Evergreen Forests

Climatic Conditions: The tropical evergreen forests grow in regions which receive more than 250 cm of annual rainfall. The average annual temperature ranges between 25°C and 27°C.
Distribution: These forests are found in areas of heavy rainfall in the Western Ghats, the Lakshadweep, the Andaman and Nicobar Islands, upper parts of Assam and the coast of Tamil Nadu.


All the trees in the evergreen forests do not shed their leaves at the same time. Hence, they always appear green.

Characteristic Features

- Trees in the tropical evergreen forests may reach up to the height of 60 metres or more. There is rich growth of plant life because the region receives more than 200 cm rainfall.
- There is no definite season for plants to shed their leaves. All trees do not shed their leaves at the same time. Hence, these forests always appear green.

Important Species of Trees and their Uses

- Rosewood: It is used for making furniture and is used as decorative wood for carving and for making ornamental ply boards.
- Ebony: It is used for ornamental carving and for making musical instruments, sports goods, piano keys and caskets.
- Chaplas: It is used for ship building and making furniture and packing boxes.
- Gurjan: It is used for construction work, for making packing boxes, tea boxes, panelling and flooring. It is also used for carriage and wagon construction.
- Telsur: It is used for making bridges, boats and carts.
- Sissoo: As the wood is hard and heavy, it is used in construction, furniture making and for making bullock carts, agricultural implements and musical instruments.
- Toon: It is used for making tea boxes, toys and furniture.

Tropical Deciduous Forests

Climatic Conditions: These forests grow in regions which receive rainfall between 200 cm and 100 cm. The annual temperature varies from 24°C to 27°C.
Distribution: These forests are found in West Odisha, eastern slopes of the Western Ghats, Chhattisgarh, Jharkhand and northeastern states of the country.
Characteristic Features

- These forests are also known as monsoon forests. These forests are largely found in India.

- Based on the availability of water, these forests can be classified into moist deciduous forests and dry deciduous forests.
- The trees of the forest shed their leaves from six to eight weeks to conserve water.
- Tropical deciduous forests are commercially exploited and provide valuable timber.

Important Species of Trees and their Uses

- **Sal**: It is used for making beams, doors and window posts.
- **Teak**: It is hard and durable and thus is used in construction, ship building, making furniture, railway carriages and bridges.
- **Shisham**: Its wood is hard and durable. It is used in construction, furniture making and for making bullock carts, agricultural implements and musical instruments. It is also used for decorative ornamental carving.
- **Mahua**: Oil is extracted from its fruit, while wine is made from its flowers.
- **Palas**: Its leaves are used for rearing shellac worms.
- **Semul**: As its timber is soft and white, it is used for making toys, packing cases, match boxes and plywood. A soft fibre is yielded from its fruit which is used in pillows.
- **Sandalwood**: It is used for making statues and ornamental objects. It is used in making aromatic substances and for extracting sandalwood oil. It is in great demand in India and abroad.
- **Khair**: Its hard wood is used for making ploughs, handles for knives, daggers and swords.
- **Axlewood**: It is used for making furniture, kitchen cabinets, radio and TV cabinets and wardrobes.

Differences between evergreen and deciduous forests:

Tropical evergreen forests	Deciduous forests
Tropical evergreen forests are found in regions which receive more than 200 cm of rainfall.	Deciduous forests are found in regions which receive rainfall of 200–70 cm.
The trees of the tropical evergreen forests do not shed their leaves at the same time as there is no particular season for shedding leaves.	The trees of the deciduous forests shed their leaves for about six to eight months during the dry season.
The tropical evergreen forests are dense.	These forests are less dense.
These forests are found in the Andaman and Nicobar Islands, the Lakshadweep, upper parts of Assam and Tamil Nadu and on the western slopes of the Western Ghats.	These forests are found in the northeastern states, parts of central India, West Odisha and Chhattisgarh.
Some species of trees are ebony, mahogany, rosewood and rubber.	Some species of trees are sandalwood, teak and sal.

Tropical Desert Forests

Climatic Conditions: This vegetation occurs in regions which receive less than 70 cm of rainfall. The temperature ranges between 25°C and 27°C.

Distribution: This kind of vegetation is found in the northwestern parts of India such as semi-arid regions of Gujarat and Rajasthan. It is found in southwestern Punjab, Uttar Pradesh, Haryana, Madhya Pradesh, Chhattisgarh and parts of Maharashtra, Karnataka and Andhra Pradesh.

Characteristic Features

- The trees are stunted with large patches of coarse grasses.
- Plants have long roots which go out deep into the soil in search of water. Leaves are waxy, small and thick to reduce transpiration.
- Main species of trees are acacias, palms, euphorbia and cacti.

Important Species of Trees and their Uses

- Ber: Its fruit is used for making beverages and pickles. Its wood is used for boat ribs, agricultural implements and charcoal.
- Babool: The tree's bark and gum have medicinal value.
- Date palm: It is used as an astringent. Its syrup is used for treating sore throat, cold and fever.
- Neem: It has medicinal properties. It is effective in treating diabetes, allergies, ulcers and several other diseases.

Littoral Forests

Climatic Conditions: These forests are found in wet marshy areas, in river deltas and swampy areas along the sea coasts.

Distribution: They are mainly found in the deltas of large rivers on the eastern coast and in saline swamps of the Sundarbans in West Bengal and the coastal areas of Andhra Pradesh and Odisha.

Characteristic Features

- These forests have evergreen species of trees generally varying in height.
- The trunks of trees are supported by several stilt roots which are submerged under water. There is also a rich growth of climbers.

Important Species of Trees

- Some important species of trees are keora, amur, sundari, bhara and canes.
- Mangrove trees are used for fuel.
- Sundari trees are used for construction purposes and in boat making.

Montane Forests

Montane forests grow in the mountainous regions. As the temperature decreases with an increase in height, there is change in the cover of natural vegetation on altitude. Montane forests can be divided into two types—Northern Montane forests and Southern Montane forests.

Northern Mountain Forests

The Northern Montane forests include the Himalayan moist temperate forests, Himalayan dry temperate forests and Alpine forests.

Himalayan Moist Temperate Forests

Climatic Conditions: They are found in regions which receive rainfall between 100 cm and 300 cm. The temperature ranges between 12°C and 13°C.

Distribution: These are found in the Himalayan zone from Kashmir to Sikkim and Arunachal Pradesh.

Characteristic Features

- These forests have mixed species of broad-leafed evergreen trees and conifers.
- These forests also contain scrubs, creepers and ferns.

Important Species of Trees

Some important species of trees are oak, fir, spruce, deodar, cedar, maple, yew and birch. The timber of the forests is used for commercial purposes.

Himalayan Dry Temperate Forests

Climatic Conditions: These forests occur in areas receiving less than 100 cm rainfall and are found at a height above 1500 m.

Distribution: They are mainly found in Ladakh, Chamba, Sikkim and in the inner Garhwal regions.

Important Species of trees are ash, junipers, maple and oak. The timber obtained from these forests is used for construction work and for making light furniture.

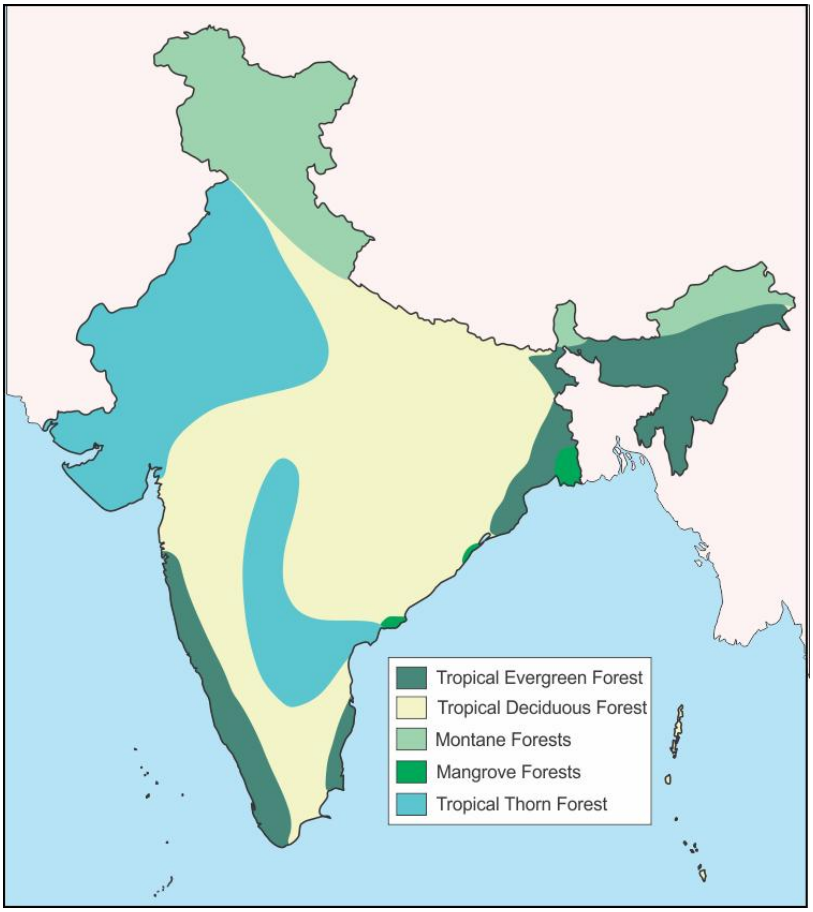
Alpine Forests

Climatic Conditions: These forests are found at an altitude of 2800–4000 m.

Distribution: These forests are found in high altitudes of the Himalayas running from the northwest to the northeast frontiers.

Characteristic Features

- Deciduous forests are found at the foothills of the Himalayas.
- Between the heights of 1000 to 2000 m, wet temperate types of forests are found. Trees are broad leaf such as oak and chestnut.
- Temperate forests are found at 1500–3000 m. Coniferous trees pre-dominate in this region. Pine, cedar, fir, deodar and spruce are some important species of trees. These forests are found in the southern slopes of the Himalayan mountains.
- At higher altitudes, temperate grasslands are found.
- Above 3600 m, Alpine vegetation can be found. Silver fir, pines, junipers and birches are some important species of trees. However, at still higher latitudes, their growth is stunted.
- At higher altitudes, mosses and lichens are found which forms part of the Tundra vegetation.



Map showing the distribution of natural vegetation in India

Important species of trees are silver juniper, pine, birch, chestnut, oak and fir. The trees yield valuable timber which is used for making furniture, wood pulp and plywood.

Southern Mountain Forests

Climatic Conditions: They are found in regions receiving annual rainfall of more than 150 cm. The temperature of the region ranges between 18°C and 24°C.

Distribution: These forests are found in the Vindhyas, Nilgiris and Western Ghats.

Characteristic Features

- These forests have both tropical and temperate vegetation.
- It is because the hilly regions located closer to the tropics have temperate vegetation, while lower regions of the Western Ghats have sub tropical forests.

Important species of trees are laurel, wattle, plum and magnolia.

Uses of Some Important Species of Mountain Trees

- **Deodar**: It is used for construction work.
- **Chir**: The wood is reddish brown and is used for making tea chests, furniture and match boxes.
- **Blue Pine**: It is used for making doors, windows and furniture.
- **Spruce**: Its soft wood is used for construction work and for making cabinets, match boxes and furniture.

- **Walnut**: Its wood is used for making musical instruments and cabinets. It is mostly used in Kashmir and North India for carving. It is also used for gun stocks.
- **Birch**: It is used for making furniture, plywood and radio cabinets.
- **Cypress**: It has durable wood which is used for making furniture.
- **Jamun**: It is used for making furniture and cabinets, and in construction.

Forests and Environment

Forests affect our environment in the following ways:
- They play an important role in controlling humidity, temperature and precipitation.
- They help in maintaining the purity of air by absorbing carbon dioxide.
- They control soil erosion, soil degradation and prevent droughts and floods.
- Forests help in water percolation.
- Decayed leaves of plants provide humus to the soil and increase its fertility.
- They provide habitation to plants and animals.

Many factors have resulted in the depletion of forest cover or deforestation. Some of these are
- Rapid growth of population has resulted in clearing land for cultivation activities
- Many forests have been cleared to convert them into pasture lands
- Overgrazing
- Increasing demand for timber for industrial expansion and urbanisation
- Construction of multipurpose river valleys has led to the submergence of lands and destruction of forests

Conservation of Forests

Some forest conservation methods are
- Afforestation or special programmes like ‘Van Mahotsav’ should be launched and celebrated on a large scale. This will create awareness among the people regarding the protection of forests. One of the other ways of making people aware is the celebration of festivals should begin with a tree plantation.
- The government should cautiously give permit to contractors for the cutting of timber.
- One of the ways in which tribals protect the forests is by declaring a large patch of forests as ‘sacred groves’. Because these are worshipped by the government, trees in the sacred groves are considered sacred and are not allowed to be cut.
- An important factor which contributes towards the conservation of forests is the Joint Forest Management (JFM). Local communities are involved in the management of degrading forests. This programme has been in existence since 1998. Because local communities undertake the responsibility of forest protection, they are given rights to use non-timber products and get a share in timber harvests by successful protection of forests. States such as Odisha and Gujarat have been practising forest conservation through JFM.
- Developmental activities should be environment-friendly. If timber is required for any project, then the same or more number of trees which are felled should be planted.
- Building of many multipurpose dams also leads to the submergence of land and forest area. Building of small check dams and reservoirs goes a long way not only in providing water to farmers for irrigation but also in recharging the groundwater. This will ensure that forest cover is not depleted because of the building of large dams.
- Using alternative sources of energy such as solar energy, wind power and tidal energy results in saving wood which is commonly used as a source of energy in the rural areas.

National Forest Policy

The National Forest Policy was adopted in 1952 by the government of India. The policy gives importance to sustainable forest management to conserve forests. Important objectives of the National Forest Policy are

- To maintain the stability of the environment by preservation and restoration of ecological balance
- To check soil erosion and denudation in the catchment areas of rivers, lakes and reservoirs
- To increase the productivity of forests to meet essential national needs
- To create people's movement on a large-scale involving women for preserving forests
- To conserve natural heritage of the country by preserving natural forests, flora and fauna.

Social Forestry

Social forestry refers to the management and protection of forests with the help of local communities. Three components of social forestry are

- To recognise, restore and reallocate the forest lands to the inhabitants for the management and protection of forests.
- The forest department works in close cooperation with local communities.
- To develop the required social and economic system to achieve the above aims.

Important Objectives of Social Forestry

- To provide wood, fodder, timber and other minor forest produce to rural people
- To develop local cottage industries by providing raw materials
- To conserve soil and water
- To increase agricultural production by using cow dung as manure

Features of Social Forestry

- Planting trees with the help and support of local communities
- Using fallow lands to take away the pressure on forest lands
- Practising sustainable forestry with short crop rotation
- Distributing the benefits derived from various projects based on forestry among local communities

Agro Forestry

Agro forestry is an agricultural practice which involves the cultivation of trees. It is a land management system in which trees or shrubs are planted and grown among crops or in pasturelands.

Objectives of Agro forestry

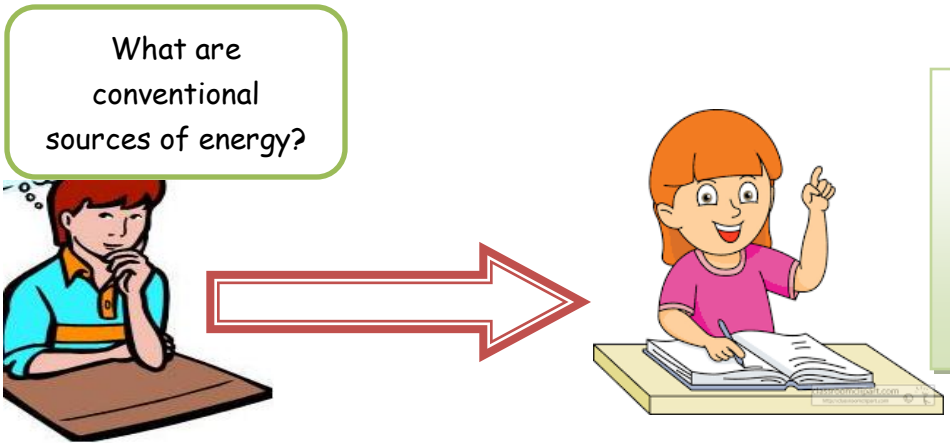
Objectives of agro forestry are

- To make the best use of all the available resources such as soil
- To obtain various forest products and agricultural crops on the same piece of land
- To check the possibility of soil erosion and floods by planting trees in crop lands
- To maintain the ecological balance along with proper use of farm resources

In traditional forestry, only trees are grown; however, in agroforestry, trees along with crops are planted. Agro forestry is also able to withstand the pressure of increasing population unlike traditional forestry. Agro forestry is a scientific system of managing land with the help of local communities which is absent in traditional forestry.

Conventional Sources of Energy

Conventional Sources of Energy



Conventional sources of energy are those which have been in use since a long time and are still being used on a large scale. Examples-coal and petroleum

Coal

Coal is an important mineral in India. It occurs as a sedimentary rock in association with carbonaceous shale, sandstone and fine clay. Coal was formed by the decomposition of large land plants and trees buried under the Earth about 300 million years ago. Sediments began to get deposited over the pile of trees and plants. The resultant heat and pressure resulted in physical and chemical change leading to the formation of coal.

Depending upon the amount of carbon and moisture content coal can be divided into four main types. These are:

Types of Coal

- **Anthracite**
  - Highest and hardest quality coal.
  - Burn slowly without smoke
  - High heating value and leaves very little smoke
- **Bituminous**
  - Highest and hardest quality coal.
  - Burn slowly without smoke
  - High heating value and leaves very little smoke
- **Lignite**
  - Known as Brown coal. It is a lower grade coal.
  - It has about 40% of carbon and has less combustible matter.
- **Peat**
  - First stage of transformation of wood into coal.
  - It is inferior to other three varieties of coal.

Distribution and Uses of Varieties of Coal in India

Variety of Coal	Distribution	Uses
Anthracite	Jammu and Kashmir	Ideal for domestic use as it is a smokeless fuel. It is used for metallurgical processes and in iron and steel industry.
Bituminous	Gondwana coal fields	Known as cooking coal as it is used to produce coke, coal gas and steam coal. High grade bituminous coal is also used for domestic purposes.
Lignite	Tami Nadu, Rajasthan, West Bengal and Puducherry	Used for the generation of electricity
Peat	Nilgiri mountains, Kashmir valley and swampy areas of coastal plains	-

Advantages of using Coal

- It is an important source of power for running machines, trains, ships and dynamos.
- Coal is used in the manufacturing iron and steel.
- It is a source of direct heat for domestic purposes, burning of bricks, tiles and in iron and brass factories.
- When coal is burnt in a closed chamber, a variety of chemicals such as ammonia and benzol are obtained as by-products.

Disadvantages

- The calorific value of coal found in India is low.
- Coal reserves in India are scattered and limited.
- Cost of production and transportation of coal is very high.
- Burning of coal results in large scale pollution.

There are two main coalfields in India. Gondwana coalfields and tertiary coalfields. **Gondwana coalfields** accounts for 98% of the total reserves of coal in India. The coalfield is largely confined to the river valleys like Damodar, Mahanadi and Godavari. The Gondwana coalfields are found in the states of West Bengal, Jharkhand, Odisha, Chattisgarh, Madhya Pradesh, Maharashtra, Uttar Pradesh, Andhra Pradesh and Telangana.

Coal found in the **tertiary coal field** has high moisture content. They are found in Assam, Arunanchal Pradesh, Meghalaya and Nagaland. The Neyveli lignite field in Tamil Nadu is the largest lignite deposit in South India.

Petroleum

Petroleum is an important mineral resource. It is known as 'liquid gold' because not even a tiniest part of crude petroleum goes waste or remains unused. Petroleum is found in underground reservoirs in sedimentary rock formations like sandstone, shale and limestone.

Petrol, diesel. Kerosene, tar, Liquefied Petroleum Gas, lubricants and paraffin wax are some products which are obtained during the refining process.

Advantages

- It has a high density. One kg of oil can generate 10,000 kcal of energy.
- Petroleum is liquid in form and can be transported through pipes or vehicles.
- It is used as a fuel. Its by-products that are used a fuel include diesel, gasoline, jet fuel, kerosene and LPG.
- Petroleum after refining is used for the production of various petrochemical products such as synthetic rubber, synthetic fiber, PVC phenol, gasoline, varnishes, lubricating oil and paraffin wax.
- Petroleum is also used for power generation.

Disadvantages

- Petroleum is a non-renewable source of energy. Hence, its availability is limited. Because of ever increasing demands, petroleum resources are fast depleting.
- Extracting and burning of petroleum generates greenhouse gases that contribute to environment pollution and global warming.
- Because of petroleum's limited supply and high demand, the cost is high.
- It is highly inflammable and can cause fire.
- Spilling of oil in water not only pollute the oceans but also leads to the death of number of marine animals.

Oil Refineries

Crude oil is refined and processed in refineries to produce light distilleries like gasoline, LPG and naphtha; middle distilleries like diesel and kerosene and heavy products such as bitumen, petroleum and coke.

The Reliance Petroleum Limited at Jamnagar in Gujarat was the first refinery in the private sector.

Most of the refineries are located near the oilfield or near the coast to minimise the cost of transport.

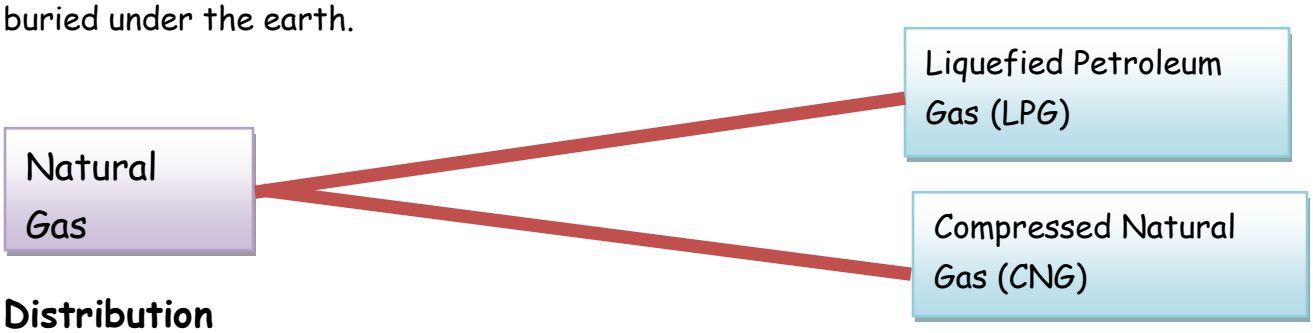
ONGC platform at Mumbai High

Distribution

- Mumbai High is an offshore oil field located 176 km off Mumbai shore in the Arabian Sea. Mumbai High is called so because of the height of the syncline of the rock structure in which the oil has been struck.
- It is the most productive oil field and has a reserve of 5 crore tonnes of oil.
- Digboi oil field in upper Assam is the biggest oilfield in India.
- In Gujarat, Cambay Basin is an important oil bearing site. The other important oil bearing sites in the state are Kalol, Koyali, Kosamba, Sanand, Anklaeshwar and Navgaon.

Natural Gas

Natural gas occurs in association with mineral oil. It is a fossil fuel. It is found along with the deposits of oil because it has been formed by decomposing remains of dead animals and plants buried under the earth.



Distribution

More than three-fourths of India's natural gas comes from Mumbai High, the rest is produced in Assam, Tamil Nadu, Rajasthan and Tripura.

Advantages

- It is an environment friendly fuel as it is made up of methane which results in less carbon emission.
- It is easier to preserve the fuel as it can be stored and transported through pipelines, cylinders or in tankers on land and sea.
- It is cheaper fuel than diesel or gasoline.
- It is used for producing hydrogen, ammonia for fertilisers, paints and plastics.

Disadvantages

- Leaks in natural gas are extremely dangerous. Such leaks may result in explosion and fire. Leakage of natural gas can have serious consequences as methane is more dangerous than carbon dioxide.
- The natural gas is s fossil fuel and hence is a non-renewable source of energy.
- The infrastructure requiring the setting up the production process and distribution of gas is very expensive.
- Natural gas when used as a fuel in vehicles provide less mileage than gasoline.

Hydel Power

Electricity that is generated from water is known as hydel power or hydroelectricity. It is generated when water stored in a dam falls from a great height on a turbine whose blades then move with a great force. This in turn rotates the generator and produce electricity. The hydro power projects are multipurpose projects because they are used for irrigation, water supply for domestic and industrial consumption and to control floods.

Advantages

- It is a clean, non-polluting source of energy. It does not release any toxic gases.

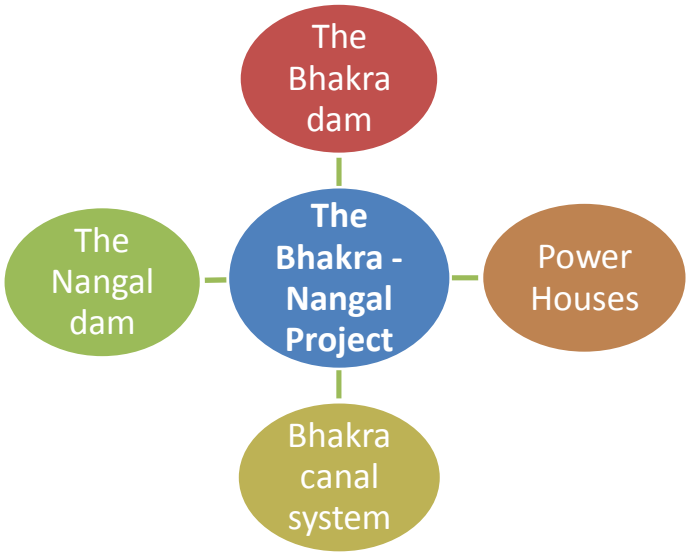
- It is a renewable source of energy which can be repeatedly used.
- The dams built to produce hydroelectricity help in saving and restoring water.
- It is economic and sustainable. The cost of electricity generation is cheaper than the electricity produced from fossil fuels and nuclear power.

Disadvantages

- The initial cost for building dams for generating hydroelectricity is extremely high.
- Building a large dam results in destruction and submergence of forests on a large scale.
- Building of huge dams may trigger earthquake in an area.
- Dam building may displace people from their villages. They may also lose their source of livelihood.

Bhakra Nangal Dam

This project is a joint venture of Punjab, Haryana and Rajasthan governments.
The Bhakra dam is the second highest dam in India. **Gobind Sagar** is the name of the reservoir of the Bhakra dam. With a storage capacity of 9.3 billion cubic meters, it is the third largest water reservoir in India.
The Bhakra- Nangal project comprises of the following:
The Bhakra Dam: It is the second highest and the third largest water reservoir in India.
The Nangal Dam: It is constructed at Nangal at river Satluj in Punjab. It supplies water to Bhakra irrigation canal.
Power Houses: There are four power houses.
Bhakra Canal System: It irrigates the lands of Punjab, Haryana and Rajasthan.
The aim of the project Bhakra Nangal project are:



- Provides water for irrigation
- Generate hydro-electricity
- Prevent flooding from Sutlej-Beas rivers

Hirakud Dam

This dam is built across the river Mahanadi. It was one of the earliest multipurpose river project that started after independence. Its construction was completed in 1953. It is the longest major earthen dam in Asia. The dam also forms the biggest artificial lake in Asia. There are two observational towers on the dam at each side. One is Gandhi Minar and the other is Nehru Minar.

Benefits of the Hirakud Dam

- The dam helps control floods in the Mahanadi delta ad irrigates 75,000 sq. km of land.

- The project provides irrigation to the 'kharif' and 'rabi' crops in districts of Sambalpur, Bargarh, Bolangir and Subarnpur.
- The dam can generate upto 307.5 MW of electrical power through its two power plants at Burla and Chiplima.
- Moreover, the project provides flood protection to 9, 5000 km^2 of delta area in districts of Cuttack and Puri.

The Hirakud dam helps in controlling floods in the Mahanadi delta and irrigates 75,000sq km of land.

Water Resources

Water Resources in India

India is a land of many rivers, lakes, lagoons and ponds. These resources account for 4% of the world's water resources. In India, water is mainly used for drinking, irrigation, household and industrial purposes. Currently, about 92% of water is used for agricultural purposes, 2% in industries and the remaining 6% is used for drinking and household purposes.
The process of watering agricultural plants through artificial means such as tanks, wells and canals is known as irrigation. Agriculture in India is largely dependent on rainfall to sustain crop production. To reduce the dependence of agriculture on rainfall, many tanks, wells and canals have been laid. Several multipurpose dams have also been constructed. Emphasis has been laid on building artificial means of irrigation because of the following reasons:

Uncertainty and Uneven Distribution of Rainfall: In India, rainfall is highly irregular and uncertain. At times, the monsoon arrives early, and sometimes, it comes too late. It also does not rain uniformly in all parts of the country. In such a situation, farmers cannot totally depend on the rainfall, and they therefore need other water sources to irrigate their fields.

Nature of Soil: Some soils require more water, while some require less. For example, clayey soil has high moisture-holding capacity and hence does not need intensive irrigation, while sandy loamy soil needs extensive watering.

Nature of River: Many rivers in India are not perennial. Most of the rivers in central and south India have water only for four months during the monsoon. Thus, an extensive irrigation system is required.

To Maximise Production: As the population of the country has increased manifold, the production of crops also needs to be enhanced to meet the demands of the people. Hence, advanced and reliable methods of irrigation are required.

Means of Irrigation

Major conventional means of irrigation in India are wells, tanks and canals.

Wells

A well is a small hole dug in the surface of the Earth to obtain water from subsoil for irrigational and other purposes. It is a traditional method of irrigation. Wells are usually found in regions having a high groundwater table.

- Well irrigation is generally found in the alluvial plains where they can be easily dug because of the soft nature of the soil.
- In India, well irrigation is generally practised in Uttar Pradesh, Goa, Punjab, Haryana, Bihar, Rajasthan, Gujarat, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu.

The water from the well is lifted in the following ways:

Persian Wheel Method: It is a water-lifting device which has a partly submerged vertical wheel with buckets attached to the rim. Animals such as buffaloes and camels are used to rotate the wheel. As they rotate the wheel, the buckets are filled, and water is then emptied into a trough above which carries water to fields.

Lever Method: It is an economical and efficient method of lifting water from wells. It is widely practised in Bihar and Andhra Pradesh.

Inclined Plane Method: This method is also known as mhote. In this method, a pair of bullocks is used to lift water from wells.

Table Wells: In this method, power-driven pumps are used to lift water from tube wells from depths below 15 m.

Advantages of Using Wells

- They can be dug at very low costs and hence can be used even by poor farmers.
- Oxen which are used for ploughing the land can also be used for drawing water from wells.
- Pumps and tube wells can be used for lifting water from great depths.

Disadvantages of Well Irrigation

- It is difficult to dig wells in the hilly regions of the north and stony areas of the peninsula.
- Wells can dry up because of the lowering of the water table.
- Use of electricity and diesel to operate tube wells makes irrigating fields expensive.

Tanks

A tank is an artificial reservoir built across a stream to impound water. Water from the tank is then carried to the fields through narrow channels.

Tanks are used for irrigation in peninsular India including Maharashtra and Gujarat. Tanks are extensively used in Deccan because of the following reasons:

- The Deccan has many natural depressions where tanks can be easily built.
- The rivers of the region are not perennial and become dry during the summer.
- Wells cannot be dug in the stony regions of the Deccan. Tanks however can be easily built by making small dams of stones in the depressions where rainwater collects.

Tank irrigation is largely practised in Andhra Pradesh, Tamil Nadu, West Bengal, south Rajasthan and south Bihar.

Advantages of Tank Irrigation

- Tank irrigation is useful in Deccan regions where rainfall is seasonal and uncertain.
- In the rocky terrain of the Deccan Plateau, it is difficult to build wells and canals. In such regions, tanks are an important source of irrigation.
- Rainwater could be stored in the tanks which otherwise flow out and get wasted. This water is then used for irrigation.

Disadvantages of Tank Irrigation

- Tanks can easily get silted up. Thus, regular desilting of tanks is required.
- In case of failure of rains, tanks also remain dry and hence are not a dependable source of irrigation.
- Because of large area coverage and shallow depth, water from tanks either evaporates or sinks underground.
- Tanks can use a large infertile area which otherwise could be used for growing crops.
- The lifting of water from tanks and bringing it to the fields is a strenuous and costly task.

Canals

Canals are also an important means of irrigation in India. There are two main types of canals. These are

Inundation Canals: These are long canals directly taken off from large rivers. They receive water when the river is high enough and especially when in flood. Thus, these canals have limited use only.

Perennial Canals: These canals are taken out from the perennial rivers by constructing small dams and barrages to regulate the flow of rivers. Most canals in India are perennial.

Some important canals in India are Upper Bari Doab, Bist Doab, Sirhind, Bhakra and Western Yamuna Canals in Punjab and Haryana; the Indira Gandhi Canal and Bikaner Canal in Rajasthan; Eastern Yamuna Canal, Sharda Canal, Ramganga Canal and Betwa Canal in Uttar Pradesh; and Damodar Canal and Mayurakhi Canal in West Bengal.

In south India, canals are extensively used for irrigation. Nagarjunasagar and Tungabhadra projects are major canals in the south. One-third of the net irrigated area in Tamil Nadu is under canal irrigation. The state of Mizoram is solely dependent on canals for irrigation.

Advantages of Canal Irrigation

- Canals irrigate fields in regions which get scanty rainfall.
- In dry regions of Rajasthan, canals irrigate fields which are yielding good agricultural harvests.
- Canals have irrigated major parts of Punjab and Haryana. These two states have become the nucleus of the Green Revolution.
- Tamil Nadu gets rainfall during winters. Canals irrigate the fields during summer and make up for the lack of rainfall.

Disadvantages of Canal Irrigation

- In canal irrigation, where the water table is only few feet below the ground, the alkaline salts may come to the surface, mix with the soil and make it unproductive.
- Because of waterlogging of canals, the capacity of the soil to absorb water decreases which can damage the crops in the absence of a proper drainage system.

Major Drawbacks of Conventional Methods of Irrigation

- In the agricultural fields, about 10–15% of land is used for preparing water channels, decreasing the effective area of cultivation.
- In tanks and canals, owing to the evaporation of water, the soil may silt.
- The fields in the low-lying areas always get excess water resulting in waterlogging and subsequently the accumulation of salt which damages the quality of soil.
- In the conventional system of irrigation, a large quantity of water is not properly used and gets wasted.

Modern Methods of Irrigation


Furrow Irrigation

Furrow Irrigation: It is a type of surface irrigation in which furrows or trenches are dug between rows of crops in the field instead of distributing water throughout the fields. It is useful in areas where water is easily available.

Spray Irrigation: In spray irrigation, water is released in an agricultural field by spray guns. In spray irrigation, water is used efficiently in irrigating the fields.

One limitation of this method is that it is expensive as it requires complex and sophisticated machinery. Further, plants may suffer from many diseases because of overwatering of fields.

Drip Irrigation: In this system of irrigation, water is given directly to the crops through perforated pipes which are placed between rows of crops. This method reduces the rate of evaporation and helps in conserving water. This is the most advanced and efficient means of irrigation.

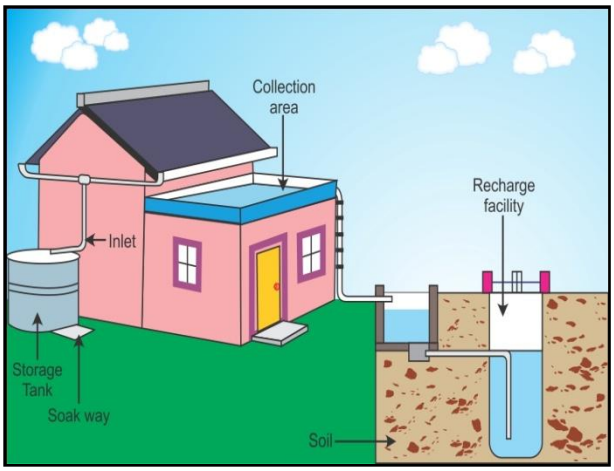
We need to conserve water as the population is growing at an extremely fast pace. Overexploitation of underground water has resulted in lowering the water table. Further, the demand of water for domestic and industrial use has also increased. Many water bodies such as rivers, lakes and tanks have been polluted and hence cannot be used for basic purposes.

Rainwater Harvesting

Rainwater harvesting is the method of collecting rainwater for use before it reaches the ground. Generally, rainwater is collected from the rooftop through pipes and stored in underground storage structures.

Mechanism of Rainwater Harvesting

- Rainwater on the rooftop is first collected using a PVC pipe. Water is then filtered by using sand and bricks.
- Water is taken down to either a sump (a hollow structure or a depression where liquids collect) for immediate use or is taken to a well or any other structure which is dug on the premises.
- Water from this well can be used later for domestic consumption. It also recharges the water table.



Rainwater Harvesting

Elements of Rainwater Harvesting:

Catchment: Catchment is an area or a surface which receives direct rainwater.

Conduits: The pipelines or drains through which rainwater is carried from the catchment to the water harvesting system are known as conduits.

Storage Facility: Rainwater can be stored in storage containers of RCC and masonry or in plastic water tanks.

Recharge Facility: Rainwater harvesting also recharges the groundwater aquifers.

Recharging Groundwater Aquifers

Some commonly used water recharging methods are digging of

- Bore wells
- Recharge pits
- Percolation pits
- Recharge trenches

Agriculture in India-Food Crops

Types of Agriculture in India

Agriculture plays an important role in the Indian economy in the following ways:

a. It provides food for the ever increasing population of the country.
b. It supplies raw materials for agro-based industries such as the textiles and food processing industries.
c. It provides a market for industrial goods such as machinery and agricultural implements.
d. It provides employment to millions of people.
e. It accounts for a large portion of India's exports.

Some types of agricultural farming in India are shifting agriculture, subsistence agriculture, intensive agriculture, extensive farming, plantation farming and mixed farming.

Shifting Agriculture

- It is also known as 'Slash and Burn Agriculture' and 'jhum', 'ponam' or 'podu'. It is a primitive method of cultivation. In this type of cultivation, a patch of forested land is cleared by felling and burning trees. The ashes of trees are mixed in the soil.
- After two to three years, when the soil loses its fertility, the land is left fallow, and a new patch of land is cleared for cultivation.
- Maize, potato, yam and cassava are grown in shifting cultivation. It is mainly practised in northeast India.
- Dry paddy, maize, millets and vegetables are commonly grown in this type of farming. This method of cultivation has some disadvantages. It results in deforestation, accelerates soil erosion and causes floods and silting.

Subsistence Farming

- A majority of farmers in India practise subsistence farming. Land holdings in this type of farming are small, and farmers use traditional methods of agriculture.
- As farmers are poor, they do not use fertilisers and high-yielding seed varieties in their fields.
- The production is not very high. Food crops are mainly produced for consumption by the family.

Intensive Farming

- This kind of cultivation is practised in areas with high density of population.
- It is a labour intensive system whereby fertilisers, high-yielding seed varieties and irrigation methods are used for increasing production.
- More than one crop is cultivated on the same field.

Extensive Farming

- This kind of cultivation is practised where the size of the agricultural field is large and productivity is high.
- Machines are extensively used, and hence, the labour employed per unit area is low.
- Farmers specialise in the production of one or two major commercial crops.
- Rice, wheat, maize and sugarcane are the main crops which are grown in extensive farming. Because the productivity is high, there is large surplus for sale.

Plantation Farming

- In plantation farming, single crops of tea, sugarcane, coffee, rubber, cotton and banana are grown on large fields.
- Large labour force and capital are required in plantations.
- Developed transport is required to transport these crops to factories for processing.
- Latest technology and modern methods of agriculture are used. In this kind of cultivation, crops are mainly exported to earn foreign exchange.

Mixed Farming

- In mixed farming, two or more crops are grown together on a rotational basis.
- Apart from growing crops and fodder crops, animals are also reared.
- This type of cultivation ensures farmers with a steady income.

Commercial Farming

- In this type of farming, crops are grown for commercial purposes, i.e. for selling in local and international markets.
- Wheat and maize are the main crops which are grown in commercial grain farming.
- Farming is mechanised and is prevalent in areas where farms are large and the market is strong.
- In India, this kind of farming is practised in Punjab, Haryana, Gujarat, Western Uttar Pradesh and Andhra Pradesh.

Dry Farming

- It is practised in areas where irrigation facilities are not readily available. Crops which can stand dry weather such as jowar, bajra and ragi are mainly grown.
- The fields are repeatedly ploughed before and during rains to preserve soil moisture.
- This type of cultivation is practised in Western Rajasthan and in some parts of Deccan.

Problems Faced by Indian Agriculture

Environmental Factors

- Unreliable rainfall
- Lack of irrigation facilities
- Soil erosion
- Reduction in net sown area

Institutional Factors

- Small and fragmented land holdings
- Exploitation of farmers

Economic Factors

- Subsistence agriculture
- Challenges posed by globalisation

Technological Factors

- Use of old and inefficient techniques by Indian farmers

Steps Taken to Improve Agricultural Production in India

- Introduction of various reforms such as the abolition of the Zamindari Act.
- Consolidation of fragmented land holdings
- Creation of irrigation infrastructure
- Announcement of minimum support prices
- Provision of subsidies to farmers for purchasing fertilisers and seeds

Green Revolution

Green Revolution is a term which is used to describe manifold increase in farm production in India. Its main features are

- Use of large-scale capital and technological inputs
- Use of high-yielding seed varieties
- Use of chemical fertilisers and extensive irrigation facilities
- Adoption of modern scientific methods of farming

Impact of the Green Revolution

- Owing to large production, the Green Revolution changed Indian agriculture from subsistence farming to commercial and market-oriented farming.
- Creation of more employment opportunities.
- Farmers were benefited by increased productivity leading to rural prosperity.
- It made India self-sufficient in food grains.

However, the Green Revolution was criticised by environmental scientists because of land degradation caused by overuse of fertilisers and decease in soil fertility due to over irrigation.

Agricultural Crops and Seasons

There are two major agricultural crops in India—rabi crops and kharif crops.
In India, there are three main types of cropping seasons. They are rabi, kharif and zaid.

Types of Cropping Seasons	Sowing Period	Harvesting Period	Main Crops or Fruits	Seasonal Conditions
Rabi	Winter (October–December)	Summer (April–June)	Wheat, barley, peas, gram and mustard	Rainfall during winter months in northern India because of western temperate cyclones helps in the growth of crops.
Kharif	Beginning of the monsoon (July)	September–October	Rice, maize, jowar, groundnut, tur and cotton	Much needed moisture is provided by the monsoon rains in India.
Zaid	March–April	May–June	Watermelon, cucumber, vegetables and fodder crops	These crops are grown between the rabi and kharif seasons. These require warm weather to grow.

However, it is to be noticed that this categorisation of the cropping season does not exist in southern India.

Rice

It is the most important staple food crop of India. It is a kharif crop which is grown extensively in the northern plains, northeastern parts of the country, and coastal and deltaic regions. Rice requires high temperature above 20°C–35°C and high rainfall between 150 cm and 300 cm. During the earlier phase of its growth, the crop requires 5–10 cm of standing water. India is the second largest producer of rice in the world after China.

The rice crop in India can be divided into upland and lowland rice.

Upland Rice	Lowland Rice
It is mainly grown on mountainous regions.	It is mainly grown on low-lying regions.
It is sown in March–April and harvested in September–October.	It is sown in June and harvested in October.
The crop is mainly used for local consumption.	The crop is not only consumed locally but is also sold to other regions.

Soil: Rice requires fertile, clayey and loamy soil for cultivation. It grows well on alluvial soil which should be able to retain standing water in the field. Manure and fertilisers are added to increase production.

Methods of Cultivation

Rice in India is cultivated by two methods—the dry method and the puddle method.

The dry system of cultivation is mainly confined to regions which depend on rainfall and do not have sufficient irrigation facilities. In this method, seeds are scattered by hand in areas of moderate rainfall and are sown in rows with the help of drills in areas of heavy rainfall.

Puddle or **wet method of cultivation** is practised in regions which have adequate supply of water. After ploughing, land is filled with 3–5 cm of water.

The cultivation of rice is carried out by the following steps:

- Sowing of seeds
- Transplanting
- Harvesting
- Processing

Sowing of Seeds

Seeds are sown by various methods. These are

Broadcasting Method: In this method, seeds are scattered all over the field. This method is prevalent in regions where labour is scarce and the soil is infertile.

Drilling Method: In this method, seeds are sown in furrows with the help of a drill usually made of bamboo. The germination of seeds is high as seeds fall into furrows systematically. This is however a time-consuming way to sow seeds.

Dibbling Method: In this method, seeds are sown at regular intervals in furrows.

Transplanting Method

- In this method, seedlings from nurseries are transplanted into rice fields in groups of four to six at a distance of 30–45 cm.
- Initially, the field is covered with 2–3 cm of water. The level of water is then increased to 4–6 cm till the crop matures.
- This method is popular as it gives higher yield.

Japanese Method

- In this method, the seedlings are prepared in nurseries.
- The rows of plants are then fixed at a distance of 25 cm, and the distance between the plants is about 15 cm.
- Manure is used extensively to increase yield. Plants give higher yield by this method.

Harvesting and Processing

- The rice fields are drained dry just before the crop is harvested. Each stalk is then hand reaped.
- The moisture content of the stalk is reduced by drying stalks in the Sun.
- In threshing, grains are separated from the stalks. It is done in the field to reduce the cost of transport.
- During winnowing, unwanted husk is removed from the grains by pouring them from a height.
- Milling is then done to remove yellowish husk from the grains.

Distribution

India produces 22% of the total rice in the world. It is mainly grown in West Bengal, Uttar Pradesh, Haryana, Andhra Pradesh, Punjab, Bihar, Assam, Maharashtra, Gujarat, Meghalaya, Manipur, Tripura and Tamil Nadu.

Wheat

It is the second most important crop in the country after rice. It is a rabi crop. India accounts for 12% of the total wheat production in the world.

Wheat is a rabi crop which is sown during winters and harvested during summers.

Climatic Conditions: Wheat requires a cool climate. It requires a temperature of 10–15°C during sowing and 20–25°C during harvesting. About 80 cm of rainfall is ideal for wheat cultivation.
Soil: Well-drained loamy soil is suitable for the growth of wheat.

Methods of Cultivation

- Seeds are generally sown by the drilling and broadcasting methods.
- The wheat crop starts ripening in March and is harvested in April when the temperature is 27.5°C.

Distribution

- Uttar Pradesh, Haryana, Rajasthan and Madhya Pradesh are five leading producers of wheat in the country. Wheat yield is extremely high in Punjab and Haryana.
- The yield of wheat is low in Madhya Pradesh, Himachal Pradesh and Jammu and Kashmir as it is grown under rain-fed conditions.

Millets

Climate required for the growth of millets

Name of the Crop	Temperature Required	Rainfall Required	Soil	Distribution
Jowar	27–32°C	It grows in arid and semi-arid regions receiving rainfall below 45 cm.	Red, grey and yellow loamy soils. It can also be grown in sandy soils.	Maharashtra, Madhya Pradesh, Karnataka, Andhra Pradesh, Tamil Nadu, Gujarat and Rajasthan
Bajra	25–30°C	Low rainfall; it can be grown in regions receiving less than 50 cm of rainfall.	Red, sandy, loamy and black soils.	Rajasthan, Gujarat, Uttar Pradesh, Punjab and Haryana
Ragi	20–30°C	It is grown in regions receiving 50–100 cm of rainfall.	Red and sandy loamy soil and well-drained alluvial soil.	Karnataka (leading producer), Tamil Nadu, Uttarakhand, Maharashtra and Andhra Pradesh

Pulses

- Pulses are an important part of the Indian diet as they provide vegetable protein. Some pulses are gram or arhar, urad, masur (lentil), moong (black gram) and matar (peas).
- Temperature ranging between 20°C and 25°C and rainfall between 50 cm and 75 cm are required for growing pulses.
- Pulses grow well in dry light soil.
- Gram is the leading pulse and is sometimes grown along with wheat. While gram is raised as a rabi crop in regions receiving about 10 cm of rainfall, urad and moong are raised as kharif crops.
- Pulses are leguminous crops which increase the content of nitrogen in the soil, increasing its fertility.
- India is the largest producer and consumer of pulses in the world. Madhya Pradesh, Maharashtra, Uttar Pradesh, Rajasthan and Andhra Pradesh are the five leading states producing pulses.

Manufacturing Industries in India-Agro Based

Industrialisation in India

India is one of the top ten industrialised countries in the world. With her command over vast natural resources and huge manpower resources, she is developing at a rapid pace.

Need for Rapid Industrialisation in India

- Rapid industrialisation is required to make India self-sufficient and self-reliable for fulfilling all her needs and requirements.
- As India is predominantly an agricultural country, about one two-thirds of the population is dependent on agriculture. Since agriculture cannot support the growing population, industries need to be established to solve the problem of unemployment.
- Industries give support to agriculture. For example, agricultural implements are manufactured in industries.
- Rapid industrialisation is required to keep pace with the technological advancements which have been made in the world.
- Industries produce goods and equipment required for maintaining the defence of the country.

Factors Affecting the Location of Industries

Geographical and commercial factors affect the location of industries. Geographical factors are

- **Raw Materials**: Industries are mostly established at areas which are located close to the fields of raw materials. For example, many iron and steel industries are located near the iron and coal fields. Industries dealing with the manufacturing of perishable goods are located close to the source of raw materials. For example, sugarcane industries are located close to the sugarcane fields as the sucrose content of sugarcane starts drying up after 24 hours of its harvest.
- **Water Supply**: Industries require water while manufacturing goods. For example, water is used in textile industries for bleaching and washing purposes. Thus, many industries are located close to the sources of water.
- **Energy**: Energy is required for processing raw materials into manufactured goods. Thus, many industries are located close to the coal fields. Industries are also located in regions where energy power resources are readily and cheaply available.
- **Transport**: Transport is required for carrying raw materials to manufacturing units. It is also required for transporting finished goods to markets. Thus, many industries are located near the port cities which are also well-connected by road and rail to major towns and market cities.
- **Labour**: The availability of skilled and unskilled labour is an important factor which decides the location of industries. Thus, many industries are located at places where cheap labour is readily available.
- **Proximity to Markets**: Industries require markets to sell off their finished goods. For example, heavy industries are located in an industrial area as their products are required by other small industries.
- **Climate**: It plays an important role in determining the location of agro-based industries. For example, many cotton textile mills are located in Mumbai and Gujarat as it has a favourable climate which is required for storing and manufacturing cotton yarn.

Commercial factors deciding the location of industries are

- **Policies of the Government**: The policies of the government play an important role in deciding the location of industries. The government makes rules and regulations for the supply of water and electricity. Further, it formulates policies for protecting and encouraging indigenous industries.
- **Capital**: Many industries are located in the big cities where most financers and investors are present. Thus, many big cities are also major industrial centres.
- **Organisational Skills**: Organisational skills and technical knowledge are required for running any industry. As a result, we find that many industries are located near educational and management institutes to hire skilled people.

Classification of Industries

Industries	Classification on the basis of	Examples
Agro-based: Use agricultural products as raw materials **Mineral-based: Use minerals as raw materials** **Forest-based: Use forest products as raw materials** **Animal-based: Use raw materials provided by animals**	Raw materials	**Agro-based**: Cotton textiles and tea industry **Mineral-based**: Iron and steel industry **Forest-based**: Wood industry **Animal-based**: Silk and woollen industry
Heavy industries: Manufacture heavy and bulky goods **Light industries: Produce lightweight goods**	Nature of product	**Heavy industries**: Iron and steel industry **Light industries**: Bottle industries
Large-scale industries: Has huge infrastructure and requires large capital investments **Medium-scale industries: Are neither big nor small** **Small-scale industries: Are small and have only small capital investments**	Size and investments	**Large-scale industries**: Iron and steel Industry **Medium-scale industries**: Paper mills **Small-scale industries**: Weaving industry
Public sector industries: Owned by the government **Private sector industries: Owned by individuals** **Joint sector industries: Owned and managed by both government and private individuals** **Cooperative sector industries: Owned by producers and distributers collectively**	Ownership	**Public sector industries**: IOC and SAIL **Private sector industries**: Reliance and Wipro **Cooperative sector industries**: Maruti Suzuki and Exide Industries **Joint sector industries**: AMUL and IFFCO

Distribution of Industrial Regions

Major industrial belts in India are

a. **The Hooghly Belt**: This industrial belt has many jute textiles, cotton textiles, chemicals, engineering, paper, leather industries etc. Kolkata is a major city in this belt. Proximity to the coal and iron ore mines of Jharkhand and Bihar, cheap labour, freshwater of River Hooghly has made this an important industrial belt of the region.

b. **The Mumbai–Pune Belt**: Cotton textile mills, oil refineries, chemical and fertiliser industries etc. are located in this belt. Development of hydroelectricity in the Sahyadris and the availability of cheap labour from Gujarat and Maharashtra have made this an important industrial belt. Further, the port of Mumbai facilitates the transport facilities in and out of the region.

c. **The Ahmedabad–Vadodara Region**: Ahmedabad has emerged as a major centre of cotton textile industries. This region has many industries such as chemical and fertiliser industries, plastics industries and engineering industries for goods and services. Availability of skilled and unskilled labour has made it an important industrial region.

d. **The Chennai–Coimbatore–Bengaluru Region**: Cheap and skilled labour, availability of cotton and large markets have made this region an important industrial belt. Chennai, Coimbatore and Madurai are important centres of the belt.

e. **The Chotanagpur Plateau Region**: This region covers parts of West Bengal and Jharkhand. This region is rich in minerals such as iron ore, coal, manganese, bauxite and mica. Jamshedpur, Bokaro and Durgapur are some important centres of steel production. Asansol, Ranchi and Dhanbad are some important centres of metallurgy and heavy industries. Because of the presence of rich deposits in this region, many industries are located here.

f. **The Mathura–Delhi–Saharanpur–Ambala Region**: Two separate belts between Faridabad and Ambala in Haryana and Mathura and Saharanpur in Uttar Pradesh merge in and around Delhi. The region has cotton textile, glass industry, chemicals and fertilisers, sugar and engineering industries. Cheap availability of raw materials, good transport system and large markets have led to the establishment of many industries in the region.

Agro-Based Industries

The sugar industry is the second largest organised industry next to cotton textile industries. Sugarcane is a cash crop.
Products of sugarcane industries are sugar, gur and khandsari. Its by-products are

- **Molasses**: It is obtained during the process of manufacturing sugar. It is used in the alcohol industry for the distillation of liquor and for producing certain chemicals and synthetic rubber.
- **Bagasse**: It is the leftover cane. It is used for producing steam which is a source of power for the sugarcane industry and is used for making wax, carbon paper and shoe polish.
- **Press mud** is used for making wax, carbon paper and shoe polish.

Distribution of Sugar Industries

- As Maharashtra is the leading producer of sugar in India, the state has 119 sugar mills. Most of the mills are large.
- Uttar Pradesh is the second largest producer of sugarcane in India. Sugarcane factories are located in two belts—the Ganga Yamuna Doab (Saharanpur, Meerut, Bualndshahar and Ghaziabad) and the Terai belt (Basti, Gonda, Gorakhpur etc).

- Other northern Indian states where sugar mills are located are Punjab, Haryana, Madhya Pradesh and Gujarat.
- Peninsular India has emerged as a leading producer of sugar in India. Tamil Nadu has become the leading producer of sugar in the region because of higher per hectare yield of sugarcane, higher sucrose content and long crushing season.
- Sugar factories are also located in Andhra Pradesh (Hyderabad, Vijayawada, Chittoor etc.) and Karnataka (Belgaum, Bellary, Bijapur etc.).

Sugar Industries have Shifted to the South because

- The climate of South India is free from the effects of summer loo and winter frost which are suitable for growing superior varieties of sugarcane. The production period is also long.
- Black soil is more fertile than the alluvial soil of north India. The sugarcane here is of superior quality with higher yield.
- The excellent transport facilities in Maharashtra and Tamil Nadu have resulted in an increased number of sugarcane mills in these regions.
- The sugarcane farmers in South India have bigger area and are managed by cooperative societies.

Problems Faced by Sugarcane Industries

- Growth of poor quality of sugarcane with low sucrose content.
- High cost of production because of low yield and short crushing season.
- As maximum sugarcane is harvested at the same time, there is pressure on industries during the harvest time.
- The supply of raw materials to sugar industries is irregular as no plantation industry exists around the factories.
- Old and obsolete machinery is used in the sugar industry which has not been replaced by new machinery and modern technology.

Cotton Textile Industries

India is the third largest cotton textile manufacturing country in the world after USA and UK. It is also the third largest exporter of cotton textiles. Nearly 40% of the country's labour force is supported by this major industry.

Many cotton textile industries are located in Maharashtra, Gujarat and Tamil Nadu. They produce three-fourths of the total output of yarn. The remaining one-fourth is produced by West Bengal, Uttar Pradesh, Madhya Pradesh, Rajasthan, Andhra Pradesh and Karnataka.

The cotton textile industry is located in almost all the Indian states. About half of the total cotton mills are located in Mumbai and Ahmedabad. Mumbai is known as the 'cottonpolis' of India as it is the most important centre of cotton production. Mumbai and Ahmedabad have emerged as the most important manufacturing centres because of the following reasons:

- Both cities are located close to the cotton-growing areas of the Deccan Plateau.
- Humid coastal climate have favoured the establishment in industries in both cities.
- Connectivity of Mumbai and Ahmedabad by rail and road routes to cotton-growing regions and by sea routes to foreign markets.
- Mumbai is the main port city and Ahmedabad uses port facilities from Kandla.
- Many big and large financial centres are located in Mumbai and Ahmedabad.
- Power supply in Mumbai and Ahmedabad is mostly regular. While power is supplied by the Tata hydroelectric system in Mumbai, Ukai and Kakrapara hydroelectric projects supply electricity to Gujarat.

Problems Faced by Cotton Textile Industries

- The yarn in India is produced by small industries and units which largely cater to the local markets. Thus, while many spinners export cotton yarn, many garment manufacturers have to import fabric. Therefore, there is a mismatch between the two.
- Most of the machinery installed in the cotton mills are outdated and need to be replaced.
- Irregular power supply has hampered the production.
- Uncertainty in procuring raw materials, low labour productivity, lack of modernisation etc. are some problems because of which sugar industries are running into loss.
- The cotton industry is facing tough competition from the fibre industry.

Handloom and Khadi Industries

It is one of the oldest industries in India. The industry provides employment to about 10 million people and contributes over 23% of the total cloth production in the country. The khadi and handloom industries are located in many Indian states such as Tamil Nadu, Manipur, West Bengal, Nagaland, Kerala, Madhya Pradesh, Karnataka and Rajasthan.

Problems Faced by Khadi and Handloom Industries

- Insufficient and inferior quality of raw materials
- Lack of technical skills among poor craftsmen
- Old and obsolete technology used in the industries
- Goods which are produced are no match to modern fast-changing fashion and designs
- Stiff competition faced by mill-made cloth
- Lack of capital and cheap credit facilities

Silk Textile Industries

India is one of the largest producers of silk in the world. It manufactures four varieties of silk—mulberry, eri, tussar and muga. The first modern silk industry was set up at Howrah by the East India Company.

Mulberry Silk

Mulberry silk accounts for about 90% of the total natural produced silk in India. Mulberry silk is produced from silkworms which are reared from mulberry trees. Rearing of silkworm for producing silk is known as **sericulture**. Mulberry silk is produced mainly in Karnataka, Andhra Pradesh, West Bengal, Tamil Nadu and Jammu and Kashmir.

Distribution

Regions producing mulberry silk are

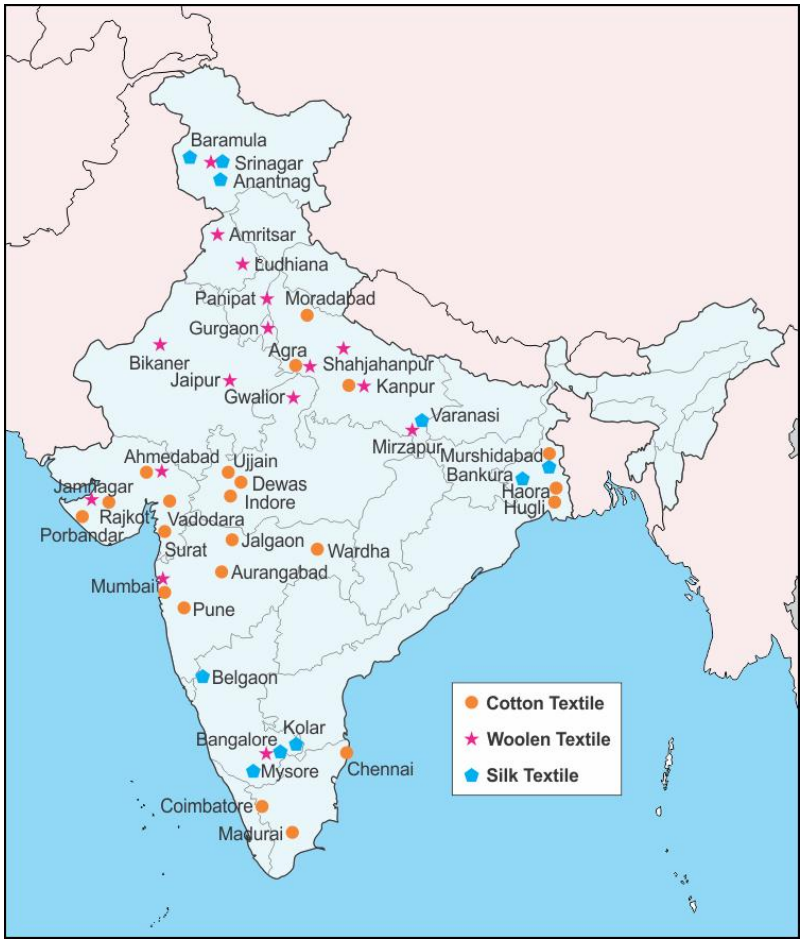
States	Regions
Karnataka	Bengaluru, Mysore, Kolar, Mandya, Belgaum and Coorg
Andhra Pradesh	Chittoor, Warangal, Karimnagar, Vishakhapatnam and Anantnagar
West Bengal	Malda, Murshidabad, Birbhum and Bankura
Tamil Nadu	Coimbatore, Dharmapuri, Nilgiris, Salem and Tirunelveli
Bihar and Jharkhand (produce tussar silk)	Bhagalpur, Palamau, Hazaribagh and Ranchi
Assam (produce tussar, eri and muga)	Goalpara, Kamrup and Nagaon

Problems Faced by the Silk Industry

- Competition from artificial silk
- Import of better quality and cheap raw silk from China
- No systematic testing and grading of silk
- Lack modern power looms for increasing production

Woollen Industry

More than 80% of woollen mills are located in northern India. The main centres of woollen production are Delhi, Srinagar, Kanpur, Dhariwal, Mumbai, Ahmedabad and Gwalior. The woollen industry in India is not as developed as cotton textile industries because the demand for woollen clothes is less as they are required only for three to four winter months mainly in northern India. Peninsular India does not experience extreme winters; hence, the demand for woollen clothes in these regions is low.



Map showing major textile industries in India

Problems Faced by the Woollen Industry

- India is a tropical country, and hence, woollen clothes are required only during winter months in northern India.
- Many people in India are poor and cannot spend on purchasing costly woollen clothes.
- Good quality of wool in India has to be imported.
- Synthetic fibres are replacing woollen industries.
- Because cotton and synthetic clothes are more in demand, capitalists prefer to invest in cotton industries.

Many steps have been taken to improve the woollen industry in India. The government has started encouraging the production of good quality wool in India. Various sheep-breeding farms have been set up in northwest India. Merino and Corriedale sheep are imported and reared in the country.

Jute Industry

It is the second important agro-based industry in India after the cotton textiles industry. It is one of the principal earners of foreign exchange.
The jute industry produces gunny bags, hessian, coarse carpets, rugs and cordage. Jute fibres are also used for packing goods.

Distribution

The jute industry is mainly centred in the Hooghly region as jute is largely grown in the Ganga Delta and in the Lower Ganga Valley. Other important jute-growing areas in Bengal are Howrah, Titagarh, Jagatal,

Serampore, Bansberia and Sibpur. Jute mills are also located in Bihar, Uttar Pradesh, Andhra Pradesh, Odisha and Madhya Pradesh.

Factors Promoting the Jute Industry around Kolkata

- The Hooghly valley is a part of the Ganga Valley where jute is predominantly grown.
- The Ganga Brahmaputra Delta has fertile soil which gets renewed every year. This has increased jute production.
- Humid climate and rainfall ranging 175–200 cm favour the growth of jute crop.
- Plenty of freshwater for retting and cleaning is available from the River Hooghly.
- Availability of labour from the neighbouring areas of Odisha and Uttar Pradesh has led to the growth of jute industries in the region.
- Kolkata is a port city and is well-connected to the other parts of the country by rail and road.

Problems Faced by the Jute Industry

- After Independence, nearly 70% of jute-producing areas went to Bangladesh. Thus, the industry suffers from inadequate supply of jute.
- The jute industry in India faces tough competition from Bangladesh, Brazil, Egypt and Thailand.
- The industry is equipped with old and obsolete machinery. Costs of production have also risen.
- Products of paper, plastic and hemp are widely used today as substitutes of jute products.

Remedial Steps Taken by the Government

- A Jute Consultative Council has been set up to advice the government on the jute industry.
- Many research programmes have been undertaken to extend the range of jute products. Some new jute products are tarpaulins, jute carpets etc.
- Modern machinery has begun to be installed in jute industries.
- Steps have been taken by the government to stabilise jute prices.

Waste Management-I

Waste

Waste refers to any discarded material which no longer remains useful. According to the Environment Protection Act, 1990, waste is any substance which constitutes a scrap material, or an effluent or an unwanted surplus which arises out of the application of any process.
There are three types of wastes—solid, liquid and gaseous wastes.
Solid Wastes: It include garbage, food leftovers, decaying fruits and vegetables, cans, bottles and ashes.
Liquid Wastes: It refers to sewage discharged from houses, hospitals, restaurants, offices and factories. Oil spill is also a liquid waste.
Gaseous Wastes: It includes fuel exhausts containing carbon dioxide, carbon monoxide, sulphur dioxide etc. Smog is an example of gaseous waste.

Wastes can also be classified into toxic and non-toxic wastes. Differences between them are

Toxic Wastes	Non-toxic Wastes
These are dangerous wastes which can pose grave health hazards to humans and animals.	These wastes do not cause any serious health hazards to humans and animals.
These wastes are produced as a result from industrial processes, use of chemical fertilisers, biomedical wastes generated from hospitals and nuclear activities.	These wastes are mostly domestic wastes.
These wastes include chlorinated solvents, asbestos, organochlorine pesticides, waste paints and release of large amounts of sulphur and nitrogen.	These include food leftovers, fruits and vegetable peels etc.

Sources of Wastes

Wastes are classified into the following categories depending on their source of origin:

Domestic Wastes

Wastes generated as a result of domestic activities are known as domestic wastes. It includes polythene bags, toilet sewage, batteries, expired medicines and scrap metals.

Industrial Wastes

Wastes emanating from various large and small-scale industries are known as industrial wastes. Industrial wastes can be categorised into the following groups depending on the nature of industry:
Mining: Wastes generated during mining activities are known as mining wastes. Many chemicals and liquids get discharged leading to the deterioration of land and water resources.
Cement Industry: These industries discharge fine dust particles which can cause serious health hazards.
Oil Refineries: These industries cause serious environment problems. They generate wastes such as organic sulphur compounds, hydrocarbons and organic acids.
Construction Sites: The wastes include bricks, plastics, pipes, roofing and insulating materials.
Paper Industry: The effluents of the industry include sulphur dioxide and chlorine which can endanger the lives of aquatic organisms.
Textile Industry: Its wastes include effluents resulting from boiling and processing of fibres.

Chemical Industries: These industries include manufacturing industries and fertiliser and pesticide industries.
Metal industries: These industries produce wastes containing copper, lead, acids, chromium and zinc which can affect the life of aquatic animals.

Agricultural Wastes

The following table shows the nature of agricultural wastes:

Classification of Wastes	Examples
Plant Remains or Crop Residues	**Field Residues:** Wastes left in agricultural fields after harvesting, straw of barley, wheat, sorghum and rye. **Process Residue:** These are the remains discarded after the crops are processed. It includes husks, seeds and bagasse.
Animal wastes	Slurry, poultry litters
Processing Wastes	Wastes produced by agro-based industries. It includes stalks and press mud (wastes produced during the process of purification of sugar to make it free from dirt and colour).
Fertilisers	Components of fertilisers such as nitrogen, phosphorus or potassium
Pesticides and Insecticides	Contains dangerous chemicals such as nitrogen. Sulphur and DDT affect humans by entering the food chain.

Municipal Wastes

Waste generated in a municipality or a local area is known as municipal waste. It is discharged by shops, offices, banks, hospitals and schools. It can be divided into the following categories:
Sewage: It is a liquid waste which is discharged from kitchens, bathrooms, lavatories, laundries and laboratories. It includes mineral and organic matter, wastewater and human excreta. As municipal sewage contains large quantities of nitrogen and organic matter, it can affect the ecosystem if it is not treated.
Degradable and Non-Degradable Wastes

Biodegradable Pollutants	Non-biodegradable Pollutants
Biodegradable wastes decompose into the soil.	Non-biodegradable pollutants take a fairly long time (or never) to decompose into the soil.
They do not pose a very serious challenge to the environment.	These wastes pose a serious challenge to the environment because they do not decompose into the soil.
Examples: Paper, egg shells	Examples: Metal cans, plastic products

Biodegradable wastes can be further classified into simple biodegradable wastes and complex biodegradable wastes. While biodegradable wastes can be easily broken down by natural processes (Examples: Leaves, vegetable peels), non-biodegradable wastes cannot be easily decomposed (Examples: Leather shoes, tin cans).

Biomedical Wastes

Wastes which are generated during medical treatment, diagnoses and immunisation of humans and animals are known as biomedical wastes. It also includes wastes generated during research and experiments conducted in laboratories. These wastes include needles, syringes, tissues, parts of the body, chemicals used during pathological tests and polythene bags.

Nuclear Waste

Radioactive wastes which are generated from nuclear reactors, nuclear power plants, trident submarines and X-ray machines are known as nuclear wastes. They are the most hazardous of all as they emit radiation which can cause several diseases, cancer and genetic disorders.
Medical X-rays constitute about 18% of artificial radiations used in radiotherapy for diagnostic purposes.

Need for Management of Wastes

It is important to dispose wastes safely and scientifically. This is because wastes can result in the spread of many diseases.

Waste on Lands

There are dangers of spreading many diseases when wastes get accumulated on land and water bodies. The following table shows the lists of common diseases spread by various insects and organisms:

Insect/Organism/Animal	Diseases Spread
Housefly	Typhoid, diarrhoea, dysentery, cholera
Sand fly	Kala-azar, sand fly fever
Tsetse fly	Sleeping sickness
Mosquitoes	Malaria, yellow fever, chikungunya, dengue
Rodents	Plague, salmonellosis
Dog	Rabies, hydrated diseases

Wastes in Water

Industrialisation and urbanisation pollute water in the following ways:

- Sewage has pathogenic agents. A pathogen is a microorganism which can cause disease.
- Effluents discharged by water include metal salts and complex organic chemicals.
- Fertilisers and pesticides can pollute water resources.
- Radioactive substances can affect reproductive organs in humans and can cause several diseases, cancer and genetic disorders.

Greenhouse Effect and Global Warming

The Earth receives sunrays which keep it warm. The Earth does not absorb all the heat but emits a part of the heat back into space. This helps in maintaining uniform temperature on the surface of the Earth.
A greenhouse is a building made of glass in which plants are grown. The building made of glass absorbs the heat of the Sun but does not allow it to go out. This increases the temperature inside the glass building. Similarly, many greenhouse gases present in the atmosphere (such as carbon dioxide) absorb the Sun's energy and do not reflect it into space, leading to the increase in the temperature of the Earth.
Four gases are mainly responsible for creating the greenhouse effect on the Earth. These gases are carbon dioxide, methane, nitrogen oxide and chlorofluorocarbons (CFCs).

Many human activities such as burning of fossil fuels and deforestation have resulted in global warming.

Effects of Global Warming

- The temperature of the Earth is likely to increase by 2°C to 5°C in the next hundred years.
- This increase in temperature will result in the melting of snow in the polar regions of the Earth. This will result in the rise of the sea level leading to the submergence of coastal lands.
- Increase in temperature will result in changes in climatic conditions all over the world by influencing the wind and rain patterns.
- Rise in temperature will result in an increased rate of transpiration which will lead to the depletion of the groundwater table.

Depletion of the Ozone Layer

The ozone layer lies in the stratosphere. It absorbs the ultraviolet rays of the Sun and protects the Earth from its harmful effects.
The ozone layer has been depleting because of the emission of nitrogen oxide and CFCs. Supersonic jets release nitrogen gas which depletes the ozone layer. CFCs are used in many countries today. During the use of materials such as paints, foam and thermal insulating materials, CFCs escape into the atmosphere and harm the ozone layer.
A hole in the ozone layer has been discovered over Antarctica. Without the ozone layer, exposure to sunrays can cause diseases such as skin cancer and cataract in humans. Ultraviolet rays can cause genetic disorders. It also disturbs the ecological balance in the marine ecosystem.

Acid Rain

Pollutants present in the air such as sulphuric acid and nitrogen oxides (released by burning of fossil fuels and industrial emissions) combine with the droplets of water in the air and come down as rain; this is known as acid rain.
Effects of acid rain are

- Affects the human nervous system by causing neurological diseases
- Affects the lives of aquatic animals
- Leads to the corrosion of buildings, monuments and bridges
- Increases acidity of soil, leading to reduced fertility

Soil Pollution

Acid rain can cause soil pollution. Soil pollution leads to reduction in mineralisation and decomposition. It also reduces soil fertility and soil aeration. Further, it is important to check the accumulation of wastes and reduce soil pollution.

Waste Management

It is thus required to effectively manage wastes. One of the easiest ways of managing wastes is following the 3-R system—reduction, reuse and recycle. We should reduce the use of resources by not overusing and overexploiting them. Materials should also be used several times to conserve resources. Materials such as glass and paper should be recycled to make new materials. This helps in protecting our environment.