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NCERT Class 11 Geography- India Physical Environment GIST

Chapter 1 India: Location

Historical Perspective:

Ancient King Dushyant had a son whose name was Bharat. In his name, this country was named as Bharat. According to some scholars, Bharat name was given according to a caste living in India in ancient times.

The name 'India' was originated from Indus valley civilization.

Huns, Egyptians, Persians, and other countrymen used to enter India by crossing Indus river. The word Hindu originated from Sindhu. People from these countries used to pronounce S as H and so they called Sindhu as Hindu.

Egyptians and Romans used to call Indus as Sindhu valley and eastern part of it as India.

India's boundaries are clear from geographical point of view. There are great mountains on its north-east and north-west side and there are great ocean in its south-east and south-west sides. Foreigners can enter India by crossing Khyber and Bolan straits.

Among all the living civilisation of the world, India is probably the oldest.

Around 2000-3000 BC a group of food gatherers developed a highly developed civilization.

With the destruction of Harappa civilization, a new civilization took birth in India. In 1500 BC, Aryans came to India which gave birth to Vedic culture.

According to historians, Aryans had not come from some other place. They had a community. They were divided in many castes. They kept roaming in Persia in West, Ganga Valley in the east and regions of Caspian Sea.

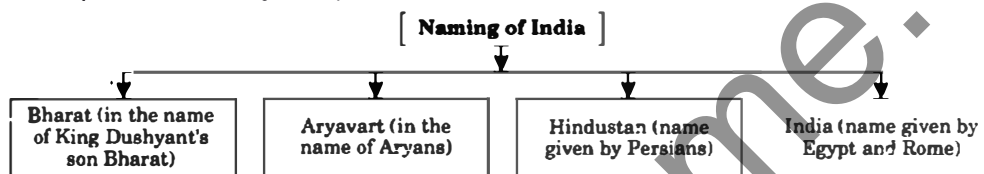
By 1000 BC, Aryans reached to the southern corner of India to tie India in a cultural knot. According to Aryans, the society was divided into four Varna: Brahmin, Kshatriya, Vaishya and Shudra.

Study of Ved, Prayers, etc were the responsibility of Brahmins. Saving people from enemies was the responsibility of Kshatriyas. Vaishyas used to take care of business activities and economy of the nation. Shudra used to provide labour for different tasks. It was occupational classification on the basis of activity.

Present Perspective:

India is the seventh largest country in the world with total area of 32,87,263 sq. km which is 2.42 per cent of the world's area. It is the second most populous country after China in the world with a population of 1.21 billion.

The mainland of India, extends from Kashmir in the north to Kanniyakumari in the south and Arunachal Pradesh in the east to Gujarat in the west. India extends from territorial limit further extends towards the sea upto 12 nautical miles (about 21.9 km) from the coast. India lies entirely in the Northern hemisphere. The mainland extends between latitudes $8^{\circ}4' N$ (Kanniyakumari, Cape Caverian) and $37^{\circ}6' N$ (Indira col, Jammu and Kashmir) and longitudes $68^{\circ}7' E$ (Dwarka, Gujarat) and $97^{\circ}25' E$ (Sadiya, Arimachal Pradesh).



Longitudinal extent of India is $68^{\circ}7'$ to $97^{\circ}25' E$ (29°). The latitudinal and longitudinal extent of India are roughly about 30 degrees, whereas the actual distance measured from north to south extremity is 3,214 km, and that from east to west is only 2,933 km.

This difference is based on the fact that the distance between two longitudes decreases towards the poles whereas the distance between two latitudes remains the same everywhere.

The southern part of the country lies within the tropics and the northern part lies in the sub-tropical zone or the warm temperate zone. This location is responsible for large variations in landforms, climate, soil types and natural vegetation in the country.

There is a variation of nearly 30 degrees from west to east in India which causes a time difference of nearly two hours between the easternmost and the westernmost parts of our country.

While the sun rises in the northeastern states about two hours earlier as compared to Jaisalmer, the watches in Dibrugarh, Imphal in the east and Jaisalmer, Bhopal or Chennai in the other parts of India shows the same time because we follow one standard time all over India called Indian Standard Time (1ST)

There is a general understanding among the countries of the world to select the standard meridian in multiples of $7^{\circ}30'$ of longitude. That is why $82^{\circ}30'$ E has been selected as the 'standard meridian' of India. Indian Standard Time is ahead of Greenwich Mean Time by 5 hours and 30 minutes. There are some countries where there are more than one standard meridian due to their vast east-to-west extent. For example, the USA has seven time zones.

The size of India has endowed her with great physical diversity. India is gifted with the presence of lofty mountains in the north; large rivers such as Ganga, Brahmaputra, Mahanadi, Krishna, Godavari and Kaveri; green forested hills in northeast and south India; and the vast sandy expanse of Marusthali.

India has second position in terms of Agrarian land after USA.

It is bounded by the Himalayas in the north, Hindukush and Sulaiman ranges in the north-west, Purvachal hills in the north-east and by the large expanse of the Indian ocean in the south, it forms a great geographic entity known as the Indian subcontinent. It includes the countries — Pakistan, Nepal, Bhutan, Bangladesh and India.

India's land length is 15,200 km and it has a coastline of 6,100 km in the mainland and 7,517 km in the entire geographical coast of the mainland plus the island groups Andaman and Nicobar located in the Bay of Bengal and the Lakshadweep in the Arabian Sea. Thus India, as a country, is a physically diverse land providing occurrence of varied resources.

India is located in the south-central part of the continent of Asia, bordering the Indian ocean and its two arms extending in the form of Bay of Bengal and the Arabian Sea. This maritime location of Peninsular India has provided links to its neighbouring regions through the sea and air routes. Sri Lanka and Maldives are the two island countries located in the Indian Ocean, which are our neighbours. Sri Lanka is separated from India by the Gulf of Mannar and Palk Strait.

India has 29 states and 7 union territories. It is situated in the middle of western Asia and Eastern Asia.

Important Terms:

- Siam: Old name of Thailand.

- **Aryavarta:** Old name of India. It was in the name of Aryans who came to India in ancient times.
- **Indira Point:** It is the southernmost part of India.
- **Varna System:** According to Aryans the society was divided into four Varna: Brahmin, Kshatriya, Vaishya and Shudra.
- **Suba:** In Mughal periods, states were called suba.
- **Sarkar:** Districts in Mughal period were called sarkar.
- **Mahal:** Towns and villages were called mahal in Mughal period.
- **Subcontinent:** Himalayas in the north, Hindukush and Sulaiman ranges in the north-west, Purvachal hills in the north-east and by the large expanse of the Indian ocean in the south forms a great geographic entity known as the Indian subcontinent. It includes the countries — Pakistan, Nepal, Bhutan, Bangladesh and India.

Chapter 2 Structure and Physiography

These geological regions broadly follow the physical features:

- The Peninsular Block
- The Himalayas and other Peninsular Mountains
- Indo-Ganga-Brahmaputra Plain.

The northern boundary of the Peninsular Block may be taken as an irregular line running from Kachchh along the western flank of the Aravali Range near Delhi and then roughly parallel to the Yamuna and the Ganga as far as the Rajmahai Hills and the Ganga delta. Apart from these, the Karbi Anglong and the Meghalaya Plateau in the north-east and Rajasthan in the west are also extensions of this block.

The Peninsula is formed essentially by a great complex of very ancient gneisses and granites, which constitutes a major part of it. The rift valleys of the Narmada, the Tapi and the Mahanadi and the Satpura block mountains are some examples of it. The Peninsula mostly consists of relict and residual mountains like the Aravali hills, the Nallamala hills, the Javadi hills, the Veliconda hills, the Palkonda range and the Mahendragiri hills, etc.

Most of the east flowing rivers form deltas before entering into the Bay of Bengal. The deltas formed by the Mahanadi, the Krishna, the Kaveri and the Godavari are important examples.

The Himalayas along with other Peninsular mountains are young, weak and flexible in their geological structure unlike the rigid and stable Peninsular Block. Consequently, they are still subjected to the interplay of exogenic and endogenic forces, resulting in the development of faults, folds and thrust plains.

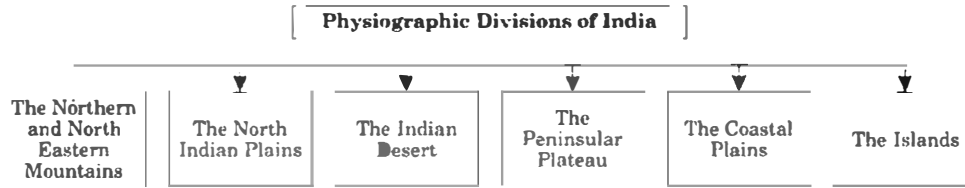
The third geological division of India comprises the plains formed by the river Indus, the Ganga and the Brahmaputra. Originally, it was a geo-synclinal depression which attained its maximum development during the third phase of the Himalayan mountain formation approximately about 64 million years ago. Since then, it has been gradually filled by the sediments brought by the Himalayan and Peninsular rivers. Average depth of alluvial deposits in these plains ranges from 1,000-2,000 m.

India can be divided into the following physio-graphic divisions:

- The Northern and North-eastern Mountains
- The Northern Plain
- The Peninsular Plateau
- The Indian Desert
- The Coastal Plains
- The Islands.

The North and North-eastern Mountains consist of the Himalayas and the North-eastern hills. The Himalayas consist of a series of parallel mountain ranges. Some of the important ranges are the Greater Himalayan range, which

includes the Great Himalayas and the Trans-Himalayan range, the Middle Himalayas and the Shiwalik.



The approximate length of the Great Himalayan range, also known as the central axial range, is 2,500 km from east to west, and their width varies between 160-400 km from north to south.

On the basis of relief, alignment of ranges and other geomorphological features, the Himalayas can be divided into the following sub-divisions:

- Kashmir or North-western Himalayas.
- Himachal and Uttaranchal Himalayas.
- Darjeeling and Sikkim Himalayas.
- Arunachal Himalayas.
- Eastern Hills and Mountains.

Kashmir or North-western Himalayas comprise a series of ranges such as the Karakoram, Ladakh, Zaskar and Pir Panjal. The north-eastern part of the Kashmir Himalayas is a cold desert, which lies between the Greater Himalayas and the Karakoram ranges.

The word shiwalik has its origin in the geological formation found in and around a place called Sivawala near Dehra Dun which was once a headquarter of the Imperial Survey and which subsequently established its permanent headquarters at Dehra Dun.

The Himachal and Uttarakhand Himalayas lies approximately between the Ravi in the west and the Kali (a tributary of Ghaghara) in the east. In this section of Lesser Himalayas, the altitude between 1,000-2,000 m specially attracted to the British colonial administration, and subsequently, some of the important hill stations such as Dharamshala, Mussoorie, Shimla, Kaosani and the cantonment towns and health resorts such as Shimla, Mussoorie, Kasauli, Almora, Lansdowne and Ranikhet, etc. were developed in this region.

The two distinguishing features of this region from the point of view of physiography are the 'Shiwalik' and 'Dun formations'. Some important duns located in this region are the Chandigarh – Kalka Dun, Nalagarh Dun, Dehra Dun, Harike Dun and the Kota Dun.

In the Great Himalayan range, the valleys are mostly inhabited by the Bhotia's. These are nomadic groups who migrate to 'Bugyals' (the summer grass lands in the higher reaches) during summer months and return to the valleys during winters. The famous 'Valley of flowers' is also situated in this region. The places of pilgrimage such as the Gangotri, Yamunotri, Kedarnath, Badrinath and Hemkund Sahib are also situated in this part.

Sikkim and Darjeeling Himalayas are also known for their scenic beauty and rich flora and fauna, particularly various types of orchids.

An important aspect of the Arunachal Himalayas is the numerous ethnic tribal community inhabiting in these areas. Some of the prominent ones from west to east are the Monpa, Daffla, Abor, Mishmi, Nishi and the Nagas. Most of these communities practise Jhumming. It is also known as shifting or slash and burn cultivation. This region is rich in biodiversity which has been preserved by the indigenous communities. Due to rugged topography, the inter-valley transportation linkages are nominal. Hence, most of the interactions are carried through the duar region along the Arunachal-Assam border.

The Eastern Hills and Mountains are having their general alignment from the north to the south direction. They are known by different local names. In the north, they are known as Patkai Bum, Naga hills, the Manipur hills and in the south as Mizo or Lushai hills. These are low hills, inhabited by numerous tribal groups practising Jhum cultivation.

The northern plains are formed by the alluvial deposits brought by the rivers – the Indus, the Ganga and the Brahmaputra. These plains extend approximately 3,200 km from the east to the west. The average width of these plains varies between 150-300 km. The maximum depth of alluvium deposits varies between 1,000-2,000 m. From the north to the south, these can be divided into three major zones: the Bhabar, the Tarai and the alluvial plains. The alluvial plains can be further divided into the Khadar and the Bhangar.

Bhabar is a narrow belt ranging between 8-10 km parallel to the Shiwalik foothills at the break-up of the slope. As a result of this, the streams and rivers

coming from the mountains deposit heavy materials of rocks and boulders, and at times, disappear in this zone. South of the Bhabar is the Tarai belt, with an approximate width of 10-20 km where most of the streams and rivers re-emerge without having any properly demarcated channel, thereby, creating marshy and swampy conditions known as the Tarai.

Northern Plains is a featureless plain with a general elevation of 50-150 m above the mean sea level. The states of Haryana and Delhi form a water divide between the Indus and the Ganga river systems.

Rising from the height of 150 m above the river plains up to an elevation of 600-900 m is the irregular triangle known as the Peninsular plateau. Delhi ridge in the northwest, (extension of Aravalis), the Rajmahal hills in the east, Gir range in the west and the Cardamom hills in the south constitute the outer extent of the Peninsular plateau. However, an extension of this is also seen in the northeast, in the form of Shillong and Karbi-Anglong plateau. The Peninsular India is made up of a series of patland plateaus such as the Hazaribagh plateau, the Palamu plateau, the Ranchi plateau, the Malwa plateau, the Coimbatore plateau and the Karnataka plateau, etc.

On the basis of the prominent relief features, the Peninsular plateau can be divided into three broad groups:

- The Deccan Plateau
- The Central Highlands
- The North-eastern Plateau.

The Deccan Plateau is bordered by the Western Ghats in the west, Eastern Ghats in the east and the Satpura, Maikal range and Mahadeo hills in the north. Western Ghats are locally known by different names such as Sahyadri in Maharashtra, Nilgiri hills in Karnataka and Tamil Nadu and Anaimalai hills and Cardamom hills in Kerala. Western Ghats are comparatively higher in elevation and more continuous than the Eastern Ghats. Their average elevation is about 1,500 m with the height increasing from north to south. 'Anaimudi (2,695 m), the highest peak of Peninsular plateau is located on the Anaimalai hills of the Western Ghats followed by Dodabetta (2,637 m) on the Nilgiri hills.

Some of the important ranges in Eastern Ghats include the Javadi hills, the Palconda . range, the Nallamala hills, the Mahendragiri hills, etc.

The Meghalaya plateau is further sub-divided into three:

- The Garo Hills
- The Khasi Hills
- The Jaintia Hills

These are named after the tribal groups inhabiting this region. An extension of this is also seen in the Karbi Anglong hills of Assam.

To the north-west of the Aravali hills lies the Great Indian Desert. It is a land of undulating topography dotted with longitudinal dunes and barchans. This region receives low rainfall below 150 mm per year; hence, it has arid climate with low vegetation cover.

On the basis of the location and active geomorphological processes, it can be broadly divided into two:

- The western coastal plains
- The eastern coastal plains.

There are two major island groups in India – one in the Bay of Bengal and the other in the Arabian Sea. The Bay of Bengal island groups consist of about 572 islands/islets. These are situated roughly between 6°N-14°N and 92°E -94°E. The two principal groups of islets include the Ritchie's archipelago and the Labrynth island.

Some important mountain peaks in Andaman and Nicobar islands are Saddle peak (North Andaman – 738 m), Mount Diavolo (Middle Andaman – 515 m), Mount Koyob (South Andaman – 460 m) and Mount Thuiller (Great Nicobar – 642 m). These islands are located at a distance of 280 km-480 km off the Kerala coast. The entire island group is built of coral deposits. There are approximately 36 islands of which 11 are inhabited. Minicoy is the largest island with an area of 453 sq. km.

Important Terms:

- **Physiography:** 'Physiography' of an area is the outcome of structure, process and the stage of development.

- **Central axial range:** The approximate length of the Great Himalayan range is known as the central axial range. It is 2,500 km from east to west
- **Indo-Ganga-Brahmaputra Plain:** It is a geological division of India that comprises the plains formed by the river Indus, the Ganga and the Brahmaputra.
- **Bhabar:** Bhabar is a narrow belt ranging between 8-10 km parallel to the Shiwalik foothills at the break-up of the slope. As a result of this, the streams and rivers coming from the mountains deposit heavy materials of rocks and boulders, and at times, disappear in this zone.
- **Kashmir or North-western Himalayas:** It comprise a series of ranges such as the Karakoram, Ladakh, Zaskar and Pir Panjal. The north-eastern part of the Kashmir Himalayas is a cold desert, which lies between the Greater Himalayas and the Karakoram ranges.
- **Duns:** The southernmost part of this region consists of longitudinal valleys. These are known as 'duns'. Jammu dun and Pathankot dun are important examples.
- **Tarai:** South of the Bhabar is the Tarai belt, with an approximate width of 10-20 km where most of the streams and rivers re-emerge without having any properly demarcated channel, thereby, creating marshy and swampy conditions known as the Tarai.
- **Bhangar:** The south of Tarai is a belt consisting of old alluvial deposits which is known as the Bhangar.
- **Khadar:** The south of Tarai is a belt consisting of new alluvial deposits is known as Khadar.
- **Dhaoladhar:** The Lesser Himalayas is locally known as Dhaoladhar in Himachal Pradesh.
- **Nagtibha:** The Lesser Himalayas are called Nagtibha in Uttarakhand.
- **Ten Degree Channel:** The Andaman in the north and the Nicobar in the south are separated by a water body. It is called the Ten degree channel.

- The Peninsular Plateau: Rising from the height of 150 m above the river plains upto an elevation of 600-900 m is the irregular triangle known as the Peninsular plateau.
- The Central Highlands: They are bounded to the west by the Aravali range.
- Satpura Range: The Satpura range is formed by a series of scarped plateaus on the south, generally at an elevation varying between 600-900 m above the mean sea level.
- Barchans: The extension of the Peninsular plateau can be seen as far as Jaisalmer in the West, where it has been covered by the longitudinal sand ridges and crescent-shaped sand dunes. These are called barchans.
- Loktak: The physiography of Manipur is unique by the presence of a large lake known as 'Loktak'.
- Molassis Basin: Mizoram is also known as the 'Molassis basin' which is made up of soft unconsolidated deposits.
- Kayals: Boatwaters are called kayals in Kerala.
- Karewas: Karewas are the thick deposits of glacial clay and other materials embedded with moraines.
- Dhaya: Bangal is called dhaya in Punjab.
- Bate: Khadar is called bate in Punjab.

Chapter 3 Drainage System

On the basis of discharge of water (orientations to the sea), it may be grouped into:

- The Arabian Sea drainage; and
- The Bay of Bengal drainage.

Nearly 77 per cent of the drainage area consisting of the Ganga, the Brahmaputra, the Mahanadi, the Krishna, etc. are oriented towards the Bay of

Bengal while 23 per cent comprising the Indus, the Narmada, the Tapi, the Mahi and the Periyar systems discharge their waters in the Arabian Sea.

On the basis of the size of the watershed, the drainage basins of India are grouped into three categories:

- Major river basins with more than 20,000 sq. km of catchment area. It includes 14 drainage basins such as the Ganga, the Brahmaputra, the Krishna, the Tapi, the Narmada, the Mahi, the Penner, the Sabarmati, the Barak, etc.
- Medium river basins with catchment area between 2,000-20,000 sq. km incorporating 44 river basins such as the Kalindi, the Periyar, the Meghna, etc.

Minor river basins with catchment area of less than 2,000 sq. km include fairly good number of rivers flowing in the area of low rainfall.

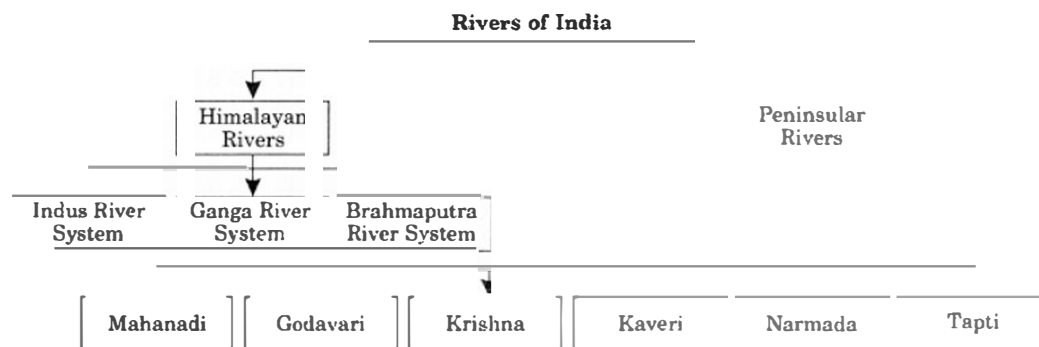
The Indus System is one of the largest river basins of the world, covering an area of 11,65,000 sq. km (in India it is 321, 289 sq. km) and a total length of 2,880 km and in India its length is 1,114 km.

The Jhelum, an important tributary of the Indus, rises from a spring at Verinag situated at the foot of the Pir Panjal in the south-eastern part of the valley of Kashmir. It flows through Srinagar and the Wular lake before entering Pakistan through a deep narrow gorge. It joins the Chenab near Jhang in Pakistan.

The Chenab is the largest tributary of the Indus. It is formed by two streams, the Chandra and the Bhaga, which join at Tandi near Keylong in Himachal Pradesh. Hence, it is also known as Chandrabhaga.

The Ravi is another important tributary of the Indus. It rises west of the Rohtang pass in the Kullu hills of Himachal Pradesh and flows through the Chamba valley of the state.

The Beas is another important tributary of the Indus, originating from the Beas Kund near the Rohtang Pass at an elevation of 4,000 m above the mean sea level. The river flows through the Kullu valley and forms gorges at Kati and Lari in the Dhauladhar range.



Satluj river flows almost parallel to the Indus for about 400 km before entering India, and comes out of a gorge at Rupar. It passes through the Shipki La on the Himalayan ranges and enters the Punjab plains. It is an antecedent river. It is a very important tributary as it feeds the canal system of the Bhakra Nangal project.

The Ganga System rises in the Gangotri glacier near Gaumukh (3,900 m) in the Uttarkashi district of Uttarakhand. Here, it is known as the Bhagirathi. It cuts through the Central and the Lesser Himalayas in narrow gorges. At Devprayag, the Bhagirathi meets the Alaknanda; hereafter, it is known as the Ganga. The Alaknanda has its source in the Satopanth glacier above Badrinath.

The Alaknanda consists of the Dhauli and the Vishnu Ganga which meet at Joshimath or Vishnu Prayag. The other tributaries of Alaknanda such as the Pindar joins it at Kama Prayag while Mandakini or Kali Ganga meets it at Rudra Prayag.

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

The Ganga basin covers about 8.6 lakh sq. km area in India alone. The Ganga river system is the largest in India having a number of perennial and non-perennial rivers originating in the Himalayas in the north and the Peninsula in the south, respectively. The Son is its major right bank tributary. The important left bank tributaries are the Ramganga, the Gomati, the Ghaghara, the Gandak, the Kosi and the Mahananda.

The Yamuna is the western most and the longest tributary of the Ganga. It has its source in the Yamunotri glacier on the western slopes of Banderpunch range (6,316 km). It joins the Ganga at Prayag in Allahabad. It is joined by the Chambal, the Sind, the Betwa and the Ken on its right bank which originates from the Peninsular plateau while the Hindan, the Rind, the Sengar, the

Varuna, etc. join it on its left bank.

Name	Origin From	Fall into	Height from sea Level(m)	Length (km)	Tributaries
Ganga	Gomukh Himani near Gangotri	Bay of Bengal	3,900	2525	Ghaghra, Gandak, Gomti, Kenson, Kosi, Yamuna.
Sutlej	Rakas Tal near Mansarovar Lakes	River Chenab	4,555	1050	Beas
Indus	Near Mansarovar Lake in Tibet	Arabian Sea		2880	Chenab, Sutlej
Ravi	Kullu Hills near Rohtang Pass	River Chenab		720	Ravi, Jhelum
Beas	Near Rohtang Pass	River Sutlej	4,330	470	
Jhelum	Sheshnag Lake near Verinag in Kashmir	River Chenab		725	
Yamuna	Yamunotri Glacier	River Ganga	6,316	1375	Chambal, Betwa, Ken, Sind
Chambal	Jana Pav Hill in M.P.	River Yamuna	0,616	1050	Banas, Shipra

Ghagra (Karnali)	Matsatung Glacier	River Ganga	-----	1080	
Kosi	Near Gosaithan Peak	River Ganga	-----	730	
Betwa	Vindhyanchal Hill in M.P.	River Yamuna	-----	480	
Son	Amarkantak	River Ganga	-----	780	
Brahmaputra (Dihang)	Near Mansarovar Lake	Bay of Bengal	5,150	2900	Lohit, Kamang, Manas, Teesta, Dharla
Narmada	Amarkantak	Gulf of Khambat	1,057	1057	
Tapti	Betul Distt. of MP	Gulf of Khambat	0,722	724	
Mahanadi	Raipur Distt. In Chhattisgarh	Bay of Bengal	-----	858	Shivnath, Telan, Ib
Luni	Mt. Aravalis in Ajmer	Rann of Kuchchh	-----	450	
Sabarmati	Jaysamudra Lake on Mt. Aravalis	Gulf of Khambat	-----	317	
Krishna	Western ghats	Bay of Bengal	1,337	1401	Musi, Tungabhadra, Bhima, Koyana, Malapharba, Ghataparba
Godavari	Nasik distt. In Maharashtra	Bay of Bengal	-----	1465	Ravara, Indrawati, Wainganga, Waradha, Pench, Kanhan and Penuganga rivers, Indravati River, Manjira River, Bindusara River, and Sabari River.
Kaveri	Brahmagir Range of Western Ghats	Bay of Bengal	1,341	805	Amaravati, Hemavati, Kabini
Tungabhadra	Western Ghats of Karnataka	Krishna River	-----	331	
Gandak	Nepal	River Ganga near Patna	-----	425	

Sharda (Black Ganga) Chhipra	Milam Glacier of Kumayun Himalyas Indore Dist.	River Ghaghra	-----	602
		River Chambal	-----	560
Hugli	Dhuliya in West Bengal (part of Ganga)	Bay of Bengal	-----	-----
Penner	Nandidurg Hills (Karnataka)	Bay of Bengal	-----	597

The Chambal rises near Mhow in the Malwa plateau of Madhya Pradesh and flows northwards through a gorge up wards of Kota in Rajasthan, where the Gandhisagar dam has been constructed. From Kota, it traverses down to Bundi, Sawai Madhopur and Dholpur, and finally joins the Yamuna.

The Gandak comprises two streams, namely Kaligandak and Trishulganga. It rises in the Nepal Himalayas between the Dhaulagiri and Mount Everest and drains the central part of Nepal.

The Brahmaputra is one of the largest rivers of the world. It has its origin in the Chemayungdung glacier of the Kailash range near the Mansarovar lake.

The Brahmaputra receives numerous tributaries in its 750 km long journey through the Assam valley. Its major left bank tributaries are the Burhi Dihing and Dhansari (South) whereas the important right bank tributaries are the Subansiri, Kameng, Manas and Sankosh.. The Subansiri which has its origin in Tibet, is an antecedent river.

The Peninsular drainage system is older than the Himalayan one. This is evident from the broad, largely-graded shallow valleys, and the maturity of the rivers.

Most of the major Peninsular rivers except Narmada and Tapi flow from west to east. The Chambal, the Sind, the Betwa, the Ken, the Son, originating in the northern part of the Peninsula belong to the Ganga river system. The other major river systems of the Peninsular drainage are – the Mahanadi, the Godavari, the Krishna and the Kaveri. Peninsular rivers are characterised by fixed course, absence of meanders and non- perennial flow of water.

Three major geological events in the distant past have shaped the present drainage systems of Peninsular India:

- Subsidence of the western flank of the Peninsula leading to its submergence below the sea during the early tertiary period.
- Upheaval of the Himalayas when the northern flank of the Peninsular block was subjected to subsidence and the consequent trough faulting.
- Slight tilting of the Peninsular block from north-west to the south-eastern direction gave orientation to the entire drainage system towards the Bay of Bengal during the same period.

There are some problems in river water usage. Some of these are:

- No availability in sufficient quantity.
- River water pollution.
- Load of silt in the river water.
- Uneven seasonal flow of water.
- River water disputes between states.
- Shrinking of channels due to the extension of settlements towards the thalweg.

Important Terms:

- Drainage: The flow of water through well-defined channels is known as 'drainage.'
- Drainage System: The network of drainage channels is called a 'drainage system'.
- Dendritic Drainage System: The drainage pattern resembling the branches of a tree is known as "dendritic" the examples of which are the rivers of northern plain.
- Radial Drainage System: When the rivers originate from a hill and flow in all directions, the drainage pattern is known as 'radial'. The rivers originating from the Amarkantak range present a good example of it.
- Trellis: When the primary tributaries of rivers flow parallel to each other and secondary tributaries join them at right angles, the pattern is known as 'trellis'.

- **Centripetal Drainage System:** When the rivers discharge their waters from all directions in a lake or depression, the pattern is known as 'centripetal'.
- **Catchment area:** A river drains the water collected from a specific area, which is called its 'catchment area'.
- **Drainage Basin:** An area drained by a river and its tributaries is called a drainage basin.
- **Watershed:** The boundary line separating one drainage basin from the other is known as the watershed.
- **Sorrow of Bengal:** River Damodar is also known as the 'Sorrow of Bengal' as it changes its course very frequently and causes floods in Bihar.
- **Sorrow of Bihar:** River Kosi is called Sorrow of Bihar.
- **River System:** A river or a river system is a body of water flowing in a channel through the surface of the earth. It consists of four important parts: river course, river source, tributaries and river mouth.
- **River Source:** A place at which begins or originates. This is usually found in mountainous areas. The source may be melting snow from the top of a mountain or a lake with stream flowing out of it. A river flows downhill from its source due to the force of gravity.
- **River Course:** The path on which the river flows along.
- **Singi Khamban or Lion's mouth:** Kailash Mountain range is known as 'Singi Khamban,' or Lion's mouth in Tibet.
- **Regime:** The pattern of flow of water in a river channel over a year is known as its regime.
- **Cusecs:** It means cubic feet per second.
- **Cumecs:** It stands for cubic metres per second.

Chapter 4 Climate

Weather is the momentary state of the atmosphere while climate refers to the average of the weather conditions over a longer period of time. Weather changes quickly, may be within a day or week but climate changes imperceptively and may be noted after 50 years or even more.

India has hot monsoonal climate which is the prevalent climate in south and south-east Asia.

While in the summer the mercury occasionally touches 55°C in the western Rajasthan, it drops down to as low as minus 45°C in winter around Leh. Churu in Rajasthan may record a temperature of 50°C or more on a June day while the mercury hardly touches 19°C in Tawang (Arunachal Pradesh) on the same day. On a December night, temperature in Drass (Jammu and Kashmir) may drop down to minus 45°C while Thiruvananthapuram or Chennai on the same night records 20°C or 22°C.

In Kerala and in the Andaman Islands, the difference between day and night temperatures may be hardly seven or eight degree Celsius. But in the Thar desert, if the day temperature is around 50°C, at night, it may drop down considerably upto 15°-20°C.

While snowfall occurs in the Himalayas, it only rains over the rest of the country. Similarly, variations are noticeable not only in the type of precipitation but also in its amount. While Cherrapunji and Mawsynram in the Khasi Hills of Meghalaya receive rainfall over 1,080 cm in a year, Jaisalmer in Rajasthan rarely gets more than 9 cm of rainfall during the same period.

Seasons of India

Winter Season
(December to
February)

Summer Season
(March to May)

South West
Monsoon Season
(June to September)

Season of Retreating
Monsoon (October-
November)

Tura situated in the Garo Hills of Meghalaya may receive an amount of rainfall in a single day which is equal to 10 years of rainfall at Jaisalmer. While the

annual precipitation is less than 10 cm in the north-west Himalayas and the western deserts, it exceeds 400 cm in Meghalaya.

The Ganga delta and the coastal plains of Orissa are hit by strong rain-bearing storms almost every third or fifth day in July and August while the Coromandal coast, a thousand km to the south, goes generally dry during these months.

Most parts of the country get rainfall during June-September, but on the coastal areas of Tamil Nadu, it rains in the beginning of the winter season. In spite of these differences and variations, the climate of India is monsoonal in rhythm and character.

With a long coastline, large coastal areas have an equable climate. Areas in the interior of India are far away from the moderating influence of the sea. Such areas have extremes of climate.

Temperature decreases with height. Due to thin air, places in the mountains are cooler than places on the plains. With increase in height by 165 metres, temperature decreases by one degree celcius. Agra and Darjiling are located on the same latitude, but temperature of January in Agra is 16°C whereas it is only 4°C in Darjiling.

An easterly jet stream flows over the southern part of the Peninsula in June, and has a maximum speed of 90 km per hour. In August, it is confined to 15°N latitude, and in September up to 22°N latitudes. The easterlies normally do not extend to the north of 30°N latitude in the upper atmosphere.

The monsoon may burst in the first week of June in the coastal areas of Kerala, Karnataka, Goa and Maharashtra while in the interior parts of the country, it may be delayed to the first week of July. The day temperature registers a decline of 5°C to 8°C between mid- June and mid-July.

The mean daily temperature remains below 21°C over most parts of northern India. The night temperature may be quite low, sometimes going below freezing point in Punjab and Rajasthan.

The mean maximum temperature for January at Thiruvananthapuram is as high as 31°C, and for June, it is 29.5°C. Temperatures at the hills of Western Ghats remain comparatively low.

April, May and June are the months of summer in north India. In most parts of India, temperatures recorded are between 30°-32°C. In March, the highest day

temperature of about 38°C occurs in the Deccan Plateau while in April, temperature ranging between 38°C and 43°C are found in Gujarat and Madhya Pradesh.

The average annual rainfall in India is about 125 cm, but it has great spatial variations.

The highest rainfall occurs along the west coast, on the Western Ghats, as well as in the Sub-Himalayan areas in the north-east and the hills of Meghalaya. Here the rainfall exceeds 200 cm. In some parts of Khasi and Jaintia hills, the rainfall exceeds 1,000 cm. In the Brahmaputra valley and the adjoining hills, the rainfall is less than 200 cm.

Rainfall between 100-200 cm is received in the southern parts of Gujarat, east Tamil Nadu, north-eastern Peninsula covering Odisha, Jharkhand, Bihar, eastern Madhya Pradesh, northern Ganga plain along the sub-Himalayas and the Cachar Valley and Manipur.

Areas of Low Rainfall: Western Uttar Pradesh, Delhi, Haryana, Punjab, Jammu and Kashmir, eastern Rajasthan, Gujarat and Deccan Plateau receive rainfall between 50-100 cm.

Areas of Inadequate Rainfall: Parts of the Peninsula, especially in Andhra Pradesh, Karnataka and Maharashtra, Ladakh and most of western Rajasthan receive rainfall below 50 cm. Snowfall is restricted to the Himalayan region.

The mean annual surface temperature of the earth in the past 150 years has increased. It is projected that by the year 2,100, global temperature will increase by about 2°C. This rise in temperature will cause many other changes: one of these is a rise in sea level, as a result of melting of glaciers and sea-ice due to warming.

Important Terms:

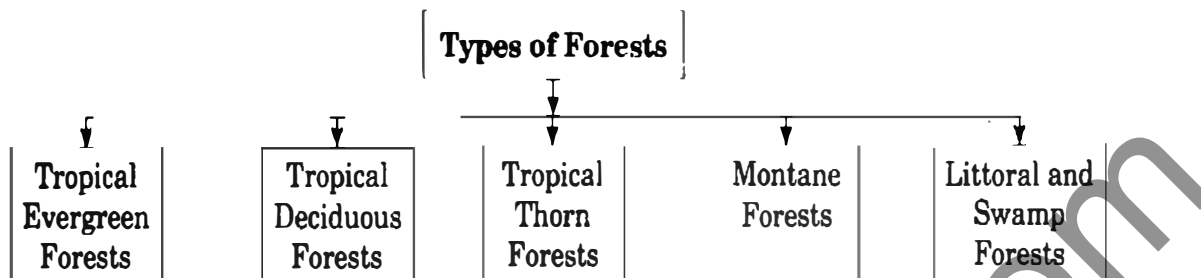
- **Monsoon:** Monsoon connotes the climate associated with seasonal reversal in the direction of winds.
- **Weather:** Weather is conditions of temperature, humidity, pressure, etc at a given point of time.
- **Climate:** Climate is condition of temperature, humidity and pressure for a longer period of time.

- **Break in the monsoon:** During the south-west monsoon period after having rains for a few days, if rain fails to occur for one or more weeks, it is known as break in the monsoon.
- **Dust storms:** Dust storms in the evening are very common during May in Punjab, Haryana, Eastern Rajasthan and Uttar Pradesh.
- **Mango shower:** Towards the end of summer, there are pre-monsoon showers which are a common phenomena in Kerala and coastal areas of Karnataka. Locally, they are known as mango showers since they help in the early ripening of mangoes.
- **Blossom shower:** With this shower, coffee flowers blossom in Kerala and nearby areas.
- **Nor westers:** These are dreaded evening thunderstorms in Bengal and Assam. Their notorious nature can be understood from the local nomenclature of 'Kalbaisakhi', a calamity of the month of Baisakh. These showers are useful for tea, jute and rice cultivation.
- **Breaks:** The wet spells are interspersed with rainless interval known as 'breaks'.
- **Climatic region:** A climatic region has a homogeneous climatic condition which is the result of a combination of factors.
- **Disturbances:** Inflow of western cyclones is generally known as disturbances during the winter season.
- **The Inter tropical convergence zone (ITCZ):** It is a low pressure zone located at the equator where trade winds converge, and so, it is a zone where air tends to ascend.
- **Monsoon trough:** In July, the ITCZ is located around 20°N-25°N latitudes over the Gangetic plain. These are sometimes called the monsoon trough.
- **ITCZ:** The inter tropical convergence Zone (ITCZ) is a low pressure zone located at the Equator where trade winds converge and so it is a zone where air trends to ascend. In July the ITCZ is located around 20°N-25° N latitudes (over the Gangetic Plain) sometimes called the monsoon trough.

- Northeast monsoon: In winter, the ITCZ moves southward, and so the reversal of winds from northeast to south and southwest, takes place. They are called northeast monsoons.
- Tropical depressions: Inflow of western cyclones is generally known as tropical depressions during the south-west monsoon period in India.
- Bardoli chheerha: In Assam, Nor Westers storms are known as “Bardoli Chheerha”.
- Loo: Hot, dry and oppressing winds blowing in the Northern plains from Punjab to Bihar with higher intensity between Delhi and Patna.
- Bursting of the monsoon: High velocity winds with extreme thundering and lightening . cause sudden rainfall. It is
- Jet stream: The winds blow across the Asian continent at latitudes north of the Himalayas roughly parallel to the Tibetan highlands are called jet stream.
- Monsoon winds: Winds that bring rainfall are called monsoon winds.
- Drought: It is a situation of scarce rainfall causing problem of usable water, failure of crops and sometimes famine like conditions.
- Western cyclone: The western cyclonic disturbances enter the Indian subcontinent from the west and the north-west during the winter months. It originate over the Mediterranean Sea and are brought into India by the westerly jet stream.
- Tropical cyclones: Tropical cyclones originate over the Bay of Bengal and the Indian Ocean. These tropical cyclones have very high wind velocity and heavy rainfall.
- October-heat: Owing to the condition of high temperature and humidity, the weather becomes rather oppressive and this is known as the October-heat.

Chapter 5 Natural Vegetation

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



Tropical Evergreen forests are found in the western slope of the Western Ghats, hills of the north-eastern region and the Andaman and Nicobar Islands. They are found in warm and humid areas with an annual precipitation of over 200 cm and mean annual temperature above 22°C. In these forests, trees reach great heights up to 60 m or above. There is no definite time for trees to shed their leaves, flowering and fruition. As such these forests appear green all the year round. Species found in these forests include rosewood, mahogany, aini, ebony, etc.

The semi evergreen forests are found in the less rainy parts of these regions. Such forests have a mixture of evergreen and moist deciduous trees. The under growing climbers provide an evergreen character to these forests. Main species are white cedar, hollock and kail.

Tropical Deciduous Forests are the most widespread forests in India. They are also called the monsoon forests. They spread over regions which receive rainfall between 70-200 cm. On the basis of the availability of water, these forests are divided into two types: moist and dry deciduous.

The Moist deciduous forests are more pronounced in the regions which record rainfall between 100-200 cm. These forests are found in the north-eastern states along the foothills of Himalayas, eastern slopes of the Western Ghats and Odisha. Teak, sal, shisham, hurra, mahua, amla, semul, kusum, and sandalwood etc. are the main species of these forests.

Dry deciduous forest covers vast areas of the country, where rainfall ranges between 70-100 cm. On the wetter margins, it has a transition to the moist deciduous, while on the drier margins to thorn forests. These forests are found in rainier areas of the Peninsula and the plains of Uttar Pradesh and Bihar.

Tropical thorn forests occur in the areas which receive rainfall less than 50 cm. These consist of a variety of grasses and shrubs. It includes semi-arid areas of south west Punjab, Haryana, Rajasthan, Gujarat, Madhya Pradesh and Uttar Pradesh.

In mountainous areas, the decrease in temperature with increasing altitude leads to a corresponding change in natural vegetation. Mountain forests can be classified into two types, the northern mountain forests and the southern mountain forests.

The Himalayan ranges show a succession of vegetation from the tropical to the tundra, which change in with the altitude. Deciduous forests are found in the foothills of the Himalayas. It is succeeded by the wet temperate type of forests between an altitude of 1,000-2,000 m.

In the higher hill ranges of north-eastern India, hilly areas of West Bengal and Uttarakhand, evergreen broad leaf trees such as oak and chestnut are predominant. Between 1,500-1,750 m, pine forests are also well-developed in this zone, with Chir Pine as a very useful commercial tree.

Deodar, a highly valued endemic species grows mainly in the western part of the Himalayan range. Deodar is a durable wood mainly used in construction activity. Similarly, the chinar and the walnut, which sustain the famous Kashmir handicrafts, belong to this zone. Blue pine and spruce appear at altitudes of 2,225-3,048 m.

In India, the mangrove forests spread over 6,740 sq. km which is 7 per cent of the world's mangrove forests. They are highly developed in the Andaman and Nicobar Islands and the Sunderbans of West Bengal. Other areas of significance are the Mahanadi, the Godavari and the Krishna deltas. These forests too, are being encroached upon, and hence, need conservation.

According to state records, the forest area covers 23.28 per cent of the total land area of the country. It is important to note that the forest area and the actual forest cover are not the same.

Both forest area and forest cover varies from state to state. Lakshadweep has zero per cent approx forest area; Andaman and Nicobar Islands have 86.93 per cent. Some of the states with less than 10 per cent of the forest area lie in the

north and north-western part of the country. These are Rajasthan, Gujarat, Punjab, Haryana and Delhi.

Geographical area under forests are:

State/UTs	Per cent (approx)	State/UTs	Per cent (approx)
Andhra Pradesh	16.23	Mizoram	82.98
Arunachal Pradesh	81.23	Nagaland	80.49
Assam	35.33	Odisha	31.36
Bihar	6.07	Punjab	4.83
Chhattisgarh	41.75	Rajasthan	4.78
Delhi	7.51	Sikkim	45.00
Goa	56.59	Tamil Nadu	16.52
Gujarat	7.73	Telangana	25.00
Haryana	3.97	Tripura	67.38
Himachal Pradesh	25.79	Uttar Pradesh	5.71
Jammu and Kashmir	9.56	Uttarakhand	44.76
Jharkhand	19.29	West Bengal	12.05
Karnataka	19.29	Andaman and Nicobar	84.01
Kerala	40.04	Chandigarh	7.51
Madhya Pradesh	25.07	Dadra and Nagar Haveli	44.60
Maharashtra	15.43	Daman and Diu	5.63
Manipur	75.81	Lakshadweep	85.91
Meghalaya	69.48	Puducherry	7.45

The Government of India proposed to have a nation-wide forest conservation policy, and adopted a forest policy in 1952, which was further modified in 1988.

The National Commission on Agriculture (1976) has classified social forestry into three categories. These are urban forestry, rural forestry and farm forestry.

Urban forestry pertains to the raising and management of trees on public and privately owned lands in and around urban centres such as green belts, parks, roadside avenues, industrial and commercial green belts, etc.

Rural forestry lays emphasis on promotion of agro-forestry and community-forestry. Agro-forestry is the raising of trees and agriculture crops on the same

land inclusive of the waste patches. It combines forestry with agriculture, thus, altering the simultaneous production of food, fodder, fuel, timber and fruits.

In 1972, a comprehensive Wildlife Act was enacted, which provides the main legal framework for conservation and protection of wildlife in India.

Now, there are 105 National parks and 514 wildlife sanctuaries covering an area of about 15.67 million hectares in the country.

Special schemes like Project Tiger and Project Elephant have been launched to conserve these species and their habitat in a sustainable manner. Project Elephant has been implemented since 1992.

Under Project Tiger, launched on 1 April 1973, 27 tiger reserves have been set up in 17 states covering an area of about 37,761 sq. km.

There are 18 Biosphere Reserves in India. Nine of them are recognized by UNESCO. They are :

- Nilgiri
- Nanda Devi
- Sunderbans
- Gulf of Mannar
- Great Nicobar
- Pachmarhi
- Amarkantak
- Norkek
- Simlipal.

Out of a total of 593 districts, 188 have been identified as tribal districts. The tribal districts account for about 59.61 per cent of the total forest cover of the country whereas the geographical area of 188 tribal districts forms only 33.63 per cent of the total geographical area of the country.

Important Terms:

- **Natural vegetation:** Natural vegetation refers to a plant community that has been left undisturbed over a long time, so as to allow its individual species to adjust themselves to climate and soil conditions as fully as possible.
- **Planted vegetation:** It refers to planting of trees under human supervision.
- **International convention:** An international convention is an agreement among member states of the United Nations.
- **Forest area:** The forest area is the area notified and recorded as the forest land irrespective of the existence of trees. It is based on the records of the State Revenue Department.
- **Actual forest cover:** The actual forest cover is the area occupied by forests with canopy. It is based on aerial photographs and satellite imageries.
- **Social forestry:** Social forestry means the management and protection of forests and afforestation on barren lands with the purpose of helping in the environmental, social and rural development.
- **Community forestry:** It involves the raising of trees on public or community land such as the village pasture and temple land, roadside, canal bank, strips along railway lines, and schools etc.
- **Rural forestry:** It lays emphasis on promotion of agro-forestry and community-forestry. Agro-forestry is the raising of trees and agriculture crops on the same land inclusive of the waste patches.
- **Biosphere reserve:** A Biosphere reserve is a unique and representative ecosystem of terrestrial and coastal areas which are internationally recognised within the framework of UNESCO's Man and Biosphere (MAB) Programme.
- **National park:** A national park is an area which is strictly reserved for the protection of the wildlife and where activities such as forestry, grazing or cultivation are not allowed.

- **Reserved forest:** An area notified under the provisions of Indian Forest acts having full degree of protection. In protected forests, all activities are prohibited unless permitted.
- **Protected forest:** An area notified under the provisions of Indian Forest Act or the State Forest Acts having limited degree of protection. In Protected Forests, all activities are permitted unless prohibited.
- **Sanctuary:** A sanctuary is an area which is reserved for the conservation of animals only and operations such as harvesting of timber, collection of minor forest products are allowed so long as they do not affect the animals adversely.
- **Unclassed forest:** An area recorded as forest but not included in reserved or protected forest category. Ownership status of such forests varies from state to state.
- **Conservation:** The protection of natural environment and natural resources for the future is called conservation. It includes the management of minerals, landscape, soil and forests to prevent their destruction and over exploitation.

Chapter 6 Soils

Soil is the mixture of rock debris and organic materials which develop on the earth's surface.

The major factors affecting the formation of soil are relief, parent material, climate, vegetation and other life-forms and time. Besides these, human activities also influence it to a large extent.

Components of the soil are mineral particles, humus, water and air. The actual amount of each of these depends upon the type of soil.

Soil is bifurcated into three layers called horizons. 'Horizon A' is the topmost zone, where organic materials have got incorporated with the mineral matter, nutrients and water, which are necessary for the growth of plants. 'Horizon B' is a transition zone between the 'horizon A' and 'horizon C', and contains matter derived from below as well as from above. It has some organic matter in it, although the mineral matter is noticeably weathered. 'Horizon C' is

composed of the loose parent material. This layer is the first stage in the soil formation process and eventually forms the above two layers.

In ancient times, soils used to be classified into two main groups – Urvara and Usara, which were fertile and sterile, respectively.

In the 16th century A.D., soils were classified on the basis of their inherent characteristics and external features such as texture, colour, slope of land and moisture content in the soil. Based on texture, main soil types were identified as sandy, clayey, silty and loamy, etc. On the basis of colour, they were red, yellow, black, etc.

On the basis of genesis, colour, composition and location, the soils of India have been classified into:

- Alluvial soils
- Black soils
- Red and Yellow soils
- Laterite soils
- Arid soils
- Saline soils
- Peaty soils
- Forest soils.

Alluvial soils are widespread in the northern plains and the river valleys. These soils cover about 40 per cent of the total area of the country. They are depositional soils, transported and deposited by rivers and streams.

The alluvial soils vary in nature from sandy loam to clay. They are generally rich in potash but poor in phosphorous. In the Upper and Middle Ganga plain, two different types of alluvial soils have developed, viz. Khadar and Bhangar.

Khadar is the new alluvium and is deposited by floods annually, which enriches the soil by depositing fine silts. Bhangar represents a system of older alluvium, deposited away from the flood plains.

Black soil covers most of the Deccan Plateau which includes parts of Maharashtra, Madhya Pradesh, Gujarat, Andhra Pradesh and some parts of Tamil Nadu. In the upper reaches of the Godavari and the Krishna, and the north western part of the Deccan Plateau, the black soil is very deep.

Red soil develops on crystalline igneous rocks in areas of low rainfall in the eastern and southern part of the Deccan Plateau. Along the piedmont zone of the Western Ghat, long stretch of area is occupied by red loamy soil.

Laterite has been derived from the Latin word 'Later' which means brick. The laterite soils develop in areas with high temperature and high rainfall. These are the result of intense leaching due to tropical rains. With rain, lime and silica are leached away, and soils rich in iron oxide and aluminium compound are left behind.

Arid soils range from red to brown in colour. They are generally sandy in structure and saline in nature. In some areas, the salt content is so high that common salt is obtained by evaporating the saline water. Due to the dry climate, high temperature and accelerated evaporation, they lack moisture and humus.

Saline soils are also known as Usara soils. Saline soils contain a larger proportion of sodium, potassium and magnesium, and thus, they are infertile, and do not support any vegetative growth. They have more salts, largely because of dry climate and poor drainage. They occur in arid and semi-arid regions, and in waterlogged and swampy areas.

Peaty soils are found in the areas of heavy rainfall and high humidity, where there is a good growth of vegetation. Thus, large quantity of dead organic matter accumulates in these areas, and this gives a rich humus and organic content to the soil. Organic matter in these soils may go even up to 40-50 per cent.

Forest soils are formed in the forest areas where sufficient rainfall is available. The soils vary in structure and texture depending on the mountain environment where they are formed. They are loamy and silty on valley sides and coarse-grained in the upper slopes.

Soil degradation can be defined as the decline in soil fertility, when the nutritional status declines and depth of the soil goes down due to erosion and misuse. Soil degradation is the main factor leading to the depleting soil

resource base in India. The degree of soil degradation varies from place to place according to the topography, wind velocity and amount of the rainfall.

The destruction of the soil cover is described as soil erosion. Forest and other natural vegetation are removed for human settlement, for cultivation, for grazing animals and for various other needs. Wind and water are powerful agents of soil erosion because of their ability to remove soil and transport it.

Soil erosion is a serious problem for Indian agriculture and its negative effects are seen in other spheres also. Eroded materials are carried down to rivers and they lower down their carrying capacity, and cause frequent floods and damage to agricultural lands.

Deforestation is one of the major causes of soil erosion. Plants keep soils bound in locks of roots, and thus, prevent erosion. They also add humus to the soil by shedding leaves and twigs. The salt lodged in the lower profiles of the soil comes up to the surface and destroys its fertility. Chemical fertilizers in the absence of organic manures are also harmful to the soil.

If soil erosion and exhaustion are caused by humans; by corollary, they can also be prevented by humans. Contour bunding, Contour terracing, regulated forestry, controlled grazing, cover cropping, mixed farming and crop rotation are some of the remedial measures which are often adopted to reduce soil erosion.

Experiments have been made to stabilize sand dunes in western Rajasthan by the Central Arid Zone Research Institute (CAZRI). The Central Soil Conservation Board, set up by the Government of India, has prepared a number of plans for soil conservation in different parts of the country.

Important Soils Found In India:

Sl. No.	Soil	Formation	Area covered	Features
1.	Alluvial Soil (expanded in 40.16% of total area)	Formed by the deposits brought by rivers.	Northern plains (Punjab, Bihar, Haryana, Delhi, Uttar Pradesh, Bengal) Chhattisgarh plains, and coastal plains.	(a) Suitable for all kinds of crops. (b) Vary in nature from sandy loam to clay. (c) Generally rich in potash but poor in phosphorous.

2.	Black Soil (Expanded in 29.69% of total area)	Formed by volcanic eruptions.	Most of the Deccan Plateau which includes parts of Maharashtra, Madhya Pradesh, Gujarat, Andhra Pradesh and some parts of Tamil Nadu.	<p>(a) Also known as the 'Regur Soil' or the 'Black Cotton Soil' because they are suitable for cotton cultivation.</p> <p>(b) Clayey, deep and impermeable.</p> <p>(c) Swell and become sticky when wet and shrink when dried.</p> <p>(d) Rich in lime, iron, magnesia and alumina.</p> <p>(e) Also contain potash. But they lack in phosphorous, nitrogen and organic matter.</p>
3.	Saline Soils (Expanded in 1.29% of total area)		They occur in arid and semi-arid regions, and in waterlogged and swampy areas. Western Gujarat, deltas of the eastern coast and in Sunderban areas of West Bengal.	<p>(a) They are also known as Usara soils.</p> <p>(b) Saline soils contain a larger proportion of sodium, potassium and magnesium, and thus, they are infertile, and do not support any vegetative growth.</p> <p>(c) Their structure ranges from sandy to loamy. They lack in nitrogen and calcium.</p> <p>(d) In the areas of intensive cultivation with excessive use of irrigation, especially in areas of green revolution, the fertile alluvial soils are becoming saline.</p> <p>(e) In such areas, especially in Punjab and Haryana, farmers are advised to add gypsum to solve the problem of salinity in the soil.</p>
4.	Peaty and Humus Soils (expanded in 2.17% of total area)	Formed in areas of heavy rainfall and high humidity, where there is a good growth of vegetation.	Northern part of Bihar, southern part of Uttaranchal and the coastal areas of West Bengal, Orissa and Tamil Nadu.	<p>(a) A large quantity of dead organic matter accumulates in these areas, and this gives a rich humus and organic content to the soil.</p> <p>(b) Organic matter in these soils may go even up to 40-50 per cent.</p> <p>(c) These soils are normally heavy and black in colour.</p>

5.	Red and yellow soil (Expanded in 22% of total area)	Formed by crystalline igneous rocks in areas of low rainfall in the eastern and southern part of the Deccan Plateau.	Along the piedmont zone of the Western Ghats, parts of Odisha and Chhattisgarh and in the southern parts of the middle Ganga plain.	<p>(a) Develops a reddish colour due to a wide diffusion of iron in crystalline and metamorphic rocks.</p> <p>(b) Looks yellow when it occurs in a hydrated form.</p> <p>(c) The fine-grained red and yellow soils are normally fertile, whereas coarse-grained soils found in dry upland areas are poor in fertility.</p> <p>(d) They are generally poor in nitrogen, phosphorous and humus.</p> <p>(e) Red laterite soils in Tamil Nadu, Andhra Pradesh and Kerala are more suitable for tree crops like cashewnut.</p>
6.	Laterite Soil (Expanded in 2.62% of total area)	Develop in areas with high temperature and high rainfall.	Karnataka, Kerala, Tamil Nadu, Madhya Pradesh and the hilly areas of Odisha and Assam.	<p>(a) Poor in organic matter, nitrogen, phosphate and calcium, while iron oxide and potash are in excess.</p> <p>(b) Widely cut as bricks for use in house construction.</p> <p>(c) Mainly developed in the higher areas of the Peninsular plateau.</p>
7.	Arid Soils (expanded in 6.13% of total area)	Formed in dry regions of less rainfall.	Western Rajasthan	<p>(a) Sandy in structure and saline in nature.</p> <p>(b) Due to the dry climate, high temperature and accelerated evaporation, they lack moisture and humus.</p> <p>(c) Nitrogen is insufficient and the phosphate content is normal.</p> <p>(d) These soils are poor and contain little humus and organic matter.</p>

8. Forest Soils (expanded in 7.94% of total area)	Formed in the forest areas where sufficient rainfall is available.	Snow covered regions of Himalayas	<p>(a) Vary in structure and texture depending on the mountain environment where they are formed.</p> <p>(b) Loamy and silty on valley sides and coarse-grained in the upper slopes.</p> <p>(c) In the snow-bound areas of the Himalayas, they experience denudation, and are acidic with low humus content.</p> <p>(d) The soils found in the lower valleys are fertile.</p>
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Important Terms:

- Soil: Soil is the mixture of rock debris and organic materials which develop on the earth's surface.
- Bad land topography: A region with a large number of deep gullies or ravines is called a bad land topography.
- Horizons: When we dig a pit on land and look at the soil, we find that it consists of three layers. These are called horizons.
- Horizon A: It is the topmost zone, where organic materials have got incorporated with the mineral matter, nutrients and water, which are necessary for the growth of plants.
- Horizon B: It is a transition zone between the 'horizon A' and 'horizon C', and contains matter derived from below as well as from above. It has some organic matter in it, although the mineral matter is noticeably weathered.
- Horizon C: It is composed of the loose parent material. This layer is the first stage in the soil formation process and eventually forms the above two layers.
- Soil profile: The arrangement of layers in three horizons, A, B and C is known as the soil profile.
- Parent rock: Underneath the three horizons there is the rock which is known as the parent rock or the bedrock.

- Estuary: The tidal mouth of a river where fresh and saline water get mixed.
- Gully erosion: It is the erosion of the soil and rock by the concentration of runoff into gullies.
- Humus: The dead organic content of the soil.
- Khadar: Khadar is the new alluvium and is deposited by floods annually, which enriches the soil by depositing fine silts.
- Bhangar: Bhangar represents a system of older alluvium, deposited away from the flood plains.
- Alluvial soil: They are depositional soils, transported and deposited by rivers and streams.
- Laterite soil: Laterite has been derived from the Latin word 'Later' which means brick. The laterite soils develop in areas with high temperature and high rainfall.
- Black soil: These soils are made from volcanoes. These soils are also known as the 'Regur Soil' or the 'Black Cotton Soil'.
- Forest soils: Forest soils are formed in the forest areas where sufficient rainfall is available.
- Peaty soils: They are found in the areas of heavy rainfall and high humidity, where there is a good growth of vegetation.
- Soil erosion: The destruction of the soil cover is described as soil erosion.
- Soil degradation: Soil degradation can be defined as the decline in soil fertility, when the nutritional status declines and depth of the soil goes down due to erosion and misuse. Soil degradation is the main factor leading to the depleting soil resource base in India.
- Soil Conservation: Soil conservation is a methodology to maintain soil fertility, prevent soil erosion and exhaustion, and improve the degraded condition of the soil.

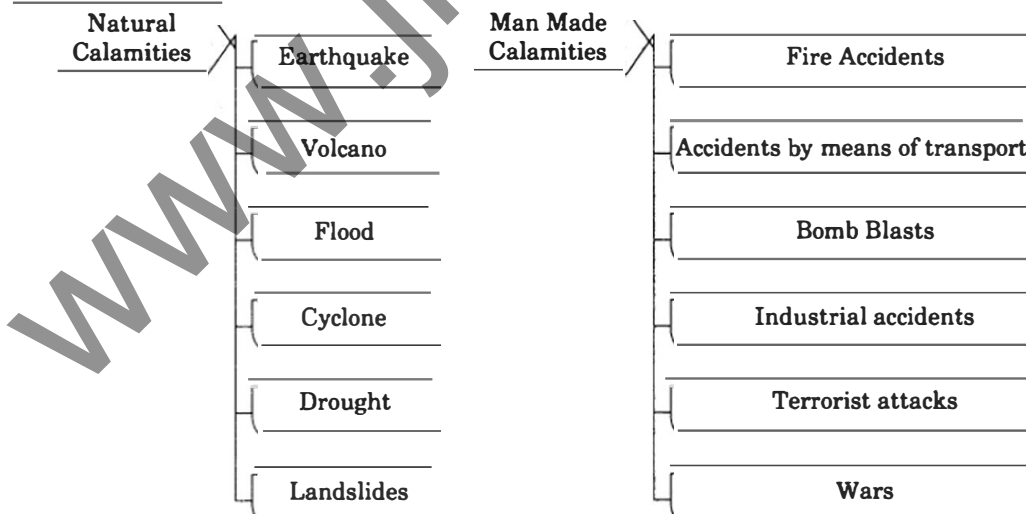
Chapter 7 Natural Hazards and Disasters

Disaster is an undesirable occurrence resulting from forces that are largely outside human control, strikes quickly with little or no warning, which causes or threatens serious disruption of life and property including death and injury to a large number of people, and requires therefore, mobilisation of efforts in excess of that which are normally provided by statutory emergency services.

Change is the law of nature. It is a process present everywhere with variations in terms of magnitude, intensity and scale. Change can be as sudden and swift as volcanic eruptions, tsunamis, earthquakes and lightening, etc.

Disasters are also caused by some human activities. There are some activities carried by human beings that are directly responsible for disasters. Bhopal Gas tragedy, Chernobyl nuclear disaster, wars, release of CFCs (Chlorofluorocarbons) and increase of green house gases, environmental pollutions like noise, air, water and soil are some of the examples.

Establishment of National Institute of Disaster Management, India, Earth Summit at Rio de Janeiro, Brazil, 1993 and the World Conference on Disaster Management in May 1994 at Yokohama, Japan, etc. are some of the concrete steps towards disaster management initiated at different levels.



Geological Survey of India, Department of Meteorology, Government of India, along with the recently formed National Institute of Disaster Management, have divided India into the following five earthquake zones:

- (i) Very high damage risk zone
- (ii) High damage risk zone
- (iii) Moderate damage risk zone
- (iv) Low damage risk zone
- (v) Very low damage risk zone.

12 Major natural calamities since 1948

Year	Location	Type	Number of deaths
1948	The Soviet Union (now Russia)	Earthquake	1,10,000
1949	China	Floods	57,000
1954	China	Floods	30,000
1965	East Pakistan (now Bangladesh)	Tropical Cyclones	36,000
1968	Iran	Earthquakes	30,000
1970	Peru	Earthquakes	66,794
1970	East Pakistan (now Bangladesh)	Tropical Cyclones	5,00,000
1971	India	Tropical Cyclones	30,000
1976	China	Earthquakes	7,00,000
1990	Iran	Earthquakes	50,000
2004	Indonesia, Sri Lanka, India etc.	Tsunamis	5,00,000
2005	Pakistan, India	Earthquakes	70,000

Disaster Management issue was raised at the U.N. General Assembly in 1989 and it was finally formalised at the World Conference on Disaster Management in May 1994 at Yokohama, Japan. This was subsequently called the Yokohama Strategy and Plan of Action for a Safer World.

Cyclones originate between 10°-15° north latitudes during the monsoon season. In Bay of Bengal, cyclones mostly develop during the months of October and November. Here, they originate between 16°-2° N latitudes and to the west of 92° E. By July, the place of origin of these storms shifts to around 18° N latitude and west of 90°E near the Sunderban Delta.

Floods occur commonly when water in the form of surface run-off exceeds the carrying capacity of the river channels and streams and flows into the neighbouring low-lying flood plains.

Various states of India face heavy loss of lives and property due to recurrent floods. Rashtriya Barh Ayog (National Flood Commission) identified 40 million hectares of land as flood-prone in India.

According to some estimates, nearly 19 per cent of the total geographical area of the country and 12 per cent of its total population suffer due to drought every year. About 30 per cent of the country's total area is identified as drought prone affecting around 50 million people.

On the basis of severity of droughts, India can be divided into the following regions:

- (i) Extreme Drought Affected Areas
- (ii) Severe Drought Prone Area
- (Hi) Moderate Drought Affected Area

Different natural calamities, their causes and measures to reduce their impact

Sl. No.	Natural Calamities	Causes	Effects	Measures to Mitigate the impact
1.	Earthquake	<ul style="list-style-type: none"> (a) Due to volcanic eruptions (b) The movements of the plates in the earth's crust (c) Shrinking of the earth's crust; (d) Mismanagement of the crust of the earth. 	<ul style="list-style-type: none"> (i) Loss of life and property (ii) Failure of transport and communication system (iii) Fissures Cracking (iv) Landslides (v) Overturning Tsunami 	Establishing earthquake monitoring centres for regular monitoring and fast dissemination of information. Use of Geographical Positioning System (GPS). Preparing a vulnerability map of the country and dissemination of vulnerability risk information.

				<p>Modifying the house types and building-designs in the vulnerable areas and discouraging construction of high-rise buildings, large industrial establishments and big urban centres in such areas.</p>
2.	Cyclone	<p>(a) When the sea-surface temperature is above 26.5°C.</p> <p>(b) Low atmospheric pressure is less than 1000 mb.</p> <p>(c) Flow of favourable broad-scale wind regimes.</p> <p>(d) A decaying tropical cyclone may interact with a weather system in higher latitudes to cause impacts far from the tropics.</p>	<p>(i) Tropical cyclones cause heavy rainfall and landslides.</p> <p>(ii) They cause a lot of harm to towns and villages, causing severe damage to kutcha houses. Coastal businesses like shipyards and oil wells are destroyed.</p> <p>(iii) They harm the ecosystem of the surrounding region.</p> <p>(iv) Civic facilities are disturbed.</p> <p>(v) Agricultural land is severely affected, especially in terms of water supply and soil erosion.</p> <p>(vi) It causes harm to human, plant and animal life.</p> <p>(vii) Communication systems are badly affected due to cyclones.</p>	<p>We need to improve our Geographical Positioning System (GPS) to provide timely information; Construction of dams, coast lines and water bodies. Planting of trees in coastal areas; By providing beforehand information</p>

3.	Flood	<p>(a) Heavy rainfall</p> <p>(b) Overflow of rivers</p> <p>(c) Dam breaking</p> <p>(d) Storms in coastal areas</p>	<p>(i) Loss of life and property.</p> <p>(ii) Failure of transport and communication system.</p> <p>(iii) May lead to spread of epidemics.</p>	<p>Dams are built along rivers to regulate the flow of water.</p> <p>Connect with hydroelectric power plants.</p> <p>Rivers should be dredged and their beds need to be laid deeper.</p> <p>Reservoirs are built to hold back water and control the flow of small rivers.</p>
4.	Drought	<p>The main cause of drought is insufficient rainfall and its uneven distribution.</p>	<p>(a) It leads to shortage of food grains, fodder and water.</p> <p>(b) Crop failure leading to scarcity of food grains (akal), fodder (trinkal), inadequate rainfall, resulting in shortage of water (jalkal),</p> <p>(c) Large-scale death of cattle and other animals, migration of humans and livestock.</p> <p>(d) Scarcity of water compels people to consume contaminated water resulting in spread of many waterborne diseases like gastro-enteritis, cholera, hepatitis, etc.</p>	<p>(a) Provision for the distribution of safe drinking water, medicines for the victims and availability of fodder and water for the cattle and shifting of the people and their livestock to safer places, etc.</p> <p>(b) Identification of ground water potential in the form of aquifers, transfer of river water from the surplus to the deficit areas, and particularly planning for inter-linking of rivers and construction of reservoirs and dams, etc.</p> <p>(c) Remote sensing and satellite imageries can be useful in identifying the possible river-basins that can be inter-linked and in identifying the groundwater potential.</p> <p>(d) Rainwater harvesting can also be an effective method in minimising the effects of drought.</p>

5.	Landslides	<p>(a) Heavy Rainfall</p> <p>(b) In several cold mountain places, snowmelt is frequent and may be a vital process for the occurrence of landslides.</p> <p>(c) Rivers can damage the slopes, particularly during the floods that trigger a landslide.</p> <p>(d) Change in water level.</p> <p>(e) Seismic shaking in mountain regions.</p>	<p>(i) Leads to floods</p> <p>(ii) Loss of life and property</p> <p>(iii) Failure of transport and communication system.</p>	<p>Afforestation in landslide prone areas;</p> <p>Terrace farming to reduce the slope of the earth;</p> <p>Construction of barrier walls on both sides of the roads and villages.</p>
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Important Terms:

- **Disaster:** Disaster is an undesirable occurrence resulting from forces that are largely outside human control, strikes quickly with little or no warning, which causes or threatens serious disruption of life and property including death and injury to a large number of people, and requires therefore, mobilisation of efforts in excess of that which are normally provided by statutory emergency services.
- **Natural hazards:** Natural Hazards are elements of circumstances in the natural environment that have the potential to cause harm to people or property or both.
- **Drought:** The term 'drought' is applied to an extended period when there is a shortage of water availability due to inadequate precipitation, excessive rate of evaporation and over-utilisation of water from the reservoirs and other storages, including the ground water.
- **Landslide:** A form of mass movement in which rock and debris moves rapidly downslope under the influence of gravity as a result of failure along a shear plane.
- **Tsunamis:** Earthquakes and volcanic eruptions that cause the sea-floor to move abruptly resulting in sudden displacement of ocean water in the

form of high vertical waves are called tsunamis (harbour waves) or seismic sea waves.

- **Flood:** When a river bursts its banks and the water spills out onto the floodplain, it is called flood.
- **Meteorological drought:** When there is a prolonged period of inadequate rainfall marked with mal-distribution of the same over time and space, it is called meteorological drought.
- **Agricultural drought:** When there is by low soil moisture that is necessary to support the crops, thereby resulting in crop failures, it is called agricultural drought.
- **A tropical cyclone or hurricane:** It is like a heat engine that is energised by the release of latent heat on account of the condensation of moisture that the wind gathers after moving over the oceans and seas.
- **Hydrological drought:** It results when the availability of water in different storages and reservoirs like aquifers, lakes, reservoirs, etc. falls below what the precipitation can replenish.
- **Ecological drought:** When the productivity of a natural ecosystem fails due to shortage of water and as a consequence of ecological distress, damages are induced in the ecosystem. It is called ecological drought.
- **Eye of the storm:** The centre of the cyclone is mostly a warm and low-pressure, cloudless core. It is known as eye of the storm.
- **Storm Surge:** Abnormal rise in the sea level is known as Storm Surge.
- **Famine:** Extreme scarcity of food as a result of drought is called famine.
- **Earthquake:** An earthquake (also known as a quake, tremor or temblor) is the result of a sudden release of energy in the Earth's crust that creates seismic waves.
- **Seismicity:** The seismicity, seismism or seismic activity of an area refers to the frequency, type and size of earthquakes experienced over a period of time.



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