

Syllabus**Climate**

Distribution of Temperature, Rainfall, winds in Summer and Winter and factors affecting the climate of the area. Monsoon and its mechanism.

Seasons: March to May — Summer; June to September — Monsoon; October to November — Retreating Monsoon. December to February — Winter.

India has a *tropical monsoon* type of climate. This is because India lies in the tropical belt and its climate is influenced by the monsoon winds which are largely confined to the Tropics, i.e., between 20°N and 20°S. The main characteristics of this type of climate are relatively high temperatures and dry winters. However, the Himalayas in the north and the Indian Ocean in the south provide distinctive climatic conditions to India. The Himalayan ranges protect northern India from the cold winds of Central Asia and Siberia and give it a continental climate, the characteristics of which are the prevalence of land winds, dryness of air and large diurnal range of temperature. The Indian Ocean in the south gives it a hot monsoon climate more typical of the tropical than of the temperate zone.

REGIONAL VARIATIONS

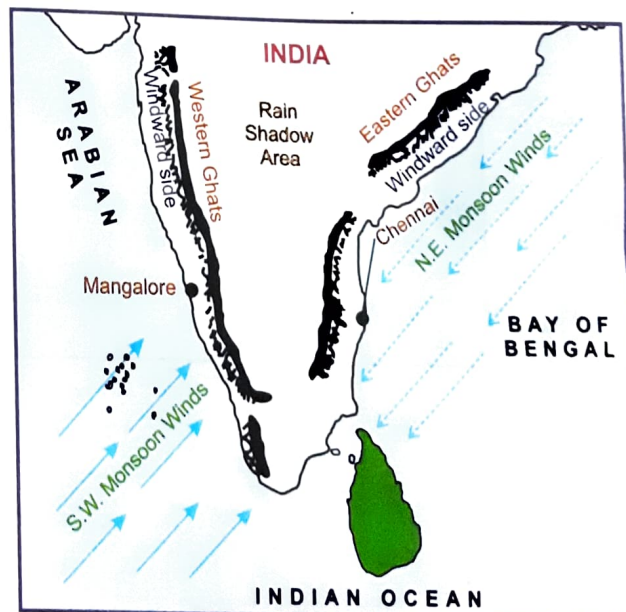
Despite the broad unity of the monsoon type of climate, variations in climate occur in different regions of the country. For example, the climatic conditions of Bihar and Uttar Pradesh in the north differ from that of Kerala and Tamil Nadu in the south; yet all of these States have a similar monsoon type

of climate. These variations are expressed in the pattern of winds, temperature and rainfall, rhythm of seasons and the degree of wetness or dryness. These regional diversities are known as the sub-types of monsoon climate.

DISTRIBUTION OF TEMPERATURE

Seasonal variations in temperature occur from place to place and from region to region. Variations in temperature are found also at a single place and in a single day. Examples of these variations are:

1. Barmer in Rajasthan may record a temperature of 48°C or 50°C on a June day, while it hardly reaches 22°C at Pahalgam or Gulmarg in Kashmir on the same day. However, in Dras near Kargil,



*Relief and rainfall: The windward side of Western Ghats receive rainfall from the S-W Monsoon and the windward side of Eastern Ghats receive rainfall from N-E Monsoon.

*Sketch (not to scale) to aid in understanding concepts.

the temperatures may go down to -40°C during winter.

2. Kerala has tropical climate with warm and moist air, whereas Punjab has continental climate with severe heat alternating with severe cold.
3. The temperature touches -40°C in Kargil in the month of December whereas Kerala records 20°C or 22°C in the same month.
4. The annual range of temperature is 3°C along the Malabar Coast and more than 20°C in the interiors.
5. The difference between day and night temperatures in the Andaman Islands and Kerala is hardly seven or eight degree celsius, whereas in the Thar desert it is between 25 to 30°C .

PRECIPITATION

Variations occur not only in the type of precipitation but also in its amount and the seasonal distribution. Snowfall occurs in the Himalayas, whereas it only rains over the rest of the country.

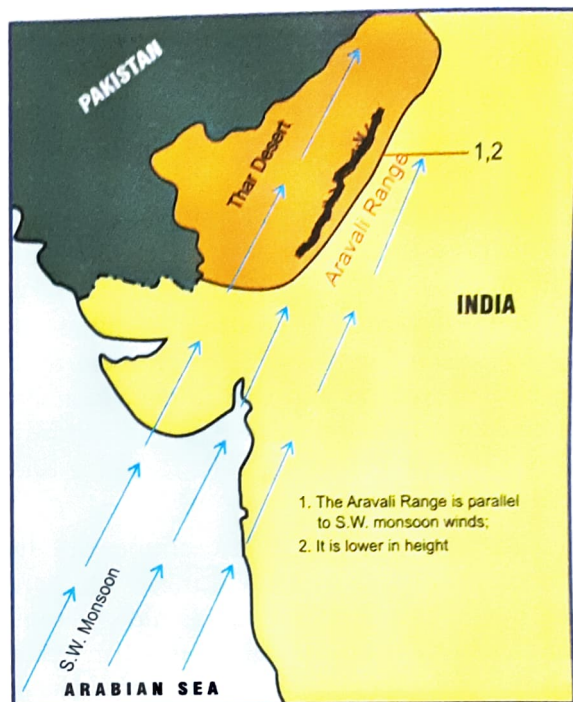
1. Cherrapunji and Mawsynram in Meghalaya get about 1100cm rain in a year, whereas Jaisalmer in Rajasthan hardly receives 9cm of rainfall in a year.
2. Tura in Meghalaya gets an amount of rainfall in a single day which is equal to 10 years of rainfall at Jaisalmer in Rajasthan.
3. The Coromandel Coast remains dry in the months of July and August, whereas the Ganga delta and the coastal plains of Odisha are hit by strong storms almost every third or fifth day during these months.
4. Most parts of India receive rainfall during June-September, but the coastal areas of Tamil Nadu get rains in the beginning of the winter season.

FACTORS AFFECTING THE CLIMATE OF INDIA

Climate refers to a generalised and composite picture of the average weather conditions spread over a long period, for a given large area. The factors which influence the climate of India are the following:

1. The Himalayas: The Himalayas form a climatic barrier separating the Indian subcontinent from the rest of Asia. They not only prevent the cold Siberian winds from entering the Indian region and from

*Sketch (not to scale) to aid in understanding concepts.



* No Rainfall in Rajasthan

India becoming a cold desert but they also force the moisture laden South West Monsoon winds to shed rainfall in India or else India would be a dry region.

2. Varied Relief: Relief plays an important role in the climatic conditions of India. The Western Ghats get heavy rainfall on the western side because they stand in the way of South West Monsoon winds which come from the Arabian Sea. On the other hand, the Deccan Plateau gets less rainfall as it lies in the rainshadow area of the Western Ghats. In Rajasthan, the Aravali Range is parallel to the direction of the South West Monsoon winds. So it is unable to stop the moisture laden winds. This makes Rajasthan a dry area. The southern hills of Assam get heavy rainfall but the northern ones do not. This is because the southern hills force the moisture laden winds to shed their moisture before they proceed northwards.

3. The Monsoon Winds: The monsoon winds have almost a universal effect in bringing summer rains over the whole of South Asia. During summers, winds move quickly into Peninsular India towards the low-pressure system of northwest India from the Arabian Sea and Bay of Bengal. The moisture carried by these south-westerly winds from the Arabian Sea and Bay of Bengal bring rain to the entire subcontinent, leaving Tibet dry in the 'rainshadow'

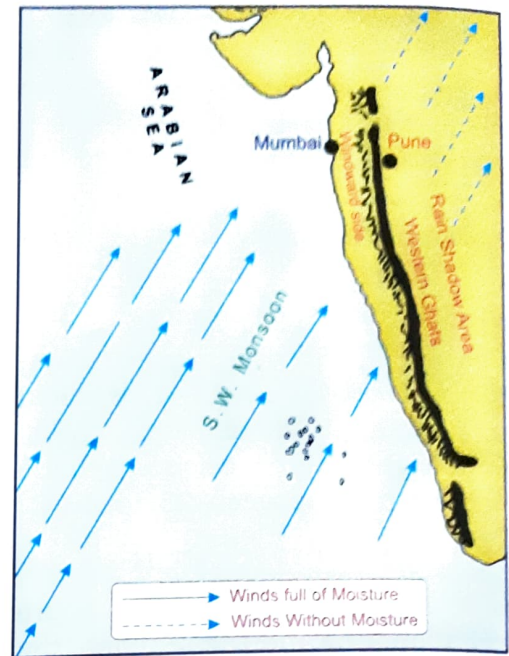
of the Himalayas. The south-west monsoon start retreating by the end of September from Punjab and Uttar Pradesh, by October from Central India and by the end of November from South India. Retreating monsoon brings rain in eastern coastal region. During winter, dry offshore, North-East Monsoon winds blow from high pressure to low pressure region which is centred at the head of Bay of Bengal. These winds originate in Mongolia and northwest China. As they blow over a vast landmass, they are cold and dry. These cold dry winds join the Trade Winds to pass over the Bay of Bengal. They pick moisture from the Bay of Bengal to bring rain to Tamil Nadu in winters.

4. Latitude: The Indian subcontinent is divided into two parts by the Tropic of Cancer. The northern portion lies in the temperate zone and the southern portion lies in the tropical zone. The warm temperate or sub-tropical climate of the northern zone gives it cold winter season and hot summer season. The southern tropical climatic zone of India is warmer than the north and does not have a clear-cut winter season. Similarly, the northern zone does not have the mid-day sun almost vertically overhead during any part of the year, while the southern zone has the mid-day sun almost vertically overhead at least twice every year.

5. Altitude: There is a decrease of 1°C for every 166m rise in height, because temperature decreases as you move to higher altitudes. So, the mountains are cooler than the plains. For example, Ooty has much lower temperature, than Kochi, because of the altitude.

6. Influence of the Surrounding Seas: India is flanked by three water bodies, namely, the Indian Ocean, the Bay of Bengal and the Arabian Sea which have a profound impact on the climate, especially in areas lying close to the sea. These water bodies act as the major source of moisture to the summer monsoons and bring heavy rainfall to the whole area. In fact, it is because of the nearness to the sea that these areas have a moderate climate.

7. Western Disturbances: The weather conditions during winter are generally influenced by the distribution pattern of pressure in Central and West Asia. In the winter season due to the shifting of the pressure belts, the westerlies blow from 20°N



*Mumbai gets more rainfall than Pune

to 50°N Latitude and north India comes under the influence of the winds and cyclones rising from the Mediterranean Sea. These cyclones bring rain to Northern Plains and snow in Jammu and Kashmir in India.

8. Jet Streams: Jet streams are cold fast blowing winds that develop in the upper layers of the atmosphere. They influence the climate of India. The westerly jet stream prevails over the North Indian Plains during the winter months, while the easterly jet stream steers the tropical depression over India. These depressions play a significant role in the distribution pattern of the monsoon rainfall in the subcontinent. The highest rainfall occurs along the track of these depressions.

9. Distance from the Sea: Areas in the interior of India have extreme type of climate or *continental climate* whereas coastal areas have equable or *maritime climate*. The effect of land breeze and sea breeze caused by differential rate of heating and cooling of land and sea are responsible for moderate climate in coastal areas.

In the Peninsula, the Western Ghats prevent the winds from carrying such benefits far inwards. Therefore, the moderating influence of the sea is limited to the coastal areas.

10. El-Nino Effect: El-Nino is a warm ocean current which sometimes appears off the coast of Peru

*Sketch (not to scale) to aid in understanding concepts.

in South America during the month of December. It increases the surface temperature of the sea and affects the movement of monsoon winds in the Indian Ocean and causes weak drought-like situation in the Indian subcontinent.

MONSOON PHENOMENA AND ITS MECHANISM

Monsoon winds are periodic or seasonal winds. They develop because of differential heating as well as cooling of the land and sea. They are divided into two wind systems—the *Summer Monsoon* and the *Winter Monsoon*.

SUMMER MONSOONS

In summer, the land gets heated more than the sea. Hence, a centre of low pressure develops on the land. Over the adjoining sea, the air is comparatively cool,

and a high pressure develops there. This causes the winds to blow from the sea to the land. It is the '*Summer Monsoon*.'

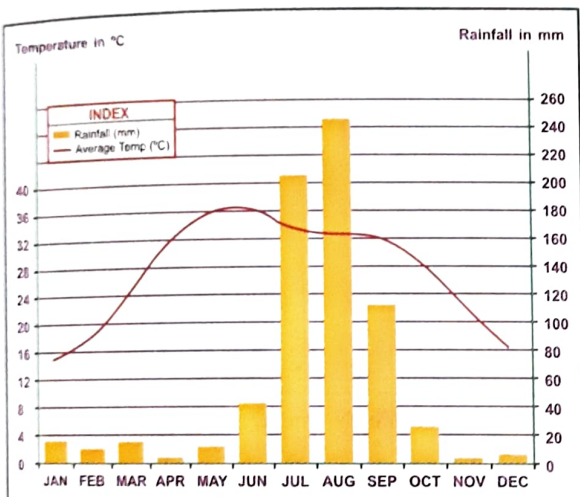
In May, June and July, the plains of the Indian subcontinent are heated by the vertical rays of the sun. The intense heat develops a low pressure. During these months, a high pressure area develops over the Indian Ocean. So, the winds blow from the Indian Ocean northward and north-westward into Asia. As they blow from the sea to the land, they bring heavy rainfall in some parts of the Indian subcontinent. The summer monsoon winds blow south-west, so they are known as the '*South-West Summer Monsoon*.'

WINTER MONSOONS

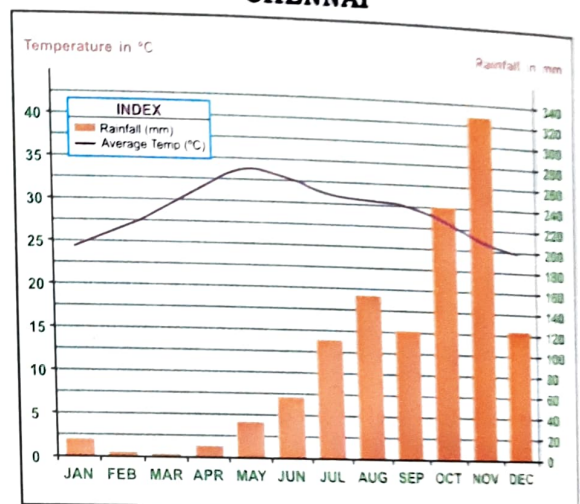
During winter season, the conditions are the reverse of those in summers. A high pressure develops over a big landmass stretching from Central Asia upto north-west Indian plains. At the same time a low

CLIMATE GRAPHS

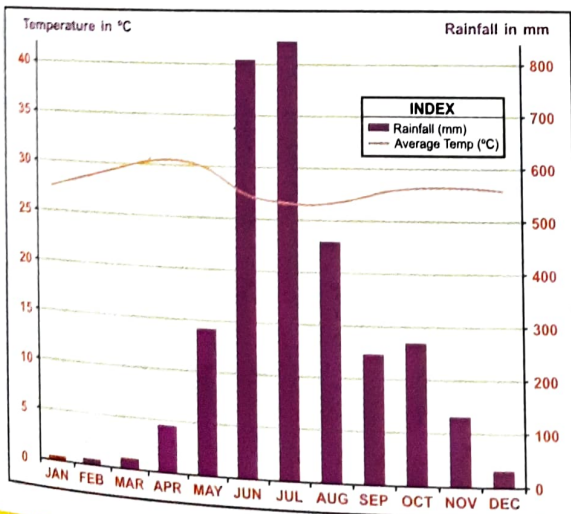
DELHI



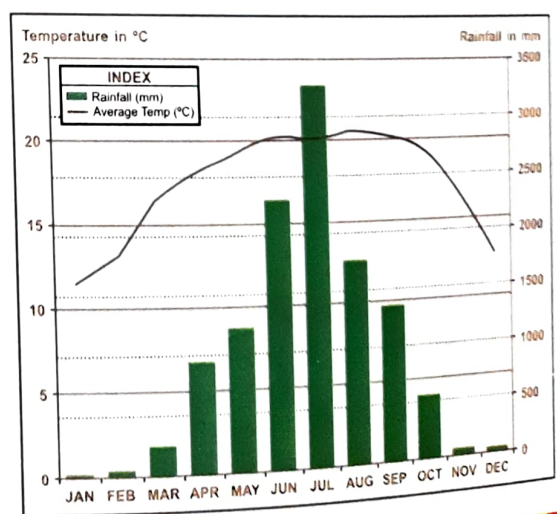
CHENNAI



KOZHIKODE



CHERRAPUNJI



pressure zone develops in the Indian Ocean. As the winds blow from the land to the sea, they bring cold dry weather. They are incapable of producing rain.

When these winds blow over seas and pass over the adjoining land, they bring some rainfall. The Southern Coromandel Coast (Tamil Nadu and southern tip of Andhra Pradesh) in India get rain from winter monsoons. The winter monsoon winds blow north-east; so the monsoon is known as the 'North-East Winter Monsoon.'

Mechanisms of Monsoon are further explained in this Chapter.

FOUR SEASONS

The Monsoon type of climate has distinct seasonal pattern marked by significant change from one season to the other. These changes are clearly visible in the interior parts of the country. The coastal areas, due to the influence of the seas do not experience much variation in temperature though there occurs variation in the pattern of rainfall. Thus, the year may be divided into four principal seasons on the basis of monsoon variations:

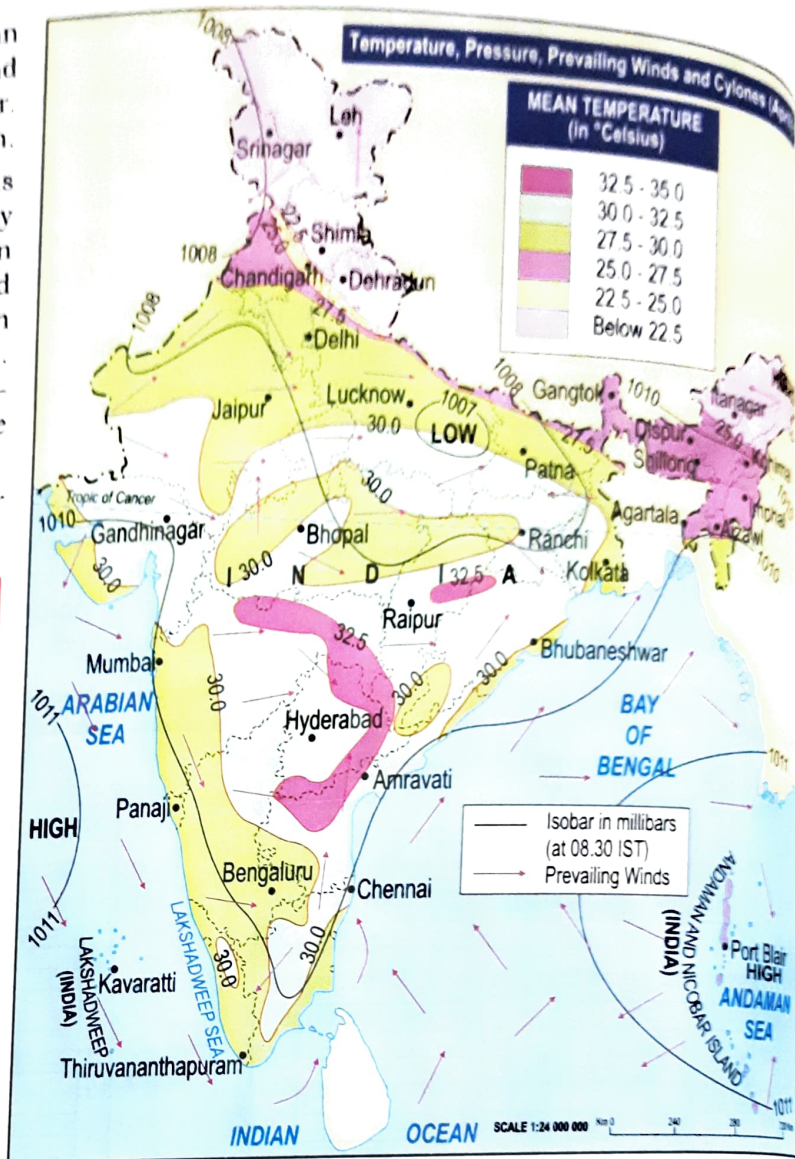
1. The Hot and Dry Summer (March to May).
2. The Hot and Wet or Rainy Season or the South-West Monsoon (June to September).
3. The Retreating South-West Monsoon (October-November).
4. The Cold and Dry Winter Season or North-East Monsoon (December-February).

1. THE HOT DRY SUMMER

In India, the hot season begins in March and lasts until June. The vertical rays of the sun fall directly over the Tropic of Cancer during this period.

TEMPERATURE

From March to May, due to the apparent northward movement of the path of the sun's vertical rays, the length of the day increases. It results in the increase in solar radiation which moves northward over the tropical areas of South Asia and the temperature



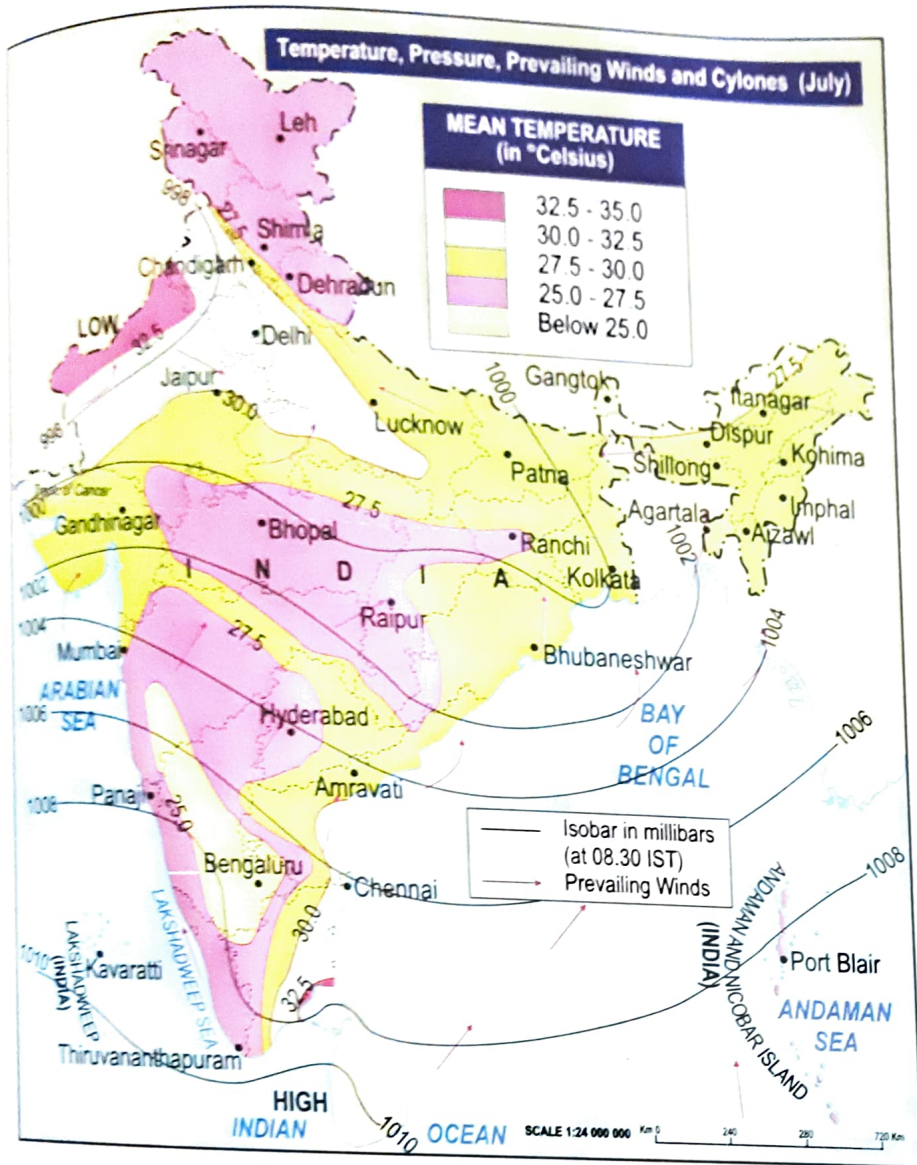
India-Pressure, Prevailing Winds and Cyclones in (April)

starts rising. In most parts of India, temperature ranges between 30°C and 32°C. The highest day temperatures increase as the heat belt moves further north. In north-western part of India, temperatures around 48°C are not uncommon.

In south India, the hot weather is not as intense as in north India. The moderating influence of the oceans together with the Peninsular situation of south India keeps the temperatures lower than that in north India. The temperatures, therefore, remain between 26°C and 32°C in south India.

There is some respite from the heat in the coastal regions due to the influence of the sea. Plateaus and hills are also relatively cool because of the elevation.

The diurnal variation is large, especially in the interior part lying on the west of the subcontinent.



PRESSURE CONDITIONS

The warmest area slowly shifts from the Deccan to northwest India. The high temperature in the subcontinent causes a low pressure between Thar Desert and Chota Nagpur Plateau. The surrounding seas are cooler and develop high pressure conditions in the Indian Ocean.

By the end of May a comparatively high pressure area develops near Cape Comorin extending towards the Arabian Sea. By June, the inland low pressure system becomes more intense and moves northward with its centre over the Indus lowlands and Baluchistan. The influx of these winds by mid-June brings about a change in the weather towards the rainy season.

STORMS AND RAINFALL

The hot-dry weather is marked by weak winds and dryness over the area. The low pressure over the Northern Plains draws winds from the surrounding areas and gives rise to thunderstorms with strong dusty winds. These winds cause a shower of rain mostly in Punjab, Haryana and Uttar Pradesh.

LOCAL WINDS

(a) A striking feature of the hot weather season is the strong and dusty winds, called *loo*, which blow during the day over northern and north-western India. These winds have temperature range between 45°C and 50°C which is hot enough to cause heatstrokes.

(b) There are occasional tornado-like dust storms in Punjab and Haryana and Uttar Pradesh.

(c) The thunderstorms accompanied with strong winds and heavy rainfall occur in Assam and West Bengal. These local winds are known as *Kalbaisakhi* which means 'the calamity of the month of Baisakh'. In Assam, these storms are known as *Bardoli Chheerha*. They originate over the Chota Nagpur Plateau and are carried eastward by westerly winds. They bring rainfall in Assam, West Bengal and Odisha. This rainfall is quite beneficial for growing jute and rice in West Bengal and tea in Assam.

(d) Thunderstorms cause rainfall along the Kerala and Karnataka coasts. The little rainfall even that they bring is important for mango, tea and coffee plants. Such rains are called *mango showers* as they help in the early ripening of the mango crop. They are also called *cherry blossoms* in Karnataka.

2. THE SOUTH-WEST MONSOON SEASON

The South-West Monsoon season is the season of general rainfall. This season lasts from June to September. The differential heating of land and sea during the summer months causes the monsoon winds to drift towards the subcontinent. The large landmass to the north of the Indian Ocean gets intensely heated during April and May. This causes the formation of an intense low pressure in the north-western part of the Indian subcontinent. Since the

pressure in the ocean to the south of the landmass is high, it attracts the South East (S.E.) Trade Winds which prevail in the southern hemisphere. These S.E. Trade winds after crossing the Equator are deflected towards the right because of the Coriolis force and reach the west coast as *South-West Monsoon*. These winds bring heavy rainfall accompanied by violent thunder and lightning. This sudden violent onset of rainfall in the first week of June is termed as the *Burst of the Monsoon*. However, when the South-West Monsoon fails to bring rainfall for two or more weeks and there is a dry period in the rainy season it is called the *Break of Monsoon*. The first State to receive the monsoon showers is Kerala and also the last to see its withdrawal.

As a result of the tapering topography of peninsular India the South-West Monsoon winds divide into two branches:

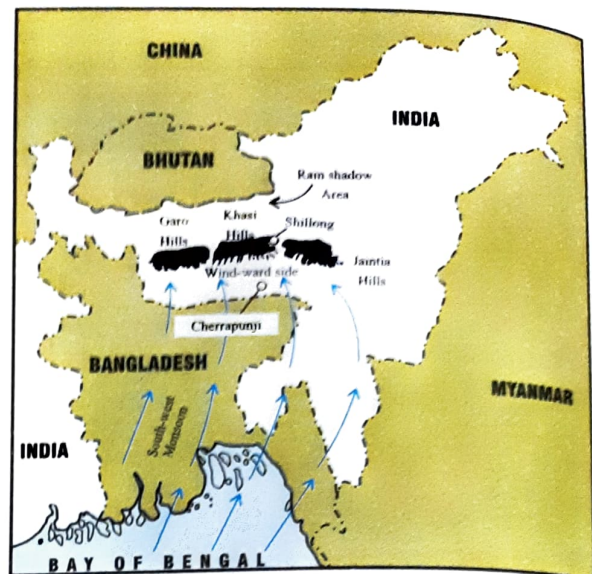
- (a) The Arabian Sea Branch; and
- (b) The Bay of Bengal Branch

The rains bring down the temperature and hence, some respite from the heat. However, there is relief only as long as it rains, because the relative humidity is quite high during July-August. In Mumbai the temperature drops by 10°C after a week's rain. Nagpur sees a maximum of 45°C in May which drops to 31°C in July.

THE ARABIAN SEA BRANCH

The South-West Monsoon winds originating over the Arabian Sea further split into three branches:

- (a) Its one branch is obstructed by the Western Ghats. These winds go up the slopes of the Western Ghats, become cool and bring heavy rains in the windward side of the Sahyadris and the Western Coastal Plains. After crossing the Ghats these winds descend, get heated up and thereby, the humidity in the winds is reduced. Consequently, these winds cause little rainfall east of the Western Ghats, *i.e.*, in the rainshadow area.
- (b) The second branch of the Arabian Sea branch of the Monsoon winds strikes the coast north of Mumbai. These winds move further along the Narmada and Tapi river valleys and cause fair amount of rainfall in Central India. The Chota Nagpur Plateau receives 15cm of rainfall from this branch. After that, it enters the Ganga plains and mingles with the Bay of Bengal Branch.



Cherrapunji is located on the windward side of hills

- (c) The third branch strikes the Saurashtra Peninsula and the Kutch. After that it passes over western Rajasthan and along the Aravalis causing scanty rainfall. The Arabian Sea Branch joins the Bay of Bengal Branch in Punjab and Haryana and together these two branches cause rainfall in the western Himalayas.

THE BAY OF BENGAL BRANCH

The Bay of Bengal branch is directed towards the coast of Myanmar and part of south-east Bangladesh. However, owing to the presence of the Arakan Hills along the coast of Myanmar, a large part of this branch of monsoon is deflected towards the Indian subcontinent. The monsoons, therefore, enter West Bengal and Bangladesh from south and south-east instead of the south-westerly direction. Now this branch bifurcates into two branches: one along the Ganga plains and the other along the Brahmaputra valley. These branches cause wide spread rain in the Ganga plains, Brahmaputra valley and Garo and Khasi Hills of Meghalaya. Cherrapunji and Mawsynram, located on the crest of the southern range of Khasi Hills, receive the highest average annual rainfall in the world.

Distribution of rainfall received from South-West Monsoons is largely governed by the relief or topography. For example, Mahabaleshwar on the windward side of the Western Ghats registers a rainfall of over 250cm. whereas Pune on the leeward side of these Ghats, receives less than 70cm of rainfall.

Sketch (not to scale) to aid in understanding concepts.



Retreating Monsoons - Low pressure trough shifts causing retreat of the Monsoon Winds.

Likewise, the heavy precipitation in north-eastern states is due to the occurrence of hilly ranges in these states. There is a decrease in rainfall as one goes from east to west. During this particular season Kolkata receives about 120cm, Patna 102cm, Allahabad 91cm and Delhi 56cm.

The Tamil Nadu coast remains dry during this season. This is because the Tamil Nadu coast is

located parallel to the Bay of Bengal branch of the south-west monsoon. Further, it lies in the rainshadow area of the Arabian Sea branch of the south-west monsoon.

3. RETREATING MONSOON

The South-West Monsoon starts retreating from northern India in early October. Hence, the months

South-West Monsoon	Retreating Monsoon	North-East Monsoon
<ul style="list-style-type: none"> • These winds blow from June to September. 	<ul style="list-style-type: none"> • These winds blow during October and November. 	<ul style="list-style-type: none"> • These winds blow from December to February.
<ul style="list-style-type: none"> • The direction of these winds is from South-West. 	<ul style="list-style-type: none"> • The direction of these winds is from North-East. 	<ul style="list-style-type: none"> • The direction of these winds is from North-East.
<ul style="list-style-type: none"> • They blow from sea to land and are moisture laden winds. 	<ul style="list-style-type: none"> • These winds blow from land to sea. 	<ul style="list-style-type: none"> • These winds blow from land to sea.
<ul style="list-style-type: none"> • They bring heavy rainfall. This is a high temperature and high humidity season. The pressure is low on the land area and high over surrounding water bodies. 	<ul style="list-style-type: none"> • The temperature changes and the humidity remains high but rainfall decreases. It is a transition from rainy season to cold dry winter season. 	<ul style="list-style-type: none"> • Clear skies, pleasant weather with low temperature and low humidity prevails over the Indian region.
<ul style="list-style-type: none"> • During these months there is rainfall in the whole subcontinent. 	<ul style="list-style-type: none"> • The coastal areas of Tamil Nadu receive maximum rainfall from these retreating winds. 	<ul style="list-style-type: none"> • When they move over the Bay of Bengal they pick up moisture to bring rainfall only to the Coromandel coast.

of October and November are known for the *retreating monsoon*.

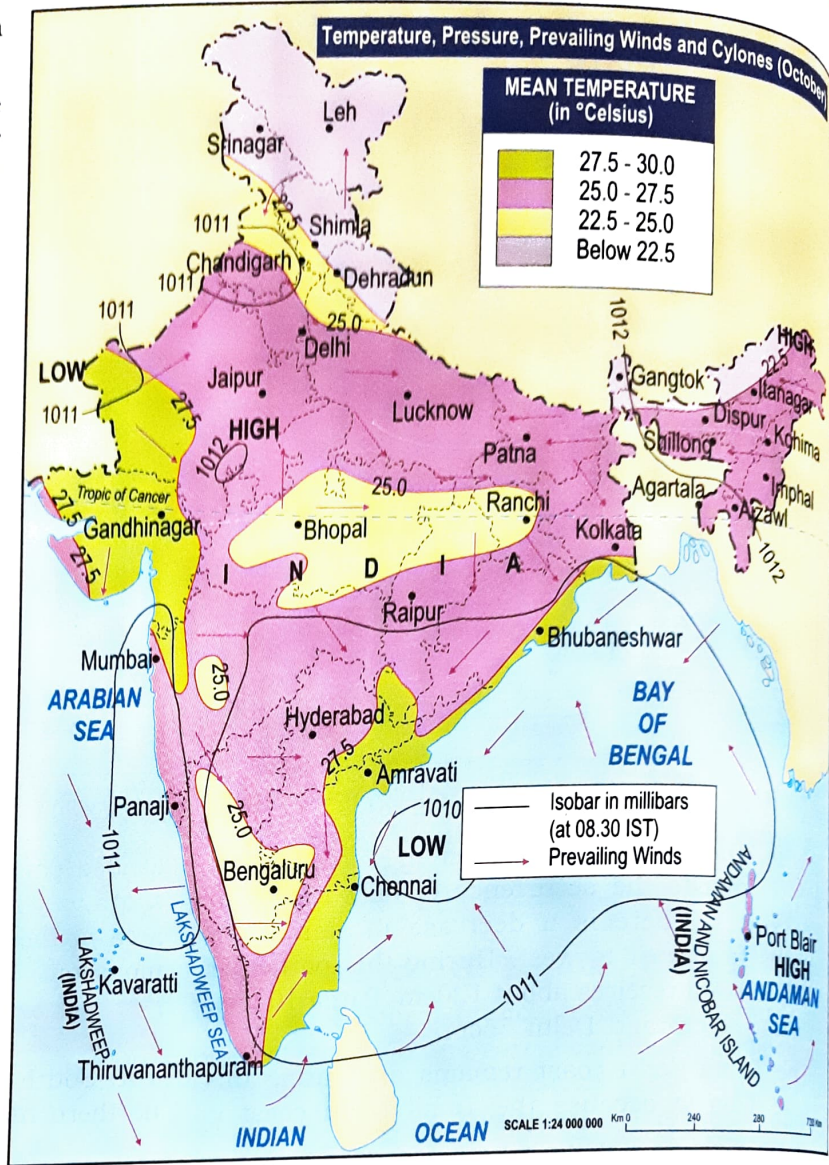
The reason of this retreat is that the Monsoon trough of low pressure over the Ganga plains becomes weaker due to the apparent southward movement of the sun. The low pressure trough is gradually replaced by high pressure. The retreat of the Monsoon is marked by clear skies and drop in night temperature. The land remains moist. The combination of high temperature and humidity gives rise to an oppressive weather. This is commonly known as 'October heat'. Day temperature rises due to clear skies.

The low pressure conditions are transferred to the centre of Bay of Bengal by early November. This shift of the low pressure area is marked by cyclonic depressions which originate over the Andaman Sea. Some of the cyclonic depressions manage to cross the eastern coasts of southern peninsula resulting in heavy and widespread rains on the coast of Tamil Nadu and parts of Odisha. These cyclonic storms move from the north-east to the south-west. The retreating monsoons are generally dry except on the coastal areas of Tamil Nadu, Odisha and parts of Karnataka. The bulk of the rainfall of the Coromandel Coast is derived from depressions and cyclones.

Retreating Monsoon winds cause rainfall in some places that is as heavy as the summer Monsoons. Interior parts of Deccan remain dry because they lie in the rainshadow of the Eastern Ghats.

TROPICAL CYCLONES

There are tropical depressions (low-pressure systems) originating in the Bay of Bengal caused by local variations of heat and moisture. They lead to tropical cyclones in November and December. Such cyclones generally originate in the neighbourhood of the Andaman Islands between 12°N and 17°N and travel west or northwest over the Bay of Bengal. Whenever they occur, they cause great loss of life and property due to heavy rains on the eastern coastal regions of India.



Weather Conditions in October

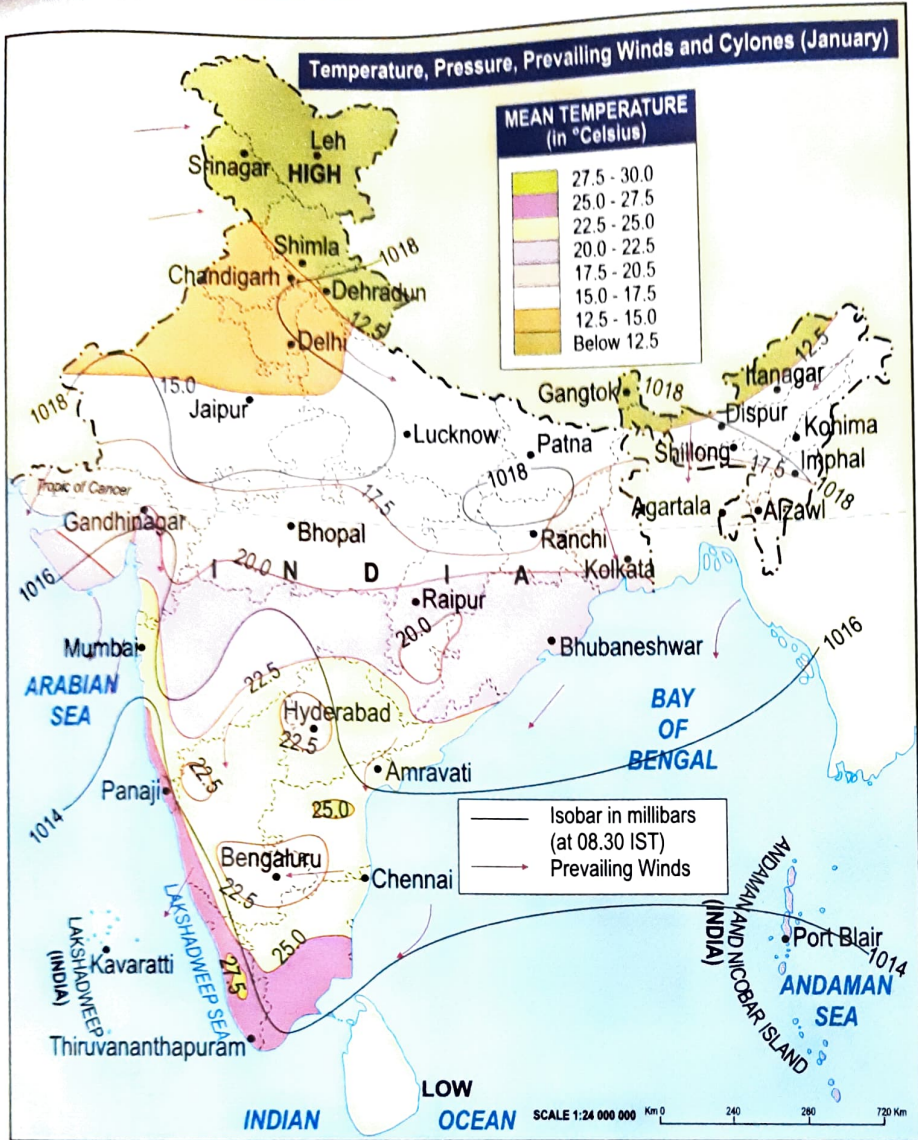
OCTOBER HEAT

October is marked by clear cloudless sky, high temperature and high humidity. As explained earlier, this sultry and oppressive weather is referred to as 'October Heat.'

It is a transition period between the hot rainy season and cold dry season. By the end of October or by the beginning of November fine weather conditions prevail over the rest of the subcontinent.

4. THE NORTH-EAST MONSOON SEASON

The cold weather season commences at the end of November and continues till March. The skies are relatively clear with dry weather. Night temperatures are low, specially in northern India, but the days



Weather Conditions in January

are pleasantly warm. The mean temperature in the northern plains is below 20°C and gets even lower in Himachal Pradesh, Jammu and Kashmir, Punjab and Haryana.

TEMPERATURE

In winter season, January is usually the coldest month. The temperature remains quite low during the winter months over the Indian sub-continent. The temperatures decrease from south to north. The mean maximum temperature for the month of January at Thiruvananthapuram is as high as 31°C, at Calicut 26°C, at Chennai 24°C, at Varanasi about 16°C and at Jammu only 10°C.

The night temperature in the Gangetic Plains varies from 2.5°C to 17.5°C. Temperatures fall below

freezing point in the higher reaches of the Himalayas. Dras Valley in Kashmir near Kargil records minimum temperature of -45°C. It is the coldest place in India.

The excessive cold in north India during this season is due to the following reasons:

- (a) In the month of February, the cold winds from the Caspian Sea and Turkmenistan bring cold wave over the northwestern parts of India;
- (b) Punjab, Haryana and Rajasthan experience continental type of climates as they are located far away from the sea to experience its moderating influence; and
- (c) The snowfall in the nearby Himalayan ranges creates cold wave situation.

In Peninsular India, the average temperature lies between 20°C to 25°C and it does not have any well defined cold weather season. The coastal areas hardly experience any seasonal change in the distribution pattern of temperature due to the moderating influence of the sea and proximity to the Equator. For example, the mean maximum temperature for June at Thiruvananthapuram is 29.5°C and it is 31°C for January.

PRESSURE

The weather in this season is characterised by feeble high pressure conditions over the north-western part of the plain. This is because of the oblique rays of the sun which reach the subcontinent as the sun moves to the Southern Hemisphere.

During this season, the North-East Trade Winds prevail over the country. These winds blow from land to sea and hence, for most parts of the country it is dry season. However, when these winds pass over Bay of Bengal they pick up some moisture and cause some amount of rainfall on the Coromandel Coast. As these winds blow from north-east to south-west, they are called the *North-East Monsoon Winds*.

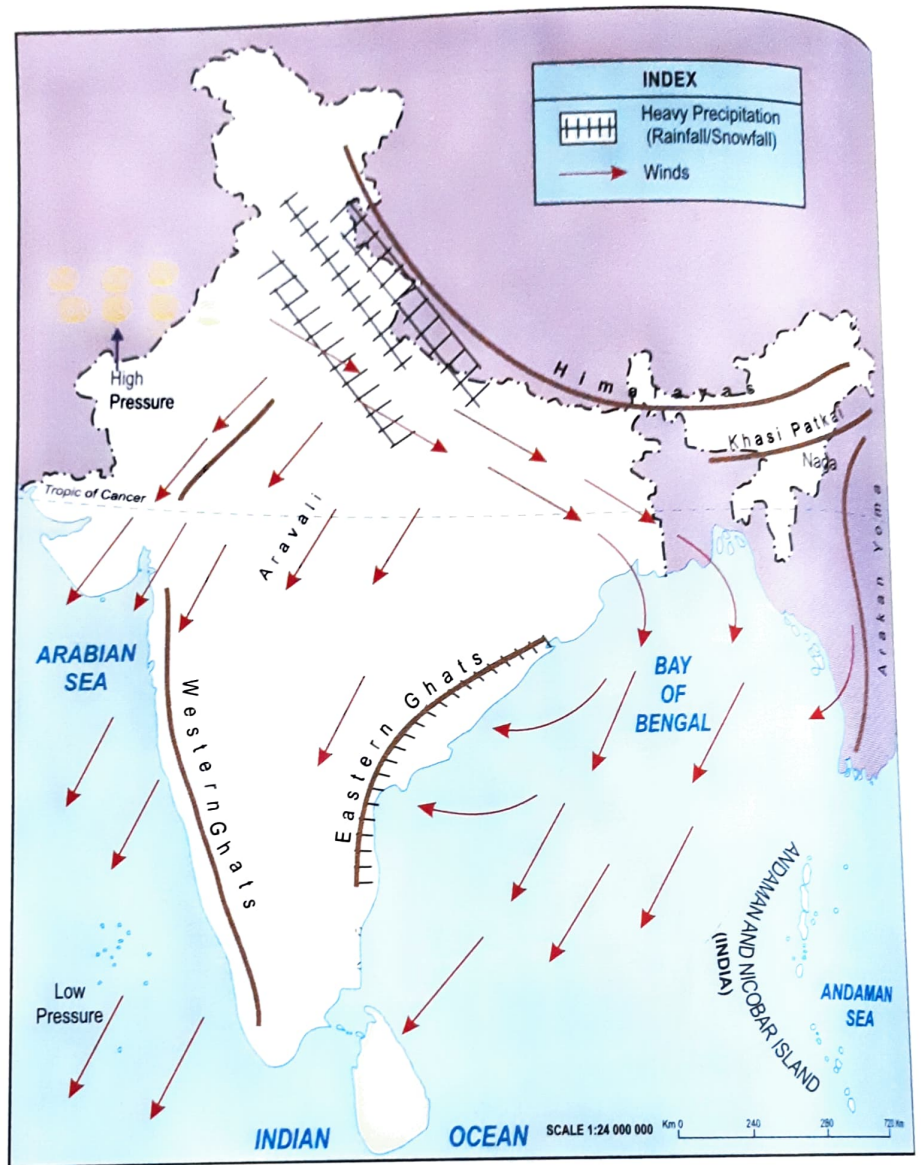
TEMPERATE CYCLONES (Western Disturbances)

A characteristic feature of the cold weather season is the inflow of depressions from the west and the north-west. These low pressure systems, called the *western disturbances*, originate in West Asia and the regions near the Mediterranean Sea. They travel eastwards across Iran and Pakistan and reach India during the winter season. They bring the much-needed winter rains over the plains and snowfall in the mountains. On an average, four or five such depressions affect India in each of the winter months. They are generally active between December and February. Though the amount of winter rainfall is small, it is of considerable importance for the cultivation of rabi crops.

RAINFALL

Most parts of India do not receive rainfall in the winter season. This is because the winter monsoons have little humidity and due to anti-cyclonic circulation on land, the possibility of rain from them decreases. However, there are some areas which do receive rainfall in the winter season. They are as follows:

1. Central parts of India and northern parts of Peninsula get occasional rainfall in winter.
2. Some weak temperate cyclones from the Mediterranean Sea cause rainfall in Delhi, Haryana,



India—Winter Rainfall

3. Punjab and western Uttar Pradesh. Though the amount of this rainfall is meagre, it is quite beneficial for the rabi crops.
3. The north-eastern part of India also gets rainfall

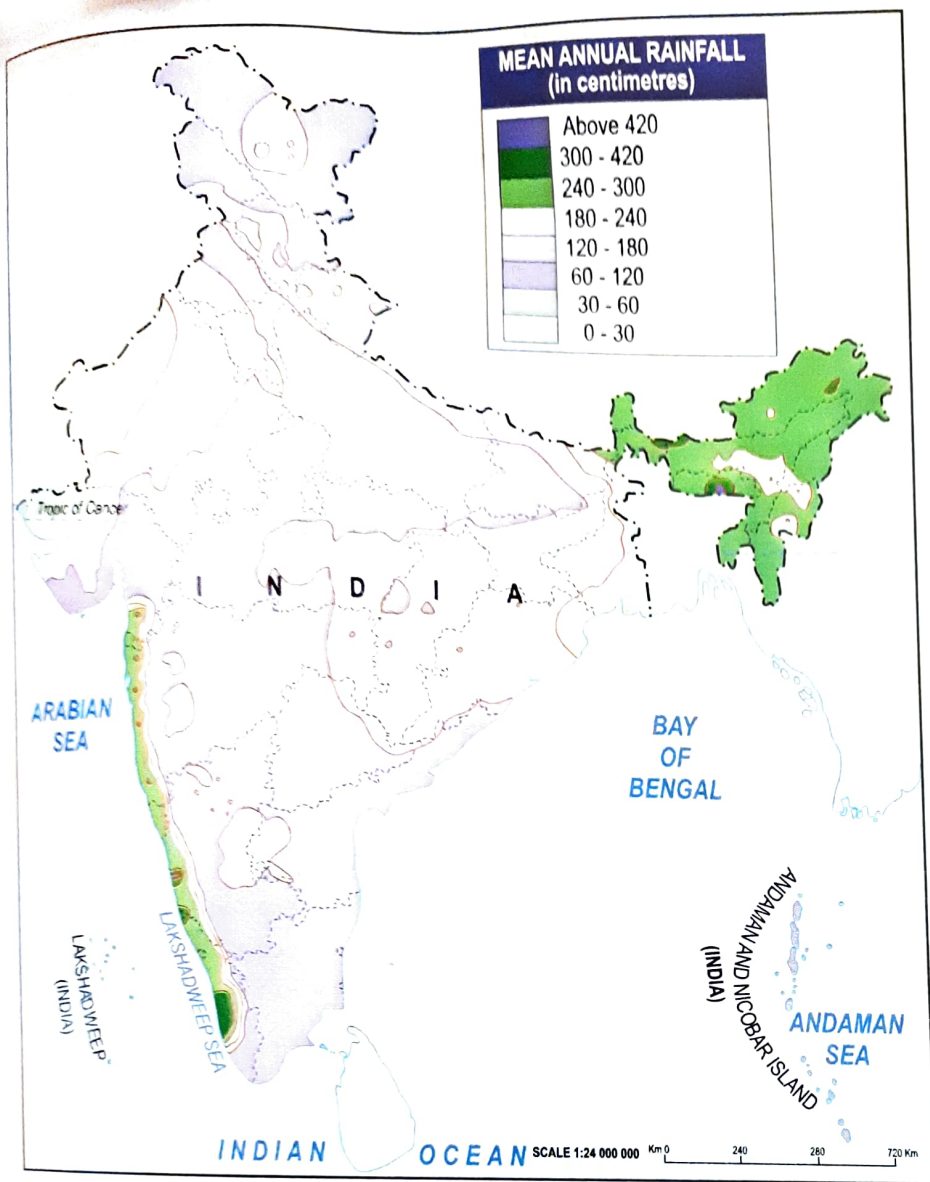
South-West Monsoon Winds

Arabian Sea Branch

1. It enters Indian landmass after blowing over a vast open sea. During this period it collects lot of moisture.
2. The Arabian Sea Branch blows over India.
3. It hits against the Western Ghats as soon as it blows over the land.

Bay of Bengal Branch

1. It travels a shorter distance (a bay) and carries less moisture.
2. The Bay of Bengal Branch partly enters India; its major part blows over Myanmar and Thailand.
3. It has to travel a long distance over land before it hits against the mountains.



India - Annual Rainfall

during the winter months. Arunachal Pradesh and Assam get rains between 25mm and 50mm during winters.

4. In the months of October and November, the North-East Monsoon while crossing over the Bay of Bengal, picks up moisture and brings torrential rainfall over Tamil Nadu coast and southern tip of Andhra Pradesh.

DISTRIBUTION OF RAINFALL

The distribution of rainfall is determined by the following:

1. the pressure conditions and the direction of the relief features;
2. the direction of the winds bearing moisture;
3. cyclonic depression determined by pressure gradient.

India can be divided into four rainfall regions:

(1) Heavy Rainfall Region: This region experiences more than 200cm of rainfall annually and includes the following areas.

- (i) The windward side of the Western Ghats like the Western Coastal Plains and the slopes of the Western Ghats.
- (ii) Meghalaya Hills (Garo, Khasi and Jaintia), the southern slopes of Eastern Himalayas, Assam, Arunachal Pradesh and West Bengal.

(2) Moderate Rainfall Region: This region receives rainfall ranging from 100cm to 200cm a year. The following areas are included in this region:

- (i) The northern parts of Andhra Pradesh, the southern parts of Tamil Nadu.

Tropical Cyclones	Temperate Cyclones
<ul style="list-style-type: none"> • Tropical cyclones are largely a summer phenomenon. 	<ul style="list-style-type: none"> • Temperate cyclones are most intense in the winter season.
<ul style="list-style-type: none"> • They are generally smaller in size and their shape is more or less circular. 	<ul style="list-style-type: none"> • They are bigger in size than the tropical cyclones and are oval in shape.
<ul style="list-style-type: none"> • Tropical cyclones develop over the seas. 	<ul style="list-style-type: none"> • Temperate cyclones develop over continents.
<ul style="list-style-type: none"> • They develop in the tropical region of Bay of Bengal and influence Indian coastal climate. 	<ul style="list-style-type: none"> • They develop in the temperate region of Mediterranean sea.
<ul style="list-style-type: none"> • They bring heavy rainfall with strong winds over the Coromandel Coast of India. 	<ul style="list-style-type: none"> • They bring light to moderate rainfall in the North western part of India under the influence of westerly jet streams.

Sources of Rainfall

1. For Punjab and Haryana — the three sources of rainfall are:
 - Western disturbances
 - South-West monsoon winds—Arabian Sea branch
 - South-West monsoon winds—Bay of Bengal branch
2. For Tamil Nadu Coast—the three sources of rainfall are:
 - South-West monsoon winds
 - North-East monsoon winds
 - Retreating monsoon winds

(ii) Middle Ganga Valley, some portions of Western Ghats, Eastern Maharashtra, Madhya Pradesh, Odisha.

(3) Low Rainfall Region: The rainfall in this region is low, varying from 50 to 100cm. The areas of low rainfall are:

- (i) Parts of the Deccan Plateau comprising the regions of Karnataka, Andhra Pradesh and Tamil Nadu.
- (ii) Eastern Rajasthan, Punjab, Haryana and Kashmir.

(4) Scanty Rainfall Region: These areas get the least rainfall, i.e., less than 50cm annually. Desert and semi-desert areas are included in this.

- The following areas come in this region:
- (i) Southern Punjab, Western Rajasthan and parts of Ladakh.
 - (ii) The rainshadow regions of the Western Ghats lying in the Deccan Plateau.

FEATURES OF THE RAINFALL

Main features of the rainfall in India are:

1. There is rainfall over three months and the rest of the year is mostly dry. Seventy per cent of annual rainfall occurs in the rainy season.
2. The rains are mainly of relief type. The windward slopes of the mountains get more rainfall than the leeward side.
3. Only a small portion of the rainfall is received from sources other than the monsoon, like cyclonic rainfall and convectional rainfall.
4. The quantity and the time of occurrence of rainfall cannot be predicted as the rainfall is erratic. It is because of this uncertainty that sometimes there are floods; and sometimes droughts.
5. India has an agrarian economy dependent on rainfall. As such rainfall affects the economy of the country.