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CLIMATE

In the last two chapters you have read about the landforms and the drainage of our country. These are the two of the three basic elements that one learns about the natural environment of any area. In this chapter you will learn about the third, that is, the atmospheric conditions that prevail over our country. Why do we wear woollens in December or why it is hot and uncomfortable in the month of May, and why it rains in June - July? The answers to all these questions can be found out by studying about the climate of India.

Climate refers to the sum total of weather conditions and variations over a large area for a long period of time (more than thirty years). **Weather** refers to the state of the atmosphere over an area at any point of time. The elements of weather and climate are the same, i.e. temperature, atmospheric pressure, wind, humidity and precipitation. You may have observed that the weather conditions fluctuate very often even within a day. But there is some common pattern over a few weeks or months, i.e. days are cool or hot, windy or calm, cloudy or bright, and wet or dry. On the basis of the generalised monthly atmospheric conditions, the year is divided into seasons such as winter, summer or rainy seasons.

The world is divided into a number of climatic regions. Do you know what type of climate India has and why it is so? We will learn about it in this chapter.

Do You Know?

- The word monsoon is derived from the Arabic word 'mausim' which literally means season.
- 'Monsoon' refers to the seasonal reversal in the wind direction during a year.

The climate of India is described as the **'monsoon'** type. In Asia, this type of climate is found mainly in the south and the southeast. Despite an overall unity in the general pattern, there are perceptible regional variations in climatic conditions within the country. Let us take two important elements – temperature and precipitation, and examine how they vary from place to place and season to season.

In summer, the mercury occasionally touches 50°C in some parts of the Rajasthan desert, whereas it may be around 20°C in Pahalgam in Jammu and Kashmir. On a winter night, temperature at Drass in Jammu and Kashmir may be as low as minus 45°C. Thiruvananthapuram, on the other hand, may have a temperature of 22°C.

Do You Know?

In certain places there is a wide difference between day and night temperatures. In the Thar Desert the day temperature may rise to 50°C, and drop down to near 15°C the same night. On the other hand, there is hardly any difference in day and night temperatures in the Andaman and Nicobar islands or in Kerala.

Let us now look at precipitation. There are variations not only in the form and types of precipitation but also in its amount and the seasonal distribution. While precipitation is mostly in the form of snowfall in the upper parts of Himalayas, it rains over the rest of the country. The annual precipitation varies from over 400 cm in Meghalaya to less than 10 cm in Ladakh and western Rajasthan. Most parts of the country receive rainfall from June to September. But some parts like the Tamil Nadu

coast gets a large portion of its rain during October and November.

In general, coastal areas experience less contrasts in temperature conditions. Seasonal contrasts are more in the interior of the country. There is decrease in rainfall generally from east to west in the Northern Plains. These variations have given rise to variety in lives of people – in terms of the food they eat, the clothes they wear and also the kind of houses they live in.

Find out

- Why the houses in Rajasthan have thick walls and flat roofs?
- Why is it that the houses in the Tarai region and in Goa and Mangalore have sloping roofs?
- Why houses in Assam are built on stilts?

Climatic Controls

There are six major controls of the climate of any place. They are: **latitude**, **altitude**, **pressure and wind system, distance from the sea** (continentality), **ocean currents and relief features**.

Due to the curvature of the earth, the amount of solar energy received varies according to **latitude**. As a result, air temperature generally decreases from the equator towards the poles. As one goes from the surface of the earth to higher **altitudes**, the atmosphere becomes less dense and temperature decreases. The hills are therefore cooler during summers. The **pressure and wind** system of any area depend on the latitude and altitude of the place. Thus it influences the temperature and rainfall pattern. The sea exerts a moderating influence on climate: As the **distance from the sea** increases, its moderating influence decreases and the people experience extreme weather conditions. This condition is known as continentality (i.e. very hot during summers and very cold during winters). **Ocean currents** along with onshore winds affect the climate of the coastal areas, For example, any coastal area with warm or cold currents flowing past it, will be warmed or cooled if the winds are onshore.

Find out

- Why most of the world's deserts are located in the western margins of continents in the subtropics?

Finally, **relief** too plays a major role in determining the climate of a place. High mountains act as barriers for cold or hot winds; they may also cause precipitation if they are high enough and lie in the path of rain-bearing winds. The leeward side of mountains remains relatively dry.

Factors Affecting India's Climate

Latitude

The Tropic of Cancer passes through the middle of the country from the Rann of Kuchchh in the west to Mizoram in the east. Almost half of the country, lying south of the Tropic of Cancer, belongs to the tropical area. All the remaining area, north of the Tropic, lies in the sub-tropics. Therefore, India's climate has characteristics of tropical as well as subtropical climates.

Altitude

India has mountains to the north, which have an average height of about 6,000 metres. India also has a vast coastal area where the maximum elevation is about 30 metres. The Himalayas prevent the cold winds from Central Asia from entering the subcontinent. It is because of these mountains that this subcontinent experiences comparatively milder winters as compared to central Asia.

Pressure and Winds

The climate and associated weather conditions in India are governed by the following atmospheric conditions:

- ***Pressure and surface winds;***
- ***Upper air circulation; and***
- ***Western cyclonic disturbances and tropical cyclones.***

India lies in the region of north easterly winds. These winds originate from the subtropical high-pressure belt of the northern

hemisphere. They blow southwards, get deflected to the right due to the Coriolis force, and move towards the equatorial low-pressure area. Generally, these winds carry little moisture as they originate and blow over land. Therefore, they bring little or no rain. Hence, India should have been an arid land, but it is not so. Let us see why?

Coriolis force: An apparent force caused by the earth's rotation. The Coriolis force is responsible for deflecting winds towards the right in the northern hemisphere and towards the left in the southern hemisphere. This is also known as 'Ferrel's Law'.

The pressure and wind conditions over India are unique. During winter, there is a high-pressure area north of the Himalayas. Cold dry winds blow from this region to the low-pressure areas over the oceans to the south. In summer, a low-pressure area develops over interior Asia, as well as, over northwestern India. This causes a complete reversal of the direction of winds during summer. Air moves from the high-pressure area over the southern Indian Ocean, in a south-easterly direction, crosses the equator, and turns right towards the low-pressure areas over the Indian subcontinent. These are known as the Southwest Monsoon winds. These winds blow over the warm oceans, gather moisture and bring widespread rainfall over the mainland of India.

The upper air circulation in this region is dominated by a westerly flow. An important component of this flow is the **jet stream**.

These jet streams are located approximately over 27°-30° north latitude, therefore, they are known as *subtropical westerly jet streams*. Over India, these jet streams blow south of the Himalayas, all through the year except in summer. The western cyclonic disturbances experienced in the north and north-western parts of the country are brought in by this westerly flow. In summer, the subtropical westerly jet stream moves north of the Himalayas with the apparent movement of the sun. An easterly jet stream, called the *sub-tropical easterly jet* stream blows over peninsular India, approximately over 14°N during the summer months.

Jet stream: These are a narrow belt of high altitude (above 12,000 m) westerly winds in the troposphere. Their speed varies from about 110 km/h in summer to about 184 km/h in winter. A number of separate jet streams have been identified. The most constant are the mid-latitude and the sub-tropical jet stream.

Western Cyclonic Disturbances

The western cyclonic disturbances are weather phenomena of the winter months brought in by the westerly flow from the Mediterranean region. They usually influence the weather of the north and north-western regions of India. Tropical cyclones occur during the monsoon, as well as, in October – November, and are part of the easterly flow. These disturbances affect the coastal regions of the country. Have you read or heard about the disasters caused by them on Odisha and Andhra Pradesh coast?

The Indian Monsoon

The climate of India is strongly influenced by monsoon winds. The sailors who came to India in historic times were one of the first to have noticed the phenomenon of the monsoon. They benefited from the reversal of the wind system as they came by sailing ships at the mercy of winds. The Arabs, who had also come to India as traders named this seasonal reversal of the wind system 'monsoon'.

Figure 4.1 : Arrival of Monsoon

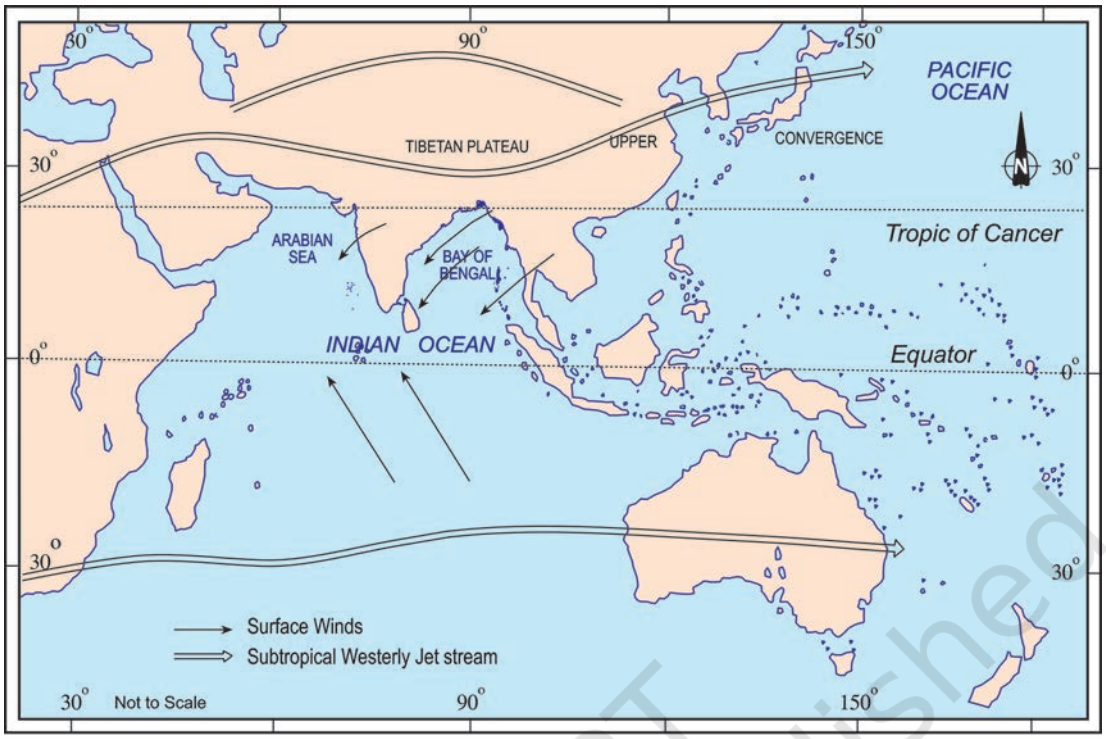

Figure 4.2 : Atmospheric Conditions over the Indian Subcontinent in the Month of January

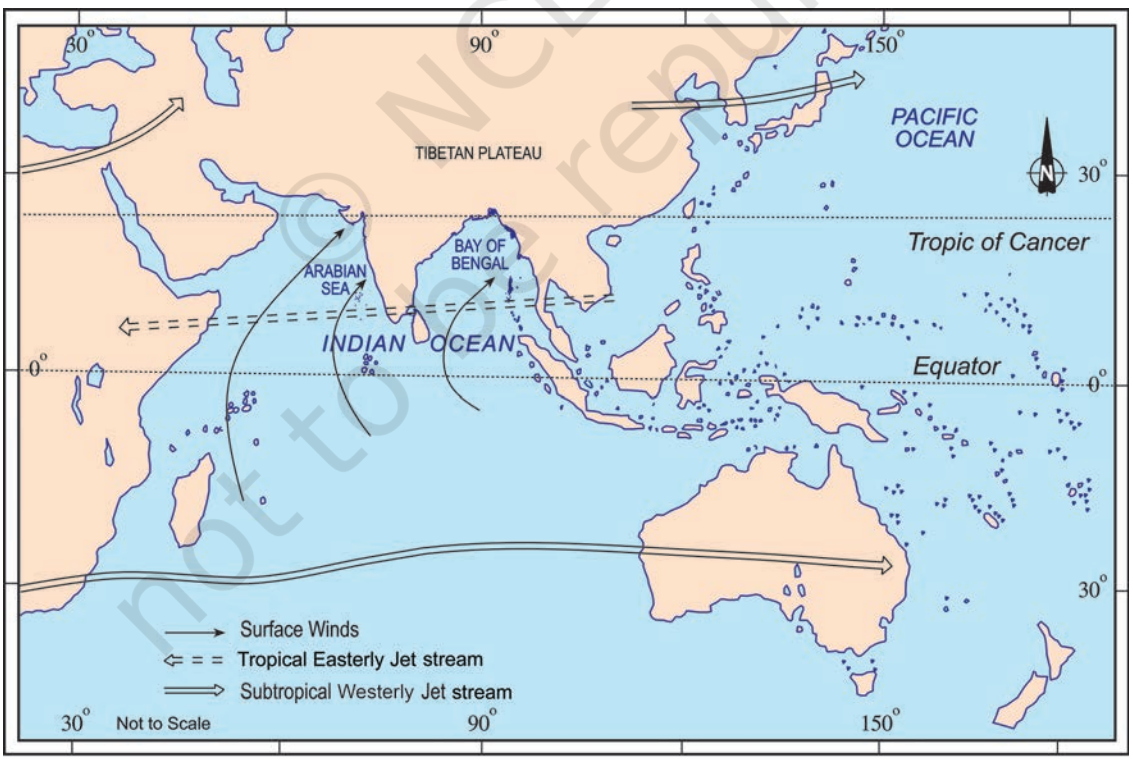

Figure 4.3 : Atmospheric Conditions over the Indian Subcontinent in the Month of June

The monsoons are experienced in the tropical area roughly between 20° N and 20° S. To understand the mechanism of the monsoons, the following facts are important.

(a) **The differential heating and cooling of land and water** creates low pressure on the landmass of India while the seas around experience comparatively high pressure.
(b) **The shift of the position of Inter Tropical Convergence Zone (ITCZ)** in summer, over the Ganga plain (this is the equatorial trough normally positioned about 5°N of the equator. It is also known as the monsoon-trough during the monsoon season).
(c) The presence of the **high-pressure area, east of Madagascar**, approximately at 20°S over the Indian Ocean. The intensity and position of this high-pressure area affects the Indian Monsoon.
(d) The **Tibetan plateau gets intensely heated** during summer, which results in strong vertical air currents and the formation of low pressure over the plateau at about 9 km above sea level.
(e) The **movement of the westerly jet stream to the north of the Himalayas** and the presence of the **tropical easterly jet stream over the Indian peninsula** during summer.

Inter Tropical Convergence Zone

The Inter Tropical Convergence Zone (ITCZ,) is a broad trough of low pressure in equatorial latitudes. This is where the northeast and the southeast trade winds converge. This convergence zone lies more or less parallel to the equator but moves north or south with the apparent movement of the sun.

Apart from this, it has also been noticed that changes in the pressure conditions over the southern oceans also affect the monsoons. Normally when the tropical eastern south Pacific Ocean experiences high pressure, the tropical eastern Indian Ocean experiences low pressure. But in certain years, there is a reversal in the pressure conditions and the eastern Pacific has lower pressure in comparison to the eastern Indian Ocean. This periodic change in pressure conditions is known as the **Southern Oscillation** or **SO**. The difference in pressure over Tahiti (Pacific Ocean, 18°S/149°W) and Darwin in northern Australia (Indian Ocean, 12°30'S/131°E) is computed to predict the intensity of the monsoons. If the pressure differences were negative, it would mean below average and late monsoons. A feature connected with the SO is the **El Nino** phenomenon in which a warm ocean current that flows past the Peruvian Coast, in place of the cold Peruvian current, every 2 to 5 years. The changes in pressure conditions are connected to the El Nino. Hence, the phenomenon is referred to as **ENSO** (El Nino Southern Oscillations).

El Nino: This is a name given to the periodic development of a warm ocean current along the coast of Peru as a temporary replacement of the cold Peruvian current. 'El Nino' is a Spanish word meaning 'the child', and refers to the baby Christ, as this current starts flowing during Christmas. The presence of the El Nino leads to an increase in sea-surface temperatures and weakening of the trade winds in the region.

The Onset of the Monsoon and Withdrawal

The Monsoon, unlike the trades, are not steady winds but are *pulsating* in nature, affected by different atmospheric conditions encountered by it, on its way over the warm tropical seas. The duration of the monsoon is between 100-120 days from early June to mid-September. Around the time of its arrival, the normal rainfall increases suddenly and continues constantly for several days. This is known as the **'burst'** of the monsoon, and can be distinguished from the pre-monsoon showers. The monsoon arrives at the southern tip of the Indian peninsula generally by the first week of June. Subsequently, it proceeds into two – the Arabian Sea branch and the Bay of Bengal branch. The Arabian Sea branch reaches Mumbai about ten days later on approximately the 10th of June. This is a fairly rapid advance. The Bay of Bengal branch also advances rapidly and arrives in Assam in the first week of June. The lofty mountains causes the monsoon winds to deflect towards the west

over the Ganga plains. By mid-June the Arabian Sea branch of the monsoon arrives over Saurashtra-Kuchchh and the central part of the country. The Arabian Sea and the Bay of Bengal branches of the monsoon merge over the northwestern part of the Ganga plains. Delhi generally receives the monsoon showers from the Bay of Bengal branch by the end of June (tentative date is 29th of June). By the first week of July, western Uttar Pradesh, Punjab, Haryana and eastern Rajasthan experience the monsoon. By mid-July, the monsoon reaches Himachal Pradesh and the rest of the country (Figure 4.3).

Withdrawal or the retreat of the monsoon is a more gradual process (Figure 4.4). The withdrawal of the monsoon begins in northwestern states of India by early September. By mid-October, it withdraws completely from the northern half of the peninsula. The withdrawal from the southern half of the peninsula is fairly rapid. By early December, the monsoon has withdrawn from the rest of the country.

The islands receive the very first monsoon showers, progressively from south to north, from the last week of April to the first week of May. The withdrawal, takes place progressively from north to south from the first week of December to the first week of January. By this time the rest of the country is already under the influence of the winter monsoon.

The Seasons

The monsoon type of climate is characterised by a distinct seasonal pattern. The weather conditions greatly change from one season to the other. These changes are particularly noticeable in the interior parts of the country. The coastal areas do not experience much variation in temperature though there is variation in rainfall pattern. How many seasons are experienced in your place? Four main seasons can be identified in India – the cold weather season, the hot weather season, the advancing monsoon and the retreating monsoon with some regional variations.

The Cold Weather Season (Winter)

The cold weather season begins from mid-November in northern India and stays till February. December and January are the coldest months in the northern part of India. The temperature decreases from south to the north. The average temperature of Chennai, on the eastern coast, is between 24° – 25° Celsius, while in the northern plains, it ranges between 10°C and 15° Celsius. Days are warm and nights are cold. Frost is common in the north and the higher slopes of the Himalayas experience snowfall.

During this season, the northeast trade winds prevail over the country. They blow from land to sea and hence, for most part of the country, it is a dry season. Some amount of rainfall occurs on the Tamil Nadu coast from these winds as, here they blow from sea to land.

In the northern part of the country, a feeble high-pressure region develops, with light winds moving outwards from this area. Influenced by the relief, these winds blow through the Ganga valley from the west and the northwest. The weather is normally marked by clear sky, low temperatures and low humidity and feeble, variable winds.

A characteristic feature of the cold weather season over the northern plains is the inflow of cyclonic disturbances from the west and the northwest. These low-pressure systems, originate over the Mediterranean Sea and western Asia and move into India, along with the westerly flow. They cause the much-needed winter rains over the plains and snowfall in the mountains. Although the total amount of winter rainfall locally known as *'mahawat'* is small, they are of immense importance for the cultivation of *'rabi'* crops.

The peninsular region does not have a well-defined cold season. There is hardly any noticeable seasonal change in temperature pattern during winters due to the moderating influence of the sea.

The Hot Weather Season (Summer)

Due to the apparent northward movement of the sun, the global heat belt shifts northwards. As such, from March to May, it is hot weather season

Figure 4.4 : Advancing Monsoon

in India. The influence of the shifting of the heat belt can be seen clearly from temperature recordings taken during March-May at different latitudes. In March, the highest temperature is about 38° Celsius, recorded on the Deccan plateau. In April, temperatures in Gujarat and Madhya Pradesh are around 42° Celsius. In May, temperature of 45° Celsius is common in the northwestern parts of the country. In peninsular India, temperatures remain lower due to the moderating influence of the oceans.

The summer months experience rising temperature and falling air pressure in the northern part of the country. Towards the end of May, an elongated low-pressure area develops in the region extending from the Thar Desert in the northwest to Patna and Chotanagpur plateau in the east and southeast. Circulation of air begins to set in around this trough.

A striking feature of the hot weather season is the *'loo'*. These are strong, gusty, hot, dry winds blowing during the day over the north and northwestern India. Sometimes they even continue until late in the evening. Direct exposure to these winds may even prove to be fatal. Dust storms are very common during the month of May in northern India. These storms bring temporary relief as they lower the temperature and may bring light rain and cool breeze. This is also the season for localised thunderstorms, associated with violent winds, torrential downpours, often accompanied by hail. In West Bengal, these storms are known as the '*Kaal Baisakhi*'.

Towards the close of the summer season, pre-monsoon showers are common especially, in Kerala and Karnataka. They help in the early ripening of mangoes, and are often referred to as '*mango showers*'.

Advancing Monsoon (The Rainy Season)

By early June, the low-pressure condition over the northern plains intensifies. It attracts, the trade winds of the southern hemisphere. These south-east trade winds originate over the warm subtropical areas of the southern oceans. They cross the equator and blow in a south-westerly direction entering the Indian peninsula as the south-west monsoon. As these winds blow over warm oceans, they bring abundant moisture to the subcontinent. These winds are strong and blow at an average velocity of 30 km per hour. With the exception of the extreme north-west, the monsoon winds cover the country in about a month.

The inflow of the south-west monsoon into India brings about a total change in the weather. Early in the season, the windward side of the Western Ghats receives very heavy rainfall, more than 250 cm. The Deccan Plateau and parts of Madhya Pradesh also receive some amount of rain in spite of lying in the rain shadow area. The maximum rainfall of this season is received in the north-eastern part of the country. Mawsynram in the southern ranges of the Khasi Hills receives the highest average rainfall in the world. Rainfall in the Ganga valley decreases from the east to the west. Rajasthan and parts of Gujarat get scanty rainfall.

Another phenomenon associated with the monsoon is its tendency to have 'breaks' in rainfall. Thus, it has wet and dry spells. In other words, the monsoon rains take place only for a few days at a time. They are interspersed with rainless intervals. These breaks in monsoon are related to the movement of the monsoon trough. For various reasons, the trough and its axis keep on moving northward or southward, which determines the spatial distribution of rainfall. When the axis of the monsoon trough lies over the plains, rainfall is good in these parts. On the other hand, whenever the axis shifts closer to the Himalayas, there are longer dry spells in the plains, and widespread rain occur in the mountainous catchment areas of the Himalayan rivers. These heavy rains bring in their wake, devastating floods causing damage to life and property in the plains. The frequency and intensity of tropical depressions too, determine the amount and duration of monsoon rains. These depressions form at the head of the Bay of Bengal and cross over to the mainland. The depressions follow the axis of the "monsoon

Figure 4.5 : Retreating Monsoon

trough of low pressure". The monsoon is known for its uncertainties. The alternation of dry and wet spells vary in intensity, frequency and duration. While it causes heavy floods in one part, it may be responsible for droughts in the other. It is often irregular in its arrival and its retreat. Hence, it sometimes disturbs the farming schedule of millions of farmers all over the country.

Retreating/Post Monsoons (The Transition Season)

During October-November, with the apparent movement of the sun towards the south, the monsoon trough or the low-pressure trough over the northern plains becomes weaker. This is gradually replaced by a high-pressure system. The south-west monsoon winds weaken and start withdrawing gradually. By the beginning of October, the monsoon withdraws from the Northern Plains.

The months of October-November form a period of transition from hot rainy season to dry winter conditions. The retreat of the monsoon is marked by clear skies and rise in temperature. While day temperatures are high, nights are cool and pleasant. The land is still moist. Owing to the conditions of high temperature and humidity, the weather becomes rather oppressive during the day. This is commonly known as 'October heat'. In the second half of October, the mercury begins to fall rapidly in northern India.

Do You Know? Mawsynram, the wettest place on the earth is also reputed for its stalagmite and stalactite caves.

The low-pressure conditions, over north-western India, get transferred to the Bay of Bengal by early November. This shift is associated with the occurrence of cyclonic depressions, which originate over the Andaman Sea. These cyclones generally cross the eastern coasts of India cause heavy and widespread rain. These tropical cyclones are often very destructive. The thickly populated deltas of the Godavari, the Krishna and the Kaveri are frequently struck by cyclones, which cause great damage to life and property. Sometimes, these cyclones arrive at the coasts of Odisha, West Bengal and Bangladesh. The bulk of the rainfall of the Coromandel Coast is derived from depressions and cyclones.

Distribution of Rainfall

Parts of western coast and northeastern India receive over about 400 cm of rainfall annually. However, it is less than 60 cm in western Rajasthan and adjoining parts of Gujarat, Haryana and Punjab. Rainfall is equally low in the interior of the Deccan plateau, and east of the Sahyadris. Why do these regions receive low rainfall? A third area of low precipitation is around Leh in Jammu and Kashmir. The rest of the country receives moderate rainfall. Snowfall is restricted to the Himalayan region.

Owing to the nature of monsoons, the annual rainfall is highly variable from year to year. Variability is high in the regions of low rainfall, such as parts of Rajasthan, Gujarat and the leeward side of the Western Ghats. As such, while areas of high rainfall are liable to be affected by floods, areas of low rainfall are drought-prone (Figure 4.6 and 4.7).

Monsoon as a Unifying Bond

You have already known the way the Himalayas protect the subcontinent from extremely cold winds from central Asia. This enables northern India to have uniformly higher temperatures compared to other areas on the same latitudes. Similarly, the Peninsular plateau, under the influence of the sea from three sides, has moderate temperatures. Despite such moderating influences, there are great variations in the temperature conditions. Nevertheless, the unifying influence of the monsoon on the Indian subcontinent is quite perceptible. The seasonal alteration of the wind systems and the associated weather conditions provide a rhythmic cycle of seasons. Even the uncertainties of rain and uneven distribution

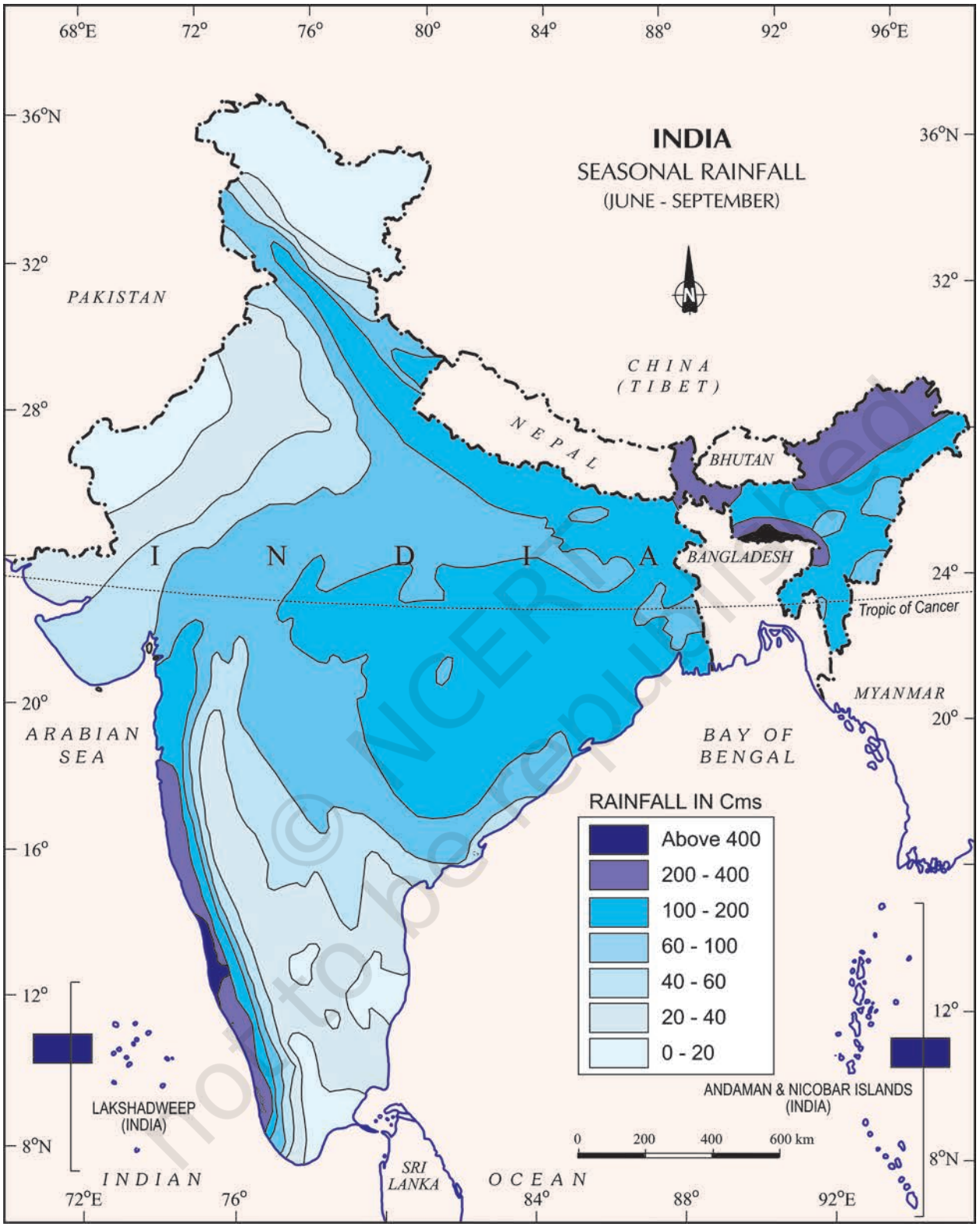

Figure 4.6 : Seasonal Rainfall (June-September)

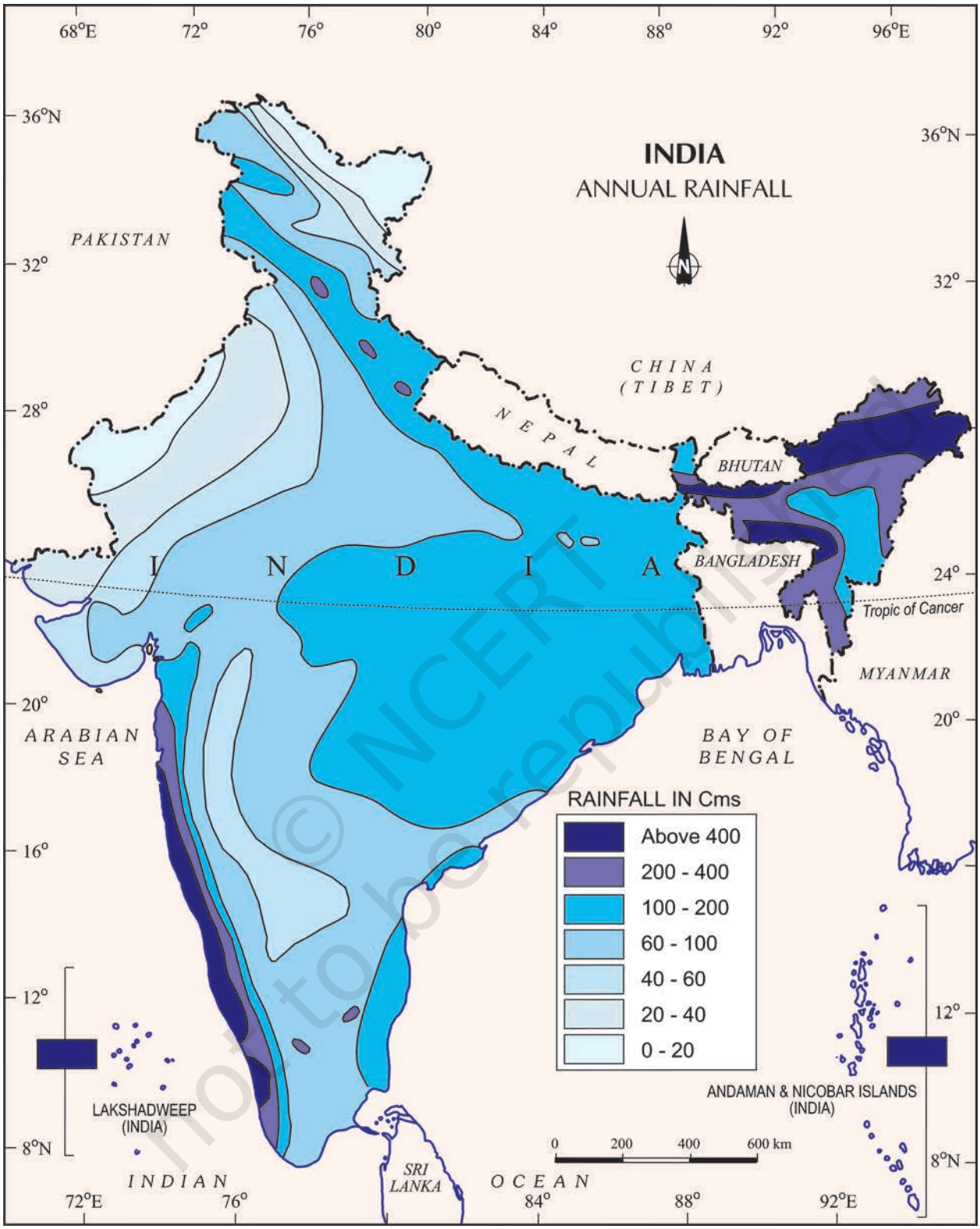

Figure 4.7 : Annual Rainfall

Devastated by deluge

Haze hazard on road

Hint of an early summer

Tuesday: 28.4 °C

HT Correspondent
New Delhi, January 31

THE MERCURY is soaring, paving the way for what could be an early onset of summer, the weatherman has said. It may touch 30 degrees Celsius within a couple of days in Delhi.

The mercury settled at 28.4 degrees Celsius on Tuesday, nearly six degrees above the average, breaking a decade-old record.

FOG CHECK

Flight operations at Delhi Airport was normal with the runway visibility at 1,500 metres. However, thick fog in the NCR made driving difficult in the early hours.

DELAYED: 17 incoming trains; departure of six trains was rescheduled.

Poorva Express from Howrah, Sampurna Kranti Express from Patna and Rajdhani Special from Mumbai.

RESCHEDULED: Kashi Vishwanath from New Delhi to Varanasi, Lichchivi Express from New Delhi to Muzaffarpur, Bhupeneshwar Raj from New Delhi to Bhupeneshwar, Seldah Raj from New Delhi to Seldah, Sultanpur Express from Delhi to Sultanpur and Janta Express from Delhi to Howrah.

Cold comfort for New Year revellers

Chennai submerged

G.C. Shekhar
Chennai, December 30

IF 2004 was the year of the tsunami, 2005 turned out to be the year of rains and floods in Tamil Nadu. Unlike the tsunami, which affected a belt of six coastal districts in Tamil Nadu and Pondicherry, the floods wreaked havoc across the state.

In five furious spells, the last two being cyclones that weakened before hitting the coast, the rain gods lashed Tamil Nadu from October to December with almost every district drenched and drowned.

Chennai, which was flaunted as an alternative to Bangalore, found itself floating on water on three occasions. The rains and floods killed 350 people. Fields were inundated, crops damaged, roads looked like backwaters. And this was the city that cried for water in summers.

The rains showed up the state's failure to literally tap the resources as 90 tmc of water flowed into the sea. Irrigation tanks and reservoirs were breached. The suburbs were the worst hit as many localities remained under water from October to December.

When the relief efforts began, that brought calamity of another order. Rush for rations resulted in one of the most avoidable tragedies as 48 people were killed in stampedes outside two relief centres.

This was one rain cloud

A day Mumbai won't forget

SORAB Ghaswalla
Mumbai, December 30

JULY 26, 2005 started off as just another soggy day in Mumbai. But, the rainfall was one of the heaviest Mumbai had seen over the past century. As citizens went about their morning chores, they had no inkling that by dusk the city would be swamped.

By sunset, 435 residents had either drowned in their houses or vehicles as rainwater started rising with alarming rapidity. By night, the city and its people were defeated. No transport, no electricity and no place to go. Mumbai was on its knees.

The weather bureau had predicted just another "normal" rainy day for the city. But it poured 944.2 m.m. (three feet of rain) over 24 hours, the highest in 100 years.

Before 26/7, Mumbaiites, used to about 15 cm of rain, would tease, "What's a Mumbai monsoon without some days of disruption?" On 26/7, the joke was on them.

The rain picked up at about 1 p.m. Initially, nobody paid attention. The enormity of the situation hit Mumbaiites at about 5 p.m. By then, many were dead and the low-lying areas of Kurla, Ghatkopar, Andheri, Dadar, Juhu and Kalina were flooded.

Fog is in, get ready for disruptions

A thin blanket of fog enveloped the city in the early hours of Friday. Visibility was reduced to 500 metres in most areas. There

Freezing Kashmir

RASHID Ahmad
Srinag

Celsius up, temperature takes normal course

IF YO
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HT Correspondent
New Delhi, January 1

DELHIITES, SHIVERING from the northwesterly onslaught, finally got some respite with the temperatures rising on Wednesday. The city experienced a high of 20.3 degree Celsius (1 degree above normal) despite a partly cloudy sky in some parts. The minimum was also bearable at 5.4 degree Celsius that was two degrees below normal.

As expected, fresh western disturbances over the northwestern regions of the country sharked up the minimum temperature in the city that had almost dropped to

WINTER BREAK

ero on Saturday at 0.2 degree Celsius. The minimum temperature remained over 6 degree C below normal for the next two days. "Things were slightly better on Wednesday. At least, the wind had lost its sting. Last three days were very cold, despite the sunshine," said Kanchan Jha, a Rohini resident.

For Thursday, the Met department forecasts a minimum temperature of 6 degree Celsius.

"There's a circulation over west Rajasthan which is moving east. The temperature has gone up because of the presence of this western disturbance.

As it moves over Delhi, the direction of the wind being received by the city may change from northwesterly to northeasterly or easterly. So far the cold northwesterlies have been knocking the temperature in Delhi down. But any further fall in temperature appear unlikely," said Safdarjung met office director R D Singh.

The RMC weather forecast also indicates that the minimum on Thursday may hover about 5 degree celsius. Towards Saturday, things are expected to warm up somewhat, according to the website and the minimum is expected to rise to 7 degree C.

"The city experienced light fog from about 7.30 am to 9.45 am," a met official said. No flight departure or arrival delay was reported. But several trains bound for Delhi were running behind schedule. Overall, things warmed up for the northern plains with the maximum temperatures rising by 1 to 3 degree Celsius. Chandigarh experienced a high of 21 degree Celsius, while the minimum was 4.2 degree Celsius. Ambala recorded a minimum of 11.9 degree Celsius.

warm," said Halima Begum, 45, a

After 2 days of biting cold, sun shines

Expect a ballistic winter after western winds are in

HT Correspondent
New Delhi, November 30

ACROSS NORTH India, it's a winter of woes. Amristar is icy with a minimum temperature of 5°C. Snowfall, of up to 78 cm, has blanketed Srinagar. In Delhi, it's still a pleasant nip. This mild wintry condition, however, will definitely not last, says the Met.

In a day or two, winds from Afghanistan, known as western disturbances, will lash the Capital. Conditions are perfect for harsh winter ahead, said Met officials, who have declared "official winter" in Delhi from Thursday.

"Wednesday's morning mist, moisture in the air, low night temperature and the cold winds that hit the city by evening are enough indications for the weather department to declare the onset of winter a day in advance," an official said.

Winter may have been delayed in much of north India by about a fortnight, but it has set in on time in Delhi, he added.

In vast swathes of north India, the past week has been colder than average. "Winter trying to make up for the lost time," the weatherman added in a lighter vein. With temperatures consistently below the average for this year, there is a spectre of this year's winter being colder than usual.

In the ski resort of Gulmarg, there's heavy snow. Night temperature dipped four degrees past normal and Churu in Rajasthan has become bitterly cold. But Delhi continues to be comfortable. Night temperature on Wednesday hovered around 10°C.

"The western disturbances are unpredictable. They might hit Delhi within the next 72 hours or may not for another week. But it is time to get your woollens out. Temperatures will drop progressively in the days to come," said Delhi Met chief R.D. Singh. With mornings getting misty, the dreaded fog may not be far behind. And with pollution levels at a five-year high, the fog this time may be worse.

Delhi has been colder this fortnight compared to the same period last year. The temperature pattern is similar to the record-breaking winter of 2003 — the worst in 40 years.

The Met office says it cannot forecast so far ahead in future. "It may not be record breaking winter, but it will definitely be chillier than an average winter," said a weather official.

The official pointed out that snowfall in Kashmir and Shimla has been heavier and earlier than usual. The temperature in Shimla dropped two degrees below normal. Sundernagar at 4.3 °C was cold too.

Northerly cold winds have struck Rajasthan, affecting normal life last night with Churu and Sriganganagar shivering at 5°C each, about two-three degrees below normal. Nights in Jodhpur, Bikaner, Ajmer and Jaipur divisions have become harsh.

So, it's officially winter in the Capital

Delhi

Max: 25°C, Min: 8 In a day or two, winds from Afghanistan —western disturbances — will lash the Capital. Winter declared from Dec 1.

Srinagar

Max: 8°C, Min: -3 it's a sea of snow there. Like much of Kashmir, it is experiencing sub-zero temperatures and bitterly cold weather.

Amritsar

Max: 21°C, Min: 5 The great plains are extremely cold. The coming days will be worse with expected sub-zero temperatures.

Shimla

Max: 10°C, Min: -4 The Himachal capital is blanketed in heavy snow. Higher reaches are even colder.

Activity

(i) On the basis of the news items above, find out the names of places and the seasons described.
(ii) Compare the rainfall description of Chennai and Mumbai and explain the reasons for the difference.
(iii) Evaluate flood as a disaster with the help of a case study.

are very much typical of the monsoons. The Indian landscape, its animal and plant life, its entire agricultural calendar and the life of the people, including their festivities, revolve around this phenomenon. Year after year, people of India from north to south and from east to west, eagerly await the arrival of the monsoon. These monsoon winds bind the whole country by providing water to set the agricultural activities in motion. The river valleys which carry this water also unite as a single river valley unit.

Exercise

1. Choose the correct answer from the four alternatives given below.
   (i) Which one of the following places receives the highest rainfall in the world?
   (a) Silchar (c) Cherrapunji
   (b) Mawsynram (d) Guwahati
   (ii) The wind blowing in the northern plains in summers is known as:
   (a) *Kaal Baisakhi* (c) Trade Winds
   (b) *Loo* (d) None of the above
   (iii) Which one of the following causes rainfall during winters in north-western part of India.
   (a) Cyclonic depression (c) Western disturbances
   (b) Retreating monsoon (d) Southwest monsoon
   (iv) Monsoon arrives in India approximately in:
   (a) Early May (c) Early June
   (b) Early July (d) Early August
   (v) Which one of the following characterises the cold weather season in India?
   (a) Warm days and warm nights
   (b) Warm days and cold nights
   (c) Cool days and cold nights
   (d) Cold days and warm nights
2. Answer the following questions briefly.
   (i) What are the controls affecting the climate of India?
   (ii) Why does India have a monsoon type of climate?
   (iii) Which part of India does experience the highest diurnal range of temperature and why?
   (iv) Which winds account for rainfall along the Malabar coast?
   (v) What are Jet streams and how do they affect the climate of India?
   (vi) Define monsoons. What do you understand by "break" in monsoon?
   (vii) Why is the monsoon considered a unifying bond?
3. Why does the rainfall decrease from the east to the west in Northern India.
4. Give reasons as to why.
   (i) Seasonal reversal of wind direction takes place over the Indian subcontinent?
   (ii) The bulk of rainfall in India is concentrated over a few months.
   (iii) The Tamil Nadu coast receives winter rainfall.
   (iv) The delta region of the eastern coast is frequently struck by cyclones.
   (v) Parts of Rajasthan, Gujarat and the leeward side of the Western Ghats are drought-prone.

5. Describe the regional variations in the climatic conditions of India with the help of suitable examples.
6. Discuss the mechanism of monsoons.
7. Give an account of weather conditions and characteristics of the cold season.
8. Give the characteristics and effects of the monsoon rainfall in India.

Map Skills

On an outline map of India, show the following.

(i) Areas receiving rainfall over 400 cm.
(ii) Areas receiving less than 20 cm of rainfall.
(iii) The direction of the south-west monsoon over India.

Project/Activity

(i) Find out which songs, dances, festivals and special food preparations are associated with certain seasons in your region. Do they have some commonality with other regions of India?

(ii) Collect photographs of typical rural houses, and clothing of people from different regions of India. Examine whether they reflect any relationship with the climatic condition and relief of the area.

FOR DOING IT YOURSELF

1. In Table-I, the average mean monthly temperatures and amounts of rainfall of 10 representative stations have been given. It is for you to study on your own and convert them into 'temperature and rainfall' graphs. A glance at these visual representations will help you to grasp instantly the smilarities and differences between them. One such graph (Figure 1) is already prepared for you. See if you can arrive at some broad generalisations about our diverse climatic conditions. We hope you are in for a great joy of learning. Do the following activities.

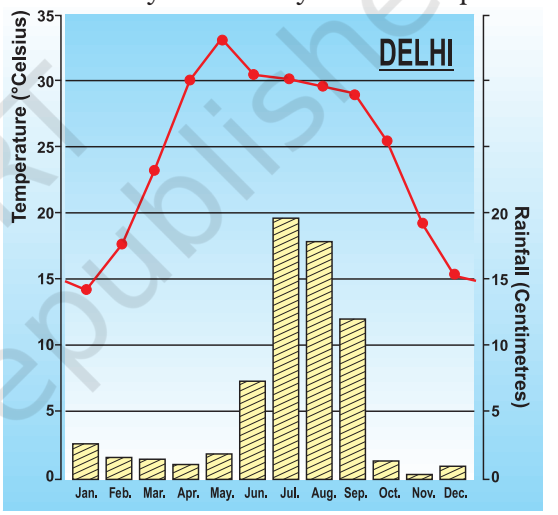

Figure 1 : Temperature and Rainfall of Delhi

2. Re-arrange the 10 stations in two different sequences:
   (i) According to their distance from the equator.
   (ii) According to their altitude above mean sealevel.
3. (i) Name two rainiest stations.
   (ii) Name two driest stations.
   (iii) Two stations with most equable climate.
   (iv) Two stations with most extreme climate.
   (v) Two stations most influenced by the Arabian branch of southwest monsoons.
   (vi) Two stations most influenced by the Bay of Bengal branch of southwest monsoons.
   (vii) Two stations influenced by both branches of the southwest monsoons
   (viii) Two stations influenced by retreating and northeast monsoons.
   (ix) Two stations receiving winter showers from the western disturbances.
   (x) The two hottest stations in the months of
   (a) February (b) April (c) May (d) June

Table I

Stations	Latitude	Altitude (Metres)	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual Rainfall
Temperature (°C)			20.5	22.7	25.2	27.1	26.7	24.2	23.0	23.0	23.1	22.9	18.9	20.2	
Bengaluru	12°58'N	909													
Rainfall (cm)			0.7	0.9	1.1	4.5	10.7	7.1	11.1	13.7	16.4	15.3	6.1	1.3	88.9
Temperature (°C)			24.4	24.4	26.7	28.3	30.0	28.9	27.2	27.2	27.2	27.8	27.2	25.0	
Mumbai	19° N	11													
Rainfall (cm)			0.2	0.2	–	–	1.8	50.6	61.0	36.9	26.9	4.8	1.0	–	183.4
Temperature (°C)			19.6	22.0	27.1	30.1	30.4	29.9	28.9	28.7	28.9	27.6	23.4	19.7	
Kolkata	22°34' N	6													
Rainfall (cm)			1.2	2.8	3.4	5.1	13.4	29.0	33.1	33.4	25.3	12.7	2.7	0.4	162.5
Temperature (°C)			14.4	16.7	23.3	30.0	33.3	33.3	30.0	29.4	28.9	25.6	19.4	15.6	
Delhi	29° N	219													
Rainfall (cm)			2.5	1.5	1.3	1.0	1.8	7.4	19.3	17.8	11.9	1.3	0.2	1.0	67.0
Temperature (°C)			16.8	19.2	26.6	29.8	33.3	33.9	31.3	29.0	20.1	27.0	20.1	14.9	
Jodhpur	26°18' N	224													
Rainfall (cm)			0.5	0.6	0.3	0.3	1.0	3.1	10.8	13.1	5.7	0.8	0.2	0.2	36.6
Temperature (°C)			24.5	25.7	27.7	30.4	33.0	32.5	31.0	30.2	29.8	28.0	25.9	24.7	
Chennai	13°4' N	7													
Rainfall (cm)			4.6	1.3	1.3	1.8	3.8	4.5	8.7	11.3	11.9	30.6	35.0	13.9	128.6
Temperature (°C)			21.5	23.9	28.3	32.7	35.5	32.0	27.7	27.3	27.9	26.7	23.1	20.7	
Nagpur	21°9' N	312													
Rainfall (cm)			1.1	2.3	1.7	1.6	2.1	22.2	37.6	28.6	18.5	5.5	2.0	1.0	124.2
Temperature (°C)			9.8	11.3	15.9	18.5	19.2	20.5	21.1	20.9	20.0	17.2	13.3	10.4	
Shillong	24°34' N	1461													
Rainfall (cm)			1.4	2.9	5.6	14.6	29.5	47.6	35.9	34.3	30.2	18.8	3.8	0.6	225.3
Temperature (°C)			26.7	27.3	28.3	28.7	28.6	26.6	26.2	2.6.2	26.5	26.7	26.6	26.5	
Thiruvananthapuram	8°29' N	61													
Rainfall (cm)			2.3	2.1	3.7	10.6	20.8	35.6	22.3	14.6	13.8	27.3	20.6	7.5	181.2
Temperature (°C)			– 8.5	– 7.2	– 0.6	6.1	10.0	14.4	17.2	16.1	12.2	6.1	0.0	– 5.6	
Leh 34° N	34°N	3506													
Rainfall (cm)			1.0	0.8	0.8	0.5	0.5	0.5	1.3	1.3	0.8	0.5	–	0.5	8.5

4. Now find out
   (i) Why are Thiruvananthapuram and Shillong rainier in June than in July?
   (ii) Why is July rainier in Mumbai than in Thiruvananthapuram?
   (iii) Why are southwest monsoons less rainy in Chennai?
   (iv) Why is Shillong rainier than Kolkata?
   (v) Why is Kolkata rainier in July than in June unlike Shillong which is rainier in June than in July?
   (vi) Why does Delhi receive more rain than Jodhpur?
5. Now think why
   — Thiruvananthapuram has equable climate?
   — Chennai has more rains only after the fury of monsoon is over in most parts of the country?
   — Jodhpur has a hot desert type of climate?
   — Leh has moderate precipitation almost throughut the year?
   — while in Delhi and Jodhpur most of the rain is confined to nearly three months, in Thiruvananthapuram and Shillong it is almost nine months of the year?

In spite of these facts see carefully if there are strong evidences to conclude that the monsoons still provide a very strong framework lending overall climatic unity to the whole country.