AKS IAS®

Foundation For Competitive Exams

Geography

QRM



www.aksias.com

8955177997 / 8448449709

Highest number of All India Ranks in Andhra Pradesh & Telangana

Our Civils 2021 Rankers


Aswin Mani Deep K
Rank : 235


C Yaswanth Reddy
Rank : 15


Tirumani Sri Pooja
Rank : 62


S. Chitharanjan
Rank : 155


Garima Garg
Rank : 220


Syed Mustafa Hashmi
Rank : 162


Amit Ranjan
Rank : 175


K Vishal Dinanath
Rank : 236


Prassanna Kumar
Rank : 264


J sri Jaswanth Chandra
Rank : 314


Rammohan Meena
Rank : 328


Vidyamari Sridhar
Rank : 336


Dibbada SV Ashok
Rank : 350


G Sharath Nayak
Rank : 374


Arun Kumar V
Rank : 378


Bairy Ruthvik
Rank : 461


M Ananya Priya
Rank : 544

50+ Ranks in UPSC CSE 2020


Anisha Srivastava
HT No : 1019374
Rank : 66


Ravi Kumar
HT No : 1132553
Rank : 84


Yashwanth Kumar Reddy
HT No : 7603033
Rank : 93


Richa Kulakarni
HT No : 1038446
Rank : 134


Rahul Reddy
HT No : 1022056
Rank : 218


P. Gouthami
HT No : 1032412
Rank : 317


Soumith Raju
HT No : 1013697
Rank : 355


Varshitha
HT No : 853576
Rank : 413


Thirupathi Rao
HT No : 1034604
Rank : 441


I Madhusudhan
HT No : 6208252
Rank : 489


Anil Kumar
HT No : 8204102
Rank : 584


Harika
HT No : 870845
Rank : 700


Sai Nihil Bharadwaj
HT No : 8200104


I Kavya
HT No : 6201121


Mansi Rajiv Gokhale
HT No : 0104868

FOREWARD

Dear Aspirants,

Every one of our student aims to get their dream job and seeks the right tools that helps them complete their career defining tests. We aim to be one of the main tool to help an aspirant become the one they aspire to be. AKS IAS thrives to be the best step a student takes towards his/her goal and we do achieve it nearly every time. Our publishing unit is one of the essential means to serve our intentions through AKS IAS Material and various imprinted and forthcoming titles.

This Exclusive book has been prepared and compiled keeping in mind the needs of those, who are looking for a focused and intensive approach, who wish to streamline their preparation strategy for the various competitive examinations.

AKS IAS Academy's - committed team has prepared this book following certain norms to ensure non-partisan treatment of the subject, a dedicated effort to help you prepare best to crack the Examinations. Explaining each and every detail required. This all-inclusive volume will facilitate the aspirants to amass a complete and detailed understanding of the concerned subject.

We wish you the best for your Test preparation!

M.S.Shashank
Founder & CEO
AKS IAS Academy

AKS IAS®
Foundation For Competitive Exams

UPSC / IAS Prelims Cum Mains

ENGLISH MEDIUM

Integrated Foundation Course

Online| Live |Offline

www.aksias.com 8448449709/ 8955177997

Contents

1. UNIVERSE AND THE SOLAR SYSTEM 3
2. OUR PLANET: THE EARTH 5
3. ROCKS, EARTHQUAKES AND VOLCANOES 10
4. EARTH MOVEMENTS 12
5. DRAINAGE SYSTEM AND PATTERNS 17
6. OUR ATMOSPHERE 21
7. THE WORLD OF OCEANS 28
8. ECONOMIC GEOGRAPHY AGRICULTURE 31
9. WORLD FISHERY, FORESTRY, MINERALS AND ENERGY 35
World Fisheries 35
World Forestry 35
Minerals 36
ENERGY RESOURCES 38
10. INDUSTRIES, TRANSPORT AND HUMAN GEOGRAPHY 40
Industries 40
Human Geography 41
11. INDIA: GEOLOGY AND PHYSIOGRAPHY 43
12. INDIA: PLAINS, PLATEAUS AND ISLANDS 46
13. INDIAN DRAINAGE AND LAKES 49
14. INDIAN CLIMATE, NATURAL VEGETATION AND SOILS 53
15. NATURAL VEGETATION OF INDIA 55
16. INDIAN FLORA AND FAUNA 57
Forests 57
17. INDIAN AGRICULTURE AND ANIMAL HUSBANDRY 60
18. IRRIGATION AND PISCICULTURE OF INDIA 64
19. MINERAL AND ENERGY RESOURCES OF INDIA 67
20. INDIAN INDUSTRIES AND HUMAN GEOGRAPHY 72
21. Human Resources of India 75
22. INDIAN TRANSPORT AND TRADE 79

AKS

1. UNIVERSE AND THE SOLAR SYSTEM

Theories of Origin

- To explain how the Universe was possibly formed, a number of theories have been proposed over a long period of time. A few examples such theories are the astronomical phenomenon called the Red Shift or the Doppler Effect, The Big Bang Theory, etc.

Doppler Effect and Red Shift

- The shifting of light coming from the galaxies to the red end of the spectrum is known as the Red Shift. The red colour band has the lowest frequency and the longest wavelength in the visible spectrum.
- This proportionate increase shows that matter in the Universe is in a state of rapid expansion and this idea of rapid expansion is the basis of all the modern theories about the origin of the Universe.

Big Bang Theory

- The Big Bang Theory proposes that about 10 to 20 million years ago, a super dense ball in a state of extremely high temperature and pressure, constituted all cosmic matter (universe), which was confined inside this ball.
- A primordial explosion hurled the broken material far into outer space, where the fragmented material is still travelling around at thousands of miles per second.
- The sudden cooling which accompanied the expansion led to the transformation of atomic particles into atoms of lighter elements, which then condensed into gascous clouds.
- Eventually, galaxies and other celestial bodies were formed, without disrupting the expansion of the universe.

Galaxies

- Galaxy is a huge congregation of millions of stars held together by their own gravitational fields.
- There are three types of galaxies, as follows:
  (i) Spiral Galaxy;
  (ii) Elliptical Galaxy; and
  (iii) Irregular Galaxy.

Local Group

A cluster of 23 known galaxies is known as a local group. Milky Way and Andromeda are the two largest known galaxies.

Table Celestial Bodies
Measurement Units of Space

Unit	Distance
Light Year	It is the distance covered by light in one year in vacuum, at a speed of 3 x 10^3 km/s. This is equal to 5.88 × 106 miles.
Astronomical Units (A.U.)	It is the mean distance between the Earth and the Sun (1.49 × 108 km). One light year is equal to 60,000 A.U.
Parsec	It represents the distance at which the mean radius of the Earth's orbit subtends an angle of one second of an arc. It is equal to 3.26 light years.
Cosmic/ Galactic Year	Sun's period of revolution around the ich is 250 million y

Distance of the Earth from the Sun = 8 light minutes = 1 A.U.
Distance of the Earth from the Moon 1.25 light seconds
Distance of the Earth from Proxima Centauri = 4.3 light years.

Nebulae

- Nebulae are distant stellar systems of luminous bodies (made up of gas and dust particles), e.g. the Orion Nebulae.

Constellations

- Constellations are clusters of stars, organised into distinct shapes and figures, and named accordingly, e.g. Hydra is the largest constellation.
- Comets are huge clouds of frozen gases and dust which have their home in the cold outer fringes of the solar system.
- A comet's head is formed by the evaporation of solid ice particles when the comet approaches the sun.
- Comets have an extremely eccentric orbit but a definite periodicity, such as the Hailey's Comet which is seen every 76 years. The tail of a comet always faces away from the sun.

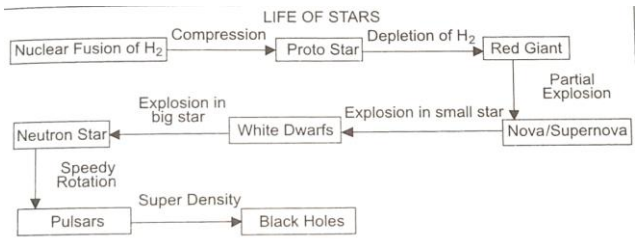
Meteors (Shooting Stars)

- Meteors are made up of small solid matter which, when coming into atmosphere of the Earth, burns out due to friction. While burning,

they emit light, e.g. Leonid shower is a meteor storm (originated in the constellation Leo).

The World of Stars

- Stars account for 98 per cent of the matter in a galaxy. A star is formed by gravitational contraction (from vast clouds of galactic gas and dust).
- Star-forming matter is richer in hydrogen and



helium.

Figure 2.1

OUR SOLAR SYSTEM

The solar system constitutes a collection of heavenly bodies that revolve around the Sun. It includes: (i) The Sun, (ii) The Eight Planets and their satellites, (iii) Asteroids, (iv) Meteors, (v) Comets, and (vi) Drifting particles called interplanetary dust and electrically charged gases called plasma.

The Sun

- One of more than 100 billion stars of the Milky Way.
- Accounts for 99.85 per cent mass of the solar system.

Solar Profile	
• Distance from the Earth	149.8 million km
• Diameter	13,84,000 km
• Mass	2 x 1027 tonnes (98.85% of solar system)
• Surface Temperature (Photosphere)	6000°C
• Core Temperature	15 million degree
• Revolution Period	250 million years
• Rotation Time	25 days
• Composition life	H_2 (71 per cent) 2 He (26.5 per cent) Others (2.5 per cent)
• Age	5 billion years
• Expected	10 billion years

Aurora Borealis/Australis

- Aurora Borealis - northern lights (visible in the Arctic region). • Aurora Australis - southern lights (visible in the Antarctic region).

PLANETARY WORLD

- Under the impact of the Sun's gravitational force, all the eight planets revolve around the Sun, in an elliptical orbit. The planets, in order from the Sun, are: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune.
- The planets, except Venus and Uranus, rotate anti-clockwise at their axes.

may be classified into:

- The planets on the basis of their characteristics (i) Terrestrial (Earth-like) planets or inner planets which have denser material. Planets in this category are Mercury, Venus, Earth, and Mars. (ii) Jovian planets (Jupiter-like) or outer planets which are gaseous, gigantic with large satellite families and high rotational velocities. These are Jupiter, Saturn, Uranus, and Neptune.
- The largest terrestrial planet is Earth while the smallest Jovian planet is Neptune.
- The planets in the descending order of their sizes are: Jupiter, Saturn, Uranus, Neptune, Earth, Venus, Mars, Mercury.
- Planets Mercury and Venus have no satellite.
- Planet closest to the Earth is Venus. followed by Mars, Mercury, and Jupiter.

Mercury

- Mercury, the innermost planet, has the fastest orbital motion (48 km/s) and the shortest period of revolution, i.e. 88 days.
- The fast speed keeps it from being drawn into the Sun's gravitational field.
- The planet is characterised by the maximum diurnal range of temperature.

Venus (The Veiled Planet)

- Venus is the closest planet to the Earth. It is also called Earth's twin because of its similar size, density, and mass.
- The planet is considered as the hottest planet in the solar system. It has the slowest rotational velocity.

Table 2.2 Planetary Facts

Planet	Mean Distance from sun(Millions of Kms)	Diameter (Kms)	Period of Revolution	Period of Rotation	Average Density
Mercury	58	4868	88d	59d	5.10
Venus	108	12,112	225d	243d	5.30
Earth	150	12,742	165.25d	23h56m	5.52
Mars	228	6,800	687d	24h37m	3.94
Jupiter	178	1,43,000	12yr	9h50m	1.34
Saturn	1427	1,21,000	29.5 yr	10h 25 m	0.70
Uranus	2869	47000	84 yr	10 h 45 m	1.55
Neptune	4498	45000	165 yr	16h 7m	2.27

Note: d = days, yr = years, h = hours, m = minutes

Earth (The Blue Planet)

- Earth is the fifth largest planet of the solar system. It is the most densest planet of the solar system.
- It has such temperature ranges that water can exist here in solid, liquid, and gaseous forms. This feature has made the existence of life forms possible on this planet.

Mars (The Red Planet)

- The angle of inclination and period of rotation of the Mars is nearly same as that of the Earth. Hence, Mars has seasons much like that of the Earth.
- Evidence from the surface of Mars shows not only stream action, but displays catastrophic flooding as well. Recently, the European Union's space missions Beagle-2 and NASA's Spirit were undertaken for the exploration of Mars.

Jupiter (The Giant Planet)

- Jupiter is composed mostly of gas and liquid swirling in complex patterns.
- It has the fastest rotational velocity among planets.
- • Its satellites are, however, solid bodies. The four largest of its sixteen known satellites are: Europa, Ganymede, and Calisto which are called Galilean satellites. Ganymede is the largest satellite of the solar system.

Saturn (The Ringed Planet)

- Saturn has a spectacular system of seven rings (discovered by Galileo), identified by the letter 'A' to 'G' (though not in alphabetical order) the rings are made up of individual moonlets of varying sizes.
- Saturn has the largest number of satellites; a total of eighteen or more. Titan, the largest satellite, is the only one in the solar system with an atmosphere of its own.

Uranus (The Green Planet or The Methane Planet)

- Its rotational motion has the appearance of rolling, unlike other planets which spinon their axis.
- Uranus has coldest atmosphere in the solar system.

Neptune

- Uranus and Neptune can be considered twins because of similar size, colour (palegreenish), attributable to the methane in their atmospheres.
- Neptune's atmosphere contains an Earth-sized blemish called the Great Dark Spot. Neptune has eight tiny satellites. Triton is the largest satellite.

2. OUR PLANET: THE EARTH

- Our Earth is a member of the solar family.
- It has been able to develop and retain an atmosphere, a hydrosphere and, a biosphere, because of its appropriate size and distance from the sun.

Origin of The Earth

- A number of theories have been put forward to explain the origin of the Earth and solar system.
- The theories pertaining to the origin of the earth can be divided into two categories:
  (i) evolutionary or natural or monistic hypothesis in accordance with which the

system of planets has evolved from one star or stars; and

(ii) the cataclysmic or catastrophic dualistic approach according to which the origin took place in a sudden and violent event in space, such as the collision or close approach of two stars.

Shape of The Earth.

- Equatorial diameter - 12,757 km (7,927 miles).
- Polar diameter - 12,714 km (7,900 miles), less by 43 km (27 miles).
- The shape of the earth is not a perfect sphere. The earth is flattened on both ends and bulges slightly around the centre, somewhat similar to the shape of an orange. It is flattened at the poles and bulges slightly at the equator. The technical term for such a shape is oblate spheroid. It is also referred to as a 'geoid', which means Earth shaped.

Movement of the Earth

The Earth has the following important movements:

(i) Rotation

- It is the spinning movement of the Earth from west to east on its axis once in 24 hours. The axis is an imaginary line joining the two poles.
- One of the most important consequence of rotation is the phenomenon of day and night, in accordance to which, the half of the Earth which faces the sun experiences day, while the other half, which faces away from the sun experiences night.
- The axis of the Earth is tilted at an angle of 23.5° to the vertical. The velocity of the rotation varies, from about 1,700 km per hour at the equator, its half at 60° parallel (850 km/hour) to nearly zero at the poles.

(ii) Revolution

- The movement of the Earth around the sun is a fixed elliptical path or orbit. It is called revolution, completed by the Earth in 365 4 days. This one-fourth day of four consecutive years is added as an extra day on the fourth year as 29 February, making that year a 'leap year'.
- Due to the elliptical shapes of the orbit, the Earth is closest to the sun on 3 January (at a distance of about 197 million km) and is said to be at Perihelion. • Around 4 July the Earth is at farthest from the sun (152 million km away) and is known to be at Apehelion.
- Average speed of the Earth's revolution is 107,000 km/hour (29.72 km/ second). • The revolution of the Earth coupled with the tilt of the Earth's axis causes different seasons to occur on the Earth.

(iii) Eccentricity

- Earth's orbit keeps changing its shape within a cyclic period between 90,000 and 100,000 years. As a consequence, the earth's orbit may become more elliptical at one point in time, and form a more circular path around the sun at another point in time.
- Scholars propose that the Ice Age and Global Warming are effects of such eccentricity of the Earth's orbit.

Inclination of the Earth's Axis

- The imaginary axis of the Earth has a constant angle of inclination of 66½"with the plane of the ecliptic, i.e. the plane in which the Earth orbits around the sun. • Parallelism is another characteristic of the Earth's axis. As the Earth revolves around the sun, the Earth's axis remains parallel to its preceding
- At different times of the year, the rotation of the earth leads to changes in the altitude of the mid-day sun in varying lengths of day and night at different times of the year, and in the four seasons.

Varying Lengths of Day and Night

- Owing to revolution and constant angle of inclination of Earth's axis, the sun is vertically overhead at the tropic of Cancer on 21 June each year.
- Towards the North Pole, the length of daytime increases, and beyond 66½°N the region has 24 hours light for six months.
- On 21 June, the Northern Hemisphere has its longest day and shortest night. This is known as Summer Solstice.
- The Southern Hemisphere faces the exact same conditions, on 22 December, when the Sun is vertically overhead at the tropic of Capricorn. The Southern Hemisphere experiences its longest day and shortest night then, and it is known as the Winder Solstice.
- The Sun finds itself directly over the equator and each and every part of the world experiences equal days and nights, on 21

March and 23 September. Hence, these two days are known as Vernal and Autumnal Equinoxes, respectively.

Latitude

- Some important parallels are:
  - (i) 0° latitude - Equator.
  - (ii) 23½°N - Tropic of Cancer.
  - (iii) 23½°S - Tropic of Capricorn.
  - (iv) 66½°N - Arctic Circle.
  - (v) 66½ °S – Antarctic Circle.
- The parallel of 60° is half of the Equator in length and 75° is one-fourth of the Equator.

Longitude

- It is the angular distance measured in degrees along the equator, cast or west of the Prime Meridian.
- The Prime Meridian (0") is that meridian which passes through Greenwich, near London, and from which all other meridians radiate eastwards and westwards up to 180°.
- 1° of latitude or longitude represents approximately 111 km. This distance is true for the longitudes along the equator only, since the distance between the longitudes gradually decreases towards the poles to 0 km.

Longitude and Time

- The same local (Sun) time is experienced by places find themselves on the same meridian. The earth takes 24 hours to complete one full rotation, passes through 15° in one hour (360 + 24 = 15) or 1° in 4 minutes. The earth's rotation takes place from west to east, thus, the places which are east of Greenwich see the sun earlier and gain time; while the places which are west of Greenwich see the sun later and lose time.
- A suitable memory acronym is: 'East-Gain-Add' (E.G.A.) and 'West-Lose-Subtract' (W.L.S.). So, if it is noon in London (near 0°), at a place located at 15°E, the time will be one hour ahead of London and the time will be 1 pm. Whereas, Chennai located on 80°E, the time will be 5 hours 20 minutes ahead of Greenwich. (80 × 4 = 320 ÷ 60 = 5.20 hours), i.e. 5.20 p.m.
- A country chooses a specific meridian to determine the time for the entire country, in order to avoid creating confusion due to the presence of many local times within the same country. The 'standard time' followed in that country is represented by this meridian.
- Generally, the standard meridians are chosen to differ from the Greenwich meridian by multiples of 15° or seven and a half degrees, i.e. by exact number of hours or half-hours.
- Thus, the world is divided into a number of time zones.
- Both the USA and Canada have five time zones each. India has adopted only one time zone, selecting the meridian of 82.5°E for the standard time which is 5 hours 30 minutes ahead of G.M.T.

Earth's Satellite: The Moon

The earth has only one satellited, i.e. the moon. Poets find it extre xtremely fascinating to them, the moon appears as a beautiful celestial body in the sky. The moon is quite distinct in the satellite system, as all other satellites are extremely small in comparison to their mother planets, but the earth's moon is about one-fourth of the size of the Earth. Hence, moon is also referred to, at times, as a sub-planet. The moon takes 27½ days for both its rotation and revolution around the earth. Thus, the same lunar hemisphere is always seen from the Earth.

- The moon has no atmosphere as its gravitational power is too weak to hold (1/6th of the Earth).
- The front side of the moon shows (i) the bright parts which are mountains and highlands; and (ii) the darker patches of lowlands which were once thought to beseas and named accordingly as Marias, though the moon has no water at all.
- The moon has a cratered surface, produced by the bombardment of meteors. The different phases of the moon are produced by the changing position of the moon vis-à-vis the sun and the Earth.
- The Blue Moon is an extremely rare celestial event which occurs when the second full moon appears within the same month. Even more unusual is the occurrence of two blue moons within the same year, for example: January and March 1999.
- The ocean of tranquillity is the name given to the area where Neil Armstrong and Edwin Aldrin landed on the moon in 1969, to become the first and the only humans to set foot on the moon's surface.

Lunar Eclipse

- It occurs when the Earth comes between the sun and the moon, and the moon is not able to get sunlight due to the shadow of the Earth cast on it.
- Lunar eclipse occurs always on full moon, but not on every full moon, since the orbital planes of the Earth and moon are inclined at 5° to each other.

NOTES

Solar Eclipse

- It occurs when the moon comes between the sun and the Earth, and its shadow is cast on the Earth, thereby inhibiting the sunlight properly reaching the Earth's surface properly.
- The Moon's Umbra is a smaller area on the surface of the moon wherein the moon inhibits all direct sunlight. Here, total solar eclipse occurs. The sun is covered partially by the moon, and a larger area receives diffused sunlight. This is the Penumbra which experiences partial solar eclipse.
- The solar eclipse always occurs on new moon, but not on every new moon, due to the inclination of the orbital plane of the moon and the Earth.
- During the final moment of solar eclipse, a magnificent flare of sunlight, coming through the uneven marginal surface of moon, is called the 'Diamond Ring'.
- In a calendar year a maximum of seven eclipses can occur (combining the solar and lunar eclipses). Solar eclipses are more frequent than lunar, the ratio being 3:2.

The International Date Line

- A person who travels east of Greenwich gains time till he or she reaches 180°E where he will be 12 hours ahead of Greenwich and he or she loses 12 hours when he or she reaches 180°W. Hence, there is a difference of 24 hours or one day between the two sides of 180°.
- So, 180° meridian is called the International Date Line which, when crossed, results in change of the date by exactly 1 day.
- A traveller crossing this date line from east to west will lose a day, while going from west to east he or she will gain a day.
- Thus, when it is midnight on Monday on the Asiatic side, it is Sunday midnight on the American side (as one gains a day going eastward).
- The International Date Line has been made to curve from the regular 180° meridian at Bering Strait, Fiji, Tonga and other island, so as to avoid confusion of day and date on the islands which are passed through by this meridian.

CONSTITUTION OF THE EARTH'S INTERIOR

Ideas about the interior of the Earth are based upon indirect evidences. Modern view of the Earth's internal structure takes into account evidences from sources such as:

(i) Density Studies: As the relative density of the Earth has been calculated to be 5.5 the relative density of the ing/cm³ and that of the upper rocks to be 2.7 g/cm³, depth rocks must be more than 5.5 g/cm³.

(ii) Temperature and Pressure: The state of the matter within the interior of the Earth is largely determined by the complex interplay of temperature and pressure. The temperature is believed to be around 25,000°C at depths of 2,900 km, and most part of the Earth's interior would have melted at such depths. However, that is not true. The melting point of the rocks at such depths is raised due to the underlying pressure.

(iii) Seismic Waves: The most authentic source of information about the Earth's interior are the earthquake waves coming from within the Earth. These are of three types as follows:

(a) Primary Waves (P-waves): longitudinal waves or compressional waves

(b) Secondary Waves (S-waves): transverse or distortional waves

(c) Surface Waves (L-waves): long-period waves

Had the Earth been a homogeneous solid sphere, then the seismic waves would have moved in straight lines, but the path of seismic waves has been found to be curved. This indicates the non-homogenous structure of the Earth. The sphere of the Earth has been found to be constituting of three concentric layers, after conducting studies of seismic waves and 'Seismic Tomography'. The three layers are as follows:

The Crust

- Thickness of this outermost layer varies from 30 to 40 km beneath continents, to about 10 km beneath the oceanic floor.
- The crust is divided into two shells: the upper, discontinuous, lighter layer of 'SiAl (silica + aluminium) and the lower, continuous, denser layer of the 'SiMa' (silica + magnesium).
- The SiAl shell is thicker under the continents and nearly disappears under the oceanic surface (composed of SiMa).
- Sedimentary rocks cover the surface of the Earth. Below the Earth's surface there lies a layer of crystalline rocks which comprise granite and gneisses in its upper section, and basaltic rocks in the lower section.

The Mantle

- The mantle is separated from the crust by a discontinuity called the Mohorovicic or Moho discontinuity, where the speed of P-wave increases suddenly from 6.9 km/s to 7.9-8.1 km/s.
- The mantle extends from this discontinuity (having an average depth of 30–35 km) to a depth of 2,900 km.
- The mantle accounts for 83 per cent of volume and 68 per cent of the mass of the Earth.
- The mantle is composed of dense and rigid rocks which have a pre-dominance of magnesium and iron.
- The mean density of the mantle is 4.6.
- The mantle can be divided into two parts: (i) the Upper Mantle (density of 3.3-4.0) which extends down to 700 km, and (ii) the Lower Mantle or Mesosphere (density range of 4.0-5.5) which extends between 700 and 2,900 km.

The Core

- The core is the innermost layer of the Earth.
- It starts from the Weichert-Gutenberg discontinuity at a depth of 2,900 km, where there is an abrupt reduction in P-wave velocity and the disappearance of S-waves (which cannot pass through liquids).
- This part of the core, categorised as the Outer Core (2,900-5,150 km), is in liquid state since the pressure at such great depth is also very high.
- The core, also called the barysphere, is composed of heavy metallic elements of nickel and iron (NiFe).
- Sixteen per cent of the volume and 32 per cent of the mass of the Earth come under the core. Its relative density ranges from 9.9 to 13.6 or even higher (average relative density being 11.0).

Mechanical Division

Lithosphere and Asthenosphere

- On the uppermost mantle upon which the crust rests, the lithosphere accounts for 80-100 km of the uppermost mantle. It is cool and rigid like the crust, and along with the crust behaves as a unit. The uppermost mantle and the rigid part of the crust together form the lithosphere.
- Beneath this rigid layer of lithosphere is the asthenosphere, the is hot and plastic, as well as relatively soft. upper part of which

Continental Drift Theory

- Alfred Wegener put forth this theory in 1915, according to which, in the carboniferous period (about 250 million years ago), Pangea was a large landmass which consisted of all the continents, joined together, and was surrounded by a large ocean called Panthalsa.
- Continents made up of the lighter SiAl were moving over the ocean basins, which are composed of the denser SiMa.
- Pangaea started breaking up during the carboniferous period.
- The continents drifted in two directions - towards the equator due to gravitational attraction of equatorial bulge (resulting in the formation of Himalayas, Alps, Atlas, etc.) and towards the west due to tidal forces of the moon and the sun (forming the mountains of Rockies and Andes).

Plate Tectonics

- The theory of Plate Tectonics postulates that the outer rigid lithosphere comprises a mosaic of rigid segments, called Plates, that move on the plastic upper mantle (Asthenosphere) carrying the continents and oceans along with them. Their thickness varies from 80 to 100 km along the oceans to over 100 km in the continents. Six major and many minor plates have been identified.

Table 2.3 Crust Composition of Earth's

Element	Quantity (%)
Oxygen	46.8
Silicon	27.7
Aluminium	8.1
Iron	5.0
Calcium	3.6
Sodium	2.8
Potassium	2.5
Magnesium	2.0

Table 2.4 Composition of the Earth

Element	Quantity (%)
Iron	35
Oxygen	30
Silicon	15
Magnesium	13
Nickei	2.4
Sulphur	1.9

NOTES

Major Earth Layer Discontinuity

(i) Moho Discontinuity: Between crust and mantle

(ii) Conrad Discontinuity: Between outer and inner core

(iii) Welchert-Gutenberg Discontinuity: Between mantle and core

(iv) Repetti Discontinuity: Between upper and lower mantle

(v) Transition Discontinuity: Between outer and inner core

3. ROCKS, EARTHQUAKES AND VOLCANOES

Rocks

- In general, a rock is any mass of mineral matter, whether consolidated or not, forms part of the Earth's crust or the lithosphere. which
- About 90 per cent of rock-forming minerals are silicates (compounds containing silicon, oxygen or more metals).
- The important rock-forming silicate mineral groups are feldspar, quartz, and ferromagnesium.
- Feldspar is the most abundant rock-forming silicate mineral (making up 54 per cent of the minerals in the Earth's crust).
- Limestones are marble rocks made up of calcite, an important mineral of the carbonate group.
- Although most rocks are made of minerals, some substances of organic origin, such as peat and guano, are accepted as rocks.
- Rocks are classified on the basis of their mode of formation into three broad categories.

Igneous Rocks (Primary Rock or Parent Rock)

1. Igneous rocks are formed by the cooling, solidification and crystallisation of molten Earth materials, known as magma and lava.
2. These are granular and crystalline rocks. The sizes of the crystals vary from one rock to another.
3. Since water does not percolate through them easily, these rocks are less affected by chemical weathering.
4. These rocks are more prone to mechanical weathering due to their granular structure.
5. These rocks are non-fossiliferous.
6. Most of the igneous rocks consist of silicate minerals.
   - On the basis of chemical composition, igneous rocks can be divided into the following types:
     (i) Acidic Igneous Rocks have more silica. They are relatively light rocks, e.g. Granites.
     (ii) Basic Igneous Rocks have a lower amount of silica. They are dark-coloured, due to the pre-dominance of ferromagnesium, e.g. Gabbro, Basalt, etc.
   - On the basis of the mode of occurrence, igneous rocks are classified into two major groups as follows:
     1) Intrusive Igneous Rocks: When the rising magma is cooled and solidifies below the surface of the Earth, they are known as Intrusive Igneous Rocks. These are further sub-divided into the following groups:
        a. Plutonic Igneous Rocks: They are formed by the cooling of magma very deep inside the Earth. Due to very slow cooling at that great

depth, large grains are developed, e.g. Granite.

b. Hypabyssal Igneous Rocks: They are formed when magma cools and solidifies just beneath the Earth's surface. They take different shapes and forms depending upon the hollow places in which they solidify.

Table 2.5 Metamorphosed Form of Some Rocks

Igneous	Metamorphic
Granite	Gneiss
Basalt	Amphibolite
Gabbro	Serpentine

(i) (ii) (iii)

(iii) (iv) Sedimentary Sandstone Limestone Shale Coal Metamorphic Quartzite Marble Slate Graphite, Diamond

(i) (ii) Metamorphic Slate Schist Metamorphosed Schist Phyllite

2. Extrusive Igneous Rocks

- These rocks are formed by the cooling and solidification of molten lava on the Earth's surface.
- Basalt is the most important example of extrusive igneous rocks, others are Gabbro and Obridian.
- They are generally fine-grained or glassy because of the quick rate of cooling of lava.
- The extrusive igneous rocks are further divided into two sub-groups:

i. **Explosive Type:** Volcanic materials of violent volcanic eruptions including bombs (big gments of rocks), lapilli (pea-sized fragments) and volcanic dusts and ashes.

ii. **Quiet Type:** In this, lava appears on the surface through cracks and fissures, and its continuous flow forms extensive lava plateaus, e.g. the Deccan Plateau, Columbia Plateau (the USA).

Sedimentary Rocks

Rocks formed from materials derived from pre-existing rocks and from organic sources by the process of denudation are known as sedimentary rocks.

- Sedimentary rocks contain different layers of sediments.
- Fossils are found in these rocks.
- About 75 per cent of the surface area of the globe is covered by sedimentary rocks, while the balance 25 per cent area is occupied by igneous and metamorphic rocks.
- Sedimentary rocks constitute only 5% of the composition of the crust even though they cover the largest area of the Earth's surface. The remaining 95 per cent of the Earth's crust constitutes igneous and metamorphic rocks.
- Layers of sedimentary rocks are seldom found in original and horizontal manner. They are prone to folding and faulting due to compressional and tensional forces.
- Most of the sedimentary rocks are permeable and porous, but a few of them are also non-porous, such as clay.
- Shale is the most abundant sedimentary rock.

Classification of Sedimentary Rocks

1) Mechanically Formed or Clastic Rocks

(a) Rocks formed by water action: e.g.(i) Sandstone,
(ii) Conglomerate, (iii) Clay, (iv) Shale(b) , etc.

(b) Rocks formed by wind action: e.g. Loess.

(c) Kocks formed by glacial action: e.g. Boulder Clay.

2) Organically Formed Sedimentary Rocks

(i) Limestone
(ii) Dolomite
(iii) Coal
(iv) Peat

3) Chemically Formed Sedimentary Rocks

(i) Gypsum
(ii) (ii) Salt rock

Metamorphic Rocks

- Metamorphic rocks are formed by the change in the texture, mineral composition and structure of the pre-existing rocks due to temperature and pressure.
- The pre-existing rocks may be igneous, sedimentary or even metamorphic rocks.
- The fossils of the original sedimentary rocks are destroyed by heat and pressure.

- When already formed metamorphic rocks are again metamorphosed, they are known as Metamorphosed Rocks.

MEASURING SCALES OF EARTHQUAKES

The most commonly used measuring scale to measure the magnitude of earthquakes is known as the Richter scale. This scale is open-ended and logarithmic. A tenfold increase in the measured wave amplitude is represented by each whole number on the scale. Thus, an earthquake of magnitude 3 on the Richter scale is actually 10 times greater in magnitude than the earthquake of magnitude 2 on the scale. The Mercalli scale is used to measure the intensity of the earthquake. The intensity of an earthquake is measured by this scale in relation to the effects it has on human life, such as the damage caused to buildings and damage to other structures. Thus, it can be said that the Richter scale is a quantitative scale, while the Mercalli scale is a qualitative scale.

4. EARTH MOVEMENTS

The forces or movements responsible for the formation of relief features and changes occurring in them are known as Earth Movements. These forces are divided into two broad categories:

i. Endogenetic Force which causes land-upliftment, subsidence, folding, faulting, earthquakes, volcanism, etc.
ii. Exogenetic Force which causes destruction of relief features through their weathering, erosional and depositional activities.

FAULTS

Faults are those fractures in the rock body along which there has been an observable amount of displacement.

Types of Faults

a. Normal Faults: Normal faults refer to the faults which have the displacement of both the rock blocks in the opposite direction. The rocks move vertically so that one side is raised or upthrown. Extension of the faulted area occurs in case of normal faults.
b. Reverse Faults (Thrust Fault): On account of extreme compression, along with the tensional force, fractured rock blocks move towards each other in Reverse Faults. There is thus shortening of the crust in these faults.
c. Lateral or Strike-Slip Fault: When the rock blocks are displaced horizontally along the fault plane due to horizontal movement, lateral faults are formed. They are usually produced where one tectonic plate slides past another at a transform fault boundary.

- Noted examples are as follows: Mona Loa in Hawaii Island (the USA), Etna and Stromboli in the Mediterranean Sea, Pinatubo volcano of Philippines, etc.
- Stromboli is also known as the Light House of the Mediterranean.

(ii) Dormant Volcanoes

- Those volcanoes which have been quiescent for a long time but in which there is a possibility of further eruption.
- Mt Vesuvius mountain of Italy, Mt Fujiyama of Japan and Mt Krakatoa of Indonesia are famous examples of such volcanoes.

(iii) Extinct Volcanoes

- A volcano in which the eruption has completely stopped and is not likely to recur is referred to as an extinct volcano.
- Mt Popa of Myanmar, Mt Kilimanjaro of Africa, Mt. Damavand and Koh-i-Sultan/Koh-e-Sultan of Iran are examples of extinct volcanoes.

Spatial Distribution of Volcanoes

(i) Circum-Pacific Belt (Ring of Fire)

- This is the volcanic zone of the convergent oceanic plate boundary and includes the volcanoes of the eastern and western coastal areas.
- The zone begins from the Erebus mountain of Antarctica and runs northwards through the Andes and the Rockies, and then to volcanoes of the island arcs (e.g. Sakhalin, Kamchatka, Japan, Philippines, etc.).
- Ojos del Salado is the highest active volcanic mountain of the world along with Mt Cotopaxi. It is also situated in the circum-pacific zone. This zone includes more than 60 per cent of world's volcanoes.

(ii) Mid-Atlantic Zone

- This zone represents the divergent boundary or splitting zone of plates located along the mid-Atlantic ridges.

- Iceland located on the mid-Atlantic ridge is the most active volcanic area. • Other examples are St. Helena, Azores Islands, etc.

(iii) Mid-Continental Zone

- Convergent continental plate boundary constitutes this volcanic zone, which includes the volcanoes of Alpine Mountain chains, the Mediterranean Sea and the fault zone of Eastern Africa.
- The Himalayas form the most striking exception because none of the mountains are volcanic in the entire range.

(iv) Intra-Plate Volcanoes

- Some volcanoes are also found in the inner parts of continental or oceanic plates, contrary to the general trend, e.g. Hawaiian Volcanic Chain, Re-Union island, Rhine Graben, etc., which lie beyond convergent or divergent boundary.
- This volcanic activity is the result of the activity of Hot Spots in the Mantle. Hot spots are the mantle plumes of hot materials whose location is stationary.

Volcanic Topography

- When magma solidifies below the Earth's surface then intrusive volcanic topography, such as Batholith, Phacolith, sill, Dyke, etc., is formed.
- Crater and Caldera: A funnel-shaped depression formed at the mouth of a volcanic vent is called a crater. Enlarged form of a crater is generally called Caldera. Geysers and Hot Spring: Geysers are a special type of hot springs from which acolumn of hot water and steam is explosively discharged at intervals.
- Hot springs and geysers differ from each other in that, there is continuous spouting of hot water from the hot springs, whereas the geysers only cause intermittent sprouting of water.
- Yellow Stone National Park of the USA is famous for its geyser.
- Fumaroles: These are vents through which there is intermittent emission of gases, smoke and water vapour.
- Fumaroles are found in groups near the Katmai Volcano of Alaska, which is known as the Valley of Ten Thousand Smokes.

MOUNTAINS

The second order of relief features constitutes the mountains. This is a portion of land surface which rises considerably above the area surrounding it. Mountains can rise singularly or in ranges or chains.

Types of Mountains

(i) Folded Mountains (Geosynclines)

- Most of the Fold Mountains are the youngest mountains in the world.
- The main examples are the Himalayas, the Alps, Rockies and the Andes.
- Compression leads to the formation of fold mountains. When two horizontal forces act towards a common point, the intervening rock strata get compressed and produce fold mountains.
- The fold consists of two inclined parts called limbs, the upper portion is called anticlines, while the lower portion is called synclines. On the basis of the period of origin fold, mountains are divided into the following groups:
  i. **Old Fold Mountains:** All the folded mountains originating before the tertiary period come under the category of old fold mountains, e.g. the old folded mountains of Caledonian and Hercynian periods, such as the Aravalis, Appalachians, etc.
  ii. **New Fold Mountains:** This category includes the Alpine fold mountains of the tertiary period, e.g. the Alps, Himalayas, Rockies, Andes, etc. • These are gigantic mountains characterised by glacier-capped high peaks, intense erosion, complex folding and faulting, volcanism, etc.

(ii) Volcanic Mountains

- Volcanic mountains are formed by the extrusion of lavas and pyroclastic materials, which, if continued long enough, produce gigantic volcanic piles.
- The Kilimanjaro (Africa), Cotopaxi (Andes), Mount Aconcagua (the highest volcanic mountain), etc. are some of the examples.

(iii) Block Mountains

These are the result of faulting caused by tensile and compressive forces.

- Examples are Vosges and Black forest mountains bordering the Rhine Rift Valley, Salt Range of Pakistan, Sierra Nevada (USA), etc.

- Sierra Nevada mountain of California is considered to be the most extensive block mountain of the world.

(iv) Relict Mountains

When mountains, plateau or high plains take the form of mountains by continued erosion over a long period of time they are known as Relict mountains.

- Examples are Aravali, Satpura, Vindhyachal in India, mountains of Scotland and Pennine range of Europe.

NOTES

Other Important Facts

- Nilgiri Hills of India are an example of Block Mountain.
- Ojas Del Saldo, situated in the Andes, is the highest active volcanic mountain of the world.
- The Western Ghats of India is not a true mountain range. It is, in fact, a fault scarp whose western part has been displaced and has subsided to the west. Andes, the fold mountains of South America, is the longest (7,000 km) range in the world.
- Fold Mountains are made up chiefly of the sedimentary rocks, but their core is characterised by massive granitic intrusions.
- Fold Mountains are generally found in arc sphere and they extend for greater lengths but their widths are far smaller.
- Great Dividing Range of Australia is an old fold mountain.
- Fold mountains are generally found along the margins of the continents either in north-south direction, such as Rockies and Andes, or in east-west direction such as the Alps in Europe, Atlas in Africa, Himalayas, etc.

Landforms Related to Faulting

(i) Rift Valley

- A linear depression or trough created by the sinking of the intermediate crystal rocks between two or more parallel faults is known as Rift Valley, e.g. the East African Valley System and the Rhine Rift Valley.
- Dead Sea, the second most saline lake in the world, is situated in a Rift Valley. • Narmada and Tapti rivers are believed to be flowing in a Rift Valley.

(ii) Ramp Valley

- When both the side blocks of rocks are raised and the middle portion remains in position, the resultant trough is known as a Ramp Valley, e.g. Brahmaputra Valley.

(iii) Block Mountain (Fault Block Mountain)

- These mountains are the result of faulting caused by tensile and compressive forces.
- Famous examples are Vosges and Black Forest mountains bordering the faulted Rhine Rift Valley, Wasatch ranges in the USA and Sierra Nevada mountains of California (considered to be the most extensive Block mountain of the world).

EARTHQUAKES

- Earthquakes are vibrations of the Earth caused by ruptures and sudden movements of rocks that have been strained beyond their elastic limits.
- It can be considered as a form of energy of wave motion transmitted through the surface layer of the Earth.
- The place of origin of earthquake inside the Earth is known as Focus or Hypocenter.

  Epicentre: It is the point on the Earth's surface vertically above the focus, where shock waves reach first. It is the most affected area.

  Seismograph: It is an instrument which records the waves generated by an earthquake.

  Isoseismal line: The line joining places which experience equal seismic intensity.

Causes of Earthquakes

1. Volcanic Eruptions;
2. Faulting;
3. Plate Tectonics; and
4. Anthropogenic Factors.

Distribution of Earthquakes

Major earthquake zones are as follows:

(i) **The Circum-Pacific Zone:** The Circum-Pacific Zone is a convergent plate boundary zone where the most intense earthquake occurs along the subduction zone. This zone records above 66% of the world's earthquakes.

(ii) **Mid-Atlantic Zone:** This zone, characterised by the divergent plate boundary, spreads over the Mid-Atlantic ridges and several islands near it.

(iii) **Mid-Continental Zone:** This zone extends along the Alpine mountain system of Europe, through Asia Minor to the Himalayan mountain system

including the mountains of China and Myanmar.

(iv) **Intraplate Earthquakes:** These earthquakes, as exceptions, do not occur along the plate boundaries. Instead, they take place in the continental platforms. For example, the earthquakes which take place in peninsular India.

VOLCANOES

- A volcano is an opening in the crust of the Earth, connected by a conduit to an underlying magma chamber, from which molten lava, volcanic gases, steam and pyroclastic materials are ejected.

Volcanism (Vulcanicity)

- Volcanism includes all the processes and mechanisms related to the origin of magma, gaseous vapour, etc., their ascent and appearance on the Earth's surface in various forms.

Causes of Volcanism

The main causes of volcanism are as follows:

(i) With increasing depth in the Earth's interior, the temperature increases gradually at the rate of 1°C per 32 m (the rate varies at greater depths). This is caused mainly by the disintegration of radioactive elements inside the Earth.

(ii) The lowering of melting point in the Earth's interior, which is caused by the reduction in the pressure due to splitting of plates and their movement in opposite directions, results in the formation of molten magma.

(iii) The movement of plates is closely associated with volcanic eruptions. Most of the active fissure volcanoes are found along the oceanic ridges, which represent the divergent boundary, while explosive types of volcanoes are found in the zone of convergent plates.

Lava and Magma

Molten rock materials are called magma when they are below the Earth's surface, whereas when they emerge on the Earth's surface, they are called lava.

Types of Volcanoes

Volcanoes are of three types:

(i) Active Volcanoes
   - It continuously ejects lava, gases and fragmental materials.
   - About 100 per cent of world's active volcanoes are situated along the perimeter of the Pacific Ocean.

LATEAUS

- Plateau is an elevated tract of relatively flat land, usually limited on at least one side by a steep slope falling abruptly to lower land.
- This second-order relief feature covers about 33 per cent of the land surface of the globe.

Types of Plateaus Based on Mode of Origin

1. Plateaus Formed by Exogenetic Processes

(a) Glacial Plateaus: Plateaus such as Garhwal Plateau or Plateau of Greenland are formed by erosion, whereas plateaus formed by deposition are the Russian Plateau and Marg of Kashmir.

(b) Fluvial Plateaus: Bhander Plateau of central India, Brazilian plateau.

(c) Aeolian Plateaus: Loess Plateau of China, Potwar Plateau of Pakistan.

2. Tectonic Plateaus

(a) Intermontane Plateaus: Tibetan Plateau is the largest and the highest plateau situated between Mt Kunlun in the north and Himalayas in the south. Bolivian Plateau in the Andes mountain range, Mexican plateau between the eastern and western Sierra Madre mountain range are other examples.

(b)) Piedmont Plateaus: Plateau formed at the foothill zone of extensive mountains, e.g. Piedmont plateau at the eastern margin of Appalachian mountain range and Patagonian Plateau in the east of Andes.

(c) Dome Plateaus: Ozark Plateau of the USA, Chhotanagpur Plateau of Jharkhand.

(d) Lava Plateaus: Deccan Plateau, Columbia Plateau (the USA).

Types of Plateaus According to Geographical Location

1) Intermontane Plateaus: Tibetan Plateau, Mexican Plateau, Iranian Plateau (betweenZagros and Elburz), Anatolian Plateau (between Pontic and Taurus).
2) Border Plateaus: Piedmont Plateau (the USA), Patagonian Plateau (Argentina)

3) Continental Plateaus: Arabian Plateau, Peninsular Indian Plateau, Australian Plateau, South African Plateau, Mexican Plateau, etc.
4) Coastal Plateaus: Coromandel coastal upland of India.

Types of Plateaus Based on Stages of Erosion

1) Young Plateau: Colorado Plateaus (the USA), Idaho Plateaus (the USA), Khandala upland (India), etc. In these plateaus, rivers form deep and narrow valleys through vertical erosion.
2) Mature Plateaus: Ranchi Plateau, Appalachian plateau.
3) Old Plateaus: They are eroded to their base level by the agents of denudation, and the plateau becomes visible as a featureless plain, save for some Monadnocks which are steep-sided resistant rocks, which are able enough to survive the onslaught of erosion. Specific examples of such plateaus are difficult to find.
4) Rejuvenated Plateaus: These are formed due to the upliftment of an old plateau, Missouri Plateau (the USA). e.g.

PLAINS

- Plain is an extensive tract of flat land or a gently undulating terrain without prominent hills or depressions.
- Plains are major centres of population concentration in the world.
- They have been categorised below:

Diastrophic Plains

- Plains are seldom formed by a single process.
- Diastrophic forces have played a dominant role in the evolution of the Great Plains of the USA; hence they are called diastrophic plains.

Erosional Plains

(i) River-Eroded Plains

- Peneplains are regarded as the end product of normal cycle of erosion (Fluvial cycle of erosion).

(ii) Glaciated Plains

- Plains of the northern part of North America and Western Europe are dominated by the imprints of glacial features.
- The Ladakh plain of India in the east of Shyok river is also a glacial-eroded plain.

(iii) Wind-Eroded Plain: Wind-eroded plains of Sahara (Africa).

(iv) Karst Plains: Plains of Yugoslavia (Karst region), Chitrakoot (India).

Depositional Plains

i. **River-Deposited Plains:** The Piedmont Alluvial Plains formed in the foothill zones (e.g. Bhabar and Terai of Ganga-Yamuna plain) come under this category. Apart from these, the flood plains formed because of the deposition of fine sediments in the flood-affected areas and Delta plains at the end of the river course are also included (e.g., Ganga-Brahmaputra delta).
ii. **Lacustrine Plains:** Formed by the filling up of lakes with sediments. Kashmir valley is regarded as a lacustrine plain.
iii. **Lava Plains:** Formed of thin sheets of lava coming through fissure eruption, e.g. lava plains of Iceland, Argentina, New Zealand, etc.
iv. **Wind-Deposited Plains:** They include sandy desert plains and loess plains, e.g. the Thar desert plain, Sahara Desert, Loess plain of China.
v. **Glacially Deposited Plains:** Plains of North Germany, N.W. Russia, etc.
    - Imphal Basin is an example of Lacustrine plain.
    - Uplifted Peneplains are found in the Appalachian region (the USA) and Chhotanagpur region of Jharkhand (India).

NOTE

Exogenetic or Geomorphic Processes

- Major geomorphic processes include weathering, mass wasting and erosion.

WEATHERING

The process of disintegration and decomposition of rocks in situ (at their places, involving no transportation) due to mechanical and chemical processes is called weathering.

Two Types of Weathering

The work of weathering can be grouped into two broad categories:

(1) Physical or Mechanical Weathering

When a rock is broken and disintegrated without any chemical alteration, it is called physical

weathering. It can take place in several ways such as:

(a) Thermal expansion and contraction,
(b) Frost action, and
(c) Biotic action

(2) Chemical Weathering

In chemical weathering, rocks decompose and disintegrate due to chemical reactions. The main chemical weathering processes are as follows:

(i) Solution
(ii) Oxidation
(iii) Hydration
(iv) Hydrolysis
(v) Carbonation

Effect of Climate on Weathering

- Physical weathering is more important in hot and dry climatic regions because of high diurnal range of temperature found there.
- Intensive chemical weathering occurs in hot and humid regions.
- Chemical weathering is minimal in deserts and polar regions.
- Weathering is at its minimum in the polar regions due to permanent ice cover.
- Both physical and chemical weathering are prevalent in the Monsoonal regions (e.g. India). Carbonate rocks, having more soluble minerals, are easily affected by chemical weathering.
- Rocks having horizontal beds are more compact and less vulnerable to weathering.
- Climate is, thus, the single most important factor influencing weathering.

EROSION

- The processes of denudation which wear away the land surface by mechanical action of the debris which is being transported by the various agents of erosion, including glaciers, winds, rivers, marine waves and currents, all come under the phenomenon called erosion.
- Running water is the most important agent of erosion. The processes involved in the erosional activities are as follows:
  (i) The acquisition of weathered material.
  (ii) Wearing away of the surface through impact of rock materials in transit and in some cases by solution.
  (iii) The breaking down of rock particles by mutual wear and tear.
  (iv) Transportation of the acquired rock debris by moving medium.

5. DRAINAGE SYSTEM AND PATTERNS

Drainage System

Drainage systems are divided into two broad categories:

1) Sequent Drainage System: System of streams which follow the regional slope and are well adjusted to the geological structure is called sequent drainage system.
   i. **Consequent Streams:** The initial streams that originate in a particular region in accordance with the initial slope of the land are called consequent streams.
   ii. **Subsequent Streams:** The streams originated after the consequent stream and joining the master consequent at right angles are called subsequent streams.
   iii. **Resequent Streams:** Streams which flow in the direction of the initial consequent stream but join the subsequent streams, thereby developing in response to a new base level.
   iv. **Obsequent Streams:** Streams flowing in a direction opposite to that of the dip of the rock strata, i.e. opposite to the master consequent stream.
2) **Insequent Drainage System:** System of streams which do not follow the regionalslope and are not adjusted to geological structure are called insequent streams.
   (i) **Antecedent Drainage:** A river that has been able to maintain its direction of flow despite the tectonic uplift of land across its course is known as antecedent river.
   (ii) **Superimposed Drainage:** When the nature and characteristics of the valley and flow direction of a consequent stream developed on the upper geological formation and structure are superimposed on the lower geological formation of entire characteristics, it is called superimposed drainage.

- The Son river, flowing across the Rewa Plateau (MP), is a typical example of superimposed drainage.

Drainage Patterns

I. **Dendritic Pattern:** In this, the network of the streams resembles the shape of a tree with its branches.

II. **Trellis Pattern:** In this pattern, the rivers form a net-like system and the tributary stream of each class flows roughly parallel to each other, e.g. Appalachian region of the USA.

III. **Rectangular Pattern:** The Rectangular Pattern is similar to the trellis pattern, the same time differs from it in that, the confluence of the tributaries is determined by faults and joints of the underlying rocks and streams are widely spaced and are more irregular than the trellis.

IV. **Radial Pattern:** It is a pattern of outflowing rivers away from a central higher point. Some structures, volcanic cones and isolated upland tend to develop this pattern, e.g. Sri Lanka, Hazaribagh plateau, Kathiwar peninsula, Mikir range, etc.

V. **Annular Pattern:** Also known as the circular pattern, the Annular Pattern is formed over a mature and directed dome which is characterised by a series of alternate bunds of hard and soft rocks, which guide the tributaries to take up a circular path.

VI. **Parallel Pattern:** Here the master and tributary streams are parallel to each other, guided by the pronounced slopes, parallel faults or parallel topographic features, e.g. streams of western coastal plain of India.

VII. **Barbed Pattern:** Generally developed due to river capture, this pattern comprises tributaries flowing in the opposite direction to the master stream.

MAJOR LANDFORMS AND ATMOSPHERE

Fluvial Landforms (River Action)

Erosion by the river involves the processes of

(i) **Attrition:** Rock fragments carried by the river strike and roll against each other. (

(ii) **Corrosion/Abrasion:** River along with the bed wears its bed and banks.

(iii) **Corrosion:** The river water dissolves the minerals in soluble rocks.

(iv) **Hydraulic Action:** The sheer weight of the water itself wears away the bed and banks.

Landform in the Upper Course of the River

I. **Deep, Narrow V-shaped Valley:** It is formed as the swift flowing river erodes its bed faster than the sides.

II. **Potholes:** The grinding action of the pebbles caused by the swirling action of water deeper the circular depressions in the river bed forming potholes.

III. **Interlocking Spurs:** It is caused by vertical river erosion where spurs alternate on each side of the river as if they are interweaving.

IV. **Waterfalls and Rapids:** When the erosion caused by the river steepens its valley suddenly forcing the water to jump or fall over the steep slope, waterfalls and rapids are formed. They are also formed when river water plunges down the edge of aplateau, e.g. the Ange! Falls on River Rio, Caroni Falls in Venezuela (highest in the world), the Niagara Falls (the USA), etc.

V. **Gorges and Canyons:** Gorges and canyons are described as deep, narrow I-shaped valleys, which have very steep sides, and are formed because of the vertical corrosion in the upper course of the river. Canyons are usually found in arid areas and are narrower and deeper than gorges, e.g. Grand Canyon of the USA cut by River Colorado.

VI. **River Capture or River Piracy:** The river that is more powerful captures the headwaters of a weaker river by headword erosion, i.e. towards its source.

Features in the Middle Course of the River

i. **V-Shaped Valley:** An open V-Shaped valley due to valley widening caused by reduced river gradient and velocity.

ii. **Alluvial Fans:** When river descends from the mountains to the plains, steep fall in river gradient forces the river to deposit its sediment in a fan shape, called alluvial fans.

iii. **Meanders:** In the middle course, due to reduced slope and increased volume of water, the river resorts to pronounced meanders.

iv. **OX-bow Lakes:** It is a crescent-shaped lake, once been part of river-meander cut

through by lateral erosion of the banks at the meander neck.

v. **Floodplains:** A flat tract of land mainly in the middle and lower courses consists of alluvium deposited by the river.

vi. **Natural Levee:** Sediment is deposited along the banks and in the channels during floods, and this elevates the channel and the bank. Natural levees refer to these raised channels or banks.

Features in the Lower Courses

(i) **Braided Rivers:** Large amounts of deposited materials on the river bed because of reduced gradient and sediment carrying capacity cause the river to divide and move around these barriers, and this results in braiding.

(ii) **Delta:** It is a deposit of sediments formed at the mouth of the river where it enters a lake or sea.

Types of Delta

(i) **Arcuate Delta:** Fan shaped, convex towards sea, e.g. Nile, Ganga, Hwang-Ho, Rhine, Meckong, Niger, etc.

(ii) **Digitate/Bird's Foot Delta:** Finger-like pattern reflecting the number of distributary streams, e.g. Mississippi river delta.

(iii) **Estuarine Delta:** Develops at the mouth of a submerged river, long and narrow, e.g. deltas of Amazon, Congo, Ob, Vestula, etc.

(iv) **Cuspate Delta:** Tooth-shaped symmetrical delta formed generally over a straight coastline, e.g. delta of Ebro (Spain), Tiber (Italy), etc.

GLACIAL LANDFORMS

Erosional Processes

(i) **Abrasion:** In this the glacier scratches, scours and polishes the valley floor through its debris.

(ii) **Plucking:** Detaching or tearing away of large particles of rocks by the moving glaciers.

Erosional Landforms

(i) **Cirque/Corrie:** An armchair-shaped depression surrounded by steep aheadwall and sidewalls.

(ii) **Aretes and Horns:** Sharpened peaks which are formed due to recession of cirques on both sides called Aretes, and they resemble saw-teeth. A Horn described as a pyramidal or triangular-faceted peak formed due to recession of three or more cirques.

(iii) **Nunatak:** Higher peaks and mounts surrounded by ice from all sides.

(iv) **Roches Moutonnees (Sheep rocks):** Asymmetrical hillocks having onset side smoothly moulded with gentle slope and steeper, rougher lee side (steepened due to plucking).

(v) **Crag and Tail:** A hill having a vertical eroded steep upglacial side and a tail-like down glacial side.

(vi) **Glacial Stairways:** Glaciated benches, separated by nearly vertical cliffs. Smaller depressions at the base of a cliff are called paternoster lakes when filled with water.

(vii) **Hanging Valley:** These are valleys of tributary glaciers which join the main glacial valley of much greater depth.

Depositional Landforms

(i) **Moraine:** A ridge-like accumulation of material which has been transported and deposited by ice.

(ii) **Drumlin:** Whaleback hillock of glacial drift looking like an inverted boat or spoon which has a steeper upglacial slope, also known as 'basket of egg' topography.

(iii) **Eskers:** Long, low, narrow ridges composed of stratified sand, silt and gravel.

(iv) **Kame:** A steep-sided alluvial cone deposited against an ice front.

(v) **Erratics:** Large rock fragments transported away from its place of origin and deposited in an area of dissimilar rock type.

(vi) **Outwash Plain:** Formed from glaciofluvial material carried out from the front of an ice sheet by melt stream, appears as extensive accumulation of gravel, sand and silt.

AEOLIAN LAND FORMS (WIND ACTION)

Erosional Processes

(i) **Abrasion:** Air currents armed with sand grains scrap, polish or etche away rock surfaces.

(ii) **Attrition:** Mutual wear and tear of rock and sand particles.

(iii) **Deflation:** Lifting and blowing away of loose materials from the ground.

Landforms of Wind Erosion

(i) **Rock Pedestals or Mushroom Rocks:** Mushroom-shaped rock pillars which have been eroded near their bases.

(ii) **Zeugen:** A ridge and furrow landscape formed in horizontal layers of hard and soft rocks.

(iii) **Yardangs:** Hard and soft rocks are arranged vertically, and the softer rocks are eroded giving rise to long, narrow corridors, which separate the steep-sided over hanging ridges called Yardangs.

(iv) **Mesas and Buttes:** Hard stratum forms a flat tabular hill of resistant rock, called Mesa, in rocks composed of horizontal layers of hard and soft rocks. Mesas which are reduced in area after a long period of denudation are called Butte.

(v) **Deflation Hollow:** Wind erosion excavates the hollow by blowing away the loose material from the surface.

(vi) **Inselbergs:** An isolated hill rising abruptly from the level ground having steep sides and rounded summits.

Landforms of Wind Deposition

(i) **Sand Dunes:** The deflation action of wind that deposits sand in ridges results in the formation of sand dunes. Barchan is a famous dune which is of crescentic shape or moon shape and a special type of transverse dune. Another type, seif is a longitudinal dune.

(ii) **Loess:** The fine dust blown beyond the desert limit is deposited on neighbouring land as loess. Loess is described as a yellow, friable material, which is usually very fertile. It is commonly found in North-west China and parts of Mid-west USA.

(iii) **Bajada:** It is a depositional feature which is made up of alluvial material that is laid down by the intermittent streams in an arid environment. Pediment is described as the erosional plain formed at the base of the surrounding mountain scarps.

KARST LANDFORMS (UNDERGROUND WATER)

The word karst is a comprehensive term applied to limestone, chalk or dolomite areas.

- Most of the landforms are produced by underground water and the diversion of surface waters to underground routes, hence the terminology Karst landforms.

Erosional Landforms

(i) **Lapies (Karren):** Highly corrugated and rough surface of limestone rocks, characterised by low ridges and pinnacles and numerous solution holes.

(ii) **Solution Holes:** Small depressions carved out by solution where chemically active rainwater sinks into the limestone at a point of weakness are referred to as sink holes. They are also called swallow holes.

(iii) **Polje:** It is a very large depression with steep sides and a flat floor, believed to be formed due to downfaulting of rock strata.

(iv) **Ponores (Aven):** A vertical pipe-like charm or shaft that connects the caves and the swallow holes.

(v) **Blind Valley:** The valley of that surface stream which disappears in limestone formation through a swallow hole and the valley looks dry.

(vi) **Caverns:** Caverns are voids of large dimension below the ground surface. (vii) Natural Bridge: These are chiefly formed due to collapse of the roofs of the caves.

Depositional Features

(i) **Stalactites:** A stalactite is described as a tapering pendant of concretionary material which descends from the ceiling of a cave. It is formed because of the deposition of calcareous solutes which are carried by water that keeps dripping through the ceiling.

(ii) **Stalagmites:** The solution that drops on the cave floor is also precipitated and crystallised and forms a columnar concretion ascending from the floor of a cave. (iii) Pillar: Stalagmites may eventually combine with stalactites to form pillars.

6. OUR ATMOSPHERE

- The atmosphere has evolved as a significant component of biospheric ecosystem through the process of degassing or volcanism.

Composition

- Nitrogen (78 per cent) and Oxygen (21 per cent) together constitute 99 per cent of the total gaseous composition of the atmosphere.
- Oxygen is essential for the survival of living organism since they require it to convert food into energy.
- Carbon dioxide is 'Green House Gas'. It absorbs most of the radiant long-wave energy from the Earth and re-radiates it back to the Earth. Carbon dioxide thus facilitates the warming up of the lower atmosphere.
- Less than 0.0001 per cent by volume, ozone is considered as another relevant gas. The ultraviolet rays are absorbed by ozone, and thus it saves humans from the harmful effects of the ultraviolet rays. It is concentrated between the altitude of 20 and 30 km.
- About 90 per cent of the total water vapour present in the atmosphere is found up to the height of 5 km. Its content ranges between 0 and 5 per cent in the atmosphere.
- The blue colour of the sky, dawn and twilight are the result of scattering by the rest particles.

Table 2.6 Composition

Gas	Volume (per cent)
Nitrogen (N^2)	78.084 2
Oxygen (0^2)	0.947
Argon (Ar)	00.934
Carbon Dioxide	00.314
Neon	00.0018
Helium	00.0005
Methane	00.0002
Krypton	00.0001
Hydrogen	00.00005

Structure of the Atmosphere

- About 50 per cent of the atmosphere lies below the altitude of 5.6 km and 97 per cent of the atmosphere is confined to the height of 29 km.
- Based on temperature and pressure, following layers of atmosphere are recognised:

Troposphere

- This is the lowermost layer.
- Extends to an average altitude of 10 km which varies between 18 km above the equator and 8 km above the poles.
- The height is more above the equator due to convective movement of the air.
- In the troposphere the temperature decreases with increasing height at the rate of 6.50 centigrade per k'n which is called the normal lapse rate.
- Most weather phenomena take place in the troposphere.
- The boundary line separating troposphere from the next layer is called 'tropopause'.

Stratosphere

- This layer lies above the troposphere.
- Extends upwards to a height of about 50 km.
- The temperature ceases to decrease in the lower part of the stratosphere after which it starts increasing.
- Strong and persistent winds blow in stratosphere from west to cast.
- Normally holds very little water vapour or dust, so weather disturbances are absent here.
- Jet air flights take place mainly in the stratosphere.
- The existence of the ozone layer between 15 and 35 km which absorbs harmful solar ultraviolet rays is an important feature of the stratosphere.

Mesosphere

- Extends from stratopause at 50 km (the dividing zone between stratosphere and mesosphere) to mesopause at 80 km.
- In this layer, temperature decreases from 0°C at the stratopause to -80°C at the mesopause. . It is a zone of chemical reactions.
- Bulk of the meteors are destroyed in this region.

Thermosphere

In this sphere, temperature increases rapidly. Thermosphere is divided into two layers:

(i) **Ionosphere**: The ionosphere is an electrically charged layer, and extends from 80 km to 400 km. Certain ions present in this layer absorb heat, which facilitates increase in the

temperature. This layer reflects radio waves transmitted from the Earth back to the Earth.

(ii) **Exosphere:** The exosphere is the uppermost layer of the atmosphere and extends beyond ionosphere, and it imperceptibly merges with the outer space. Temperature increases to extreme levels but the highly rarefied air holds little heat, so the extreme temperature is not felt. Hydrogen and helium are predominantly found in this layer.

INSOLATION

- Solar radiation that is intercepted by the Earth is known as Insolation.
- The amount of insolation reaching the outer limit of the atmosphere is called solar constant which is of the value of 2 gram calories per square centimetre per minute.
- Insolation is measured with the help of pyranometers.
- The amount of insolation depends on following factors:
  (i) The area and nature of the surface
  (ii) The inclination of the rays of the sun
  (iii) Length of the day
  (iv) Distance between the Earth and the sun
  (v) The transparency of the atmosphere
- As the angle of the sun's rays decreases poleward, the amount of insolation received also decreases in that direction.
- On 3 January the Earth comes closest to the sun. Hence, the amount of incoming solar radiation is about 7 per cent more in January.

Table 2.7 Records of Extreme Temperatures

Record	"C	Location
Highest official air temperature	58	Al Azizia, Libya
Highest mean annual temperature	**34.4**	Dalol, Ethiopia
Lowest world surface air temperature	**-56.7**	Plateau, Station Antarctica
Coldest place (Lowest average annual temperature)	**-88.3**	Vostoc, Soviet Station
Lowest official temperature in Northern Hemisphere	**-68**	Verkoyansk, Siberia

World Temperature Patterns

1. Temperature decreases from the equator to the poles.
2. Lowest temperatures are experienced in January over the northern continents of Asia and North America in the Arctic and Sub-Arctic zone.
3. The highest temperature for both January and July are found over the continents.
4. All the isotherms are seen to move northward between January and July.
5. Seasonal changes are less prominent over the Southern Continents than over the Northern Continents.
6. Isotherms bend poleward over the oceans and equatorward over the continents in the month of January, in the Northern Hemisphere, as the continents cool faster than the oceans.
7. Generally the annual range of temperature increases from the equator to the poles.
8. Coastal regions have smaller range of temperatures than continental interiors.
9. In the same latitude, the eastern sides of North America and Asia have greater range of temperature.
10. Highlands are always colder than surrounding lowlands.

PRESSURE AND WINDS

- Pressure is exerted on the Earth's surface by the overlying weight of the air.
- The standard air pressure at the sea level is 1,013.25 millibars.
- The global air pressure varies from region to region due to combined effect of rotation of the Earth and conditions of temperature as follows:

(a) Effect of Temperature

i. Low temperature at the poles causes contraction of air and so high pressure is formed.
ii. High temperature at the equator causes expansion of air, so low sure called Doldrums Low Pressure Belt is formed.

(b) Effect of Rotation

i. As the air moves away from the poles, it crosses latitudes that are longer; it has to spread to occupy more space and so pressure falls as at 60° N and S latitudes.
ii. At the equator the spinning Earth causes the rising air to spread towards the poles so it has to cross latitudes which are

shorter. So the air has to occupy less space, thus, it contracts and sinks at latitudes 30° N and S, forming Horse Latitude High Pressures.

- Coriolis Forces (Ferrel's Law): The Coriolis Force, which is caused by rotation of the Earth, deflects the winds to their right in the Northern Hemisphere and to their left in the Southern Hemisphere.
- Some important facts related to atmospheric circulation:

(i) The winds are strong where the isobars are closely spaced and weak where they are wide apart.

(ii) The wind does not move freely in a horizontal plain along and near the Earth's surface. The direction of winds is influenced by the irregularities of the Earth's surface (e.g. mountains, valleys, etc.).

(iii) The maximum speed of wind usually occurs in the early afternoon and the minimum in the early morning.

(iv) Winds are named after the direction from which they come. A wind blowing from west to east is a westerly wind.

Patterns of Pressure Belts and Permanent Wind System

(i) Equatorial Low Pressure Belt:

- Zone of low pressure caused thermally near the equator.
- Extending between 50°N and 50°S latitudes, this belt is known as 'Doldrums' because of calm winds prevailing here.

(ii) Sub-Tropical High Pressure Belts (Horse Latitudes): Extending between 25° and 35° in both hemispheres, this high pressure belt is dynamically induced by the rotation of the Earth and sinking down of winds.

- This zone is characterised by anticyclonic conditions which cause atmosphere stability and aridity.

(iii) **Sub-Polar Low Pressure Belts:** Situated between 60° and 65° latitudes in both the hemispheres.

- This low pressure belt is dynamically produced by the rotation of the Earth.
- The area of contact between cold and warm air masses forms a contact zone, known as the Polar front, near 60° latitude.

(iv) Polar High Pressure Belts: The Arctic and Antarctic Polar regions are the belts of high pressure characterised by permanent anticyclone.

- Polar easterly winds spiral outward from this belt.

Trade Winds

- These are regular winds in direction and force.
- They blow from the sub-tropical High Pressure Belt to Doldrums.
- In the Northern Hemisphere, they are deflected to their right to form North-East
- Trades and in the Southern Hemisphere from South-East Trades.
- Between the two trade wind systems is found the Inter-Tropical Convergence Zone (ITCZ).
- A zone of westerly winds intervenes between the two trades in the Doldrums, called the Equatorial Westerlies.

Westerlies

- They blow from the Horse Latitudes (sub-tropical highs) to Sub-Polar Low-Pressure Belt.
- Due to Coriolis Force, their direction is from south-west in the Northern Hemisphere and from north-west in the Southern Hemisphere.
- The Southern Hemisphere sees the westerlies become more vigorous between 40 and 60 degrees, and they are known as the Roaring Forties, Furious Fifties and Shrieking Sixties in the respective latitudes.
- Where these warm westerlies meet with the cold polar winds, a cyclonic front, called the Polar Front, is formed and temperature cyclones are originated.

Polar Winds

- They blow from Polar High Pressure to Sub-Polar Low Pressure.
- They are easterly winds due to the effect of Coriolis Force. They are generally sporadic and of low velocity.

Jet Stream

- Jet stream is a very high-speed wind blowing from west to east in a meandering course at high altitude, usually near the level of tropopause (12 km). summer to 190
- The speed of the jet stream varies from a mean of 110 km/hour in km/hour in winter.

- Has an important influence in the formation of global climatic phenomena, e.g. cyclones, variability of the monsoons, etc.

CYCLONES AND ANTICYCLONES

- Cyclone is a system of low pressure in which the barometric gradient is steep.
- In a cyclone, winds circulate, blowing inwards in an anticlockwise direction in the Northern Hemisphere and in a clockwise direction in the Southern Hemisphere.

Temperate Cyclones

- These are cyclones of temperate latitudes caused by contrasting cold air from polar regions and warm moist air from tropical regions.
- Their general direction of movement is from west to cast along with the westerlies.
- The rainfall is light to moderate which occurs in the form of light showers.

Tropical Cyclones

- It is a system of a low pressure occurring in tropical latitudes.
- They move westward through the trade wind belt.

Anticyclones

- These are characterised by the system of high pressure in the centre.
- In the Northern Hemisphere, the wind circulation is clockwise and anticlockwise in the Southern Hemisphere.

HUMIDITY, CLOUDS AND PRECIPITATION

Humidity

The water vapour content of air is known as humidity. Warmer air has a greater capacity for holding water vapour, whereas cooler air has a lesser capacity.

Relative Humidity

Relative Humidity is the ratio of water vapour actually present in the air to the maximum water vapour holding capacity of the air at that temperature, expressed as a percentage, as follows

$$100\ x = \frac{Actual\ water\ vapour\ content\ of\ the\ air}{\text{Max. water vapour holding capacity of the air}}$$

Dew Point

The temperature at which a given mass of air becomes saturated is termed as the Dew Point.

Absolute Humidity

The amount of water vapour present in a unit volume of air is called Absolute Humidity. It is expressed as gram/m^3.

Specific Humidity

The mass of water vapour contained in a unit mass of air is termed as Specific Humidity. It is expressed as grams of water vapour per kilogram of air.

Clouds

- The aggregation or grouping of moisture droplets and ice crystals which are suspended in the atmosphere and have enough volume and density to be visible to the naked is eye known as a cloud.

Types of Clouds

A. Low Clouds (from the surface to 2,000 m)

(i) Strato cumulus clouds - arranged in globular masses.

(ii) Stratus clouds - resemble fog, comprise uniform layer, appear dull.

(iii) Nimbostratus-known as rain clouds, dark and thick enough to beat the sun. (The term Nimbus is associated with any cloud that gives rain.

B. Middle Clouds (from 2,000-6,000 m)

(i) Altostratus - in the form of continuous sheet or veil.

(ii) Altocumulus - a greyish sheet cloud.

C. High Clouds (Above 6,000 m)

(i) Cirrus clouds - long-drawnout wisps, known as mare's tails are produced, delicate fibrous or wispy clouds consisting of tiny spicules of ice, an indication of an approaching cyclone.

D. Clouds with Considerable Vertical Development

(i) Cumulus clouds - convection clouds, have 'cauliflower heads', appear puffylike 'cotton balls'.

(ii) Cumulonimbus clouds - clouds with a considerable vertical extent, their top acquiring an 'anvil shape', usually associated with heavy precipitation and thunder storms.

- The amount of cloud cover in the sky is expressed in eights or oktas such as 2/8 (quarter covered), 4/8 (half cast), etc.

Precipitation

Forms of Precipitation

(i) Rain - Liquid water particles with the drops of more than 0.5 mm diameter.
(ii) Drizzle - Fine drops of water, less than 0.5 mm of diameter.
(iii) Snowfall - White and opaque grains of ice.
(iv) Sleet - Water droplets and snow all in combination is called sleet.
(v) Hail – It refers to the falling of small pieces of ice with a diameter of 5 to 50 mm.

Types of Rainfall

(i) **Convectional Rainfall:** The equatorial climate usually sees convectional rainfall occur. Here, constant high temperature and high humidity produces convectional rainfall, and it occurs in early summer.
(ii) **Orographic Rainfall:** Winds which are containing moisture are coerced into rising with the slope of the mountain. The air thus gets cooled adiabatically and causes rainfall on the windward side of the mountains. The leeward side of the mountain becomes known as a rain-shadow area. This type of rainfall is larger than any other type of rainfall in the world.
(iii) **Cyclonic or Frontal Rainfall:** The passage of a cyclone or depression is associated with this type of rainfall. They are a result of a warm moist air mass which moves upwards over colder air, which is heavy. It usually occurs in the middle and high latitudes.

Table 2.8 Local Winds

	Winds	**Nature**	**Region**
	Fohn	Warm	Alps/Europe
	Chinook (Snow eater)	Warm	Rockies (USA and Canada)
	Sirocco	Hot	North Africa
	Khamsin	Hot	Egypt
	Harmattan (The Doctor)	Hot	Sahara to Guinea
	Zonda	Warm	Coast (Ghana, Nigeria etc.)
	Brick Flelder	Hot	Argentina, Chile/Andes
	Samun	Hot	Australia Iran
	Leveche	Hot	Algeria, Morocco
	Santa Ana	Warm	USA (California)
	Berg	Warm	South Africa
	Yoma	Warm	Japan
	Karaburan	Hot	Tarim Basin
	Black Roller	Hot/Dusty	North America
	Kalbaisakhi	Hot	North India
	Buran	Cold	Siberia
	Mistral	Cold	France to Mediterranean (Rhine Valley)
	Pampero	Cold	Argentina
	Bora	Cold	Yugoslavia
	Southerly Burster	Cold	Australia
	Blizzard	Cold	Siberia, Canada, SA
	Purga	Cold	Russians, Tundra
	Bire	Cold	France
	Cape Doctor	Cold	South Africa's Coast

Fog

- Fog is regarded as a layer of cloud on the ground, with visibility reduced to less than 1 km.
- The cause of fog is the condensation of water vapour in the lower layers of the air due to the cooling of air below its dew point mainly through radiation from the Earth's surface.
- Favourable condition for the formation of fog are (i) very light wind and (ii) a clear sky at night.

Haze

- It is a state of obscurity in the lower layers of the atmosphere due to the presence of a large number of condensation nuclei such as dust, smoke or salt spray.

Smog

- It is a special case of fog that is heavily laden with smoke or similar atmospheric pollutants. It frequently occurs in the industrial cities and densely populated urban areas. Intense smog can be a major health hazard.

Dew

- When terrestrial radiation from the Earth cools the lower layers of air below the dew point, the water vapour condenses into

drops on the ground surface, grasses, leaves, etc. in the form of dew.

Frost

- Moisture on the ground surface condenses directly into ice, i.e. when condensation occurs below freezing point.

WORLD CLIMATIC TYPES

Tropical Rain Forest/Equatorial Climate

1. Prevails mainly between 10° N and 10° S of the equator
2. Found in the Amazon lowlands (S. America), Congo Basin (Africa), Madagascar and East Indies (from Sumatra to New Guinea).
3. Rainfall mostly convectional occurs throughout the year.
4. Annual rainfall is about 200 cm, though some regions get heavier rains.
5. Climate is consistently moist with no month recording less than 6 cm of rainfall.
6. Mean monthly temperature ranges between 24°C and 27°C.
7. Annual ranges of temperature commonly less than 2°C to 3°C.
8. Diurnal range of temperature is more, i.e. 6°C to 8°C.
9. A region of great biodiversity - abundance of flora and fauna.
10. Diseases and insects, harsh climate and dense forests pose hindrance to economic development.

Tropical Monsoon Climate

1. Within the tropics in the eastern sides of the continents.
2. Spreads over South, South-East and East Asia (India, Myanmar, South China) and Northern Australia.
3. Dominant characteristics - complete reversal of prevailing wind direction from season to season coastline 7,516 km. (including the coastline of Andaman Nicobar and Lakshadweep islands).
4. Average annual rainfall about 150 cm.
5. Rainfall is highly erratic, mainly in summer season.
6. Average temperature of summer is 30°C and of winter is 15°C. 7. A distinct dry season (in winter) one or more months with rain less than 6 cm. 8. Forests are rich in Sal, Teak, Shisham and Bamboo.

Tropical Grassland/Savanna/Sudan Climate

1. Found between 5° and 15° North and South.
2. Transitional zone between the equatorial and monsoon on the one hand and arid and semi-arid climates on the other.
3. Found in Africa (north and south of the Equatorial belt), East-Central South America (Llanos in Columbian Highland, Campas in Brazil), Northern Australia and some parts of India (man-induced).
4. High temperature throughout the year.
5. Average annual temperature is more than 25°C
6. High summer temperature around 32°C, while winter temperature is about 21°C.
7. Annual range of temperature 11°C.
8. A distinct dry season in winter when the region comes under the influence of trade winds
9. Average annual rainfall is around 75 cm, rainfall mainly in summer (mainly of convectional type).
10. Natural vegetation comprises toll grasses with scattered trees, called 'Parkland Vegetation'.

Dry Tropical (Desert) Climate

1. Found on the western margins of continents along the Tropic of Cancer and Tropic of Capricorn.
2. Chief regions are Sahara desert (Africa), Great Australian Desert, bian, Iranian and Thar Desert in Asia, Kalahari and Namib Desert (Africa), Mohava Desert in North America and Atacama Desert in South America.
3. The main cause of aridity is their location in the sub-tropical high pressure belt and the effect of dry offshore trade winds on the western margins of continents.
4. Mean summer temperature around 30°C and mean winter temperature about 10°C.
5. Diurnal temperature ranges are very high - from 15°C to 40°C.
6. Highest temperatures have been recorded in this climate, e.g. 58.7°C in Al Azizia (Libya), 58°C in Death Valley, 52°C Jacobabad (Pakistan) of Thar.
7. Annual rainfall is very low, about 12 cm, rainfall is highly variable.

8. Vegetation is of endophytic type.

Temperate Western Margin/Mediterranean Climate

1. Found between 30° and 45° latitude in both the Hemispheres on the western side of each continent.
2. Its typical areas are around the shores of Mediterranean Sea, South-West Africa (Cape region), Central Chile, Central California and South-west and Southern Australia (Adelaide to Melbourne).
3. Pre-dominant characteristic is dry summer and mild moist water.
4. Summer is dry because trade winds blow offshore.
5. But in winter the region comes under the influence of onshore westerlies due to shifting of the pressure belts towards equator. These westerlies bring winter rainfall here.
6. Annual rainfall varies between 50 cm and 75 cm.
7. Summer temperature ranges between 20°C and 27°C, while winter temperatures are 4° to 10°.
8. his climate experiences hot dusty wind of Sirocco and cold winds of Mistral (France) and Bora (Yugoslavia).
9. This climatic region is noted for its orchard farming of citrus fruits, especially viticulture (grape farming).

Temperate Continental (Steppe)/ Warm Temperate Interior Climate

1. Located in the interiors of the continents due to which they do not get sufficient rainfall from the westerlies.
2. Spreads over the temperate grassland regions of the world, i.e. Steppes of Eurasia, Prairies of North America, Velds of South Africa, Pampas of South America, Downs of Australia,Canterbury Grasslands of New Zealand and Pustaz ofHungary.
3. Warm summer with about 20°C temperature and cold winter with about 5° to 10°C.
4. Average annual rainfall ranges between 25 cm and 75 cm.
5. Rainfall occurs mostly in summer.
6. Grasslands are practically treeless.

Dry Mid-Latitude/Temperate Desert Climate

1. Found between 30° and 45° latitudes in the interiors of continents.
2. Main areas are Gobi, Tibet, Mangolia and Turkistan in Central Asia, Patagonia in South America.
3. Diurnal ranges of temperature up to 50°C.
4. Annual range of temperature is low (high).
5. Rainfall is scanty, about 12 cm.
6. Main cause of aridity is the interior location or inter-montane location.

Warm Temperate Eastern Margin/ China Type Climate

1. Found on the eastern margin of continents between 25° and 45°N and S.
2. Chief regions are Eastern and Central China, S.E. America and South Eastern parts of Africa and Australia, S. Brazil and S. Japan.
3. Average summer temperature is 26°C, while average winter temperature is 13°C.
4. 70 per cent or more of the mean annual rainfall in warmer six months.
5. Warmest month of summer has at least 10 times the precipitation of the driest month of winter. Average annual rainfall is 100 cm.
6. Pampero (Argentina) and Southerly Buster (Australia) are cold local winds blowing in this climate.
7. Tropical cyclones, e.g. Typhoons (S. China) and Hurricanes (S.E. USA) are common in summer.
8. Normally mixed coniferous and broad-leaved forests are found.

Cool Temperate Western Margin/ West European Climate

1. Prevails along the western margins of continents between 45° and 60° latitudes in both the hemispheres.
2. Representative areas are N-W Europe, Western Canada, Southern Chile, Southern Island of New Zealand and Tasmania.
3. Rainfall throughout the year, but more in winter.
4. The region comes under the permanent westerly winds which blow from the oceans keeping the climate moist throughout the year.
5. Total annual rainfall – 100 cm, rainfall mainly cyclonic. –

6. Mean winter temperature is 5°C, while that of summer is 15°C.
7. The annual temperature ranges are not high, i.e., 80° C to 110° C caused by the combined effect of warm ocean currents (North Atlantic and N. Pacific Drifts) and winds
8. Both deciduous and coniferous forests are found.

Cool Temperate Continental/Taiga Climate

1. Extends from 45° to 70° latitude in Northern Hemisphere.
2. From Alaska to New Found Land in North America and from Norway to Kamchatka in Eurasia.
3. Greatest annual range of temperature of over 55°C is found here.
4. The summer temperature is around 15° to 20°, while winter temperature range from -34°C in Canada to 45°C in parts of CIS.
5. Summer is short (4-5 months), while winters are long.
6. Annual rainfall is 25-50 cm, mostly in summer
7. This climate is distinct for its evergreen coniferous forest or Boreal Forest Biome.

Tundra Climate

1. Found in the north of 70° latitude in North America and Eurasia, coastal tract of Iceland and Greenland.
2. Warmest month temperature is below 10°C but more than 0°C; average annual temperature is -12°C, annual range of temperature is 39° to 50°C.
3. Mean annual precipitation, mostly in the form of snowfall, is below 40 cm. 4. Vegetation comprises lichens and mosses supported by characteristic lithosols of Tundra.

Highland Climate

1. All the mountain regions of the world lie above 1,500 m height.
2. Temperature decreases with altitude, therefore, vertical zonation of climate, from tropical to ice-cap type.
3. Rainfall on windward slopes, leeward sides are dry.

7. THE WORLD OF OCEANS

- Oceans extend over 70.8 per cent part of the Earth's surface.
- About 60.7 per cent part of the Northern Hemisphere is covered by oceans, while80.9 per cent surface area of the Southern Hemisphere is occupied by the oceans. Total area of the Earth is about 510 million km² of which about 360 million km² (70.8 per cent) is represented by the seas and oceans.
- Oceans with their vast extent have a profound impact on the climatic phenomenon of the world. They work as the repositories of the solar energy. Oceanic currents are one of the chief means of the distribution of temperature on the Earth. Almost all of rainfall on the continent is caused by the moisture drawn from the oceans.
- The elevation of the landmasses and the depth zones of oceans are represented by the Hysographic or Hypsometric curve which shows these regions as percentage of the area of the globe.

Ocean Bottom Relief

- The study of the ocean bottom relief features has shed immense light on the origin and evolution of Earth's crust and the theory of plate tectonics.
- The mean elevation of the land surface is 840m, while the average depth of oceans is more than 4.5 times, i.e. 3,800 m.

(i) Continental Shelf

i. The shallow submerged extension of the continent is called the continental shelf.
ii. Average depth - 100 fathoms (200 m); average slope - 17 feet/mile or about 1º.
iii. Average width - 70 km;
iv. Continental shelf covers 7.5 per cent area of the oceans. It extends over 13.3 per cent part of the Atlantic Ocean, 5.7 per cent part of Pacific Ocean and 4.2 per cent part of Indian Ocean.
v. Narrow Shelves occur where mountains are found along the coasts, e.g. along the Andean coasts.
vi. Continental shelf of the western coast of India is wider than that of the eastern coast, mainly because of the subsidence of the western continental part.

vii. Continental shelves represent the rich fishing grounds of the world and they also contain other marine foods, metallic nodules, petroleum, natural gas, etc.

(ii) Continental Slope

i. Seaward part adjacent to continental shelf having steep slope
ii. Average slope - 20 to 50 degrees.
iii. Depth - 200 to 2,000 fathoms (3,660 m).
iv. An important feature of continental slope is the existence of steep submarine canyons on them.

(iii)Continental Rise

i. Average Slope – 0.5° to 1°
ii. With increasing depth, it becomes almost flat and merges with abyssal plain.

(iv) Deep Sea/Abyssal Plains

i. Average depth – 3,000 to 6,000 m
ii. Very low slope gradient (1 100)
iii. Covers 75.9 per cent of total oceanic area including 80.3 per cent of Pacific, 80.1 per cent of Indian Ocean and only 54.9 per cent of Atlantic
iv. The main reason for lesser extent of abyssal plains in the Atlantic is the existence of wide continental shelves and slopes

(v)Deepest/Trenches

i. Deepest part/feature of the oceanic floor.
ii. Usually parallel to the coasts and island arcs and not in middle of the oceans.
iii. Tectonic in origin, represents the site of sub-ducting plate boundary.
iv. Mariana trench (Challenger deep) is the deepest trench in the world situated in the N.W. Pacific oceans.

(vi) Oceanic Ridges

i. It is thousands of kilometres long and hundreds of kilometres wide mountain range on the oceanic floor.
ii. These ridges have been formed by the volcanic activity along the spreading boundary of plates.
iii. Their summits may rise above the sea level in the form of islands, e.g. Iceland, Azores island, etc.

(vii) Sea Mounts and Gyots

i. Sea mounts are submarine hills which rise above the oceanic floor up to 1,000 m.
ii. Flat-topped sea mounts are called gyots.
iii. Both have been formed by the volcanic activity.
iv. Largest number of sea mounts and gyots are found in the Pacific.

(viii) Submarine Canyons

i. Deep gorge-like features on the ocean floor are called submarine canyons.
ii. They are deep valleys having very steep slopes, confining of the continental shelf, slope and rise.
iii. Many submarine canyons are found along the mouths of major rivers, e.g., canyon. Hudson

(ix) Bank, Shoal and Reef

i. Flat-topped elevations located in the shelf and slope area are known as banks. Adequate water depth exists for navigation. They represent world's famous fishing grounds such as Grand Bank (Atlantic), Dogger Bank (North Sea), etc.
ii. Detached elevations with shallow depth are called shoals which are dangerous for navigation.
iii. Coral reefs are formed by the skeletal remains of the coral organisms. These organic deposits are rich in calcareous matter. Many islands are formed by the coral deposits. 'Great Barrier Reef' off the N.E. coast of Australia is the largest one.

Ocean Temperature

- Usually the temperature of oceanic water ranges from -5°C to 33°C.
- Mean diurnal range of temperature of oceanic surface water is almost negligible (about 1°C).
- The maximum annual temperature of Northern Hemisphere is recorded in August and lowest in February.
- High annual range of temperature is found in land-locked seas, e.g. 200°F in Mediterranean Sea and 40°F in Baltic Sea.
- Atlantic Ocean exhibit more annual range of temperature than Pacific because of its smaller size.

- The warm Gulf Stream current does not allow the Norwegian coast to freeze even in winter.

Salinity

- Salinity is defined as the total amount of salt particles in grams contained in 1 kg of sea water and is expressed as part per thousand (%).
- Salinity affects the physical properties of the oceans such as temperature, density, pressure, currents, etc.
- More saline water freezes slowly, while the boiling point of saline water is higher than the fresh water. Evaporation is lower over more saline water. Salinity also increases the density of water.

Table 2.9 Salt in the Sea

Salt	Percentage
Sodium Chloride (NaCl)	77
Magnesium Chloride (MgCl)	10.9
Magnesium Sulphate ($MgSO_2$)	9.7
Calcium Sulphate (CaSO)	3.6

Tides

- The rise of sea water and its movement towards the coast is called a tide and the resultant high water level is known as high tide water.
- The fall of sea water and its movement towards the sea is called ebb and the resultant low water level is called low tide water.
- Tides vary from place to place because of:
  (i) The change in the position of the sun and the moon in relation to Earth.
  (ii) Uneven distribution of water over the globe.
  (iii) Irregularities in the configuration of oceans.
- The moon though a smaller heavenly body, exerts a greater influence on tides because of its lesser distance from the Earth than that of the sun.
- The sun, the moon and the Earth come in a straight line on the full moon and the new moon and, therefore, the gravitational forces of the sun and the moon work together producing very high tide, called spring tide.
- The position of the sun, the moon and the Earth in a straight line is called synergy. • When the sun and the moon are in a straight line, the position is called conjunction. When the position of the Earth is in between the sun and the moon, it is called opposition. The position of conjunction and opposition takes place during new moon and full moon, respectively.
- The sun, the Earth and the moon come in the position of a right angle (called quadrature) on seventh or eighth day of every fortnight of a month and thus the tide producing forces of the sun and the moon work in opposite directions; as a result low tide is caused. Such tides are called neap tides.

Time of Tides

- Generally, tides occur twice a day. But Southampton, along the southern coast of England, experiences tides four times a day because the tidal water comes through the English Channel and through the North Sea at different intervals.

Ocean Currents

- Ocean currents are large masses of surface water that circulate in regular patterns around the oceans.
- The planetary winds have probably the most dominant influence on the flow of ocean currents.
- Between the equator and the tropics, blow the trade winds which move equatorial waters westwards and polewards and warm the eastern coast of continents.
- In the temperate latitudes blow the westerlies which result in a north easterly flow of water in the northern hemisphere and to the left in the southern hemisphere.

Coral Reefs

- Coral reefs are masses of limestone and dolomite accumulated by limepsecreting organism known as coral polyps.

Types of Coral Reefs

i. Fringing Reefs: There are narrow belts of coral reefs developed along the continental margins. They are usually attached to the coastal land, but occasionally they are separated from the shore by a sallow and narrow lagoon called 'Boat Channel'.

ii. Barrier Reefs: These are the largest coral reefs off the coastal platforms but parallel to them. The reef lies at a distance away from the coast. Hence, a broad lagoon develops between the reef and the shore. Great Barrier Reef off the coast of N-E Australia (1,200 miles long) is a famous example.

iii. Atolls: They are circular or horse-shoe shaped, enclosing a lagoon often without any central island. The depth of the lagoon is few metres only with sand and limestone debris at the bottom. Funafuti atoll of Ellice Island is a famous atoll.

8. ECONOMIC GEOGRAPHY AGRICULTURE

Economic activities of humans are grouped under following four categories:

i. Primary Activities: Hunting, food-gathering, fishing, live-stock raising, agriculture, mining, lumbering, etc.

ii. Secondary Activities: Manufacturing industry.

iii. Tertiary Activities: Transport, communication, trade, etc.

iv. Quaternary Activities: Higher range of services, education, management, research,

Agriculture

Only 11 per cent of total landmass of the world comes under the agricultural activity in which 50 per cent of world's population is engaged. Following types of agriculture are generally practiced in the world:

1. **Shifting Agriculture:** The primitive form of agriculture is prevalent in the tribes of tropical forest, which is also called slash and burn agriculture and bush-fellow agriculture.
    - Shifting agriculture is called Bewar, Dahia, Peda in M.P. and Chhattisgarh, Podu in Andhra Pradesh, Kaman, Binga and Dhavi in Odisha, Kumari in Kerala, etc.
2. **Subsistence Agriculture:** This type of agriculture is done for the consumption of farmers family involving mainly farming of food grains. Subsistence agriculture is practiced in the monsoonal climatic regions of Asia in which maximum utilisation of agricultural land is done.
3. **Commercial Agriculture:** In this agriculture, practiced mainly by the developed countries, crops are grown for the commercial purpose.
4. **Intensive Agriculture:** The main purpose of this agriculture, practiced in the regions of high population density, is to extract maximum production from the minimum agricultural land.
    - Intensive subsistence agriculture is practiced in the developing countries and intensive commercial agriculture is practiced in the developed countries.
5. **Extensive Agriculture:** This agriculture involves growing of crops by the modern scientific methods on large farms in which minimum labour and maximum use of machines are done.
    - In this agriculture per hectare production is very low, but per labour and total production is very high.The regions of temperate grasslands are noted for extensive agriculture.
6. **Plantation Agriculture (Estate farming):** In this type of commercial agriculture huge amount of capital and labour is required. The development of this agriculture has taken place mainly in the coastal areas of tropical regions, where facility of marine navigation is available for the export of agricultural products.
7. **Mixed Agriculture:** In the mixed agriculture both crops and livestocks are raised for the commercial purpose. This type of agriculture is practiced mainly in the densely populated areas of developed countries.
8. **Mixed Cropping:** In this agriculture, crops of different maturity period are grown simultaneously in a farm.
9. **Multiple Cropping:** It refers to growing of two or more crops alternatively on a farm within the same year.
10. **Crop Rotation:** In this, different crops are grown in a systematic succession in each field of a farm for the maintenance of soil nutrients for a long time.
11. **Dry Farming:** Farming done without the facility of irrigation in the regions of inadequate rainfall is called dry farming.
12. **Truck Farming:** The intensive, specialised production of fresh vegetables, fruits and

flowers at considerable distances from the metropolitan markets is called truck farming in which the produce is sold. Truck farming is practiced on a large scale in Florida and California of the USA, Britain, France, Denmark, Italy, etc.

Major Crops

Wheat

- Wheat is mainly a crop of temperate region, but it is also grown in the sub-tropical regions. Wheat holds first position in the world in terms of agricultural area. Necessary Conditions

  Temperature: 10°-20°C. Rainfall: 15.75 cm. Soil: Heavy loamy or fertile black soil. Other: Well drained land.

Winter wheat is grown in the middle and low latitudes. This wheat is sown in the winter season and harvested in the summer season. Seventy-five per cent of total wheat production of the world is contributed by winter wheat. Spring wheat is grown where temperature goes below 10°C in winter.

Producing Regions:

i. China
ii. USA and Canada
iii. Western Europe
iv. Former USSR

Apart from the above mentioned regions, wheat is also grown in the Mediterranean region, towns of Australia, Pampas of Argentina, Cape Province of South Africa, etc. Among the food grains, wheat is the most traded commodity. The USA, Canada, Australia and Argentina are major exporters of wheat, while Britain and other European countries, Japan, China, Brazil etc. are importers.

Rice

- Rice is a crop of tropical and sub-tropical region. Japonica rice is cultivated in temperate regions. Indica rice is grown in the south and south-east Asia.

Required Conditions

- Temperature: 20-27°C. Rainfall: 125-200 cm.
- Soil: Fertile loamy and alluvial soil. Other: Cheap labour.
- Producing Regions: Ninety per cent of world's rice is grown in the monsoon climatic regions of Asia. The region situated between 30° North and 30° South is important rice-producing region. Some of these countries are as follows:

(i) China
(ii) Indonesia
(iii) Thailand
(iv) Bangladesh
(v) Myanmar

Only 3-5 per cent of rice production enters in the world trade, because of the home consumption of rice in the major producing countries. Thailand is the largest exporter of rice.

Maize

- Maize is a crop of tropical and subtropical climate. It is produced in the developed countries as a fodder crop.

Ideal Conditions

Temperature: 18°-27°C. Rainfall: 50-125 cm. Soil: Rich loamy and well-drained. Others: Frost free period of 120 days.

Producing Regions:

i. USA
ii. China
iii. Brazil
iv. Argentina
v. South Africa

Barley

- Barley can be cultivated in the conditions of lower temperature and lower rainfal! compared to wheat.

Producing Regions: Barley is cultivated mainly in Mediterranean region, Turkey, Central Asia, Australia and California. Barley is used as a fodder in the European countries.

Table 2.10 Regional Names of Shifting Agriculture

Name	Region
Ladang	Malaysia and Indonesia
Chenna	Sri Lanka
Caguin	Philippines
Taungya	Myanmar
Milpa	Central America & Mexico
Rocca	Brazil
Conuco	Venezuela
Tawi	Madagascar
Masole	Central Africa
Logun	West Africa
Huma	Java
Tamrai	Thailand
Jhoom	North-East India

Oat

- This food crop requires all the geographical conditions required for the cultivation of

wheat-producing regions. in the north of wheat

- The most important producing regions of oats is situated producing regions in Eurasia.

Cotton

- Cotton is a crop of tropical region, but nowadays its maximum production comes from sub-tropical regions.

Geographical Conditions

Temperature: 21-270°C. Rainfall: 50-100 cm. Soil: Light, fertile and black and calcareous. Other: Cheap labour, abundant sunshine in the growing period, frost-free period of 200 days.

Varieties of Cotton: Long Staple Cotton is the best one, (length is 4-6.5 cm). It is mainly cultivated in the USA, Egypt and the Carribean islands. Medium staple cotton (2.5-4 cm) is grown in Peru, Mexico and the East African countries. The short staple cotton, also called Indian cotton, is grown in India and Brazil.

Producing Regions:

i. China
ii. USA
iii. Armenia, Ajerbaijan, Belarus, Kazakhistan, Kyrgystan, Moldova, Russia, Tajikistah, Ujbekistan
iv. Brazil
v. Egypt

Jute

Jute is a crop of hot and wet climate, the cultivation of which is carried out mainly in the Ganga-Brahmaputra delta of India and Bangladesh.

Geographical Conditions

Temperature: 25°-35°C. Rainfall: 150-250 cm
Soil: New alluvial and deltaic clay. Relative Humidity: More than 80 per cent

Sugarcane

India is largest producer of sugarcane

- More than 2/3rd of total sugar production comes from this tropical crop. Marine climate is suitable for this crop.

Geographical Conditions

Temperature: 20°-27°C. Rainfall: 100-200 cm.
Soil: Fertile loamy, light friable lava soil. Relative Humidity: Adequate sunshine, cheap labour.

Producing Regions:

(i) Cuba
(ii) Brazil

Apart from these, sugarcane is also cultivated in the Gulf, coastal plains and Hawaii an islands of the USA, Java islands of Indonesia, New South Wales and Queensland of Australia, southern coastal regions of China, Philippines, Mauritius, Fiji, etc. Productivity of sugarcane is highest in the Hawaiian Islands.

Sugar beet

Sugar is also obtained from sugarbeet, but it costs more in comparison to sugarcane. Sugarbeet is a temperate crop.

Suitable Conditions

Temperature: 16°-24°C. Rainfall: 50-75 cm. Soil: Loamy, calcareous friable Others: Adequate input of nitrogenous fertilisers. Producing Regions:

i. Armercia, Azerbaijan, Belarus, Kazakhistan, Kyrgystan Moldova, Russia, Taijikistan, Uzbekistan
ii. France
iii. Germany
iv. Poland
v. China
vi. USA
vii. Italy
viii. Holland, etc.

Rubber

- Rubber is a crop of wet tropical climate.

Producing Region:

(i) Thailand
(ii) Indonesia
(iii) Malaysia
(iv) Sri Lanka
(v) Other countries: India, Philippines, Brazil, Zaire, etc.

Coffee

- Coffee is a beverage plantation crop of tropical climate.
- Arabica coffee is of high quality and is cultivated mainly in Latin American countries.
- Robusta coffee is cultivated mainly in African countries.

Suitable Conditions

Temperature: 15°-25°C. Rainfall: 100-200 cm. Soil: Adequate amount of iron, nitrogen and

humus in the soil, lava soil and terrarosa soil are better suited.

Others: Sloping land preventing water logging; protection from strong wind and direct sunlight.

Producing Regions: Brazil, South Eastern plateau region, Columbia (coffee estates are called Finca), Venezuela, Ecuador, Central America, Cuba, Haiti, Jamaica, Ivory Coast, Ethiopia (native place of coffee), India, Sri Lanka, etc. High-quality Mocha coffee is obtained from the coastal regions of Red Sea in Yemen. Blue Mountain coffee of Jamaica is regarded as the best variety of coffee in the world.

Tea

- It is tropical and subtropical crop. In India and Sri Lanka mainly Black Tea/ Assam Tea is grown, while Green Tea is grown in China and Japan.

Suitable Conditions

Temperature: 25°-30°C. Rainfall: 150-200 cm.

Soil: Light acidic loamy soil with high phosphorous and iron content. Others: Sloping topography that prevents water logging, as well as availability of cheap labour.

Producing Regions:

i. China
ii. Sri Lanka
iii. India
iv. Armenia, Ajerbaijan, Belarus, Kazakhistan, Kyrgystan, Moldova, Russia, Tajikistah, Ujbekistan
v. Kenya, Indonesia, Uganda, etc.

Cocoa

- Cocoa is a crop of wet tropical climate, whose cultivation is confined within 20°C south latitude.

Suitable Conditions

Temperature: 24°-27°C. Rainfall: 150-200 cm.

Soil: Deep and fertile. Others: Protection from strong wind and direct sunlight.

Tobacco

- Tobacco is a tropical and subtropical crop. Its Virginia variety is cultivated in the USA and Zimbabwe, while the Oriental variety is cultivated in Turkey and Greece. Cuba and Connecticut valley of the USA are famous for the Cigar Tobacco.

Geographical Conditions

Temperature: 18°-27°C. Rainfall: 60-100 cm. Soil: Loamy soil rich in minerals and humus.

Producing regions:

(i) China
(ii) USA
(iii) Others: Brazil, CIS, Turkey, Cuba, India, Zimbabwe.

Silk

- It is obtained from a worm which is reared on the trees of Mulberry. Silk is produced in tropical and subtropical regions.
- China, Japan and India are major producers of raw silk.

Coconut

- A tropical and subtropical crop requiring more than 25°C of temperature and 150 cm of rainfall. India, Indonesia, Philippines, Malaysia and Sri Lanka are the major producers.

Oil Palm

- This is also a crop of wet tropical climate. Presently, Malaysia leads in the production of oil palm in the world, followed by Nigeria, Indonesia and Congo.

Groundnut

- It is a tropical and subtropical crop. India is the largest producing country of groundnut. China, Nigeria and the USA are other producers.

Soyabean

- It is cultivated both in tropical and temperate regions. The United States of America (52 per cent), Brazil (21 per cent), China (11 per cent) and Argentina (6 per cent) are major producers of soyabean. The USA is the largest exporter of soyabean.

Sunflower

- CIS, Argentina, China and Hungary are the major producers, in descending order.

Fruits

- India, Brazil and Philippines are major producers of bananas. Iraq is the largest producer of date palm. France, Italy and Spain are major producers of grapes.

9. WORLD FISHERY, FORESTRY, MINERALS AND ENERGY

World Fisheries

Types of Fish

Fishes are obtained both from oceans and freshwater bodies of the world. Fishes obtained from oceans are classified into the following two categories:

i. Pelagic Fishes
Tuna, Salmon, Herring, Mackarel, Sardine, Pilcard, etc. are example of Pelagic fishes which are found near the surface of water since these fishes need light for their living.

ii. Demersal Fishes
These fishes are found in the depths of the sea, where light and temperature of water are greatly reduced. Cod, Halibut, Flounders, Hadcock, etc. are examples of these fishes. These fishes are not found in groups.

Important regions

Important regions of marine fisheries in the world are as follows:

i. North-West Atlantic Region
This region extends from Long Island in the south to the New Found land in the north. Continental shelves of this region are very wide where Grand Bank, Georges Bank and St. Peare Bank are famous for pisciculture. Chease-peak Bay situated in this region is famous for oyster farming, and the southern part is noted for prawn culture.

ii. **North-East Atlantic Region**
It extends from the Arctic Circle in the north to the boundary of Spain and Portugal in the south. Wide continental shelf, indented and long coastline and lack of agricultural land in the coastal areas are favourable factors for the developments of fishing industry in this region. Doggar Bank situated in the North Sea is a famous fishing ground of this region. Norway is the leading fishing nation of this region, where cod and herring fishes are caught.

iii. North-West Pacific Region
This region extends between the Berring Sea in the north and the Philippines Sea in the south.

Apart from the above-mentioned fishing regions, North-East Pacific Region, coastal areas along Peru, Argentina, Brazil, South Africa and Indonesia are important fishing regions in the world.

- Largest catch of fishes is obtained from the Pacific Ocean, followed by the Atlantic Ocean, Indian Ocean and the Arctic Ocean.
- China is the leading producer of marine fishes in the world. Peru, Japan, Chile and the USA follow.
- China also leads in the production of fresh water fishes, followed by India, Bangladesh and Indonesia
- Japan is the largest producer of whales in the world, followed by Norway.
- 90 per cent of the production of Anchovish fishes in the world comes from Peru.
- The development of Pearl Fisheries has taken place in the tropical oceans. It is developed in the Persian Gulf, the Red Sea and the Gulf of Mannar.

World Forestry

Presently, 30 per cent area of the landmass is covered by forests. One-third of the total forest area is covered by coniferous forests, and two-thirds of total forests are broad-leaved forests.

i. Equatorial Rain Forests

- These forests are found in the Zaire (Congo) Basin, Amazon Basin and in the equatorial regions of Malaysia and Indonesia.
- These forests are called 'Selves' in the Amazon Basin.
- These forests are very dense due to high temperature and high amount of rainfall occurring in this region.
- Broad-leaved evergreen trees of hardwood variety are common including Mahogany, Ebony, Rosewood, Cedar, Rubber, Palm, Cinchona, etc.
- Occurrence of trees of different species having no pure stands, lack of transportation, inaccessibility, unhealthy climate, marshy tract, high density of trees, etc. are major problems.
- Largest expanse of equatorial forests is found in the Amazon Basin.
- Amazon is known as the 'lungs of the world'.

ii. Monsoonal Deciduous Forests

- These forests are found in the monsoonal climatic regions of India, South-East Asia and North-East Australia.
- The usual species of these forests include Sal, Teak, Sisham and Bamboos which yield valuable woods from economic point of view.
- Exploitation of these forests is easy since these are not very dense.

iii. Temperate Deciduous Forests of Hardwood Trees

- These forests are found in central and western Europe, North-Eastern Part of America, southern part of Russia, China, Japan, Korea, etc.
- Oak, Birch, Maple, Walnut, Elm, Chestnut, etc. are found in these forests.

iv. Temperate Coniferous Forests of Softwood Trees

- These forests, also called Boreal, found mainly between 50° and 70° N latitudes.
- They occur mainly in Canada, Scandinavia and Russia.
- Trees are mostly evergreen, exception being larch which is deciduous.
- About 45 per cent of coniferous forests of the world are found in Russia which is called 'Taiga' there.

NOTES

Other Facts

- Of the total land coming under the vegetation in the world, 24 per cent is occupied by Savanna (tropical grassland, 14 per cent by coniferous forests, 9 per cent by temperate grasslands and 8 per cent by the equatorial rain forests).
- Quinine is obtained from the barks of Cinchona trees found in the tropical forests.
- Java (Indonesia), India, Sri Lanka and Madagascar are its important producers. Zanzibar and Pamba islands in the eastern coast of Africa are important producers of cloves.

  India and South-East Asia are important producers of teak. Teak of Myanmar is world-famous.
- More than 50 per cent of total cork production of the world comes from Portugal. Cork is obtained from the bark of wak trees.
- The United States of America is the largest producer of commercial timber in the world followed by former USSR, China, Brazil, India and Canada.

Minerals

Iron Ore

Types

i. Magnetite: 72 per cent iron content, black colour.
ii. Haematite: 70 per cent iron content, generally of red colour. Most of the iron found in the world is of haematite type.
iii. Limonite: 60 per cent iron content.
iv. Siderite: Lowest category; less than 50 per cent iron content.

NOTES

Types of Minerals

1. Ferro-metallic Minerals: Iron, manganese, nickel, cobalt, tungsten, cromium, molybdenum, vanadium, etc.
2. Non-ferrous Minerals: Aluminium, tin, copper, lead, zinc, gold, silver, mica, platinum, etc.
3. Non-metallic Minerals: Marble, diamond, gypsum, asbestos, lime-stone, etc.
4. Power Minerals: Coals, petroleum, natural gas, etc.
5. Nuclear Minerals: Uranium, thorium

Producing Regions:

1. USA
2. Armenia, Ajerbaijan, Belarus, Kazakhistan, Kyrgystan, Moldova, Russia, Tajikistah, Ujbekistan
3. Canada
4. China
5. France
6. Sweden
7. Brazil
8. Australia

Other Areas: Spain (Bilbao), Germany (Salzgitter, Siegerland), Venezuela (lower Orinoco valley), Chile (altofo, La Sarena), Liberia (Bomi hills), South Africa (Transual, Cape region), Japan (Murora).

Reserves of Iron Ore: Armenia, Ajerbaijan, Belarus, Kazakhistan, Kyrgystan, Moldova, Russia, Tajikistah, Ujbekistan, India, USA, Brazil.

Manganese

Producing Regions

i. China: Sikiang Valley
ii. Armenia, Ajerbaijan, Belarus, Kazakhistan, Kyrgystan, Moldova, Russia, Tajikistah, Ujbekistan: Nickopol (Ukraine), Chaitura (Georgia, about 90 per cent).
iii. South Africa: Postmassbergy; Brazil-Minas Geras, India, Gabon, Ghana, Australia,etc. are other important producers.

Copper

Producing Regions

i. Chile: Chuquicamata, EI-Teniete
ii. USA: Butte region (western part)
iii. Canada (Sadbury region, Flin-flon)
iv. Zaire: Katanga region (Kishansa, Musonai, etc.)
v. Australia: Mt. Ira and Tasmania, Zimbabwe, India, Yugoslavia, South Africa, etc. are other major producers of copper. Chuquicamata mine of Chile is world's largest mine. Famous Katanga region is spread over Zaire and Zambia in a 500-km long belt.

Bauxite

Producing Regions

Cape York Peninsula of Australia (Weipa and Arnhamland), Jamica (St. Marry), Guinea, Ghana, Brazil, Greece, India, Yugoslavia, etc. are major producers of Bauxite. The largest reserves of bauxite in the world are found in Australia.

Mica

Producing Regions

i. India: Jharkhand (Koderma, Giridih), Andhra Pradesh (Nellore) and Rajasthan (Ajmer, Bhilwara).
ii. Brazil: Santalucia, other countries are south Africa, USA, Armenia, Ajerbaijan, Belarus, Kazakhistan, Kyrgystan, Moldova, Russia, Tajikistah, Ujbekistan, Zambia, etc. Importance of mica has declined due to emergence of artificial mica in the world.

Tin

Tin is mainly found as a placer deposit. These are four major areas of tin production in the world: (i) South-East Asia, (ii) Bolivian Plateau (iii) Western Part of Central Africa and(iv) Armenia, Ajerbaijan, Belarus, Kazakhistan, Kyrgystan, Moldova, Russia, Tajikistah, Ujbekistan.

Distribution

i. Malaysia: Kinta Valley, Kelong Valley, Perak, etc.
ii. Indonesia: Bangka, Biliton, Singkep.
iii. Thailand: Southern region (Phuket, Kra Peninsula).
iv. Bolivia: Potasi.
v. CIS: Around Lake Baikal.
vi. Nigeria: Bauchi Plateau, Jos plateau.
vii. Zaire: Katanga region.
viii. China: Yunnan Plateau, Kwangri.

Gold

Gold is a precious metal found in the veins of rocks and as a placer deposit.

Distribution

i. South Africa: Witwatersrand, Transvaal, Johannesberg.
ii. CIS: Lena river placer deposit.
iii. Canada: Flin Flon.
iv. Australia: Kalgoorlie, Kulgardee.

Other important producing countries are Zaire, Zimbabwe, Ghana, Gabon, Peru, Mexico, India and USA (Yukon river valley, Colorado, Arizona, Utah).

Silver

Silver generally occurs along with Lead, Zinc and Copper.

Distribution

i. Mexico: Chihuahua mines.
ii. USA: Idaho and Utah.
iii. Canada: Ontario (Sadbury region), British Columbia.
iv. CIS: Atlai region.
v. Peru: Cerro-depasco.
vi. Myanmar: Badween (largest Asian Silver producer).

Lead

Distribution

i. Australia: Broken hill and Mt. Ira.
ii. Canada: British Columbia, Sulivan.
iii. CIS: East Kazakhstan.
iv. USA: Butte region.

Zinc

Sulvian mine of British Columbia in Canada is the largest zinc producing region in the world. Broken Hill and Mt. Ira of Australia are other noted regions of zinc production.

Nickel
Sadbury region (Ontario) of Canada is world-famous for the production of Nickel. Kola peninsula of Russia, Mayurbhanj and Cuttack (Odisha) of India are other important regions of nickel production.

Cobalt
Zaire is the leading producer of cobalt in the world. The United States of America, Canada, CIS, New Calcedonia, etc. are other important producing regions.

Diamond
The continent of Africa has a predominant position in the production of diamonds. South Africa (Kimberley) is the leading gems stone producer in the world, while Zaire (Bakawanga) leads in the production of industrial diamonds (borts). Bostwana, Sierra Leone, Liberia, Angola, Tanzania, etc. are other important producers. Antwerp, Amsterdom, Hague, London, New York, Paris, Johanesberg, Surat, Jaipur, etc. are noted diamond cutting and polishing centres.

Platinum
It is a precious metal whose melting point is very high. Largest reserve of platinum is found in the countries of CIS, but Canada is the largest producer of platinum in the world. CIS, South Africa, USA, and Australia are other important producers.

NOTES	
Minerals	**Other Minerals Producers**
Tungsten	China, CIS, USA
Gypsum	USA, Canada, U.K.
Nitrate	Chile
Sulphur	USA, Canada, Germany
Asbestos	Canada, Zimbabwe
Molybdenum	USA, Chile, CIS
Chromium	South Africa, Kazakhstan
Vanadium	South Africa, Russia
Phosphate	USA, CIS, Chile
Potash	Canada
Antimony	China, South Africa
Barytes	China, USA
Iron	Magnetite, Haematite, Limonite, Siderite
Manganese	Pyrolusite
Aluminium	Bauxite, Cryolite
Sodium	Borax
Mercury	Cinnabar
Copper	Chalcopyrite, Cuprite
Chromium	Chromite
Lead	Galena
Silver	Argentite
Magnesium	Magnesite, Dolomite
Tin	Cassiterite
Zinc	Zinc Blende, Calamine
Tungsten	Wolframite
Uranium	Pitchblende

ENERGY RESOURCES

Coal
Coal is found in the seams of sedimentary rocks, mainly of carboniferous period. They have been formed due to the submergence of natural vegetation. Coal has also been formed in the tertiary period.

Types of Coal

1. Anthracite: Very hard and free from impurities, carbon content is about 90 per cent, gives little ash and smoke when burnt. Pennsylvania in the USA and Donatas basin of Ukraine are noted for the production of anthracite coal.
2. Bituminous: The carbon content is 70-90 per cent. It gives more smoke while burning. It contributes about 80 per cent of world coal.
3. Lignite/Brown Coal: Carbon content is 45-75 per cent. It has more content of vegetation because of its formation in tertiary period.
4. Peat: It does not have industrial importance because of its high moisture content. It represents the first stage of coal formation.

NOTES

Coal Reserve

1. USA 2. Former USSR 3. China 4. Germany 5. India

Production Order

1. China 2. USA 3. Australia 4. India

Reserves of Lignite

1. Former USSR 2. USA 3. Germany 4. Australia

Production of Lignite

1. Germany 2. USA 3.Poland 4. China

World Distribution of Coal

1. **China:** Shansi, Shensi, Inner-Mongolia, Fenhe valley, Henan, etc.
2. **USA:** Pennsylvania (Anthracite field contributing 50 per cent of world's anthracite production). Appalachian-bituminous field, largest coal region of USA.
3. **CIS:** Donbas region (Ukraine), Kuzbas (Russia), Karaganda (Kazakhstan).
4. **UK:** Northumber Land, Durham, Yokshire, Midland.
5. **Germany:** Ruhr, Westphalia region, Saar coat-field, Saxony.
6. **France:** Alsace, Saar region.
7. **Poland:** Siberia valley.
8. **Australia:** New South Wales (largest coal producing region in the Southern Hemisphere).

Petroleum

Petroleum has been formed through the disintegration of the remains of vegetation and organisms.

i. **USA:** Mid continental region, Gulf coastal region (southern Texas, Lousiana), California region, Appalachian region and Alaska.
ii. Mexico: Tampico and Tuxpan in the Gulf region.
iii. Venezuela: Lake Maracaibo and Orinoco valley.
iv. Former USSR: Volga-Ural region (largest oil field), Cremea Caucasus region (Baku oil field in Azerbaizan), Grozny in Georgia, East Caspian region, Sakhalin Island, Eastern Siberia
v. Saudi Arabia: Dharan, Abquiq, Ghawar, Damman, Abu-Safaj, etc. (vi) Iraq: Kirkuk, Mosul, Rumaliya, Basra
vi. Kuwait; Bargan, Rudhtan
vii. Iran: Masjid-e-Sulaiman, Gach Saran, Marun, Aghazari, Nafat, Lali, etc. (ix) Indonesia: Sumatra and Borneo. Other areas include North Sea region in Europe, Damborija valley in Rumania, etc.

Reserves of Petroleum

1. Saudi Arabia	22,700 m.t.
2. Iraq	13,400 m.t.
3. Kuwait	12,700 m.t.
4. Iran	12,700 m.t.
5. U.A.E.	22,100 m.t.
6. Venezuela	8,100 m.t.
7. Former USSR	8,000 m.t.
8. Mexico	6,800 m.t.
9. USA	4,200 m.t.

Natural Gas

It occurs either with petroleum oil or independently.

Producing regions: CIS Western Siberia, Northern Caucasus, Fargana valley, etc.

Nuclear Energy

Uranium

Australia has the largest reserve of Uranium followed by S. Africa, Nigeria, Brazil, Canada and the USA.

i. Canada: Uranium city on the northern coast of lake Athabaska, Port Radium and Beaver lodge near Great Bear lake.
ii. USA: Colorado Plateau
iii. CIS: Tuya-Mayaum, Majlisay, Tarshan, Tarak region in Siberia
iv. Australia: Port Darwin region, Mary-Kethleen
v. South Africa: Witwatersrand
vi. Japan: Tobo

Thorium

Monazite is the most important source of Thorium. The largest reserve of Thorium in the world is found in India in the Malabar coast of India (Kerala) and Tamil Nadu coast. Other producers of Thorium are the USA (Montana, North California, etc.) Brazil, Australia, Malaysia and Sri Lanka.

Hydro Electricity

- USA is the largest producer of hydro-power in the world. The development of hydropower has taken place in the following areas: (i) Fall line region along the Atlantic coast; (ii) Niagra waterfall region; (iii) Tenessey valley and (iv) Appalachian region.
- Congo River of Africa has the largest hydro-power potential in the world. Hydro-

electricity contributes 99 per cent to Norway (highest).

- Norway and Sweden have highest per capita production of electricity in the world.

Table 2.11 Hydro-Electricity Projects of World

River	Country/ continent	Project
Colorado	USA	Davis, Parker, Boulder and Hoover Dams
Columbia	USA	Grand Coulie Dam and Bonville Dam
Tennessey	USA	Wheller, Vilson and Noris Dams
Sacramento	USA	Sasta Dam
Mississippi	USA	St. Anthoni Project
Zambezi	Africa	Kariba Dam
Nile	Egypt	Aswan Dam
Congo	Africa	Stanley Dam
Hurangi	China	Lubuz Project

10. INDUSTRIES, TRANSPORT AND HUMAN GEOGRAPHY

Industries

- Location of industries is influenced very much by the availability of raw material, market, power, skilled labour, facilities of transportation, etc.
- Heavy industries tend to locate near the sources of raw materials.
- Availability of electricity, especially hydro-electricity favours the location of aluminium industry since it is a cheap power.
- killed labours are required in the industries of diamond cutting, ornaments, watch making, etc.
- Good transportation facility has been the chief localising factor in the industries of Great Lakes region of America.
- Light industries which do not require any locational advantage and can be established irrespective of sources of raw material, etc., are called Footloose industries, such as electronic industry, hosiery industry, etc.

Table 2.12 Major Industrial Centres

Cities	**Industry**
Hamilton	Iron and Steel
Windsor	Automobile
Sarnia	Oil refinery
Quebec	Ship building
Anshan	Iron and Steel
Shanghai	Cotton Textile
Shenyang	Iron and Steel
Glasglow	Ship building
Goteburg	Ship building
Stockholm	Ship building
Lawel	Cotton Textile
New York	Garments
Los Angles	Aircraft
Akron	Synthetic Rubber
San Fransisco	Ship building
Seattle	Air craft
Detroit	Automobile
Chicago	Agricultural implements and meat
Hamburg	Ship building
Dallas	Air craft
Ottawa	Paper
Ahmadabad	Cotton Textile
Baku	Petroleum
Bel Fast	Ship building
Burmingham	Iron and Steel
Cadiz	Cork
Cheliabinsk	Iron and Steel
Dhaka	Carper
Dundey	Jute and cotton textiles
Dresden	Optical and photographic Instruments
Beunos Aires	Dairy
Ascen	Iron and Steel,Engg.
Firozabad	Sand-glass
Gorky	Engineering
Hawana	Cigar
Hollywood	Film Industry
Johannesburg	Gold mining
Kansas	Meat
Kawasaki	Iron And Steel
Kiev	Engineering
Kiberley	Diamond Mining
Krivoy ROg	Iron And Steel
Leeds	Woollen Textile
Leningrad	Ship building, Aircraft
Leons	Silk
Magnigorsk	Iron And steel

Manchester	Cotton textiles
Milan	Silk
Multan	Pottery
Munich	Lens Manufacturing
Nagoya	Cotton Textiles, Ship Building
New Castle	Iron and Steel
Osaka	Cotton Textiles, Iron And Steel
Philadelphia	Locomotives
Pitts Burg	Iron and Steel
Sheffield	Cutlery
Tula	Iron and steel
Venice	Glass
Viena	Glass
Viadivostok	Ship Bulding
Wellington	Dairy
Zurich	Light Engineering

- This industry requires huge investment of capital and skilled labour, therefore the industry is concentrated in the developed countries.

Transport

- Waterways, roadways, and airways are chief modes of transportation available. Among these water transport is the cheapest one.
- Cargo on international level is mainly transported through the waterways. Ships moving on the fixed route are called cargo liner.
- Mostly, the oceanic routes follow the path of Great Circles because a great circle represent the shortest distance between two places.

North Atlantic Waterway: This is the busiest and most important water way in the world which links Western Europe to North America. Major ports on this route are London, Liverpool, Glasgow, Southampton, Bristal, Hamburg, Rotterdam, Antwerp, New York,Boston, Philadelphia, New Orleans, Quebec, Montreal, etc.

Suez Canal Water Way: This important canal joining Red Sea to Mediterranean Sea was constructed in 1869. Northern gateway of this canal is formed by Port Said and Southern gate way by the Suez port.

Cape of Good Hope Water Way: The importance of this route has declined after the opening up of Suez Canal. The trade between West and South Africa and Australia-New Zealand is carried through this route.

North Pacific Waterway: This route joins western coast of North America with the ports of Far East.
Panama Canal Waterway: This canal constructed in 1914 joins Atlantic ocean with the ports of Far East.

Inland Waterway

- Rivers such as Rhine, Seine, ELb and the Canals joining them make important waterways in Europe.
- Rhine river of Europe is the busiest river of the world in terms of cargo transport.
- Volga system of CIS is an important inland waterway there.
- In North America, an important waterway is formed by the Great Lakes, St. Lawrence river, Ohio river system, and Mississippi river system.

Important Canals

Kiel Canal: Joins North Sea with Baltic Sea
Soo Canal: Joins Lake Superior with Lake Huron (USA)
Welland Canal: Joins Lake Erie and Ontario (USA)
Erie Canal: Joins Lake Erie and Michigan (USA)
Manchester Canal: Joins Manchester and Isthum in the UK
Gota Canal: Between Stockholm and Goteberg (Sweden)
Stallin Canal: Between Rostov and Stalingrad (called Don-volga canal)
New Waterway: Joins Amsterdam with North Sea, and
Rhine-main-Danube Waterway: Join North sea with Black sea.

Human Geography

- It studies the location and distributional aspects of cultural phenomena, resulting from ever changing human-nature interaction.

The World Population

- The world at the beginning of twenty-first century, recorded over 6 billion population. It has quadrupled from 1.6 billion just in one century.
- We are adding 80 million people each year to the world population.
- People may move from an area as a result of one or more push factors (e.g., difficult economic conditions, unemployment conflicts, etc.) Likewise pull factors such as improved economic opportunities may attract people to a place.

Table 2.13 Ten Largest Countries in Terms of Area

Countries	Area (million sq. km)
Russia	17.0
Canada	9.9
China	9.5
USA	9.3
Brazil	8.5
Australia	7.6
India	3.2
Argentina	2.7
Sudan	2.5
Algeria	2.3

- Civil unrest, wars, political control and policies of National Government have also fostered population growth, decline/migration.
- There are four major Regions of high population density (7,100 persons/km²).
    i. East Asia (China, Japan, Kerala and Taiwan),
    ii. South and South East Asia,
    iii. Northwest Europe, and
    iv. The Eastern Coast of North America.
- The largest cluster claiming about one-fourth of the world's population is found in East Asia followed by South Asia.
- Singapore is the most densely populated country of the world.
- The country with world's lowest density of only 1 person/km² is Mangolia.
- The Netherlands is the most densely populated country of Europe.
- World's 90 per cent of population lives in Northern Hemisphere and only 10 per cent lives in Southern Hemisphere.
- Fifty per cent of the world's population lives between 20° and 40° of North latitude. Likewise about 30 per cent of world population lives between 40°-60° N latitude in Europe. Region beyond 60°N latitude contain only 1 per cent of world population.

Table 2.14 Descending Order of Continents in Terms of Area of Population

Area-wise	Population-wise
Asia	Asia
Africa	Africa
North America	North America
Europe	North America
South America	South America
Oceania and Antartica	Oceania and Antartica

Table 2.15 World's Smallest Countries in Terms of Area and Population (Ascending Order)

Area wise	Population wise
Vatican City	Vatican Cit
Tuvalu	Tuvala
Nauru	Nauru
Palau	Palau

Table 2.16 Descending Order of Major Religions and Languages

Major Religions	Major Languages
Christianity	Mandarin
Islam	Hindi
Hinduism	Spanish
Budhism	English
Sikhism	Arabi
Jew	Bengali
Bahawi	Portuguese, Russian, Japanese and German

Table 2.17 Descending Order of Population Density (people per km²)

Asia	137
World	54
Least Developed region	45
Developed	38
Africa	32
Europe	24
North America	17
South America	16
Oceania	5

NOTES

Demographic Transition Theory

Stage - I

Type-1 Primitive Demographic Regime: High birth and death rate and slow population growth.

Stage-II

Type-2

Expanding/youthful Demographic Regime; Rapidly declining death rate, high birth rate and rapid growth of population

Type-3

Late Expanding Demographic Regime: Declining birth rate, low death rate and decline in population growth rate.

Type-4 Low Fluctuating or Mature Demographic Regime, low birth rate.

Stage – III

Type-5 Regime of almost zero population growth due to low and equal birth and death rate.

Major Tribes of the World

Tribe	Place
Pygmies	Congo
Bushman	Kalahari Desert
Eskimo	Canada and Greenland
Semang	Malaysia
Hausa	Nigeria
Lapps	Tundra (Europe)
Samoeds	Asian Tundra
Tartar	Siberia
Maori	New Zealand
Aborigines	Western and Central Australia
Bantu	South and Central Africa
Barbars	N. Africa (Morocco Algeria Tunisia)
Bindibau	Western Australia
Fins	European Tundra
Gaucho	Pampas region
Hamites	N.W. Africa
Khirgiz	Steppes Region
Kikuku	Kenya
Masai Red Indians	East Africa
Popuans	New Guinea
Popuans	North America
Vedda	Sri Lanka
Yukadhir	Asian Tundra
Zula	South Africa
Punon	Bornco
Auka	Ecuador
Boro	Amazen
Bedouins	Basin
Ainu	Arabs Japan
Hottentot	Kalahari Desert
Kaggak	Central Asia
Fulani	Nigeria
Kalmukh	Central Asia
Fellah	Egypt (Farmers)
Afridi	Pakistan
Magyar	East Europe
Maya	Mexico
Boer	S. Africa (Farmers of Dutch Origin)

11. INDIA: GEOLOGY AND PHYSIOGRAPHY

- India has been a distinct geographical and geopolitical unit since ancient times.
- Bounded by the young folded mountains in the north-west, north and north-east and washed by the waters of the Indian ocean in the south, India occupies the most important part of the south Asian realm.
- India is the only country after which an ocean has been named, that is Indian Ocean.
- This region may gain geopolitical and geo-economic importance in the near future; it is organised on the pattern of Asia-pacific region or European Economic Community.

Size and shape

- India is the seventh largest country in the world after Russia, Canada, China, the USA, Brazil and Australia.
- India commands a total geographical area of 32,87,263 square km which is roughly 0.57 per cent of the area of the Earth and 2.4 per cent of the total area of the land.
- This 2.4 per cent of the land area is occupied by 16 per cent of the world population making India the second most populous country in the world.
- India has roughly a quadrangular shape.
- It measures about 3,214 km, from north to south and about 2,933 km from east to west. So, the north-south extent is 281 km more than the east-west extent.

Location

- India lies in the northern and eastern hemisphere of the globe between 8'4' and 37°6' north latitudes and 68°7' and 97°25' cast longitudes.
- Infact the southernmost extent goes up to 6°45' north latitude to cover the last island known as Pygmalion point or Indira point.
- With almost 30° of longitudinal extent the country may be divided into two zones. but India has adopted only one standard meridian that is 82°30' cast longitude to determine Indian Standard Time (5½ hours ahead of GMT).
- The Tropic of Cancer divides the country into two equal halves - the southern half falling

under the Torrid Zone and the northern half forming a sub-tropical zone.

- India's neighbours include Pakistan and Afghanistan in the west, China, Nepal and Bhutan in the north and Bangladesh and Myanmar in the east.
- In the south, narrow Palk Strait separates the Indian mainland from Sri Lanka.
- The total land frontier of India is 15,200 km.
- India has a mainland coastline of 6,100 km and total coastline 7,516 km (including the coastline of Andaman Nicobar and Lakshadweep islands).

Physiographic Features

On the basis of physiographic features, India may be divided into four major physiographic provinces:

The Northern Mountains

This region marked by the lofty ranges of the Himalayas extends all along the Northern frontiers of the country, from eastern boundary of Pakistan to borders of Myanmar.

(a) The Greater Himalaya/Himadri

- This is the most continuous, loftiest and northern most range of Himalayas.
- It has a core of Archaean rocks flogged by Metamorphous-sedimentary rocks.
- The average height of Himadri is 6,100 m.
- Most of peaks exceed 8,000 m, such as Mount Everest - 8,848 m (the highest peak in the world). Kanchanjunga – 8,598 m, Makalu – 8,481 m, Dhaulagiri – 8,172 m, etc.
- This range is penetrable through some passes existing at very high altitude.
- They are Burzila and Zozila in Kashmir, Baralapchala and Shipkila in Himachal Pradesh, Phagala, Niti Pass and Lipu Lekh Pass in Uttarakhand and Nathula and Jelepla in Sikkim.
- The Himadri runs in arc shape to a length of 2,500 km from Nanga Parbat in the west to Namcha-Barwa in east.
- There exists a number of glaciers of which Gangotri, Milan (Kumaun) and Zemu (Sikkim) are important.
- Between Himadri and Himachal exists the famous valley of Kashmir.

(b) The Lesser Himalaya/Himachal/Middle Himalaya

- To the south of greater Himalaya lies the middle Himalaya which is separated from the Shivalik range in south through the Main Boundary Thrust (MBT).
- It comprises parallel ranges in Nepal and Punjab but of scattered mountains in Kumaun, the Dhauladhar, Pir-Panjal, Nag Tiba, Mahabharata and Mussourie range.
- Pir Panjal range of Kashmir is longest one running for 400 km between Jhelum and Beas.
- Shimla, Ranikhet, Chakrate, Mussourie, Nainital, Almora, Darjeeling, Dalhousie, etc., are situated over the lesser Himalaya.
- The famous hill-resort of Shimla is situated on Dhauladhar range.
- Between Pir-Panjal and Zaskar range of main Himalayas lies the famous valley of Kashmir.
- The Kangra valley in Himachal Pradesh extends from foot of the Dhauladhar Range to south to Beas river. Kangra Valley is a strike valley.
- Kullu valley is a transverse valley in upper course of Ravi river. Eastward of this lies the Kathmandu valley in Nepal.
- Steep bare southern slopes and gentle forests covered northern slopes of Himachal, present a typical hogback topography.
- Along slopes of lesser Himalaya are found a number of small pastless, called merg in Kashmir (Gulmerg, Sonmerg, Tanmerg) and Bugyal and Payar in Uttarakhand.

(c) The Outermost/Shivalik Himalaya

- The Shivalik comprises the southernmost range of Himalayas.
- This chain of hills runs almost parallel to the lesser Himalayas for a distance of about 2,400 km from the Patwar plateau to Brahmaputra valley.
- The altitude varies from 600 to 1,500 km.
- The Shivaliks are formed of great thickness of Mio-Pleistocene sands gravels and conglomerates which have been brought by the river flowing from the higher ranges of Himalayas.

- It has been folded, faulted and elevated during Earth movements of Miocene to Pleistocene period.
- The width of Shivaliks varies from 50 km in Himachal Pradesh to 15 km in Arunachal Pradesh.
- These are called Jammu hills in Jammu and Dafla, Miri, Abor and Mishmi Hills in Arunachal Pradesh.
- The Dundwa range of Uttarakhand and Churia-Muria hills of Nepal are also part of it. • Between Shivalik and the Himachal (Middle Himalaya) there are some flat floored structural valleys, known as Doons.
- The Doons are intensively cultivated and densely populated, e.g., Dehradun, Patlidun, etc.
- These Doons in the east are known as Duars.

(d) The Trans Himalayas (Tibetan Himalayas)

- It consists mainly of Karakoram, Laddakh and Kailash ranges.
- The range acts as a water divide between rivers draining into Bay of Bengal and into the Tibetan lakes.
- Karakoram range determines India's frontiers with Afghanistan and China. • The Laddakh plateau lies to north-east Karakoram range and highest plateau lies to north-east Karakoram range.
- It has been dissected into a number of plains and mountains, the important ones being Soda plains, Aksai, China, Depsang plains, etc.
- Mt. Godwin Austin (K2) is the highest peak of India.

(e) The Eastern Hills or Purvanchal

- After crossing the Dihang gorge the Himalaya takes a sudden southward turn and forms a series of comparatively low Hills called Purvanchal.
- In the north is Patkaibum which forms the international boundary between Arunachal Pradesh and Myanmar.
- It merges into Naga Hills southwards where Saramati is highest peak.
- To its west is Kohima Hills whose highest peak is Japvo.
- South of Naga Hills are Man
- Naga Hills from Manipur hills.
- South of Manipur Hills are Mizo Hills whose highest point is Blue Mountain.
- Dapha-Bum is the highest peak of Mishmi Hills.
- Mizo Hills are the southernmost part of the north-eastern range.

Regional Division of Himalayas

(a) Punjab Himalayas

- This 560-km-long stretch of the Himalayas lies between the Indus and Sutlej rivers.
- Karakoram, Laddakh, Pir-Panjal, Zaskar and Dhauladhar are the main ranges of this section while Zozila is the major pass.

(b) The Kumaun Himalayas

- It lies between the Sutlej and Kali rivers.
- General elevation is higher than Punjab Himalayas.
- Nanda Devi, Kamet, Badrinath, Kedarnath, Gangotri are all important peaks. Nainital and Bhimtal are important lake regions.

(c) Nepal Himalaya

- This section of Himalayas is situated between the Kali and Tista river.
- Mount Everest, Kanchanzunga, Makalu, Dhaulagiri, etc., are located in this region.

(d) Assam Himalayas

- The Himalayan ranges from Tista to Brahmaputra rivers are included in the Assam Himalayas.
- The important peaks of this region are Namcha-Barwa, Kula-Kangri, etc.

NOTES

Origin and Evolution of Himalayas

As per the postulates of Plate Tectonics, the origin and rise of mighty Himalayas is the result of collision between the Indian plate and Eurasian plate, of which now contain continental portion along the collision boundary (a continent-continent collision). The major events can be summarised as follows:

1. The wedge of sediments occurring along the margins of Indian and Eurasian plate were deformed as Indian plate carrying Gondwanaland began to move towards Eurasia.
2. As collision proceeded the oceanic crust descended into the mantle (the subduction process) and melted leading to explosive volcanisms.

3. As collision proceeded of oceanic crust brought the continental crust of Indian crator in collision with that of Eurasian continental crust.
4. Instead of subducting, leading continental edge of Indian plate was forced to thrust under Asia, generating a double layer of low density continental material which rose buoyantly. This process accounts for the high elevation of Himalaya and the Tibetan plateau.
5. The final phase of the upliftment of the Himalayas involved the receding of Pleistocene glaciers and resultant isostatic upliftment. This upliftment due to isostatic adjustment is still in progress. Thus the continued collision of plates and related processes have made the Himalayan zone highly unstable which is indicated by the frequent Earthquakes occurring there.

12. INDIA: PLAINS, PLATEAUS AND ISLANDS

The Great Plains

- This is a transition zone between northern mountains and peninsular uplands in the south.
- It is formed by the depositional work of three major river systems viz., the Indus, the Ganga and the Brahmaputra. Hence, also known as Indo-Gangetic-Brahmaputra plain.
- This is the largest alluvial tract of the world extending for a length of 3,200 km from mouth of Indus to mouth of Ganga of which Indian sector comprises 2,400 km.
- Its width decreases eastwards.
- It covers a total area of 7.8 lakh km².
- This plain is characterised by extremely low gradient.

Geomorphology of the Plains

i. The Bhabar is a narrow belt running in east west direction along the foot of Shivalik. Most of the streams sink and flow underground.
ii. The Tarai is a wide marshy tract in the south of Bhabar running parallel to it. It is characterised by the re-emergence of underground streams of the Bhabar belt. It is a zone of excessive dampness, thick forest, rich wildlife and malarial climate.
iii. Bangar plain is made up of old alluvial soil of the rivers and lies above flood limit of the plains. The alluviam is of dark colour and often impregnated with calcareous concretions known as Kankar.
iv. Khadar Plains is the younger alluviam of flood plains called the Khadar or BET in Punjab. A new layer of alluviam is deposited by river flood almost every year, confined to the vicinity of the present channels.

Regional Division of the Great Plains

(i) The Rajasthan Plain

- This includes Marusthali and Rajasthan Bagar areas.
- The Great Indian Desert or Thar desert covers the western extremity of the great plains in western Rajasthan.
- The eastern part of the Marusthali is rocky while its western part is covered by shifting sand dunes locally known as Dharian.
- The eastern part of Thar desert up to Aravali range is a semi arid plain called Rajasthan Bagar.
- The patches of fertile tracks in Bagar are called 'rohi'.
- Luni salt river is the only living river in the arid plain which is originated from Annasagar and is last in the Rann of Kutch.
- The tract north of Luni is known as Thali or Sandy plain.
- A part of the plain has also been formed by the recession of the sea as is evident by the occurrence of several salt water lakes, e.g., Sambhar, Degana, Kuchamau, Pachpadra, Didwara, Lun Karransar.
- The Rajasthan plain has several dry beds of rivers (Saraswati and Drusdvati).

(ii) Punjab or Haryana Belt

- To the east and north-east of Thar desert is Punjab - Haryana Plain.
- Its eastern boundary is formed by Yamuna river.
- It is characterised by flat, narrow strips of low lying flood plains known as beds, formed by shifting of river courses.
- This plain formed by deposits of five rivers is called Doab.
- From east to west these Doabs are:
  Bist: between Beas and Sutlej

Bari: between Beas and Ravi
Rachna: between Ravi and Chenab
Chaj: between Chenab and Jhelum
Sindhsagar: between Indus and Jhelum-Chenab.

- Rivers in this plain have caused for themselves broad flood plains of Khadar flanked by bluffs locally called Dhaya.
- The northern part of this plain adjoining the Shivalik has been eroded by numerous streams called Chos.

(iii) The Ganga Plain

- This is the largest unit of the great plains stretching from Delhi to Kolkata in the states of Uttar Pradesh, Bihar and West Bengal.
- Physiographically, this plain can be sub-divided into following three divisions:

I. Upper Ganga Plain

This part is bordered by the Yamuna in the west and 100 m contour line (Allahabad - Faizabad railway line) in the east. The upper Ganga plain can be divided into three micro units.

a. Ganga-Yamuna Doab: Between the river Ganga and Yamuna forming the largest Doab, it comprises three sections. Upper Doab - Haridwar to Aligarh, Middle Doab- Aligarh to Kanpur, Lower Doab - Kanpur to Allahabad
b. Rohelkhand Plain: East of Ganga Yamuna Doab, it lies entirely in U.P. and drained by Ramganga, Gomti and Sarda rivers.
c. Awadh Plains: Eastward of Rohelkhand plain drained by Ghagra.

II. Middle Ganga Plain

It occupies eastern UP and Bihar plains. Its eastern boundary corresponds to the BiharBengal border. This is a very low plain, no part of which exceeds 150 m in elevation and alluviam deposits have less concur formations. Besides Ganga, Gomti, Ghagra, Rapti, Gandak, Kosi (in the north) and Son (in the south) are other important rivers. It has two parts: north Bihar plain and south Bihar plain (west of Rajmahal hills). A long line of Marshes, along Chhapra are known as Chaurs. On its outward side occur vast lowlands called Jala near Patna and Tal near Mokama.

III. Lower Ganga Plain

It extends from the eastern margin of the Chhotanagpur plateau in the west to the border of Bangladesh and Assam in the east. Most of these plain is perceived as Deltaic. This plain can be divided into:

a. North Bengal Plain: Its eastern part is drained by rivers joining Brahmaputra (Tista, Sankosh) and western part by the tributaries of Ganga (Mahananda, Ajay, Damodar) etc. Further southward lies the older delta of the Ganga which has been eroded into terraces known as Barind plain.
b. Bengal Basin (Delta Proper): The heavily forested sundarbans in south and the east Bhagirathi plain in the north offer contrasting features.
c. Low land to the west of Bhagirathi. It comprises Birbhum, Asansol Rarh, Bankurah and Midnapur Rarh.

IV. Brahmaputra Plain (Assam valley)

This is the eastern most part of the great plains. These plains extend from Sadiya in the east to Dhubri near Bangladesh border in the west. The region is surrounded by high mountains from all sides except on the west, Majuli is the largest river island in the world. The right bank tributaries of Brahmaputra form Trellis pattern while left bank tributaries form Dendraitic pattern.

The Peninsular Plateau

The peninsular plateau is roughly triangular in shape with base coinciding with southern edge of the Great Plains. It covers a total area of 16,00,000 sq km (about half of total land area of the country).

The Plateaus of Peninsular India

1. **The Marwara Upland:** It lies east of Aravali range, made up of sand stone, shales and limestone of Vindhayan period. The upland is drained by Banas river originating in Aravali range.
2. **The Central Highland:** Also called the Madhya Bharat Pathar, lying in the east of Marwara upland.
3. **The Bundelkhand Upland:** To south of Yamuna river between Madhya Bharat Pathar and the Vindhyan scarap lands consists of granites and gneiss.
4. **Malwa Plateau:** It is an extensive lava plateau in M.P. with black soil drained by a

number of north flowing rivers like Betwa, Prabati, Kali Sindh, Chambal and Mahi.

5. **Baghelkhand:** East of Makal range and bounded by Son river on the north.
6. **Chotanagpur Plateau:** It covers mostly Jharkhand, adjoining eastern Madhya Pradesh and Purulia of West Bengal. This plateau is composed mainly of Gondwana rocks with patches of granites and gneisses and Deccan lavas. The plateau is drained by numerous rivers in a radial pattern such as Damodar, Subarnrekha, North Koel, South Koel and Barakar river.
7. **Meghalaya Plateau:** This plateau has been separated from main block of the peninsular plateau by a gap called Garo-Raj Mahal gap. From east to west the plateau comprises Garo, Khasi and Jaintia hills and Mikir hills. Shilong is the highest point of the plateau.
8. **The Deccan Plateau:** It comprises Maharashtra plateau, Karnataka plateau and the Telengana plateau (Andhra Pradesh). The general slope is from west to east indicated by flow of major rivers like Mahanadi, Godawari, Krishna and Cauveri.
9. **The Chhattisgarh Plain:** It is the only plain worth the name in the vast stretch of plateau drained by upper course of Mahanadi. The saucer shaped depression lies between Makal range and Odisha hills.

Hill Ranges of the Peninsula

1. **Aravali Range:** Aravalis are the world's oldest fold mountain running in north east to southwest direction from Delhi to Palampur in Gujarat. Gurushikhar is the highest peak situated in Mount Abu. Barr, Piplighat, Dewair and Desuri passes allow movements by roads and railways.
2. **Vindhyan Range:** It rises as an escarpment flauting the northern edge of the Narmada, Son-trough. The Vindhyas are continued eastward as the Bharner and Kaimur hills. This range acts as a water divide between Ganga system and river system of south India. The Makal range forms a connecting link between Vindhya and Satpuras.
3. **Satpura Range:** It is a series of seven (Sat) mountains running in cast-west-direction south of Vindhya and in between the Narmada and Tapi. Connects from Rajpipla hills in the west through the Mahadeo hills. It extends to Makal range in the east Dhupgarh near Panchmarhi on Mahadeo hills in highest peak of Satpuras.
4. **Western Ghat (Sahyadris):** The Western Ghats run in north-south direction from Tapi valley to north of Kanyakumari. Sahyadris form the real water divide of the peninsula. All the important rivers rise from these hills and flow eastward. The Sahyadris up to 160 north latitude are mainly composed of basalt. There are three important passes in the Sahyadris:
   (a) Thalghat (b) Bhorghat
   (c) Palghat
5. **Eastern Ghat:** It is a chain of highly broken and detached hills starting from Mahanadi in Odisha to Vaigai in Tamil Nadu. In the northern part between Mahanadi and Godavari eastern ghats exhibit true mountain character comprising Maliya and Madugula konda ranges. South of Godawari the broken hill ranges are Nallamalai, Palkonda, Javadi, Shavroy and Billigiri Rangan hills. Mahendragiri is the tallest peak of Eastern Ghats.

Coastal Plains and Islands

1. **West Coastal Plains:** It is 1,500 km long from Surat to Cape Comorin. This plain is sub-divided into:
   a. **Kachchh Plains:** Previously an island surrounded by seas and lagoons. In the north of Kachchh, lies the Great Rann - a broad level salt soaked plain to its south is Little Rann.
   b. **Kathiawar Peninsula:** Lying south of Kachchh its central part is highland of Manddu hills having radial drainage. Mount Girnar is the highest point. Further south lies the Gir range.
   c. **Gujarat Plains:** East to Kachchh and Kathiawar formed by the rivers Narmada, Tapi, Mahi and Sabarmati. It includes the southern part of Gujarat and Gulf of Khambhat coastal areas.
   d. **Konkan Coast:** Extends from Davay to Goa for a distance of about 500 km. Mumbai was an island where the coast is wide east.

e. **Karnataka or Kanara Coast:** It extends from Goa to Bangalore in narrow belt. Sharavati river drains this part making Gerosoppa falls.

f. **Malabar Cost/Kerala Coast:** It extends between Bangalore and Kanyakumari. The back waters locally called Kayals are the shallow lagoons. The largest among these is Vembanded Lake followed by Ashtamudi, Sand dunes locally called Teris are very common.

2. East Coastal Plain

- The east coastal plain is much wider and drier than the west and has a number of deltas.
- The Utkal plain along Odisha coast includes the Mahanadi delta whose most prominent feature is the Chilka lake south to Mahanadi delta.
- The Andhra plain lying south of Utkal extends up to Pulicat lake.
- The Andhra plain comprises delta of Godavari and Krishna rivers.
- Kouru lake is situated between the two deltas.
- The Tamil Nadu plain extends from Pulikat lake to Kanyakumari comprising the Cauvery delta known as granary of south India.

Islands

India has a total of 247 islands (distant islands) of which 204 lie in Bay of Bengal and remaining in the Arabian Sea.

(i) Arabian Sea Island

- These comprise 36 islands of Lakshadweep group of islands. Kavaratti is the capital of Lakshadweep.
- The southernmost island Minicoy is separated from Maldives by 8° Channel. These islands are of coral origin.

(ii) Bay of Bengal Islands

- The Andaman and Nicobar group of islands is separated by 10 Degree Channel.
- These islands have been formed by extension of tertiary mountain chain of Arakan Yoma.
- The Andaman group of islands is divided into 3 major groups, viz., North Andaman, Middle Andman and South Andaman, collectively called Great Andmanas.
- The Nicobar group of islands consist of 18 islands of which Great Nicobar is largest and southern most one.
- Little Andaman is separated from Great Andaman by Duncan passage.
- Saddle peak situated in Andaman islands is the highest peak of Andaman and Nicobar group.
- The Dhuliar peak is the highest peak of Nicobar group of islands.
- There are two volcanic islands. The Barren island and Narcondam island.
- They extend southernmost point of India that is Indira Point (Pygmelion point).

(iii) Off Shore Islands

There are many nearby islands such as Diu, Bhaisala along Kathiawar. Khadiabet and Aliabet along Narmada-Tapi mouth, Elephanta Salsette, etc., near Mumbai, Bhatkal (Mangalore Coast), Anjidiv (Goa Coast), Pambam, Crocodile in the gulf of Mannar, Sriharikota (mouth of Pulikat), Parikud, (mouth of Chilka), Wheeler (MahanadiBrahmani mouth) and New Moore and Sagar in Ganga delta.

13. INDIAN DRAINAGE AND LAKES

Drainage of India

On the basis of their size, Indian rivers can be classified as under.

1. Major river basins with catchment area of over 20,000 km² which account for 85 per cent of total run-off of all the rivers. There are 14 major rivers in India, including, Ganga, Indus, Godavari, Krishna, Brahmaputra, Narmada, Tapi, Kaveri, Penner, Brhamani, Mahi, Subarnrekha and Sabarmati.
2. Medium river basins with catchment area between 2,000 and 20,000 km², accounting for 7 per cent of total run-off. They are 44 in number.
3. Minor river basins with a catchment area of below 2,000 km² accounting for 8 per cent of total run-off.

- Over 90 per cent of the water carried by the Indian rivers is drained into the Bay of Bengal, the rest is drained into Arabian sea or forms inland drainage.
- The Ganga river has maximum water storage capacity followed by Krishna.
- The river system of India formed varied drainage patterns:

i. Antecedent pattern - Indus, Brahmaputra, Satluj, etc.
ii. Superimposed pattern - Damodar, Chambal, Banas, etc.
iii. Dendritic pattern - by the rivers of Ganga Plain.
iv. Rectangular pattern - by Kosi and its tributaries
v. Radial pattern - Amarkantak region, Mikir, Kathiawar, etc., parallel pattern - in west coastal plane and inland drainage in Rajasthan desert area.

Table 2.19 Himalayan Rivers v. Peninsular River System

Basis	Himalayan Rivers River System	The Peninsular System
Name	The origin of these rivers are from Himalayan ranges, hence named Himalayan rivers.	The rivers originate and flow in the peninsular plateau, hence named peninsular rivers.
Water Flow	These rivers receive water both from the monsoons and the snow melt of the lofty peaks, hence they are perennial in nature.	They receive water only from rain fall, therefore are seasonal in character
Evolution	These rivers are young and are still busy in deepening their valleys. They have carved out deep gorges. V-Shaped valleys in their courses	These rivers exhibit senile topography, because they are very old. They have reached their base level stage flowing through open shallow valleys.
Basins	These rivers have small basins and catchment areas.	These rivers have small basins and catchment areas.
Courses	These rivers have long courses flowing through the rouged mountains, level plains and marshy deltaic areas.	These rivers are mostly smaller, flowing through the plateau and narrow coastal plains.
Meanders	These rivers have large basins and catchment areas. These rivers have long courses flowing through the rouged mountains, level plains and marshy deltaic areas.	The intensity, magnitude and frequency of floods is lesser than Himalayan rivers.
Deltas and Estuaries	These rivers form big deltas in their mouths, e.g., Ganga Brahmaputra delta is regarded as the largest one in the world.	The rivers like Mahanadi, Godavari, Krishna and Kaveri from Estuaries. Several small streams draining into the Arabian sea do not form any delta.
Extent of Flood	These rivers are flood prone. Floods are intense and frequent.	Some peninsular rivers are the tributaries of Himalayan rivers, e.g., Son Ganga; Chambal, Banas, etc., of Yamuna.
Character	The Himalayan rivers are utilised for power generation in hilly areas and for irrigation and navigation in the plains.	The peninsular rivers have great potential for power generation in the plateau region but have limited use in irrigation and navigation (confining to narrow coastal tract).
Ground water Storage	Himalayan rivers pass through alluvial plains which are act as huge reservoir of ground eater	The hard and impermeable rocks of the plateau restricts the storage of ground water.

Table 2.20 East-Flowing Peninsular Rivers

River	Sources	Total Length(Km)	Area Drained ($km^{2)}$	Tributaries
Mahanadi	In Raipur districts, 442 mt.	860	141600	Sheonath,Harde,Mand,Lb,Unytel
Baitarni	In Bihar, 600 m	333	19500	
Subaranrekha	In Jharkhand	395	19300	Konchi, Kasjjari
Godavari	From Trambak in Nasik 1067 m	1465	312812	Pravasa, Mula, Manjra, Pranhita, Penganga, Wardha, Wainganga, Sabri, Indravati Purna (CSPE, 2015)
Penganga	In Buldhana range	675	23888	
Wardha	In Betul district	483	24087	
Wainganga	In Seoni district	462	61093	
Indravati	In Kalahandi district	531	41663	Narangi, Boarding, Kotri, Bandia
Sabari	In Saikaram Hill	418	20427	Silaru
Krishna	Mahabaleshwar, 1,360 mt	1400	258948	Koyna, Yerla, Muneru, Varma, Panchganga. Dudhganga, Ghatprabha, Mala-prabha, Bhima, Tungbhadra, Musi
Bhima	Near Bhimeshwar village	867	69144	Grad, Nira, Kagna, Sina
Tungbhadra	From Gomantak peak		69562	Runga, Bhadra, Hagari Hemavai, Hasangi, Shimas, Lokpouni, Arkavati, Savashavathi, Kabbani, Bhavani
Cauveri	In Brahmgiri hills	800	87900	

Table 2.21 West Flowing River

River	Sources	Total Length(km)	Area (km^2)	Tributaries
Sabarmati	Mewar hills	320	21,679	Wakul,Hathmari
Mahi	Vindhya range	533	34,8624	
Narmada	Amarkantak (M.P.)	1312	98796	Left Bank Tributaries: Tawa,Burhm
Tapi	Multaion Satipura Range			Right Bank: Hiran Left Bank: Puma, Veghar, Girva, Bari Right Bank: Betul, Arunavati Gayal, Gomai

Table 2.22 Ganga and its Tributaries

River	Sources	Total Area Length (km)	Area Drained (km^2)	Tributaries
Ganga (comprised two head stream)	Alaknanda at an elevation of 7,800 mt. Bhagirathi at an elevation of 6,600 mt.	2,526	86,1404	Yamuna (near Prayag right bank), Ram-Ganga Gandak, Kosi, Ghaghara, Burhi-Gandak, Gomti, Baghmati, Gomti, Son, Mahananda, Kamla, Damodar, Jalangi, Bhairab;

				Confluence of Yamuna at Allahabad.
Yamuna	From a glacier at Yamunotri (6,330 mt)	1,300	359,000	Chambal, Betwa, Son, Hinduken, Sarda.
Ram Ganga	Near Nainital, 3110 mt. height	596	32,412	Khos, Gangan, Anil-Kosi, Deoha join Ganga below Farukkhabad.
Ghaghara	Trans Himalatyins	1,086	127,950	Rapti, Sarda
Gandak	In the central Himalaya 425 (India) 7650 mt.	460	9,540(in India)	In Nepal called Narayani join Ganga near Patna
Burhi Gandak	Somesar Hill, 330 mt	320	10,150	Koshi, Arun, Tamur
Kosi	From Tiber/Nepal	730(India)	11,600	Koshi, Arun, Tamur
Damodar	Chotanagpur Plateau near Tori	541	22,000	Join Ganga at Monghyr Join Hoogly below Kolkata Gartur, Konar, Jomunia, Barakar
Gomti	East of Pilibhit Town	940	30,437	Sai, Barma, Saryu, Chula
Brahmaputra and its Tributaries				
Brahmaputra	Chenayungdung glacier, near Mansorovar lake	885		Rajo, Tsangpo, LihotseDzony, Ngang Chu, Torsa, Giamduchu, Lohit, Dihing, Disang, Dhansiri, Tista. (CSPE, 2016)

'Namami Ganga'

The Government has proposed to set up an integrated Ganga Conservation mission called (Namami Ganga). An amount of INR 20,000 crore has been set aside for the mission in the year 2014. The Mission was launched because a substantial amount of money had been spent in the conservation and improvement of the river Ganga but the efforts had not yielded desired results because of the lack of concerted effort by all the stakeholders. To harness the enthusiasm of the NRI Community to contribute towards the conservation of the river Ganga, an NRI Fund for Ganga was set up which financd special projects. Programme for inter-linking of rivers, which was pursued during the previous NDA regime, was revived. For this, the Minister announced an allocation of INR 100 crore for preparation of Detailed Project Reports.

Table 2.23 Wetlands of India

Wetlands	Location
Kolleru	Andhra Pradesh
Wular	Jammu and Kashmir
Chilka	Odisha
Loktak	Manipur
Bhoj	Madhya Pradesh
Sambhar	Rajasthan
Pichola	Rajasthan
Astamudi	Kerala
Sasth	Kerala
Harike	Punjab
Kanjali	Punjab
Ujni	Maharashtra
Reuna	Uttar Pradesh
Kabar	Bihar
Kushna	Chandigarh

Lakes of India

- Sambhar Lake is the largest inland salt lake of India situated in Rajasthan, west of Jaipur. • Lonar lake situated in Lonar in Maharashtra is a crater lake.
- Chilka lake situated in Puri district of Odisha and south of the Mahanadi delta is the biggest lake of the country.
- Kolleru lake is a deltaic lake of Andhra Pradesh situated between the Krishna and Godavari delta.
- Pulicat Lake situated in the north of Chennai is a shallow lagoon. It has been barred by a long sandspit which is actually Sri Harikota Island.
- Loktak Lake situated in Manipur is the largest Fresh-water lake in the North-East India. Keibul Lamjao, the only floating National Park of the country is situated here.
- Vembanad lake is a lagoon in Kerala which is an important tourist spot. Coconut islands are located in it.
- Gohna lake situated near Devprayag in Garhwal has been formed by a huge landslide across a tributary of the Ganga.
- Wular Lake and Dal Lake are tectonic lakes formed by faulting activity.

14. INDIAN CLIMATE, NATURAL VEGETATION AND SOILS

Climate

- India is a tropical monsoon country, indicating the impact of its location in tropical belt and the monsoon winds.
- Although a sizeable part of the country lying north of Tropic of Cancer falls in the northern temperate zone but the shutting effects of the Himalayas and the existence of the Indian ocean have largely given India a distinct tropical climatic characteristic.

Weather Conditions

The year is conveniently divided, by Indian Meteorological Department, into the following four seasons:

(a) The Cold Weather Season (December to February)

- It begins in early December and continues up to February.
- During winter season there is general increase of temperature from North to South. Isotherms run in east-west direction almost parallel to the latitudes.
- The 21°C isotherm runs east-west through the middle of the country roughly parallel to the tropic of cancer connecting Tapi estuary and Mahanadi delta.
- The western coast is warmer than the eastern coast by about 1.7°C.
- The peninsular region of the country however does not have well defined cold weather season.
- A high pressure system develops over north and north-western part of the country from where cold and dry winds blow outwards.
- During the cold weather season a number of cyclonic depressions travel eastwards from the Mediterranean sea to North India. These depressions called western disturbances bring considerable amount of precipitation over the area.

(b) The Hot Dry Weather (March to May)

- The north Indian region experiences a well defined hot weather season between cool and mainly dry winter and the west monsoon season.
- With the northward march of the sun towards the Tropic of Cancer after vernal equinox, the temperature begins to rise continuously and rapidly.
- In May, the scene of highest temperature shifts to Rajasthan where temperature as high as 50°C may be recorded.
- The maximum summer temperatures are comparatively lower in the southern parts of the country due to moderating effect of the sea.
- Because of the heating of the sub-continent the equatorial trough moves northward and lies at 25°N.
- Under such conditions hot dust laden strong winds blow over most parts India, known as 'Loo'. of North
- The strong dust stroms resulting from the convective phenomenon (due to intense heating) are locally called 'Andhi' in U.P.', 'Norwester' in eastern India and 'Kalbaishakhi' in West Bengal.
- These storms bring some amount of precipitation which is called 'cherry blossoms in Karnataka (suitable for coffee plantation).

Elsewhere in South India this rainfall is called 'Mango-Showers'.

(c) The Wet Season/South West Monsoon Season (June-September)

- During this period an extensive low pressure area develops over north west India and Pakistan which is called monsoon trough.
- This trough attracts south west monsoonal winds.
- Due to tapering of the southern peninsula the south west monsoon winds are bifurcated and enter the country in two branches the Arabian Sea branch and the Bay of Bengal branch. The sudden outbreak of rainfall in this period is called monsoon burst.
- The Arabian Sea branch contributes 65 per cent of total humidity brought by the monsoon.

NOTES

Origin and Mechanism of Monsoon

Monsoon is the single most comprehensive expression which stands for the totality of Indian weather and climate and the single most important characteristics of monsoon is the seasonal reversal of wind system. The origin and mechanism of Indian monsoon can be understood under the flowing heads.

1. Thermal Concept: This concept simply regards monsoon as land and sea breezes on a gigantic scale. At the time of summer solstice, the sun's rays fall vertically over Tropic of Cancer and the huge landmass of Indian sub-continent is heated forming low pressure area over the land. The surface air flow is, therefore, from the highs over the oceans towards the lows over the heated land which is known as southwest monsoon.
2. Dynamic Concept: According to this concept, during summer the zone of intertropical convergence (ITCZ or doldrums) shifts northward and establishes itself over North India. Due to this shifting the major part of Indian sub-continent comes under the impact of equatorial westerlies (which blow in doldrums). The south-west monsoons are actually these equatorial westerlies.
3. Recent Concept: Today monsoon is considered as a part of the primary circulation. Recent concepts/theories mainly rely on the role of Jet-streams, Tibet plateau and ocean bodies in explaining the origin of Indian monsoon.

   (a) Jet-Stream: During summer season upper air, westerly jet-streams shift northward from the southern slopes of the Himalaya. This has a profound impact on the circulation of monsoon.

   (b) Tibet Plateau: The Tibet plateau acts as a heat source. The intense heating here causes a low pressure area from where air moves up, diverges, flow southward in the upper air and descends over south Indian ocean to be drawn towards the low pressure area of north-west India as south-west monsoon.

   (c) Tele-connection Between Ocean Bodies: The Indian monsoon has local, regional and global links. There exists close relationship between Indian monsoon, Elnino and southern oscillation.

- The Indian sub-continent receives bulk of its rainfall (about 78 per cent) during the South West Monsoon period.
- The Arabian sea branch of monsoon causes rainfall along the West Coast, Western Ghat, Maharashtra, Gujarat and parts of Madhya Pradesh and Rajasthan. • The Bay of Bengal branch of Monsoon enters the Ganga plain after being deflected westwards by the Arakan Yoma mountains.
- The Bay of Bengal branch is trapped in the deep tunnel-shaped valley of Garo, Khasi and Jaintia hills which is surrounded by high hills on three sides. Due to this, heaviest rainfall occurs at Mawsynram (1,141 cm) and Cherapunji (1,087 cm).
- The weather and rain during this season are also affected by a number of cyclonic depressions which enter the country through Bay of Bengal and the Arabian Sea.
- The normal date of onset of the South West (S.W.) monsoon is 20 May in Andaman and Nicobar islands, 1 June on Kerala coast and by 15 July it covers whole of India.
- The east coast of India remains almost dry during this season because it lies in the rain shadow area of the Western Ghats and is parallel to the Bay of Bengal branch of monsoon.
- As the Arabian Sea branch of monsoon crosses the Western Ghats, the places

situated on the leeward side of the Ghats receive less rainfall.

- Kachchh, Saurashtra and western Rajasthan fail to get adequate rainfall due to absence of mountain barrier in Kachchh, parallel position of the Aravali ranges to monsoon winds and the shutting effect of the hot and dry air from Baluchistan.
- The monsoon trough of low pressure does not remain stationary rather it moves north and south over North India, affecting greatly the distribution of rainfall in the country.

(d) Retreating Monsoon Season

- By the end of September, the S.W. monsoon becomes weak as the low pressure trough of the Ganga Plain starts moving southward in response to the southward march of the Sun. As a consequence, monsoon also starts retreating by completely reversing its direction of flow.
- The withdrawal of monsoon starts from September and is completed in mid December from the south-eastern coast of Tamil Nadu.
- The direction of retreating monsoon becomes North-Easterly (hence called N.E. monsoon after full development). It causes rains in the coastal areas of Tamil Nadu. Elsewhere the season is marked by dry weather.
- Weather during this period is also influenced by a number of very violent and destructive tropical cyclones. Such cyclones are less frequent in the Arabian Sea.

Climate Regions of India

The climatic division of India is based upon Trewartha's scheme, which is a modified form of Koppen's system and it corresponds with the vegetative, agricultural and geographical regions of India. Main climatic regions of India include:

i. Tropical Rain Forest (AW): It is found on the west coastal plain, the Western Ghats and some parts of Assam. It is characterised by high temperature in winter not below 18.2°C; and in summer about 29°C. The average rainfall exceeds 200 cm.

ii. Tropical Savana (AW): It is located in peninsular region except the semi-arid zone in the leeside of Assam. It is characterised by high temperature in winter not below 18.2°C; and in summer about 29°C. The average rainfall exceeds 200 cm.

iii. Tropical Semi-arid Steppe (BS): Prevails in the rain-shadow belt running southward from central Maharashtra to Tamil Nadu in the leeside of the Sahyadris and Cardamom Hills. It is characterised by low rainfall which varies from 38 cm to 80 cm, high temperature between 20° and 30°C.

iv. Tropical and Sub-Tropical Steppe (BSh): Occurs over Punjab extending to Kutch region. The Thar desert is in the west and the more humid climate of the Ganga plain and the peninsula to its east and south respectively. Characterised by the annual rainfall of 30.5 cm to 63.5 cm, temperature from 12°C (January) to 35°C (June).

v. Tropical Desert (BWh): The area includes the western parts of Barmer, Jaisalmer and Bikaner districts of Rajasthan. A large portion of Kutch peninsula along with Thar Desert is also included. It is characterised by scanty rainfall (30 cm average) with few parts receiving 12 cm annual rainfall. Temperature is above 35°C.

vi. Humid Sub-tropical with Dry Winter (CWa): The area includes south of the Himalayas, East of the tropical and sub-tropical steppe and north of tropical Savana. It is characterised by rainfall of 63.5 cm to 254 cm, most of it is received during the south west monsoon season.

vii. Mountain Climate (H): The area lies above 6,000 m of sea-level. Examples are the Himalayas and Karakoram ranges. Temperature decreases with altitude. The Trans Himalayan region particularly Ladakh has a dry and cold climate - what may be called cold desert. Drought is permanent.

15. NATURAL VEGETATION OF INDIA

The Indian vegetation can be classified into five major categories:

(i) Tropical Evergreen or Rain Forest Type

These are further subdivided into three categories on the basis of rainfall:

(a) Tropical Wet Evergreen Forest

In areas receiving more than 300 cm of rainfall and a short dry season. Strip along the Sahydris up to 1370 m, the hilly regions of North-east India, the

Tarai region of eastern Himalaya and the Andaman and Nicobar islands have evergreen forests. (CSPE-2015)

(b) Tropical Semi-Evergreen Forest

In areas of 200 cm of rainfall, found along the margins of wet evergreen forest.

(c) Tropical Moist-Deciduous Forest

Typical monsoon forest found in the areas of Western Ghats, Eastern Ghats, Chhotanagpur plateau, M.P. and the Bhabar and Tarai regions of the Himalaya receiving 102-200 cm. rainfall. Open forests, Sal, Teak and Sandalwood are trees of economic importance. (CSPE-2015)

(ii) Dry Tropical Types

Occurs in areas of 75-125 cm of rainfall and sub-divided into three types:

(a) Tropical Dry Deciduous

Biotic variation of moist deciduous forests degenerating on the drier side into thorny forests, occurs over large areas between Thar and Himalayan and interior of Sahyadris. Teak, Tendu, Sal, Palm, Laural, Khair are important trees.

(b) Tropical Dry Evergreen Forests

Confined to the coastal areas of Andhra Pradesh and Tamil Nadu, because these areas receive 100 cm of rainfall mostly during winter season through North-east monsoon. Neem, Tamarind, Palm, Casuarina are important trees.

(c) Tropical Thorn Forests

Occurs in low rainfall (less than 75 cm) regions of Rajasthan and Gujarat. Stunted trees like Acacia are common with scrubs and xerophytes bushes in the drier side. Such forests also occur in the interior regions of peninsula having rain-shadow effect of Western Ghats.

(iii) Himalayan Montane Vegetation

The Himalayan vegetation is classified as Tropical, Temperate and Alpine mainly on the basis of altitude and rainfall (CSPE-2014).

- Tropical evergreen montane forest is confined to the humid foothills of eastern and central Himalayas up to a height of 1,500 m.
- Ironwood, oak, chestnut, bamboos, etc., are found in these forests.
- Temperate forests are formed at altitudes between 1,500 and 3,500 m containing conifers and broad leaved temperate trees.
- Pine is the dominant species at 920-1,640 m altitude. Deodar, a highly valued species grows mainly in the western part of the Himalayan range up to 2,700 m.
- The alpine zone begins above the tree line at an altitude of 3,200–3,500 m, extending up to 3,900 m in the western Himalaya.
- Juniper, rhododendron, mosses and lichen are characteristics vegetation.

(iv) Peninsular Montane Vegetation

The sub-tropical forests occur on the lower slopes of Sahyadris and in Satpura and Maikal At higher levels the temperature is lower but rainfall is higher, therefore temperate forests are denser and called as Sholas in the Nilgiri, Annamalai, and Palani hills. range.

Magnolia, laurel, rhododendron, eucalyptus, cinchona are found in the forest.

(v) Tidal Forest

In the tide washed coast dense mangrove forests flourish with peculiar edaphic adaptations. The seaward fringes and islands of the deltas of the Ganga, Mahanadi, Krishna and Godavari are belt of dense tidal forest. The great Sundarban is a typical example inhabited by sundari trees.

Soils of India

On the basis of genesis, colour, composition and location, the Indian council of Agricultural Research (ICAR) has classified the soils of India into the following eight categories:

(i) Alluvial Soil

These most productive soils are depositional soils transported by steams and winds.

- They are largely sandy loam in texture or are mixed with both silt and clay.
- They are sufficient in phosphorus and potassium, but lack nitrogen and organic matter.
- These alluvial soils are divided into Bangar (old alluvium) and Khadar (new alluvium).
- They are found throughout the Indo-Gangetic Plain and river delta of peninsula.

(ii) Black Soil (Regur Soil)

These are the typical soils developed on the basaltic rocks of the Deccan plateau.

- This soil is rich in iron, lime and aluminium content, and has high moisture retentive

capacity. This soil lacks nitrogen, phosphorus and organic matter.
- It is found mainly in Maharashtra, south and east Gujarat, western Madhya Pradesh, northern Karnataka, northern Andhra Pradesh, north east Tamil Nadu, south east Rajasthan, etc.
- Apart from cotton crops like groundnut, tobacco and sugarcane, pulses and oil seeds are also grown in this soil.
- This soil is also suitable for dry farming because of its high moisture retentive capacity.

(iii) Red and Yellow Soils

These soils have been formed through the weathering of granite, gneiss and schist rocks.
- The colour is red, because of the presence of iron oxides.
- Tamil Nadu, Karnataka, Andhra Pradesh, Odisha and Chhotanagpur plateau of Jharkhand have large extend of this soil.
- This soil lacks nitrogen, phosphorus and humus.
- It is mainly suitable for the cultivation of coarse grains, pulses and oil seeds.

(iv) Laterite Soils
- These are typical soils of the tropical regions with heavy seasonal rainfall alternative with dry seasons.
- Lime and Silica are leached away with rains and soils rich in iron oxide and aluminium compounds are left behind.
- The organic matter nitrogen, phosphate and calcium are low in these soils.
- They are found in eastern and western Ghats Rajmahal hills, parts of Kerala and Karnataka, Parts region of Chhotanagpur, Meghalaya plateau, and Assam.
- The soil is generally of low fertility in which only coarse grains, pulses and oil seeds can be cultivated.

(v) Arid Soils

Due to dry climate, high temperature and accelerated evaporation, these soils lack moisture and humus content.
- Iron and phosphorus content is normal.
- They are found in west Rajasthan, southern Punjab and Haryana and north Gujarat.
- With irrigation these soils can be better utilised for cultivation.

(vi) Saline Soils ('Usara' soils)

They contain a larger proportion of sodium, potassium and magnesium.
- They occur in arid and semi-arid regions and water logged and swampy areas.
- They acquire salts largely because of dry climate and poor drainage. They are found on southern Punjab and Haryana, west Rajasthan, Kerala coast, Sunderban area, etc.

(vii) Peaty and Organic Soils
- It occurs in the northern Bihar, southern Uttarakhand (Almora district) and coastal areas of West Bengal, Odisha and Tamil Nadu.

(viii) Forest Soils

They are formed in the forest areas where sufficient rainfall is available.
- They are loamy and silty on valley sides and coarse grained in the upslopes.
- The soil lacks potassium phosphorus and lime, resulting into two fertility. It is more suitable for the plantation crops, like tea, coffee, spices
- This soil is found mainly in Himalayan region, Western Ghat, Eastern Ghat and Hilly regions of Peninsular India.

16. INDIAN FLORA AND FAUNA

Forests

Four Regions of Indian Forests
- The Indian flora, belongs to 'tropical monsoonal' category but due to complex physiographic, climatic and pedological conditions, it is divided into 174 natural orders and over 30,000 plant species ranging from thorny bushes to evergreen forests.
- Most of our Himalayan and Peninsular areas are covered with indigenous or endemic flora while Ganga plain and Thar desert contain plant species which are exotic.

Forest Area

The forest area is the area notified and recorded as forest land irrespective of the existence of trees. The actual forest cover is the area actually occupied by forest.

Actual Forest

The former is based on the records of the state revenue department, while the later is based on aerial photographs and satellite images.

- Both forest area and forest cover vary from state to state. On the basis of the of the actual forest cover, the states have been grouped into four regions: percentage

(a) The Region of High Concentration

The region includes the states where percentage cover of the forest is more than 40 per cent.

- All the Eastern states except Assam fall in this category, Mizoram has the highest percentage of actual forests cover in the country (86-97 per cent) followed by Nagaland and Arunachal Pradesh.
- In the Union Territory of Andaman and Nicobar islands, forests occupied more than 92 per cent of the geographical area.

(b) The Region of Moderate Concentration

It includes Madhya Pradesh, Odisha, Goa, Kerala, Assam and Himachal Pradesh.

(c) The Region of Low Concentration

It includes Maharashtra, Karnataka, Andhra Pradesh, Tamil Nadu, Uttar Pradesh and Bihar.

(d) The Region of Very Low Concentration

The north-western part of India falls in this category, which includes West Bengal also.

Three Categories of Indian Forests

- Based on administrative consideration Indian forests were classified under following three categories:
  1. Reserved forests This region, is under the direct supervision of the government, where no public entry is allowed for collecting timber and grazing of cattle. It constitutes 53 per cent of total forest area in the country.
  2. Protected forests - Here local people were allowed to collect timber and grazing their cattle. These occupy about 29 per cent of total forest area.
  3. Unclassified forests - Here, there is no restrictions on the cutting of trees, and cattle grazing. These occupy about 18 per cent of the country's forest.

Table 2.24 Forest and Tree Cover of India in 2017

Class	Area (sq.km)	% of Geographical Area
Forest cover		
(a) Very dense forest	98158	2.99
(b) Moderately dense forest	308318	9.38
(c) Open forest	301797	9.18
Total Forest Cover	**708273**	**21.54**
Scrub	45979	1.40
Non-forest	2533217	77.06
Total Geographical Area	**3287469**	**100.00**

* Includes 4,921 sq. km. area under mangroves.

Wild Life

Out of a known world total of 1.5 million species of animals, about 75,000 animal species are in India.

- Various efforts to conserve wildlife culminated in the establishment of a network of wildlife sanctuaries and national parks.
- A national park is a large area of one or several ecosystems where plant and animal species, geomorphologic sites and habitats for special scientific education and recreation are preserved.
- A wild life sanctuary is dedicated to protect the wild life and concerned species. Biosphere reserves are created to conserve biological diversity and genetic integrity of plants, animals and micro-organism in their totality.
- In India there are 89 National Parks and 482 wild life sanctuaries

Table 2.25 Mangroves in India

Mangrove	State
Northern Andaman	Andaman and Nicobar
Sunderbans	West Bengal
Bhitar Kanika	Odisha
Loringa	Andhra Pradesh
Krishna Estuary	Andhra Pradesh
Godavari Delta	Andhra Pradesh
Mahanadi Delta	Odisha
Pichavaram	Tamil Nadu

Point Calimere	Tamil Nadu
Gulf of Kutch	Gujarat
Coondapur	Karnataka

Table 2.26 Biosphere Reserves in India

Reserve	State
Nilgiri	Tamil Nadu
Nanda Devi	Uttarakhand
Nokrek	Meghalaya
Manas	Assam
Sunderbans	West Bengal
Gulf of Mannar	Tamil Nadu
Great Nicobar	Andaman and Nicobar
Simlipal	Odisha
Dibru-Saikhowa	Assam
Dehang Debang	Arunachal Pradesh
Pachmarhi	M.P.
Kanchanjunga	Sikkim
Agasthyamalai	Kerala
Ratnagiri	Maharashtra
Vembanad	Kerala

Other Important Facts Regarding Forest Resources

- Contribution of forests in the national economy of India is only 2 per cent. Ninety-three per cent of total forests of India are tropical forests in which 80 per cent belongs to Monsoonal category (deciduous) and 12 per cent to evergreen forests and remaining 1 per cent to other types.
- Temperate forests constitute only 7 per cent of India's total forests of which 4 per cent are broad-leaved forests and 3 per cent are coniferous forests. In this way 97 per cent of total forests of the country are broad-leaved and only 3 per cent of the total forests are comprised coniferous forests.
- India stands seventh in the world in terms of total geographical area but second in terms of cultivated land. About 46.6 per cent of the geographical area of the country is currently under cultivation.
- Punjab and Haryana have 82.20 per cent of their land areas as net sown area (Highest) while Arunachal Pradesh has only 3.2 per cent area as net sown area (Lowest).
- Pasture land occupy 3.63 per cent of total area of the country while 4.56 percent area is classified as culturable wastes which can be brought under cultivation with efforts.
- Rajasthan has the largest area under culturable wasteland in the country.
- Proportion of pasture land to the total geographical area is highest in the State of Himachal Pradesh.
- The highest percentage of culturable wasteland lies in Meghalaya followed by Goa, Rajasthan, and Gujarat.

Table 2.27 Important Wildlife Sanctuaries

Sanctuary	Place
Manas Wildlife Sanctuary	Barepta, Assam
Gasam Pani Wildlife Sanctuary	Difu, Assam
Namdafa Wildlife Sanctuary	Tirap, Arunachal Pradesh
Pakkui Wild Life Sanctuary	Kameng, Arunachal Pradesh
Chandre Prabha Sanctuary	Varanasi, Uttar Pradesh
Malan Sanctuary	Pauri Garhwal, Uttarakhand
Simplipal Sanctuary	Mayurbhanj, Odisha
Mudumallai Sanctuary	Nilgiri, Tamil Nadu
Vedanthangal Bird Sanctuary	Chinglepet, Tamil Nadu
Shravati Valley Sanctuary	Shimoga, Karnataka
Rangathitoo Bird Sanctuary	Mysore, Karnataka
Someshwar Sanctuary	Canara, Karnataka
Tungabhadra Sanctuary	Bellary, Karnataka
Benurd Sanctuary	Kozhikode, Kerala
Dompha Sanctuary	Aizwal, Mizoram
Itangti Sanctuary	Kohima, Nagaland
Jaldapara Sanctuary	Jalpaigudi, West Bengal
Bhimbondt Sanctuary	Monghyr, Bihar
Ratapani Sanctuary	Raisen, Madhya Pradesh
Hazaribagh Sanctuary	Hazaribagh, Jharkhand
Dalma Sanctuary	Singbhum, Jharkhand
Panchmarhi Sanctuary	Hoshangabad, M.P.

Bori Sanctuary	Hoshangabad, M.P.
Badalkhol Sanctuary	Raigarh, Chhattisgarh
Bhairamgarh Sanctuary	Bastar, Chhattisgarh
Udayanti Sanctuary	Raipur Chhattisgarh
Situ Sanctuary	Raipur, Chhattisgarh
Sansinhgarh Sanctuary	Raigarh Chhattisgarh
Borivalli Sanctuary	Mumbai, Maharashtra
Tatowa Sanctuary	Chandrapur, Maharashtra
Tansa Sanctuary	Thane, Maharashtra
Pench Sanctuary	Nagpur, Maharashtra
Sariska Sanctuary	Alwar, Rajasthan
Kevladev Ghana Bird Sanctuary	Bharatpur, Rajasthan
Sikridevi Sanctuary	Mandi, Himachal Pradesh
Rohela Sanctuary	Kullu, Himachal Pradesh

17. INDIAN AGRICULTURE AND ANIMAL HUSBANDRY

Agriculture in India

- Due to climatic variability, all the three types of crops - tropical, sub-tropical and temperate are grown in India.
- The average size of agricultural land holding is largest in Rajasthan and lowest in Kerala.
- Seventy-five per cent of the total agricultural land of the country is devoted to food grain crops.
- The percentage of area sown more than once is about 25 per cent of the total agricultural land in the country.
- High-yielding variety seeds are grown on about 55 per cent of the net cultivated area of the country.
- India has been divided into 15 agro-climatic regions by the Planning Commission of India.
- The crops in India can be grouped under three categories:

- Rabi crops: These are sown in October and harvested in April. Wheat, barley, gram, peas, mustered, etc., are important Rabi crops.

- Kharif crops: Crops of rainy season which are sown in July and harvested in November-December. Rice, jaiwar, bajra, maize cotton, soyabeen, groundnut, jute, tobacco, etc., are important crops.

Zaid crops: Sown in March and harvested in June. Maize, groundnut, vegetables and fruits are grown with the help of irrigation.

Major Crops

Rice

- It occupies 1/4th of total cultivated land, and 1/3rd of area devoted to food grains.
- India is the second largest producer of rice after China, in the world.
- Rice is grown in three agronomic seasons:
  (i) Aman-sown in July-August, and harvested in November-December; contributes three-fourths of total rice production.
  (ii) Aus-sown in May-June and harvested in September-October, contributes 1/5th of total rice production.
  (iii) Boro-Sown in November-December and harvested in March-April
- In Assam, West Bengal, Odisha and Andhra Pradesh, all the three Aman, Aus and Boro rice are cultivated.
- Hansa, Annapurna, IR-8, Ratna, Jamuna, Krishna, Kaveri, Padma, etc., are important varieties of rice in India.
- Rice is cultivated mainly in middle and lower Ganga-Plain, Mahanad valley and Brahmaputra Valley.
- Basmati rice of Dehradun is famous for its special aroma and flavour.
- India is 4th largest wheat producing country in the world.

Wheat

- Wheat ranks second in terms of area of production after rice in the country.
- It occupies 15 per cent of total cropped area and 20 per cent of total area devoted to food grain cultivation in the country.
- A 100-cm isohyets line is regarded as the dividing line between wheat and rice producing regions.
- The two important wheat zones in the country are the Ganga-Satluj Plain in the north-west and the Deccan black soil region in the central part.

- In the north-western part, loamy soil, winter cyclonic rainfall, enterprising farmers and most importantly development of irrigation and other infrastructure facilities are the favourable factors making this region the wheat land of the country.
- Sona, Sonalika, Kalyan, Sona, etc., are the high-yielding varieties of wheat in the country.

Barley

- Barley is a rabi crop which can be grown in more dry and cold conditions.
- Its producing regions coincides with the wheat growing regions of the country.
- Punjab has the highest productivity of barley in the country.

Coarse Cereals

- Mainly Jowar, Bajra, Maize, Ragi, Sawa, etc., are the coarse cereals cultivated in India.
- These are mainly rain-fed crops. They occupy 17 per cent of total crop area and 25 per cent of area devoted to food grains.
- They contribute 14 per cent of total food grains production in the country.

Jawar

- India is the largest producer of Jawar in the world.
- Jawar is both Kharif and Rabi crop and it ranks third in area among food grains.
- CSH-1, CSH- CSH-9, CSH-10, etc., are the high-yielding varieties of Jawar.

Bajra

- Bajra can withstand more dryness than Jawar.
- Bajra is mainly cultivated west of the 80° East latitude in the low fertile land.
- Pusa-23, HHB-67, ICMS-7703, ICTP-8203 etc., are the high-yielding varieties of Bajra.

Maize

- Maize originated in central America. It is grown in May-July and harvested in Aug Nov.
- Production of Maize has increased five times between 1951 and 2001.
- Use of yield raising hybrid varieties, fertilisers and irrigation helped in enhancing productivity. Ganga-101, Ranjit, Deccan, Himalaya, Jawahar, Sartaj, Dhawal, Vijay, Navjot, Shaktimaan, etc., are the more yielding varieties of maize.

Pulses

- They are leguminous crops and enhance soil fertility.
- They are the main source of protein in Indian diet.
- Tur, Urad, Moong and Moth are major Kharif crops and gram, peas, masoor are rabi crops.
- India is the largest producer and consumer of pulses in the world. The country also has the largest area under pulses.

Gram

- The principle pulse crop is cultivated mainly in North India.
- The major gram growing area is the Malwa plateau of M.P., north-eastern Rajasthan and southern Uttar Pradesh.

Oil Seeds

- Principle oil seeds are Soya been (7.1 million tonnes in 1900-2000), rape seeds and mustard (4.2 million tonnes) and groundnuts (6.2 million tonnes).
- 1/5th total area under oil seeds in the world is in India.
- Oil seeds occupy 12 per cent of the cropped area of the country.

Coconut

- India has emerged as the largest producer of coconut in the world.
- Ninety per cent of coconut production comes from Kerala, Tamil Nadu, Andhra Pradesh and Karnataka.
- Coconut cultivation is more developed on the Western Coast than in the Eastern Coast.
- Soil enriched with salts are suitable for coconut cultivation.

Other Oil Seeds

Production of Sunflower: Karnataka, Maharashtra, Andhra Pradesh.
Production of Rape Seeds and Mustrad: Rajasthan, U.P., Haryana.
Production of Castor Seed: Andhra Pradesh, Gujarat, Rajasthan.

Sugarcane

- Sugarcane is a tropical and sub-tropical crop.

- India is the largest producer of both sugarcane and sugar in the world. India also has largest area under sugarcane.
- Traditionally, northern plain was the main producing region of sugarcane, but its cultivation has also developed in south India in recent times.
- South India in recent times. High-yielding varieties like Co 421, Co 427, Co 116, Co 313 of sugarcane are available.

Tea

- India is the largest producer and consumer of tea in the world.
- More than half of the total tea area lies in the Brahmaputra valley of Assam. High rainfall, high temperature and well-drained land are favourable conditions for tea plantation here.
- Assam tea grown in the Brahmaputra valley has poor flavour but is a good liquor.
- In West Bengal, Darjeeling, Jalpaiguri and Cooch Bihar are important tea-producing districts. Darjeeling tea has good flavour.
- In south India, lower slopes of Western Ghats, Nilgiri and Cardamom Hills are important tea producing areas.

Coffee

- India produces only 4 per cent of the world coffee, but the Indian coffee is regarded very high in quality.
- Robusta and Arabica varieties of coffee produced in the country are in great demand all over the world.
- Coorg and Chilkmagloor districts in Karnataka and Nilgiris in Tamil Nadu are major coffee producing regions in the country.

Cotton

- India is the third largest cotton producing country in the world after China and the USA, contributing 14 per cent of the world output.
- India has the largest area under cotton cultivation in the world.
- India produces three types of cotton:
    i. Long staple cotton - contributes 40 per cent of total production
    ii. Medium staple cotton - 45 per cent of total production
    iii. Short staple cotton - 15 per cent of total production
- Black soil (Regur) is specially suited to this fibre crop because of its moisture retentive capacity.
- Major areas of cotton cultivation are
    (i) plateau area east of Western Ghat in Maharashtra,
    (ii) Gujarat plain and Kathiawar in Gujarat,
    (iii) Western Andhra Pradesh, Southern Tamil Nadu and Southern Karnataka and
    (iv) Punjab, Haryana and western U.P.
- American, Bengal, Malwi, Jarina, Sujata, MCU-4, DHB-105, etc., are important varieties of cotton cultivated in the country.

Jute

- More than half of the world jute production comes from India.
- Jute requires warm and moist climate and well-drained fertile soil.
- It is called golden fibre of Bengal.
- West Bengal produces 7.4 million bales- nearly 85 per cent of the country's total followed by Bihar, Assam and Odisha.

Tobacco

- India is the third largest producer of Tobacco in the world after China and the USA.
- India produces two types of tobacco (i) Nicotina Tobaccum, (ii) Nicotina Rhustica. 97 per cent of total tobacco production comes from Nicotina Tobacco.
- Andhra (Prakasham, Nellore, West Godavari, Krishna, Guntur), Karnataka (Mysore, Mandya) and Gujarat (Bijapur) are the major Cigerette tobacco producing states.
- A large quantity of cigerette tobacco is exported from Kakinada port.
- Gujarat (Kaira, Vadodara), Maharashtra (Kolhapur) and Karnataka (Belgaum), are the major beedi tobacco producing states.
- Dindigu and Tiruchirapalli are main Cigar and Cheroot centres in India.

- Hooka tobacco is produced mainly in Bihar and Punjab.

Rubber

- India stands at forth place among the rubber producing countries.
- Rubber is cultivated mainly in Kerala and Tamil Nadu.

Horticulture Crops

- Agroclimatic conditions enable India to produce a wide varieties of horticulture corps such as fruits, vegetables, tuber crops, ornamental crops, medicinal plants and spices.
- India leads the world in production of mangoes, bananas, sapotas and acid limes. In addition, India has earned the highest productivity of grapes in the world.
- Anab-e-Shahi is the well-known Indian variety of grapes. Main producing areas of grapes are Coorg district of Karnataka, Wayanad in Kerala, Nilgiri in Tamil Nadu, Maharashtra, H.P. and Andhra.
- Some important varieties of mangoes are Alphanso of Maharashtra, Bangnapalli of Andhra, Dashehari and Langra of UP and Maldah of West Bengal. Uttar Pradesh occupies the prominent place in mango production in hectarage followed by Bihar, Andhra Pradesh and West Bengal.
- Maharashtra is the largest producer of citrus fruits in India including oranges and grapes.
- Arunachal Pradesh is the leading producer of pineapple followed by Assam and Sikkim.
- Western Himalayan region is noted for the cultivation of temperate fruits. Among temperate fruits apple alone accounts for more than 50 per cent of total production.
- Seventy-five per cent of total production of apples comes from the state of Jammu and Kashmir.
- India is the largest producer, processor, consumer and exporter of cashew nut in the world.
- Maharashtra is the leading producer of cashew nut in India.
- India is the second largest producer of vegetables in the world after China.

Animal Husbandry

- Animal husbandry contributes 26 per cent of the total agricultural production of the country.
- Madhya Pradesh has the largest percentage of cattle in the country, followed by Uttar Pradesh, Bihar and West Bengal.
- Gir, Sindhi, Sahiwal, Tharparkar and Deoni are some of the outstanding breeds of milch cattle.
- The Nayori, Malvi, Kankadha, Hallikar, Siri, etc., are important drought breeds of cattle.
- Tharparkar, Kankarej, Nimari, etc., are important dual purpose breeds.
- Buffalos contribute about 54 per cent of the country's total production of milk though these contribute only 17 per cent of the country's total livestock.
- Uttar Pradesh has the highest number of buffalos followed by Andhra Pradesh and Rajasthan.
- Buffalos thrive best in areas of warm and humid climate.
- India is the largest producer of milk in the world.
- Goats are the main source of meat for the country (about 35 per cent).
- Bihar has the largest number of goats, followed by Rajasthan, West Bengal and Uttar Pradesh.
- About 90 per cent of the goats are deshi, whose maximum concentration is found in the Deccan plateau region of the country.
- Other important breeds include the Himalaya or Angora (Also known as Gaddi or Chamba breed), breed in Himachal Pradesh, Haryana and J&K. It provides pashmina for high quality fabrics.
- The Jamunapari breed of goat is found between the Yamuna and Chambal rivers and the Barbari breed is very popular in the western UP and Haryana.
- In India, Mumbai is the largest centre of meat production and export.
- Rajasthan accounts for one-fourth of total sheep population of the country followed by Andhra Pradesh and Tamil Nadu.
- In terms of wool production, Rajasthan is the leading state followed by Jammu and Kashmir, Karnataka and Gujarat.
- The country's best quality sheeps are found in Kashmir, Kullu, Chamba and Kangra Valleys.
- A central sheep breeding farm has been established at Hissar.

- India is a unique country producing all the four varieties of silk, viz., Mulberry, Tussar, Eri and Munga.
- India ranks third among the silk producing countries of the world.
- Karnataka is the largest producer of san silk in the country (60.6 per cent) followed by Andhra Pradesh, West Bengal and Tamil Nadu.
- The major producers of Tussar Silk are Bihar (46 per cent), Madhya Pradesh (31 per cent), Odisha (15 per cent), etc.
- Assam is the largest contributor of Eri silk (50 per cent) and Munga silk (96 per cent).
- The largest number of poultry population is found in Andhra Pradesh followed by Bihar, W.B., and Tamil Nadu.
- West Bengal has the largest population of ducks in the country.
- India ranks fifth in the world in the production of eggs.
- India is the world's largest producer of leather.

18. IRRIGATION AND PISCICULTURE OF INDIA

Irrigation

- The process of supplying water to the crops by artificial means, such as canals, wells and tanks is called irrigation.
- Surface water and ground water are two major sources of water for irrigation.

Surface Water

The mean annual flow of all the rivers is estimated to be 1,869 billion cubic metres (bcm). Out of this about 690 bcm (32 per cent) can be utilised.

Ground Water

The replenishable ground water potential in India is estimated at 433.9 bcm.

- Uttar Pradesh alone accounts for 19 per cent of the estimated ground water potential, more than 42 per cent of the potential is confined to the great plains.
- Of the total ground water resources one-fourth is used for domestic and industrial purposes and three-fourth for irrigation.

Distribution of Irrigated Area

- More than one-fourth (27.8 per cent) of total net irrigated area of the country is concentrated in Uttar Pradesh including Uttarakhand.
- Irrigated area is more than 5 million hectares in Madhya Pradesh and Rajasthan, thus comprising nearly half the next irrigated area of the country.
- In terms of net irrigated area as the percentage of net cropped area of the States, Mizoram has the lowest percentage (6.4 per cent) while; Punjab has the highest percentage (92.9 per cent). Punjab is followed by Haryana.

Sources of Irrigation

There are three major sources of irrigation: 1. Tanks, 2. Wells and Tubewells, 3. Canals.

Tanks

- Tank irrigation is very popular in the eastern part of the southern peninsula.
- Largest net irrigated area by tanks is 844 thousand hectares in Andhra Pradesh.
- In terms of percentage of net irrigated area, Tamil Nadu is at the top, where 21.6 per cent of net irrigated area gives water from tanks.
- Tank irrigation is also important in Odisha, Maharashtra Karnataka and Kerala.

Well and Tube wells

- These are very popular sources of irrigation in the alluvial plains, where ground water is plentiful.
- The proportion of well and tube well irrigated area to the net irrigated area is highest in Gujarat followed by Uttar Pradesh, Goa, Rajasthan, Punjab and Maharashtra. Canal
- More than half of canal irrigated area is confined to the states of Northern great plains.
- In terms of share in total net irrigated area of each state, canal irrigation is very important.
- The irrigation canals are of two types, viz., (i) Inundation canals which use the excess water of rivers at the time of floods and remain operational during rainy reason. (ii) Perennial canals which are taken out from the perennial rivers by constructing barrage or weir. Most of the canals of the country belong to this group.
- The development of canal irrigation has taken place mainly in the Northern Great Plains because of existence of perennial rivers here, loose alluvial soil making easy the construction of canals, low gradient of slope and high population pressure on agriculture.
- The development of Tank irrigation has occurred in the Peninsular India since hard rocky structure makes the digging of canals a

difficult task and uneven plateau character favours the formation of many natural tanks in the peninsula.

India now has the largest area under irrigation in the world. Total irrigated area of the country stands at about 40 per cent of the net sown area.

Pisciculture in India

- India has a long coastline of 6,083 km and a continental shelf spreading over 3.1 lakh square km, apart from EEZ (Exclusive Economic Zone) of 2.02 million km².
- India ranks seventh in the total fish production in the world but in inland fisheries, India is 2nd largest country after China.
- Western coast produces about 75 per cent of total fish production of the country, in which Sardine, Mackerel and Prawn are important.
- Percentage of different fishes in the total fish production of the country - Mackerel (33 per cent), Herring (15 per cent), Prawn (10 per cent), others (42 per cent).
- Along the western coast the fishing season is from September to February-March.
- Coastal fishing of the country consists of pelagic fishes such as sardines, mackerel, Bombay-duck, silver bellies, etc.
- Prawn culture is being developed in the brackish waters of the country. Fifty per cent of Prawn export comes from this region.
- In the total export of India, marine products contribute 4 per cent of the total in which prawn contributes 70 per cent value wise.
- Presence of large and lagoons (Chilka and Pulicat) along the east coast provide greater scope for estuarine fisheries.

Table 2.28 Important River Valley Projects

S.No	Projects	River	State	Objective
1	Damodar Valley Project: Damodar Valley Project based on Tenessey valley project of USA eight dams and one barrage (Durgapur) has been constructed in this project Three thermal power stations at Bokaro, Chandrapura and Durgapur	Tilaiya dam - Barakar R. Maithon dam - Barkar R. Bal Pahari- Barakar R. Bermi dam Damodar R. Panchet PahariDamodar R. Konar Dam - Konar R.	Jharkhand and West Bengal	Flood control (main objective), Power generation, irrigation
2	Bhakhra-Nangal ProjectLargest multi purpose project of India. Bhakhra dam is the 2nd highest gravity dam in the world. The name of its reservoir is Govind Sagar.	Sutlej River	Punjab,Haryana, Himachal Pradesh and Rajasthan	Hydel power and irrigation
3	Chambal Project Gandhi Sagar Dam - M.P. • Rana Pratap Sagar Dam –	Chambal River	Rajasthan and M.P.	Hydel power and irrigation

	Rajasthan • Jawahar Sagar/Kota Dam - Rajasthan			
4	Hirakud Project Hirakud dam is the largest main stream dam in the world.	Mahanadi River	Odisha	Hydel electricity and irrigation
5	Beas Project Pong Dam has been constructed under this project.	Beas River	Punjab,Haryana, Himachal Pradesh and Rajasthan	Irrigation
6	Indira Gandhi Canal Project	Confluence of Dutej and Beas River	Rajasthan	Hydel Power
7	Idduki Project	Periyar	Kerala	Hydel Power
8	Chukha project	Wang-Chu ruver	Indian and Butan	Hydel power and irrigation
9	Sardar Sarovar Project	Narmada River	M.P., Maharashtra Gujarat and Rajasthan	Navigation
10	Tulbul Project	Jhelum	J&K	Hydel Power
11	Tanakpur Project	Mahakali	Indian and Nepal	Hydel Power
12	Parvati Hydro-Project	Parvati	Himachal Pradesh	Hydel Power
13	Dulhasti Project	Chenab	J&K	Hydel power and irrigation
14	Subarnrekha Project	Subarnrekha	Jharkand and West Bangak	Hydel power
15	Mahatma Gandhi (Jog Project)	Sharavati	Karnataka	Hydel power and irrigation
16	Shiv Samudram Project Krishnaraj Sagar Constructed on Cauvery	Cauvery	Karnataka	Hydel Power
17	Shravti Project	Shravati	Karnataka	Hydel Power
18	Palivaral Project	Madirapuja	Kerala	Hydel Power
19	Papanashanm Project	Tamaraparni	Tamil Nadu	Hydel Power
20	Mettur Project	Cauvery	Tamil Nadu	Hydel Power
21	Tata Hydro-Project	Lonawala,Balhan and Shivarat Lakes	Maharashtra	Hydel Power
22	Chhibri Hydro project	Ghaghra	Uttarkand	Hydel Power
23	Tungabadra Project	Tungabadhra	Karnataka and Andhra pradesh	Hydel power and irrigation
24	Nagarjuna Sagar Project	Krishna	Andhra Pradesh	Hydel power and irrigation

25	Sri sallam Project	Krishna	Andhra Pradesh	Hydel power and irrigation
26	Manchkund Project	Manchkund	Andhra Pradesh and odisha	Hydel power and irrigation
27	Rihand Project	Rihand	Uttar Pradesh	Hydel power and irrigation
28	Pochmpad Project	Godavari	Andhra pradesh	Irrigation
29	Ukai Project	Tapti	Gujarat	Hydel power and irrigation
30	Farakka Project	Ganga	West Bengal	Navigation and Irrigation
31	Nathpa Jhakri Project	Satluj	West Bengal	Hydel Power
32	Salal Project	Chenab	J&K	Hydel Power
33	Thein Dam Project	Ravi	Punjab,Haryana, Himachal Pradesh and Rajasthan	Irrigation
34	Mayurakshi Project	Mayurakshi	West Bengal	Hydel power and irrigation
35	Kosi Project	Kosi	Bihar and Nepal	Hydel power and irrigation
36	Tehri Dam Project	Bhilanganand Bhagirathi (main)	Uttarakhand	Hydel Power
37	Koyna Project	Koyna	Maharashtra	Hydel Power
38	Ram Ganga Project	Ramganga	Uttarakhand	Hydel power and irrigation
39	Upper Krishna Project	Krishna	Karnataka	Irrigation
40	Matatila Project	Betwa	U.P. and M.P.	Hydel power and irrigation
41	Kunda Project	Kunda	Tamil Nadu	Hydel power and irrigation
42	Tawa Project	Tawa	Madhya Pradesh	Irrigation
44	Sabrigiri (PambaKaki) Project	Kaki	Kerala	Hydel power

19. MINERAL AND ENERGY RESOURCES OF INDIA

Mineral Resources of India

- Mineral is a naturally occurring substance having a definite chemical composition and atomic structure and is exploited economically for various industrial and other purposes.
- The ancient crystalline landmass of India contains both metallic and non-metallic minerals.

Distribution: In India the distribution of minerals is uneven. The important areas of mineral occurrence are :

i. North-Eastern Peninsular Belt: This block consist of Chhotanagpur plateau, Odisha plateau and Chhattisgarh.
   - A large quantity of coal, iron ore, manganese, mica, bauxite, copper,

etc., are found in this belt, which is rightly called the mineral heart of India.

ii. Central Belt: M.P., Chhattisgarh, Maharashtra and Andhra Pradesh are included in this belt.
- This is the second largest mineral region of India.

iii. Southern Region: This region includes Karnataka plateau and Tamil Nadu highland.
- Iron ore, manganese, chromite, etc., are found in this region, but it lacks coal (except Neyveli coal).

iv. South Western Region: Comprising south Karnataka and Goa this region has iron ore, granite, lemenite, zircon, monazite sands.

v. North-Eastern Belt: Spreading along the Aravalis and adjacent Gujarat.
- This region mainly comprises non-ferrous minerals like copper, lead, zinc and uranium, mica, etc. This region also has mineral oil in the Gujarat plains.

Iron Ore

- In India iron ore is mainly found in the Dharwar structure of peninsular India.
- In India we get four types of iron ores:

i. Magnetite: Best quality iron ore, contains 72 per cent pure iron. Mainly found in the Dharwar and Cuddapah system of Tamil Nadu (Salem and Tiruchirapalli districts) Karnataka, Andhra and Kerala.

ii. Haematite: Second best quality, 60-70 per cent pure iron, constitutes 74 percent of the total iron ore reserves of the country, concentrated in Jharkhand, Odisha, Chhattisgarh, Karnataka, etc.

iii. Limonite: Contains 40-60 per cent iron, found in the Raniganj coal field, Kangra valley, Garhwal etc.

iv. Siderite: Inferior variety.

- India has the largest iron ore reserves in Asia.
- Jharkhand has the largest reserves of iron ore followed by Odisha.
- Karnataka has the largest reserves of Magnetite in India.

Production and Distribution

1. **Jharkhand:** Here iron ore is mainly found in Singhbhum district, iron is of high quality haematite. Noamundi, Gua, Jamda and Manoharpur are important mining centres in Singhbhum.
2. **Chhattisgarh:** Bailadila in Bastar district and Dallirajhara in Durg district are important producing regions. Iron ore of Bailadila is exported to Japan.
3. **Karnataka:** Baba Budan hills and Kudremukh region in Chikmangloor, Sandur region of Bellary district, Chitradurg and Shimoga districts are important regions. Iron is exported from Kudremukh region to Iran.
4. **Odisha:** Gurumahisani, Badampahari, Sulepat, Kiriburu, Daimatri are important mining centres in Mayurbhanj, Sundergarh and Keonjhar districts.
5. **Maharashtra:** Mainly in Chanda and Ratnagiri districts.
6. **Goa: Goa:** Major mining centres are located in Mandvi and Juari river valleys. Reserves: Jharkhand, Odisha, Karnataka and M.P.

Manganese

- Manganese ore is an important ingredient in the manufacture of iron and steel.
- India is the third largest producer of manganese in the world.

Production and Distribution:

1. Odisha: Mainly in Keonjhar, Sundergarh, Kalahandi and Koraput districts.
2. Maharashtra: Mainly in Nagpur, Bhandara and Ratnagiri districts.
3. Madhya Pradesh-Chhattisgarh: Found in the Balaghat, Chindwara, Madla, Bilaspur, Jabalpur districts, etc.
4. Karnataka: Bellari, Shimoga, Northern Canara, Chikmangloor districts, etc. Production: Odisha, Maharashtra, Madhya Pradesh and Karnataka.

Bauxite

India has adequate reserves of high quality bauxite. Bauxite is an ore of Aluminium and its formation is related to the formation of laterite rocks. Production and Distribution

1. **Odisha:** There are two huge reserves of bauxite in Odisha: (i) Panchpatmalli (ii) Gandhamardam hills.
2. **Andhra Pradesh:** Anontagiri plateau region around Vishakhapatnam district contains good reserves.

3. **Madhya Pradesh:** There are two important regions here (i) Katni-Jabalpur region (Bargawan hills) (ii) Amarkantak region.
4. **Jharkhand:** Mainly in Ranchi, Palamau (one of the best qualities) and Lohardagga districts
5. **Gujarat:** Khera, Jamnagar, Sabarkantha, etc.
6. **Maharashtra:** Kolhapur, Thane and Ratnagiri districts.

Production: Odisha, Gujarat, Jharkhand.
Reserves: Odisha, Andhra Pradesh, M.P., Maharashtra.

Copper

Copper is found in the country in the form of sulphide (caleopyrite, calcosite) and oxides (cuprite). There is shortage of copper in the country.

Production and Distribution

1. **Jharkhand:** Mosabani, Rakha and Sonamakhi are important copper mines in Singhbhum district. A copper melting plant is located at Maubhandar,
2. **Rajasthan:** Khetri Copper belt in Jhunjhunu district is the most important one followed by Kho-Dariba of Alwar District.
3. **Andhra Pradesh:** Guntur (Agni-Gundala belt), Nellore and Nalconda districts are important areas.
4. **Madhya Pradesh:** Malajkhand region of Balaghat district.
5. **Other Areas:** Kalyani, Chitradurg, Gulberg in Karnataka, Dikchu (Sikkim). Production: M.P., **Rajasthan, Jharkhand.**

Chromite

- An oxide of iron and chromium, widely used in the metallurgical and chemical industries.
- Largest producer of chromite is Odisha followed by Karnataka. Japan is the principle buyer of our chromite.

Tungsten

- Wolfram is the ore of tungsten.
- Tungsten is used in manufacturing of steel.
- Degana in Rajasthan and Chandpathar in W.B. are the main areas.

Mica

- India is the largest producer of mica in the world. Distribution and Production

1. Jharkhand: The state has the largest reserves which occurs mainly in Giridih and Hazaribagh districts. Kodarma in Hazaribagh district is the world's largest market of mica.
2. Andhra Pradesh: Found mainly in Vishakhapatnam, Krishna and Nellore districts.
3. Rajasthan: Jharkhand, Andhra Pradesh, Rajasthan.

Gold

Gold in India is found in the veins of quartz rocks and in the sands of rivers.

Distribution and Production

1. Karnataka: Two regions are important - (i) Kolar gold mines, (ii) Hutti region.
2. Andhra Pradesh: (i) Chigragunta mines, (ii) Ramgiri

Apart from that, gold has also been found in Salem of T.N., Singhbhum of Jharkhand, Sambalpur and Koraput of Odisha, etc.
Production: Karnataka, Jharkhand, Andhra Pradesh.

Silver

It occurs generally with the ores of zinc, lead and copper.

Producing regions: (i) Karnataka: Kolar region, Chitradurg, (ii) Rajasthan: Jawar region.

Lead

It occurs in the mixed form with zinc and silver. Its chief ore is galena.

Producing regions: (i) Rajasthan: The only mine of lead in India is situated in this state in Jawar. Lead deposits has also been found in Bhilwara and Rajsamand districts.

Zinc

It is used in making dry batteries, electrodes, etc. Ninety-nine per cent of zinc comes from Jawar area in Udaipur (Mochia-magra, Jwarmala) of Rajasthan.

Zinc Smelting in India

i. Debari: Rajasthan (largest)
ii. Tundu: Kerala
iii. Vishakhapatnam: Andhra Pradesh
iv. Chanderia (Chittorgarh): Rajasthan

Asbestos

Distribution: (i) Rajasthan: Ajmer, Bhilwara, Pali, Alwar, Udaipur, etc. (ii) Andhra Pradesh: Cudappah, Anantpur, Mahboobnagar, (iii) Jharkhand:

Singhbhum. Production: Rajasthan, Andhra Pradesh.

Dolomite

Limestone with more than 45 per cent magnesium is called dolomite. It is refractories and also in glass and fertiliser industry. Production: Odisha, Chhattisgarh, Andhra Pradesh and Jharkhand.

Limestone

1. Rajasthan: Nagaur (Makrana), Rajsamand, Jaisalmer, Ajmer, etc.
2. Madhya Pradesh: Jabalpur, Baital, Siwani, Chhindwara.
3. Andhra Pradesh: Vishakhapatnam.

Gypsum (Salenite)

Production: Rajasthan (95 percent), Tamil Nadu, J&K.

Table 2.29 Other Minerals and their Producing States

	Mineral	State
1.	Pyrites	Bihar (Rohtas)
2.	Rock Salt	Himachal Pradesh (Mandi)
3.	Phosphorus	M.P., Rajasthan, U.P.
4.	Magnesite	Karnataka, Tamil Nadu, Uttar Pradesh
5.	Kaolin	Karnataka, Andhra Pradesh, Rajasthan
6.	Fire Clay	Rajasthan, M.P., Gujarat
7.	Feldspar	Rajasthan, Gujarat, Maharashtra
8.	Barytes	Andhra Pradesh (Cudappah), Maharashtra
9.	Diamond	M.P. (Panna), Andhra Pradesh
10	Graphite	Odisha, Rajasthan, Andhra Pradesh
11	Nickel	Odisha and Jharkhand
12	Sulphur	Tamil Nadu
13	Tin	Jharkhand
14	Kyarite (India is largest producer)	Jharkhand (Saraikela), Maharashtra, Karnataka
15	Apatite	Jharkhand (Singhbhum), Andhra Pradesh (Vishakhapatnam)

Energy Resources

Coal

Coal is the most important source of energy in India. It contributes 65 per cent of the total electricity generation. Sixty-one per cent of the total demand of commercial energy is fulfilled by the coal.

- Coal is an inflammable organic substance composed mainly of hydrocarbons and is found in between the sedimentary rocks.
- Coal in India is found in the rocks of three periods: (i) Gondwana period, (ii) Mesozoic period, (iii) Tertiary period.
- 96 per cent of total coal reserves of the country belongs to Gondwana period which contributes 98 per cent of total production. This coal is mainly of bituminous types found mainly in peninsular plateau.
- The coal of mesozoid period is insignificant in the country.
- Tertiary coal ranges from lignite to anthracite and it is found in the regions outside peninsula also.

Distribution and Production

- Distribution of coal is concentrated in the east of 78°E longitude in the plateau region. mainly in the various river valleys.

Coal Fields of Gondwana Period

1. Damodar Valley Coal Field: This valley contains India's largest coal reserves. This is also the largest producing region of the country, spreading over Jharkhand and West Bengal.
2. Son Valley Coal Field: This region comprises mainly the coal fields of Madhya Pradesh, situated in Sohagpur, Umaria, Tatpani etc.,
3. Mahanadi Valley Coal Field: It includes Korba Jhilmili, Chirmiri of Chhattisgarh, Talcher and Sambalpur of Odisha.
4. Godavari Valley Coal Field: Singreni, Sasti, Tandur, Kothagudem are important coal fields in this region.

5. Pench and Kanhan Valley Coal Field: This field is situated in southern Madhya Pradesh.
6. Vardha Valley Coal Field: Nagpur, Yavatmala, Chandrapur of Maharashtra comes under this field.

Tertiary Coal Field

i. Dafla coal field in Arunachal Pradesh
ii. Makum coal field in Assam
iii. Darjeeling coal field
iv. Jammu and Kashmir coal field

Lignite Coal Field

1. Tamil Nadu: Largest reserves of lignite coal are found mainly in the Neyveli.
2. Rajasthan: Mainly in the Palna (Bikan
3. **Reserves:**

Table 2.30 Atomic Power Centre

S.no	Atomic power centre	Location
i.	Tarapur (India's First, 1969)	Maharashtra
ii.	Kota	Rajasthan
iii.	Naroura	Uttar Pradesh
iv.	Kalpakkam	Tamil Nadu
v.	Kalkrapar	Gujarat Karnataka
vi.	Kaiga Kudankulam	Tamil Nadu

Table 2.31 Thermal Power Projects

S.No	Project	Capacity (megawatt)
1.	Singrauli	2000
2.	Korba	2600
3.	Ramagundam	2600
4.	Farakka	2100
5.	Vindhyanchal	4200
6.	Rihand	3000
7.	Kahalgaon	2340
8.	Rajdhani	
9.	Talcher	3000
10.	Gasbased	
	i. Kawas	645
	ii. Auraija	652
	iii. Anta	413

Petroleum

- Mineral oil is mainly found in anticlinal formations of sedimentary rocks of Mesozoic and Tertiary period.
- The reserves of petroleum have been estimated by International Geological Conference to be of 6,000 million tonnes.

Distribution

1. Oil regions of Assam and Meghalaya
   - Digboi, Naharkatiya and Moran regions and Surma valley are ancient oil fields of Assam.
   - Rudrasagar and Lakhwa are important new oil fields of Assam.
2. Gujarat Oil Field: Ankleshwar is the most important oil field of Gujarat.
   - Second major region is Cambay (Lunej) field. Ahmedabad, Navgaon, Kusamb, Kalol, Mehsana, etc., are important oil fields of second belt.
   - Recently oil has also been struck in western Rajasthan (Jaisalmer), Cauveri and Godavari basins.
3. Off-shore Oil Fields of India

i. Mumbai High Oil Field: This oil field is situated in the Arabian sea, west of Mumbai. This is the largest oil producing field of India.
   - The drilling is done by specially designed platform called Sagar-Samrat.

ii. Bassein Oil Field: It is situated in south of Mumbai-High. (iii) The Gulf of Cambay Oil Field: Huge reserves of oil have been found near Aliabet island located here.
   - 27 prospective basins have been identified.

Reserves: Mumbai-High, Assam, Gujarat

Production: Mumbai-High (64 per cent), Gujarat, Assam

- Two third of total petroleum production of India comes from off-shore region.
- Presently India imports 60 per cent of its requirement of petroleum and petroleum products.

Natural Gas

- Natural gas in India is found in Mumbai-High, Bassein, Gujarat, Rajasthan and Cauvery delta.
- Natural gas of Mumbai-High is transported from Hazira of Gujarat to Jagdishpur of UP through a pipeline called HBJ pipeline.

- Fertiliser factories based on gas of HBJ pipeline

(i) Sawai Madhopur, (ii) Bijapur, (iii) Babrala, (iv) Aonia, (v) Shahjahanpur, (vi) Jagdispur

- Refinary established by Reliance in Motikhawadi in Jamnagar district of Gujarat is the largest grassroots refinery in the country.

Nuclear Minerals

Uranium

It is found in Dharwar and Archaean rocks of India.

Producing Region: (i) Jharkhand - Jadugoda mine of Singhbhum district is an important producing region of Uranium, (ii) Rajasthan (Bisundih, Ajmer), Umra (Udaipur), (iii) Andhra Pradesh (Nellore).

Some amount of Uranium has also been found in Kullu (HP), Dehradun and Chamoli district (Uttarakhand) and in Meghalaya.

Thorium

- It is obtained from monazite.
- India has the largest reserves of monazite.
- Monazite is mainly found in the sands of Kerala. Apart from that thorium is also found in Hazaribagh, Udaipur and in Nilgiri.

20. INDIAN INDUSTRIES AND HUMAN GEOGRAPHY

- In India, the modern industrial sector in an organised pattern started with the establishment of cotton textile in Mumbai in 1854.
- The post independence period witnessed a systematic process for industrialisation through successive Five-Year Plans.

Factors of Localisation

The location of a particular industry is guided by many factors :

i. Geographical Factors: Raw material, energy, transport, labour, water supply, market, climate.

ii. Non-Geographical factors: Capital, policies, organisation, banking, insurance, agglomeration effect, industrial interia.

iii. New Factors: Long distance transmission of energy, export potential of products, the government policies to seek regional parity, etc.

Iron and Steel

- Iron and Steel is a basic industry and is the backbone of industrial development of any country.
- he real beginning was made in 1907 at Sakchi (now Jamshedpur) called TISCO. Locational Factors
- As the industry is weight loosing industry, the localisation is primarily controlled by the availability of raw materials.
- A new trend of localisation near ports is being emphasised. For example, Vizag Plant in A.P. for export purposes.

Aluminium Smelting

The aluminium industry is the second most important metal based industry in India and is an essential pre-requisite for a country's progress and industrial growth.

Locational Factors: About 30 to 35 per cent of the cost of production is accounted for power; thus, availability of power of economic rates is one of the primary pre-requisite for the industry.

Copper Smelting

Indian Copper Corporation was set up in 1924 and a plant was setup at Ghatsila in Singhbhum district of Jharkhand.

- The Hindustan Copper Corporation was established in 1967.
- It took over Indian Copper Corporation in 1972.

At present copper is produced at only two centres. One is located at Maubhandar near Ghatsila in Singhbhum district of Jharkhand and other at Khetri in Jhunjhunu district of Rajasthan.

Lead and Zinc Smelting

- The first lead smelting plant was set up at Tundoo near Dhanbad (Jharkhand). In was taken over by Hindustan Zinc Ltd. (HZL).
- The supply of lead concern of Rajasthan. centrates are obtained from Zawar and Rajpur-Dariba areas
- At present there are four zinc smelters in the country; one each at Alwaye (Kerala), Debari and Chanderia (Rajasthan) and Vishakhapatnam.

Fertilisers Industry

- The location of fertiliser industry is closely related to petro-chemicals. • About 70 per cent of the plants producing Nitrogenous fertilisers use Naptha as raw material and Neatha is a by-product of oil refineries.
- Phosphate plants are dependent on mineral phosphate found in Uttar Pradesh and Madhya Pradesh.
- Recently, natural gas based fertiliser plants are also being set up.
- The first super phosphate plant was established in 1906 at Ranipet (Tamil Nadu).
- The Fertiliser Corporation of India (FCL) was set up in 1961.
- National Fertilizer Limited (NFL) was setup in 1974.
- Later both FCI and NFL were organised into four companies on the basis of feedstock and geographical factors.

Table 2.32 Iron and Steel Plants and Inputs Sources

Plants	Iron Ore	Manganese	Limestone	Coal	Power
TISCO Jamshedpur (Singhbhum Distt) on Kharkai river bank	Gurumahisani (Mayurbanj) Naomundi, Singhbhum	Jod (Keonjihar	Sundargarh Birmitpur	Jharia, West Bokaro	DVC
IISCO-Burnpur,Hirapur,kulti	Damodar Valley, Gua, Bagaiburer	Keonjahar	Biramitpir	Raniganj,Jharia	DVC
VISL-Shimoga distt(Karnataka)	Kemmangyddi area (Chickmanglur Distt)	Locally	Locally	Use of Electricity	HEP, Mahatmaa Gandi HEP
HSL-Rourkela(On Brahmin river bank)	Sunderagarh,Bolani Keonijhar	Barajamda	Purnapani	Bokaro,Jharia,Talcher	Hirakud HEP
HSL-Bhilai (Durg)	Dalli-Rajhara Balaghat Bhahanar	Balaghat	Nandini	Kargali	Korba Thermal Power
HSL – Durgapur(West Bengal on the bank of Damodar)	Gua,Bolani	Jamba(Keonjhar)	Birmitpur	Jharia,Raniganj	DVC
HSL – Bokaro Jhalem-Tamil Nadu	Kiriburu Locally	Jamda	Plamu	Jharia Neyveli (lignite)	DVC
Vishakapattanam	Bailadiala	Balaghat	Nandini	Damodar Valley	HEP
Vijaynagar	Bababudan Hills			Kanhan Valley	Tungbhadra HEP

Machine Tool Industry

- Machine tools form the basis for the manufacturing of industrial, defence equipments, automobiles, railway engines and electrical machinery.
- The manufacturing started in 1932 with the advent of Kirloskar Brother Limited. The Hindustan Machine Tool a public sector undertaking is the largest manufacturer of machine tool in the country.
- The units are located at Bangalore and other at Pinjore (Haryana) Kalamassery (Kerala), Hyderabad, Srinagar and Ajmer.
- The Heavy Machine tool plant at Ranchi was started in 1966. Praga Tool Limited at Secundarabad is mainly meant for defence equipment.

Railway Equipment

- Chittaranjan Locomotive Work was started in 1950, it produces electric locomotive.
- Diesel Locomotive works at (DLW) Varanasi and BHEL at Bhopal private sector, locomotives are produced by TELCO at Jamshedpur.

- Diesel Component Works (DCW) has been set up at Patiala for manufacturing and repair of components, of diesel locos.
- Bulk of passenger coaches are manufactured in Integrated Coach Factory (ICF) Perambur (Chennai) and Rail Coach Factory, Kapurthala (Punjab).

Ship Building

- The major centres of shipbuilding are the Hindustan Shipyards at Vishakhapatnam, Mazgaon Docks, Mumbai, Cochin Shipyard, Cochin, Garden Reach Workshop, Kolkata.

Cement Industry

- Cement factories are located near limestone deposits.
- First mill based on seashall was founded in 1904 in Chennai which proved abortive.
- The real successful attempt was made in 1912-13 when the Indian Cement Co Ltd set up a plant at Porbandar.
- In 1915 plant at Katni (H.P.) was set up and at Lekhari in1916.
- Madhya Pradesh is the leading producer of cement (24 per cent), followed by Andhra Pradesh (20 per cent) Rajasthan (11 per cent) Tamil Nadu (8.5 per cent).

Paper Industry

- The real beginning of paper industry was made in 1870 when a modern paper mill was established at Ballygunj near Kolkata and finally in 1881 at Titagarh in West Bengal.
- It is a weight loosing industry, thus seeks raw material base.
- Bombaoo, Sabai grass and Bagasse are the chief raw materials. Leading producers are following:
  (i) Maharashtra (18 per cent)
  (ii) Andhra Pradesh (13 per cent)
  (iii) Gujarat (10 per cent), U.P., (9 per cent), West Bengal, M.P. and Odisha are other leading states.

Raw Material:

Bamboo (70 per cent), Salaiwood (12 per cent) Sabai (9 per cent) Bagasses (4 per cent).

Sugar Industry

India is the largest producer of sugar. Sugar industry has to be located near the sugarcane growing areas.

Textile Industry

Textile is a broad term comprising Cotton, Jute, Wool and Synthetic fibre textiles. Textile sector is important in terms of employment potential.

Cotton Textile

First cotton textile mill was set up in 1818 at Fort Gloster.

- Cotton textile industry is not a weight loosing industry.
- Its raw material is pure and localised and therefore the industry has developed the tendency of Icoalisation in both raw material and market region.
- This is the only industry in India which is developed in most of all states.

Leading producers are as follow:

Maharashtra: It produces about 43 per cent mill clothes and 17 per cent of yarn.

Gujarat: It is the second largest producer with 23 per cent of mill clothes and 8 cent of yarn. per

Madhya Pradesh: Important centres are Indore, Ujjain, Devas, Ratlam, Mandsore, Gwalior, Bhopal, etc.

Tamil Nadu: Accounts for 33 per cent of the yarn production and 8 per cent of clothes.

Woollen Textile

- Before 1850, the woollen industry in India was largely a cottage industry.
- The real beginning on an organised scale goes back to 1876 with the establishment of 'Lal Imli' at Kanpur.
- It was followed by 'New Egerton Woollen Mills' at Dhariwal and another mill at Bangalore and later on in Mumbai.
- Punjab leads all other states and account for 42 per cent of the mills in India.
- Dhariwal is the largest centre in India. Others are Amritsar, Ludiana, Kharer. Maharashtra is the second largest with Mumbai as most important centre. U.P., Gujarat, Jammu and Kashmir are other important producers of woollen textile.

Silk Industry

The location of silk industry is governed by two factors - prevalence of sericulture practices and availability of skilled labour.

Karnataka (70 per cent of mulberry silk and 50 per cent of silk clothes is the leading producer. West Bengal, Bihar, Jharkhand, Chhattisgarh are other important producing states.

Jute Industry

The first large scale jute industry was set up in 1855 at Rishra near Kolkata.

- This is highly localised industry, about 85 per cent are located between Naihati and Kolkata in West Bengal. Other states are Bihar, U.P. and Odisha.

21. Human Resources of India

- India is the second largest country of the world after China.
- With the current rate of growth of population, India is expected to overtake China by 2050 to become the most populous country on the Earth.
- Our population is more than the population of the USA, Russia, Canada, Australia and Brazil put together.
- It is even more than the combined population of North and South America. • Many of the problems faced by our country are directly or indirectly related to our high population base.
- This is because India's population is over 6 times greater than its area (from the world point of view, the country's 2.4 per cent of world area contain 16.7 per cent of the world population).

2011 CENSUS OF INDIA

- India has a long and rich tradition of conducting census taking. The earliest references of census taking in the country are found in Kautilya's 'Arthashastra' (321-296 B.C.) and later in the writings of Abdul Fazl's in 'Ain-e-Akbari' during the days of Emperor Akbar.
- However, the first systematic and modern population Census, in its present scientific form was conducted non-synchronously between 1865 and 1872 in the country. The first synchronous census in India was conducted in the year 1881.
- The census 2011 was the fifteenth Census in this series as reckoned from 1872 and the seventh since independence. The successful conduct of Census without break since 1872 makes the Indian census unique and unparalleled in the world.
- Census has been conducted in India since 1872 and 2011 marks the first time biometric information was collected.
- The motto of census 2011 was 'Our Census, Our future'.
- Spread across 35 states and union territories, the Census covered 640 districts, 5767 tehsils, 7742 towns and more than Six lakhs villages.
- The cost of the exercise was approximately 2,200 crore this comes to less than $ 0.5 per person, well below the estimated world average of $ 406 per person.
- Information on castes was included in the census following demands from several ruling coalition leaders including Lalu Prasad Yadav, Sharad Yadav and Mulayam Singh Yadav supported by opposition parties Bharatiya Janata Party, Akali Dal, Sena and Anna Dravida Munnetra Kazhagam.
- Information on caste was last collected during the British Raj in 1931.
- There is only one instance of a caste-count in post-independence India. It was conducted in Kerala in 1968 by the Communist government under E.M.S. Namboodiripad to assess the social and economic backwardness of 1968 and the results were published in the Gazetteer of Kerala, 1971.
- The responsibility of conducting the decennial Censuses rests with the Office of Ministry of Home Affairs, Government of India.
- Later, this office was also entrusted with the responsibility of implementation of Registration of Births and Deaths Act, 1969 in the country.
- The Census Organisation was set up on an adhoc basis for each Census till the 1951 Census.
- The Census Act was enacted in 1948 to provide for the scheme of conducting population census with duties and responsibilities of census officers. Shri C. Chandramouli was the Registrar General and Commissioner of 2011 Indian census.
- Census data was collected in 16 languages and training manual was prepared in 18 languages.

The 15th Census of India and the seventh of Independent India-2011 was started on 1 April 2010 with President Pratibha Patil being the first citizen to be enumerated, followed by Vice President Hamid Ansari.

States/ Union Territories	-	35
Total Districts	-	640

Sub-districts	-	5,924
Towns	-	7936
Villages	-	6.41 Lakh

The population of the country as per the provisional figures of Census 2011 is 1210.19 million of which 623.7 million (51.54%) are males and 586.46 million (48.46%) are females.

The major highlights of the Census 2011 (Provisional figures) are as under:

i. The population of India has increased by more than 181 million during the decade 2001-2011.

ii. Uttar Pradesh (199.5 million) is the most populous state in the country followed by Maharashtra with 112 million.

Five Largest Populous State of the Country

Uttar Pradesh	19,95,81,477
Maharashtra	11,23,72,972
Bihar	10,38,04,637
West Bengal	9,13,47,736
Andhra Pradesh	8,46,65,533

Five Least population state of the country

Lakshadweep	64,429
Daman and Diu	2,42,911
Dadra and Nagar Haveli	3,42,853
Andaman and Nicobar Islands	3,79,944
Sikkim	6,07,688

Density of Population (person per sq km)

Density of population of India	**382**
Highest Density in State	Delhi
Lowest Density in State	Arunachal Pradesh

Sex Ratio (females per 1000 Males)

Sex ratio in state	940
Child (0-6 years) sex ratio	914
Highest sex ratio in state	Kerala (1084)
Lowest sex ratio in UTS	Daman and Diu (618)
Highest child (0-6) sex ratio in state	Mizoram (917)
Lowest child (0-6) 914	Haryana (830)

Literacy Rate in India

Total person literacy rate Males	74%
Males	82.14%
Females	65.46%
Highest Literacy Rate in state	Kerala - 93.11%
Lowest Literacy Rate in state	Bihar- 63.82%

Top States/U.T. by Least Population

Rank	State/U.T.	Population
1.	Uttar Pradesh	19.96 crore
2.	Maharashtra	11.24 crore
3.	Bihar	10.38 crore
4.	West Bengal	9.13 crore
5.	Andhra Pradesh	8.47 crore
6.	Madhya Pradesh	7.26 crore
7.	Tamil Nadu	7.21 crore
8.	Rajasthan	6.86 crore
9.	Karnataka	6.11 crore
10.	Gujarat	6.04 crore

Top States/U.T. by Population

Rank	State/U.T.	Population
1.	Lakshadweep	64.43 thousands
2.	Daman	2.43 lakh
3.	Dadra and Nagar Haveli	3.43 lakh
4.	Andaman and Nicobar Islands	3.80 lakh
5.	Sikkim	6.08 lakh
6.	Chandigarh	10.55 lakh
7.	Mizoram	10.91 lakh
8.	Pondicherry	12.44 lakh
9.	Arunachal Pradesh	13.83 lakh
10.	Goa	14.58 lakh

Top States/U.T. by Population Density

Rank	State	Density
1.	Delhi	11297
2.	Chandigarh	9252
3.	Pondicherry	2598
4.	Daman and Diu	2169
5.	Lakshadweep	2013
6.	Bihar	1102
7.	West Bengal	1029
8.	Kerala	859
9.	Uttar Pradesh	828
10.	Dadra and Nagar Haveli	698

Top States/U.T. by Population Growth Rate

Rank	State	Growth Rate
1	Bihar	25.07
2	Rajasthan	21.44
3	Madhya Pradesh	20.3
4	Uttar Pradesh	20.09
5	Gujarat	19.17
6	Lakshadweep	6.23

Top States/U.T. by Sex Ratio

Rank	State	Sex Ratio
1	Kerala	1084
2	Pondicherry	1038
3	Tamil Nadu	995
4	Andhra Pradesh	992
5	Chhattisgarh	991
6	Manipur	987
7	Meghalaya	986
8	Odisha	978
9	Mizoram	975
10	Himachal Pradesh	974

Top States/U.T. by Least Sex Ratio

Rank	State	Sex Ratio
1	Daman and Diu	618
2	Dadra and Nagar Haveli	775
3	Chandigarh	818
4	Delhi	866
5	Haryana	877
6	Andaman and Nicobar Islands	878
7	Jammu and Kashmir	883
8	Sikkim	889
9	Punjab	893
10	Uttar Pradesh	908

Top Ranking States/U.T. in Urbanisation

Rank	State	Urban Population (%)
1	Delhi	97.5
2	Chandigarh	97.25
3	Lakshadweep	78.08
4	Daman and Diu	75.16
5	Pondicherry	68.13
6	Goa Mizoram	62.17
7	Tamil Nadu	51.51
8	Kerala	48.45
9	Dadra and Nagar	47.72
10	Haveli	46.62

Lowest Ranking States/U.T. in Urbanisation

Rank	State	Urban Population (%)
1	Himachal Pradesh	10.04
2	Bihar	11.3
3	Assam	14.08
4	Odisha	16.68
5	Meghalaya	20.08
6	Uttar Pradesh	22.28
7	Arunachal	22.67
8	Chhattisgarh	23.24
9	Jharkhand	24.05
10	Rajasthan	24.89

Top Urban Cities of India by Population

Rank	City	State	Urban Population (%)
1	Mumbai	Maharashtra	1.84 crore
2	Delhi	Delhi	1.63 crore
3	Kolkata	West Bengal	1.41 crore
4	Chennai	Tamil Nadu	86.96 lakh
5	Bangalore	Karnataka	84.99 lakh
6	Hyderabad	Andhra Pradesh	77.49 lakh
7	Ahmadabad	Gujarat	63.52 lakh
8	Pune	Maharashtra	50.50 lakh
9	Surat	Gujarat	45.85 lakh
10	Kanpur	Uttar Pradesh	9.20 lakh

Top 10 Districts By Population

Rank	City	State	Population
1	Thane	Maharashtra	1.11 crore
2	North Twenty Four Parganas	West Bengal	1.01 crore
3	Bangalore	Karnataka	95.89 lakh
4	Pune	Maharashtra	94.27 lakh
5	Mumbai Suburban	Maharashtra	93.32 lakh
6	South Twenty Four Parganas	West Bengal	81.53 lakh
7	Barddhaman	West Bengal	77.24 lakh

8	Ahmadabad	Gujarat	72.08 lakh
9	Murshidabad	West Bengal	71.02 lakh
10	Jaipur	Rajasthan	66.64 lakh

Top Districts By Highest Sex Ratio

Rank	City	State	Sex Ratio
1	Mahe	Pondicherry	1176
2	Almora	Uttarakhand	1142
3	Kannur	Kerala	1133
4	Pathanamthitta	Kerala	1129
5	Ratnagiri	Maharashtra	1123
6	Rudraprayag	Uttarakhand	1120
7	Kollam	Kerala	1113
8	Thrissur	Kerala	1109
9	Pauri Garhwali	Uttarakhand	1103
10	Alappuzha	Kerala	1100

Top 10 Most Densly Populated Districts

Rank	District	State	Density
1	North East Delhi	Delhi	37346
2	Chennai	Tamil Nadu	26903
3	East Delhi	Delhi	26683
4	Kolkata	West Bengal	24252
5	Central	Delhi	23149
6	Mumbai Suburban	Maharashtra	20925
7	Mumbai City	Maharashtra	20038
8	West Delhi	Delhi	19625
9	Hyderabad	Andhra Pradesh	18480
10	North Delhi	Delhi	14973

Some facts of Census 2011

- Census 2011 mascot is a female enumerator (who everybody would indemnify as the school teacher next door).
- The population of India has increased by more than 181 million during the decade 2010-2011.
- The absolute addition is slightly lower than the population of Brazil, the fifth most populous country in the world.
- The population of India, at 1210.2 million, is almost equal to the combined population of U.S.A., Indonesia, Brazil, Pakistan, Bangladesh and Japan put together (1214.3 million).
- The percentage decadal growth during 2001-2011 has registered the sharpest decline since Independence - a decrease of 3.90 percentage points from 21.54 to 17.64 per cent Of the total population, 623.7 million are males and 586.5 million are females.
- Uttar Pradesh (199.5 million) is the most populous state in the country followed by Maharashtra with 112 million.
- The combined population of Uttar Pradesh and Maharashtra is bigger than that of the US.
- While Dadra and Nagar Haveli and Pondicherry has the highest population growth rate of about 55 per cent, Nagaland has the lowest, 0.47 per cent.
- The density of population is highest in Delhi, followed by Chandigarh.
- The report said that Jammu and Kashmir, Bihar and Gujarat show decline in sex ratio while 29 states show an increase.
- Population (0-6 years) 2001-2011 registered minus (-) 3.08 per cent growth with minus (-) 2.42 for males and (-) 3.80 for females.
- The report further said that the literacy rate has gone up from 64.83 per cent in 2001 to 74.04 per cent in 2011 showing an increase of 9.21 per cent.



22. INDIAN TRANSPORT AND TRADE

TRANSPORT

Total Rail Route (2015-16)	67,368 km 2
Electrified Rail Route (31 March 2019)	9,376 km (43.6%)
Percentage of Passenger Traffic Operated on Electric Traction	54.00%
Percentage of Freight Traffic Operated on Electric Traction	65.00%
Rail Operating Ratio (2017-18)	98.44%
Rail Operating Ratio (2018-19)	96.20%
Asia's First and World's Second Largest Rail System	Indian Railways
Largest Railway Zone.	Northern Railway
Total Road Network	56 lakh km (approximate)
Total Length of National Highways	1,01,011 km
Total Length of State Highways	1,76,166 km
Longest National Highway	NH 44 (3,806 km)
Shortest National Highway	NH966B (6 km)
State with Highest Road Length	Maharasta
Number of Major Ports	13
Number of Non-major Ports	200

Transport In India

Road Transport

- The total length of roads in India is 5,603,293 km.
- Maharashtra also has the largest length of surfaced roads in India followed by Tamil Nadu, Uttar Pradesh and Gujarat.
- Among the states, Goa has the highest road length per hundred square km area, followed by Kerala and Tamil Nadu.

Table 2.33 Length of Roads (Lakh Km)

Type	1950-51	2010-11	2015-16
Surfaced roads	1.57	25.25	35.01
Unsurfaced roads	2.42	21.65	21.02
Total	3.99	46.9	56.03

Classification of Roads

The Nagpur Plan (1943) has classified Indian roads into four categories, viz. National highways, state highways, district roads and village roads.

1. National Highways

- National highways are those major roads, the construction and maintenance of which are the responsibility of central government.
- The total length ways constitute only 2 per cent of the total length of surfaced roads in the country; their share in the total road traffic is nearly 40 per cent. Some longest national highways in India connecting the Indian states and cities:

National Highway No. 44

The National Highway (NH) 44 is the longest national highway in India with a length of 3,745 kilometres running from Srinagar in the north to Kanyakumari in the south.

It covers the entire nation and connects 11 states and about 30 important cities with each other. This highway came into being after fully or partially merging seven national highways NH 1A, NH 1, NH 2, NH 3, NH 75, NH 26 and NH 7. The Central Public Works Department (CPWD) takes care of the maintenance of this highway.

Total Length - 3,745 km

Connecting States Jammu & Kashmir, Punjab, Haryana, Delhi, Uttar Pradesh. Madhya Pradesh, Maharashtra, Telangana, Andhra Pradesh, Karnataka, and Tamil Nadu.

National Highway No. 27

National Highway 27 sits at the second position in the list of the longest national highways in India. It is 3,507 km long and connects the eastern part of India with the western part. A part of north-

south east-west corridor of NHAI, this highway runs from Porbandar in Gujarat to Silchar in Assam. It connects 7 states and 47 cities to each other on a single stretch. NH 27 is considered as the economical pulse of the country.
Total Length - 3,507 km
Connecting States - Gujarat, Rajasthan, Madhya Pradesh, Uttar Pradesh, Bihar, West Bengal and Assam.

National Highway No. 48
National Highway 48 came into existence after adjoining two previous national highways, i.e. NH 4 and NH 8. It runs for a distance of 2,807 km and connects the northern states to the southern states. The highway starts from New Delhi and terminates in Chennai. It became the most used highway as it connects the major states and cities to each other. The Delhi-Gurugram expressway, Jaipur-Kishangarh expressway and the Western Expressway constitute a part of this highway.
Total Length - 2,807 km
Connecting States - Delhi, Haryana, Rajasthan, Gujarat, Maharashtra, Karnataka and Tamil Nadu.

National Highway No. 52
National Highway 52 connects the north of India to the south of India. This 2,317-km-long highway begins from the city of Sangrur in Punjab and ends at Ankola city in Karnataka. This highway also shares connectivity with NH 7 near Sangrur and NH 66 near Ankola. The highway is economically beneficial due to its connectivity with the major commercial cities of India.
Total Length - 2,317 km
Connecting States - Punjab, Haryana, Rajasthan, Madhya Pradesh, Maharashtra and Karnataka.

National Highway No. 30
The 2,040-km-long National Highway 30 starts from Sitarganj in Uttarakhand and terminates at Ibrahimpatnam in Andhra Pradesh. The highway connects with NH 9 in the beginning and with NH 65 at the end. It is considered as one of the safest highways in India owing to the less number of road accidents.
Total Length - 2,040 km
Connecting States - Uttarakhand, Uttar Pradesh, Madhya Pradesh, Chhattisgarh, Andhra Pradesh and Telangana.

National Highway No. 6
National Highway 6 offers some amazing and tantalizing view of the mountains as it passes through the north-eastern stretch of India. It is 1,873 km long and is said to be the backbone of the northeast as it connects Assam, Mizoram, and Meghalaya with each other. This highway shares its connectivity with NH 44, NH 37, NH 2, NH 54, NH 53, NH 40 and NH 154.
Total Length - 1,873 km
Connecting States – Meghalaya, Assam and Mizoram.

National Highway No. 53
This national highway is 1,781 km long and passes through the states of Gujarat, Maharashtra, Chhattisgarh and Odisha. It starts from Hajira in Gujarat and ends in Paradip Port in Odisha. It is built by making use of the best technology. NH 53 is a segment of the Asian Highway Network 46 in India. Total Length - 1,781 km
Connecting States - Gujarat, Maharashtra, Chhattisgarh and Odisha.

- The length of national highway is longest in Madhya Pradesh followed by Maharashtra
- Golden Quadrilateral is a highway network connecting Delhi, Mumbai, Chennai and Kolkata. It consists of building 5,846 km of 4/6 express highways. As on 31 October 2010, 5806 km of entire work has been completed.

Super Highway Project
Under this project, two six-lane express highways are to be constructed from Kashmir to Kanyakumari and Silchar to Saurashtra. These highways will meet at Jhansi.

2. State Highway
These are constructed and maintained by the state PWDs. Among the states, Maharashtra has the longest network of state highways followed by Gujarat, Madhya Pradesh and Karnataka.

3. District Roads
The roads mostly connect district head quarters and towns.

4. Village Roads
Village roads are constructed and maintained by village Panchayats. These are mostly unsurfaced roads.

Railways

- Indian railway is the largest railway system in Asia and forth largest system in the world. It is the biggest public undertaking in the country.
- The first train in India started off from Bombay to Thane in 1853.

Table 2.34 Railway Headquarters

Railway zone	Headquarters
Central	Mumbai, Victoria Terminals
Eastern	Kolkata
Northern	New Delhi
North Eastern	Gorakhpur
North East Frontier	Maligaon-Guwahati
Southern	Chennai
South Central	Secunderabad
South Eastern	Kolkata
Western East	Mumbi-Churchgate
Coast East	Bhubaneshwar
Central North	Hajipur
Central North	Allahabad
Western South	Jaipur
Western	Bangalore (Hubli)
West Central	Jabalpur
South East Central	Bilaspur

- The Indian railways operate in three different gauges: 1. Broad gauge (1.676 m), 2. Meter guage (1 m), 3. Narrow guage (0.762 m). The broad guage accounts for nearly 70 per cent of total rail line.
- Northern railway having length of 10995 km is the longest railway.
- Punjab has the highest density of rail road per thousand square km of area, followed by West Bengal and Haryana
- The density of railways is highest in the northern Great Plains due to its high population density level topography, proximity of mineral reach areas etc.
- The peninsular plateau has low density of railway due to uneven topography, proximity of mineral reach areas, etc.
- The fleet of locomotive of Indian railway consist of diesel, electric and steam engine. About 23 per cent of the route is electrified.
- On an average 13 million people are moved everyday by the Indian railway.
- The major commodities transported by railway in their decreasing order of amount are coal, cement, iron, petroleum, fertilisers, etc.
- Indian Railways run 6 units to manufacture rolling stock: (i) Chittaranjan Locomotive Works, Chittaranjan, (ii) Diesel Locomotive Works, Varanasi, (iii) Integral Coach Factory, Perambur, (iv) Rail Coach Factory, Kapurthala, (v) Wheel and Axle Plant, Bangalore, (vi) Diesel Component Works, Patiala.

Luxury Tourist Trains

- Palace on Wheels (1982)
- Deccan Odyssey (2001)
- Golden Chariot (2008)
- Royal Rajasthan on Wheels (2009)
- Maharaja's Express (2010)

Water Transport

Waterways are an important mode of transport for both passenger and cargo traffic in India. It includes inland water ways and seaways.

Inland Waterways

There are 111 designated National Waterways (NWs) in India identified for the purposes of inland water transport, as per The National Waterways Act, 2016. Out of the 111 NWS, 106 were created in 2016. The NW network covers around 20,275.5 km. NW-1, 2, & 3 are already operational. Cargo as well as passenger / cruise vessels are plying on these waterways.

The National Waterways Bill, 2015

- The National Waterways Bill, 2015 was introduced in Lok Sabha on May 5, 2015 by the Minister of Road Transport and Highways and Shipping, Mr. Nitin Gadkari.
- Under Entry 24 of the Union List of the Seventh Schedule of the Constitution, the central government can make laws on shipping and navigation on inland waterways which are classified as national waterways by Parliament by law.
- The Bill identifies additional 101 waterways as national waterways. The Schedule of the Bill also specifies the extent of development to be undertaken on each waterway.
- The Bill repeals the five Acts that declare the existing national waterways. These

five national waterways are now covered under the Bill.

- The Statement of Objects and Reasons of the Bill states that while inland waterways are recognised as a fuel efficient, cost effective and environment friendly mode of transport, it has received lesser investment as compared to roads and railways. Since inland waterways are lagging behind other modes of transport, the central government has evolved a policy for integrated development of inland waterways
- Cheapest means of transport and is therefore suitable for carrying heavy and bulky materials.
- Fuel-efficient and environment friendly mode of transport.
- Share of inland water transport is only 1 per cent in the country's transport system.
- India has about 14,500 km of navigable waterways, which comprises rivers, canal, backwaters, creeks, etc.
- At present, only 3700 km of major rivers are navigable by mechanised flat bottom crafts, but only 2000 km are actually used.
- Out of 4,300 km of the network of navigable canals, only 900 km is navigable by mechanised crafts.
- The inland Waterways Authority of India was setup in 1986 for the development, maintenance, and regulation of National Waterways in the country. country; ten other
- At present there are only three National waterways in the waterways are being considered for up gradation as National Waterways.
- National waterways -1: The Allahabad-Haldia stretch of the Ganga-Bhagirathi-Hoogly river system 1620 km); National Waterways 2: The Sadiya-Dhubri stretch of the Brahmaputra rivers (891 km); National Waterways 3: The west coast canal from (205 km). -Kottapuram to Kollam along with Udyogmandal and Champakar canals
- Besides the National waterways, the deltaic regions of the Godavari, Krishna and Mahanadi rivers, the Barak river, the Mandovi and the Juari rivers of Goa, the Backwaters of Kerala are also used as inland waterways.
- Buckingham canal in Andhra Pradesh and Tamilnadu and the Cumberjua canal in Goa were once very important navigable canals.

Seaways

- India has a vast coastline of about 7,516 km and over two million square kilometres of Exclusive Economic Zone. Shipping provides transport facilities in this vast coastal tract.
- About 98 per cent of the overseas trade is moved by the seaways.
- Coastal shipping also carries domestic traffic.
- The country has the largest merchant shipping fleet among developing countries and ranks 17th in the world in shipping tonnage.
- The overall share of the Indian vessels in the country's overseas trade is about 3.15 per cent only.
- Coal and petroleum products constitute bulk of the cargo.

Sea Ports

- India has twelve major ports, six on each coast, and 185 minor.
- Major ports are Mumbai, Jawaharlal Nehru (Nhava Sheva), Kandla, Mormugao,
- New Mangalore and Cochin on the West Coast; and Kolkata/ Haldia, Paradip, Vishakhapatnam, Chennai, Ennore and Tuticorin on the east coast.
- The major ports are in the jurisdiction of central government, while minor ports come under the jurisdictions of the respective state governments.
- Maharashtra has the largest no. of Minor Ports (53), followed by Gujarat (40).

Mumbai

- Mumbai is a natural harbour and the biggest port of the country. This port played very crucial role in the industrial development of the country.
- To release the pressure of the Mumbai port a new mechanised port named Jawaharlal Nehru port has been

developed at Nhava Sheva, off the Mumbai port.

Kandla

- It was the first port developed soon after the independence to ease the increased pressure on Mumbai port in the wake of loss of Karachi port to Pakistan.
- In order to cater to the north western part of the country, Kandla was developed as a major part.
- The traffic handled at Kandla consists of crude petroleum, petroleum products, fertilisers, food, cotton, cement, sugar, edible oil and scrap.

Mormugao

- Mormugao located in Goa, is a natural harbour.
- It is mainly involved in export of iron ore, fish products, coconut and spices.
- Among the import consignments are fertilisers, chemicals, food articles, etc.

New Mangalore

- Located in the state of Karnataka, caters to the export of Kudremukh iron ore and iron concentrates.
- It also handles fertilisers, petroleum products, edible oils, coffee, tea, wood, pulp, yarn, granite stone, molsses, etc.

Cochin

- Cochin in Kerala handles crude petroleum and petroleum products along with fertilisers and raw materials.
- It caters to the needs of Kerala, South Karnataka and south-western Tamil Nadu.

Kolkata

- It is a tidal port and requires constant degrading of Hughly for maintaining a minimum level of water in the river.
- To ensure its navigability, water is supplied from the Farrakka barrage on the Ganga.
- Kolkata port serves very large and rich hinterland.
- Another port at Haldia 105 km downstream from Kolkata, has been constructed to remove the congestion at Kolkata port.
- These ports jointly handle a variety of cargo among them engineering goods, machines, petroleum and petroleum products, chemicals, tea, sugar, iron and steel, jute products, cotton and cotton yarn are major ones.

Paradip

- On Odisha coast, mainly handles iron ore and coal.

Vishakhapatnam

- Vishakhapatnam in Andhra Pradesh is the deepest land-locked and protected port.
- The traffic handled by this port consists of iron ore, crude oil, petroleum products and fertilisers.

Chennai

- Chennai is also one of the oldest but artificial port on the east coast.
- It handles petroleum and its products, fertilisers, iron ore and general cargo.

Ennore

- Ennore a new port; has recently been constructed 25 km north of Chennai.
- It has been developed to reduce the pressure on Chennai port. The Ennore Port Company Limited manages this port.

Tuticorin

- Tuticorin located in the extreme south is a new port in Tamil Nadu. It deals with a variety of cargoes including coal, salt, food-grains, edible oils, chemicals and petroleum products. sugar,

Air Transport

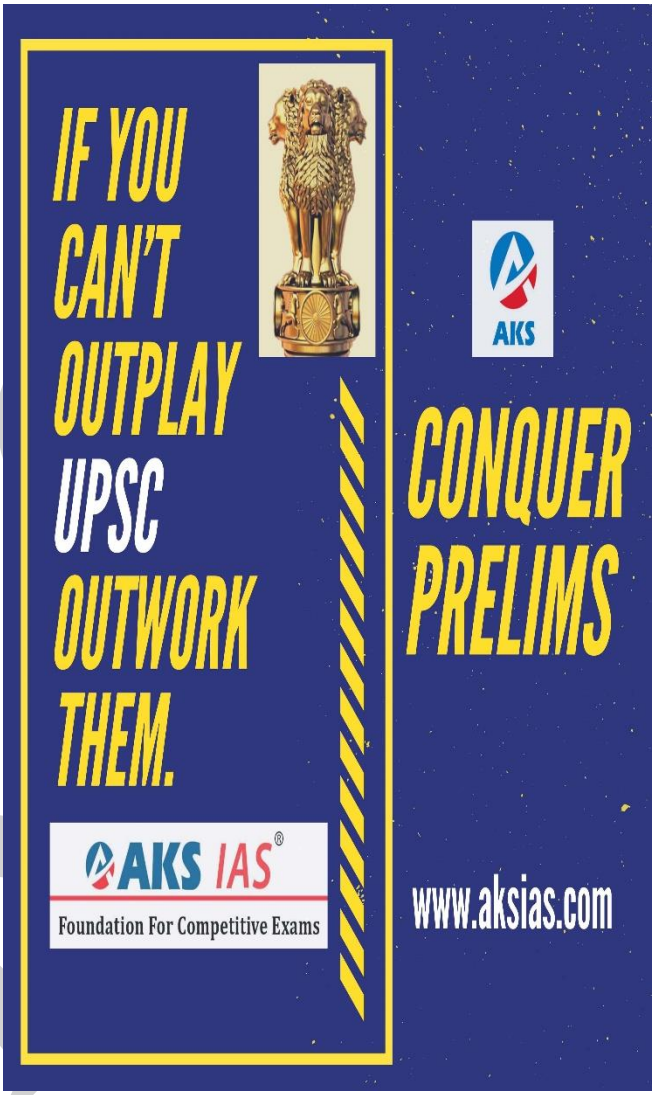
- There are five international airports - Delhi (Indira Gandhi International AirportPalam); Kolkata (Dum Dum); Mumbai (Santa Cruz); Chennai (Meenabakkam) and Kerala (Thiruvananthapuram).
- Besides, there are 87 aerodromes and 20 civil enclaves maintained by Civil Aviation Department.
- The Civil Aviation centre in Fursatganj near Allahabad provides, among other things, ground training to the pilots. India has bilateral air services agreements with 88 countries.

Air India established in 1953 is having bilateral air services agreement with 90 countries as on 1 January 1998.
Indian Airlines established in 1953, operates to 72 domestic (including Alliance Air operations) and 16 international stations in 14 countries. Indian Airlines, in 1999, with a fleet of 52 aircraft handled 200 flights a day.
Pawan Hans Limited basically provides helicopter support services to oil sector, hill station and remote areas. It also provides air support services to several customers which include ONGC, Punjab, M.P., Lakshadweep Administration, GAIL, BSF and also caters to private sector.

Posts and Telegraphs

- The first Indian postal stamp was issued in 1852 in Karachi.
- The postal department was setup in 1854 when nearly 700 post offices were already functioning.
- Today, there are about 1,53,454 post offices.
- For the efficient and correct handling of the volume of mail, a numerical postal address code, known as the Postal Index Number (PIN), was introduced with digits which help to identify and locate every departmental delivery post offices excluding branch post offices.
- The first digit indicates the region, the second the sub region and the third the sorting districts whereas the last three digits indicate a particular delivery zone of the post office in the areas served by the sorting district.
- The entire country has been divided into the PIN code zones as given below:

  1. Delhi, Haryana, Punjab, Chandigarh, Himachal Pradesh.
  2. Uttar Pradesh
  3. Rajasthan, Gujarat, Daman and Diu, Dadra and Nagar Haveli
  4. Maharashtra, Goa, Madhya Pradesh
  5. Andhra Pradesh, Karnataka
  6. Tamil Nadu, Kerala, Puducherry, Lakshadweep
  7. West Bengal, Assam, Arunachal Pradesh, Meghalaya, Mizoram, Nagaland, Tripura, Sikkim, Odisha, Andaman and Nicobar Islands.
  8. Bihar.



AKS IAS®

Foundation For Competitive Exams

UPSC CSE



Prelims cum Mains
Comprehensive Guidance

INNOVATIVE & INTERACTIVE COURSES

CONQUER PRELIMS | MAINS MAXIMIZER | INTERVIEW MENTORSHIP

Quick Revision | Test Series | Value Addition

Be With The Best ! To Be The Best !

UPSC / IAS Exam

Prelims Cum Mains
Comprehensive Guidance Program (C.G.P)

NEW BATCH

Online | Offline | Live

Head Office : 1-10-249/1/1, Beside Sub-registrar Office Main Road,
Near Eswar Lakshmi Hosptial Ashoknagar Hyderabad - 500020

8955177997, 8448449709

www.aksias.com

DELHI | VIZAG | KERALA | HYDERABAD | BENGALURU

AKS IAS®

Foundation For Competitive Exams

UPSC Prelims cum Mains
Integrated Coaching

Want to be become IAS / IPS ??

Premier Institution for UPSC

Online | Offline

Limited Seats

Admissions Open



Our Features

- Holistic coverage of core concepts & Current affairs as per syllabus.
- Deconstruction Exersices with theme based approach.
- Subject wise classes by experts.
- Regular assesment through class tests.
- Delhi & Hyderabad Top Faculties.

MAIN BRANCH HYDERABAD & REGIONAL BRANCH VIZAG

Follow Us: AKS IAS

www.aksias.com

8448449709