

MODULE - 2

India: Natural Environment, Resources and Development



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10

CLIMATE

Mona and Raju were excited about proposed first trip to a hill station, Shimla with their parents. While they were packing their clothes, their mother asked them to pack some woolen clothes also. They reside in Chennai, a city and capital of Tamil Nadu, a state in South India. They were really surprised as it was the month of May and it's very hot in Chennai. Their mother told that although India has monsoon climate but in Shimla, it being a hill station the weather was cool. They were little confused with a few questions in their mind like - what is weather? What is the difference between the weather and the climate? Why do we find different climatic conditions in India? You will find the answers to such questions in the following lesson.



OBJECTIVES

After completing this lesson, you will be able to:

- list the factors that influence the climate of India;
- explain the mechanism of monsoon and its various characteristics;
- recognize the cyclic system of seasons along with their unique features;
- describe the distribution of rainfall in India;
- analyse how our social and cultural life is deeply associated with the cycle of seasons; and
- describe the global environmental changes and its impact on Indian climate.

10.1 FACTORS AFFECTING THE CLIMATE OF INDIA

When Mona and Raju were in the train along with their parents they asked the questions to their parents about the difference between the weather and climate. One of the fellow passengers was a teacher, Mrs. Rupa and she explained that **climate**

is always for a large area like a country or a big region and generally it does not change, like India has monsoon climate whereas **weather** is always for a smaller area like that of your city or village where it may frequently change like raining in the morning and sunny in the afternoon. Mrs. Rupa asked them to observe the changes in the weather conditions along the way to Shimla. They realized the changes: it was hot and humid weather in the southern regions and slowly it became hot and dry in the northern plains; and they felt cool on their way when they were close to Shimla. They asked the teacher the reason for it and she explained that there are many factors which affect the climate or weather.



Do you know

Climate refers to the sum total of weather conditions and variations over large area for a long period of time (more than 30 years). **Weather** is state of atmosphere over an area at any point of time. Similarly weather conditions which last for longer duration are responsible for making a season.



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10.1.1 Factors Affecting the Climate of India

- 1. Location:** The places which are closer to equator have high temperature. As one moves towards the poles temperature decreases. As our country, India is located in Northern hemisphere closer to equator at $8^{\circ}4'$ and $23\frac{1}{2}^{\circ}$ Tropic of Cancer passes through the central part of India. So in south of this latitude we find tropical climate and towards the north we find sub-tropical climate. For example, Andhra Pradesh would be hotter than Haryana. Broadly speaking parts lying south of the Tropic of Cancer receive more solar heat than those lying north of it.
- 2. Distance from the sea:** The southern half of India is surrounded by sea from three sides: the Arabian Sea in the west, the Bay of Bengal in the east and the Indian Ocean in the south. Due to moderating influence of the sea this region is neither hot in summer nor very cold in winter. For example the area of North India which is far away from the sea has extreme type of climate and the area of south India which is nearer to the sea has equable type of climate. We can see the variations in temperature and rainfall at different stations in the given table 10.1.
- 3. Altitude:** It means the height above the average sea level. The atmosphere becomes less dense and we feel breathlessness as we go higher from the earth surface and thus the temperature also decreases with the height. For example, the cities located on the hills are cooler like Shimla whereas the cities lying in the plains will have hot climate like Ludhiana.



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4. **Mountain Ranges:** Mountain ranges also affect the climate of any region to a great extent. The Himalaya Mountain is located in the northern part of our country with an average height of 6000m. It protects our country from cold winds of Central Asia. On the other hand, they check rain bearing South-West Monsoon winds and compel them to shed their moisture in India. Similarly, Western Ghats force rain bearing winds to cause heavy rain fall on the Western slopes of the Western Ghats.
5. **Direction of surface winds:** The wind system also affects the Indian climate. This system consists of monsoon winds, land and sea breeze, and local winds. In winter the winds blow from land to sea so they are cold and dry. On the other hand, in summer wind blow from sea to land bringing the moisture along with them from the sea and they cause wide spread rain in most part of the country.
6. **Upper air Currents:** Besides surface winds, there are strong air currents called Jet streams which also influence the climate of India. These jet streams are a narrow belt of fast blowing winds located generally at 12,000 metre height above the sea level. They bring western cyclonic disturbances along with them. These cyclonic winds originate near the Mediterranean Sea and move eastwards. On their way, they collect moisture from Persian Gulf and shed it in the North western part of India during winter seasons. These Jet streams shift northwards during summer season and blow in Central Asia. Thus helps in the onset of monsoons.



ACTIVITY 10.1

Temperature (T) and Rainfall (R) of some important stations

Stations	Month												
		J	F	M	A	M	J	J	A	S	O	N	D
Leh	T	-8	-7	-1	9	10	14	17	17	12	6	0	-6
	R	10	8	8	5	5	5	13	13	8	5	0	5
Chennai	T	25	26	28	31	33	33	31	31	30	20	26	25
	R	4	13	13	18	38	45	87	113	119	306	350	135

- (i) Write annual range of temperature between two places.
- (ii) Which is the rainiest month of the year in each stations?



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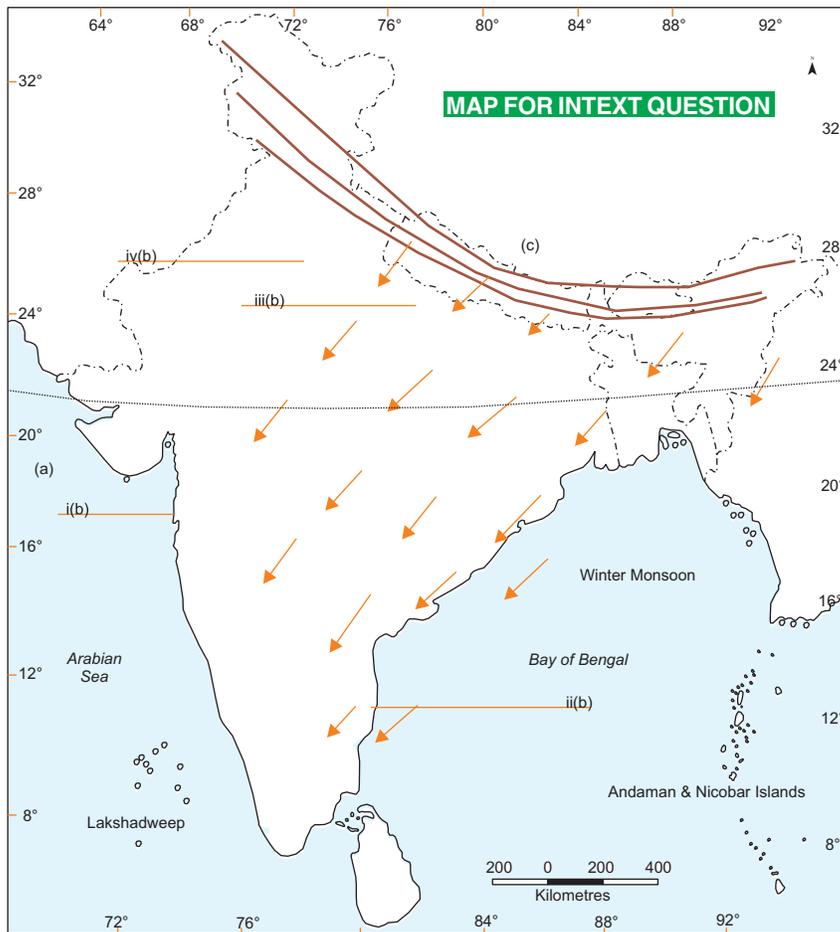


Figure 10.1



INTEXT QUESTIONS 10.1

Look at the map given above and answer the following questions:

- Name the important latitude drawn on the map which has divided India in two heat zones. Also tell the degree of that latitude.
- Name the cities located on map which are influenced by the sea and cities which are not influenced by the sea.
- Which mountain range protects our country from cold breeze of Central Asia?
- Observe the wind direction given on the map and tell why do we have dry winter season?

Mona and Raju returned from Shimla after five days stay. They were very happy and shared their experience with their friends. Few days later they were surprised to see a news headline that monsoons are coming on time. What is the meaning of



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monsoon? They wanted to know the answers of their questions with the help of their teacher. Try to find out answers in the following section.

10.2 MECHANISM OF MONSOON

The word monsoon is derived from the Arabic word ‘Mausim’ which means season. Monsoon refers to the seasonal reversal in the wind direction during a year. During summer, the interior parts of North Indian Plains covering Rajasthan, Punjab, Haryana, and Western Uttar Pradesh are intensely hot. The daily maximum temperature in some of these parts is as high as 45° to 47° C. Table 10.1 given below indicates the climatic diversity in India. Try to understand the varying temperature that different stations in India have.

Table 10.1: Temperature (in ° Celcius) and Rainfall (in cm) of some important stations in India

STATIONS		MONTHS											
		J	F	M	A	M	J	J	A	S	O	N	D
LEH	Temp.	-8	-7	-1	9	10	14	17	17	12	6	0	-6
	Rainfall	10	8	8	5	5	5	13	13	8	5	0	5
SHILLONG	Temp.	10	11	16	19	19	21	21	21	20	17	13	10
	Rainfall	14	29	56	146	295	476	359	343	302	188	36	10
DELHI	Temp	14	17	23	29	34	35	31	30	29	21	20	15
	Rainfall	21	24	13	10	10	68	186	170	125	14	2	9
JAISALMER	Temp	16	20	25	30	33	34	32	31	30	28	22	17
	Rainfall	0.2	0.1	0.3	0.1	0.5	0.7	0.9	86	14	01	0.5	0.2
MUMBAI	Temp	24	24	24	28	30	29	27	27	27	28	27	25
	Rainfall	4	2	2	2	18	465	613	329	286	65	18	2
CHENNAI	Temp	25	26	28	31	33	33	31	31	30	28	26	25
	Rainfall	4	13	13	18	38	45	87	113	119	306	350	135
THIRUVANA NTHAPURAM	Temp	27	27	28	29	29	27	26	26	27	27	27	27
	Rainfall	23	21	39	106	208	356	223	146	138	273	206	75



Do you know

- Air has weight and this weight exerts pressure on us, which is known as air pressure.
- There is an inverse relationship between temperature and air pressure, i.e. if the temperature of any area is high then the air pressure will be low and vice-versa.
- Difference in the air pressure is responsible for the attraction of the winds.

The average maximum temperature is above 33°C in the month of May at Delhi and Jodhpur. Such high temperature heats up the air of that region. Hot air rises, low pressure area is created under it. This low pressure is also known as monsoonal trough. It lies between Jaisalmer in the west and Balasore in Odisha in the East.

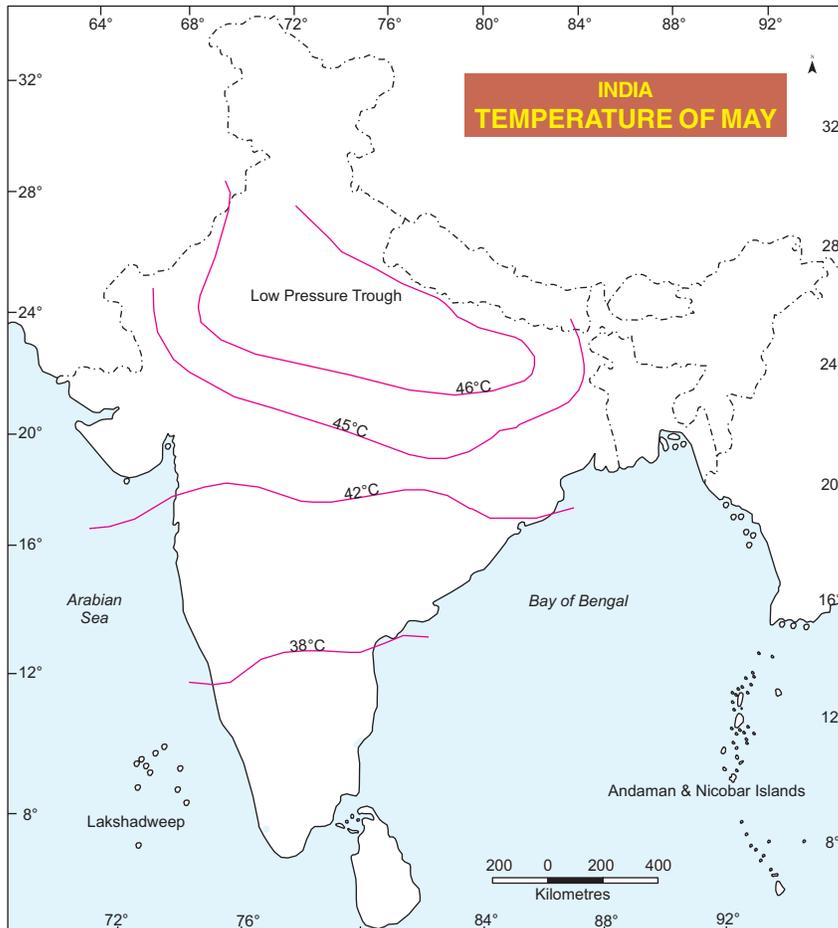


Figure 10.2 *Temperature of May*

On the other hand temperature over Indian Ocean is relatively low, as water needs more time to get heated as compared to land. So a relatively high pressure region is created over the sea. See the map 10.2 given above and try to understand the given phenomenon.

Thus, there is a difference of temperature and resultant pressure over North Central Indian Plains and Indian Ocean. Due to this difference, air from high pressure region of the sea starts moving towards the low pressure region of North India. Thus, by mid June the general movement of air is from equatorial region of Indian Ocean to the Indian subcontinent and the direction of these winds in general is from South-West to North-East. This direction is exactly opposite to that of the trade winds (North – East to South-West) prevailing during winter in India. This complete reversal



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of wind direction from North-East to South West and vice-versa is known as monsoons.

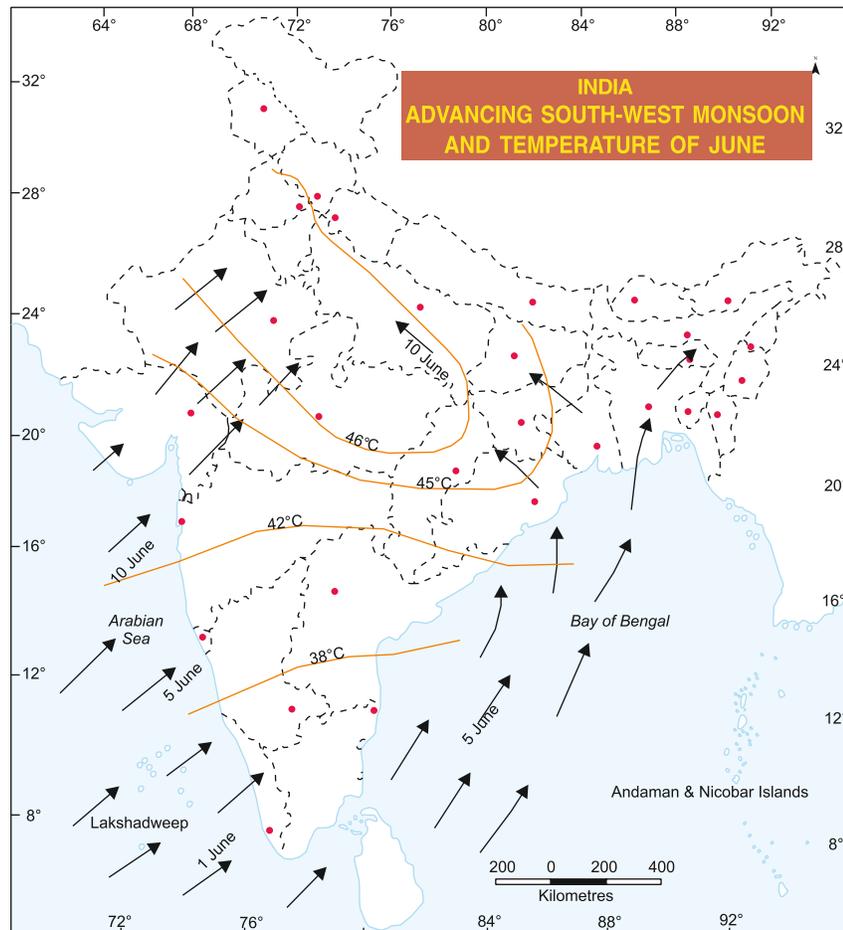


Figure 10.3 *Temperature of June*

These winds originate over warm seas. Therefore, they contain a lot of moisture. When these moisture laden winds move over the Indian sub-continent they cause wide spread rain throughout India and from June to September 80% to 90% of the total rainfall in India is confined to these four months only.

10.2.1 Characteristics of the Monsoon

1. Monsoons are not steady winds. They are irregular in nature affected by different atmospheric conditions i.e. due to regional climatic conditions. Sometimes monsoon early or some times late.
2. Monsoons are not equally distributed. Coastal areas like Kerala West Bengal and Odisha receive heavy rain fall, whereas interior regions like Haryana, Madhya Pradesh, receive less rainfall.

- When monsoon arrives, it gives heavy rainfall which continues for several days. This is known as 'burst of monsoon'. This occurs mainly at Kerala coast where it reaches first.



ACTIVITY 10.2

Observe the picture and answer the following questions:



(a)



(b)



(c)

Figure 10.4

- Identify the seasons in the given pictures (a), (b) and (c).
- Arrange them on the basis of their occurrence.
- Which season you like the most and why? Write answer in about 30 words.



INTEXT QUESTIONS 10.2

Look at maps (Fig. 10.2, Fig. 10.3) of advancing monsoon and answer the following questions:

- Name the states which lie within the low pressure regions.
- As the monsoon winds are coming from south-west which state they will strike first.
- When the monsoon winds reach the Bay of Bengal, what is their direction?
- Observe the rainfall data of the following cities and find out the average duration of monsoon in four cities. Name of the cities are:

(a) Mumbai	(c) Delhi
(b) Jaisalmer	(d) Shillong

A few months later Mona and Raju's father was transferred to Delhi. They were excited to live in the capital of India. They shifted to Delhi. New home, new school, new friends and new environment and everything was new for them. They realized



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that now they were going to see the real changes of the seasons which they had read in their book. Try to discover the various seasons and how they happen in the following section.

10.3 CYCLE OF SEASONS

Our country, India, enjoys variety of seasons due to geographical locations. Now you will know about the seasons of India and their unique features. We have four seasons:

- (a) Cold weather season (December – February)
- (b) Hot weather season (March – May)
- (c) Advancing South – West monsoon season (June – September)
- (d) Post or retreating monsoon season (October – November).

You will know more about each of them in the following section.

(a) Cold Weather Season: The duration of cold weather season is from December to February. The temperature decreases from the South to the North. December

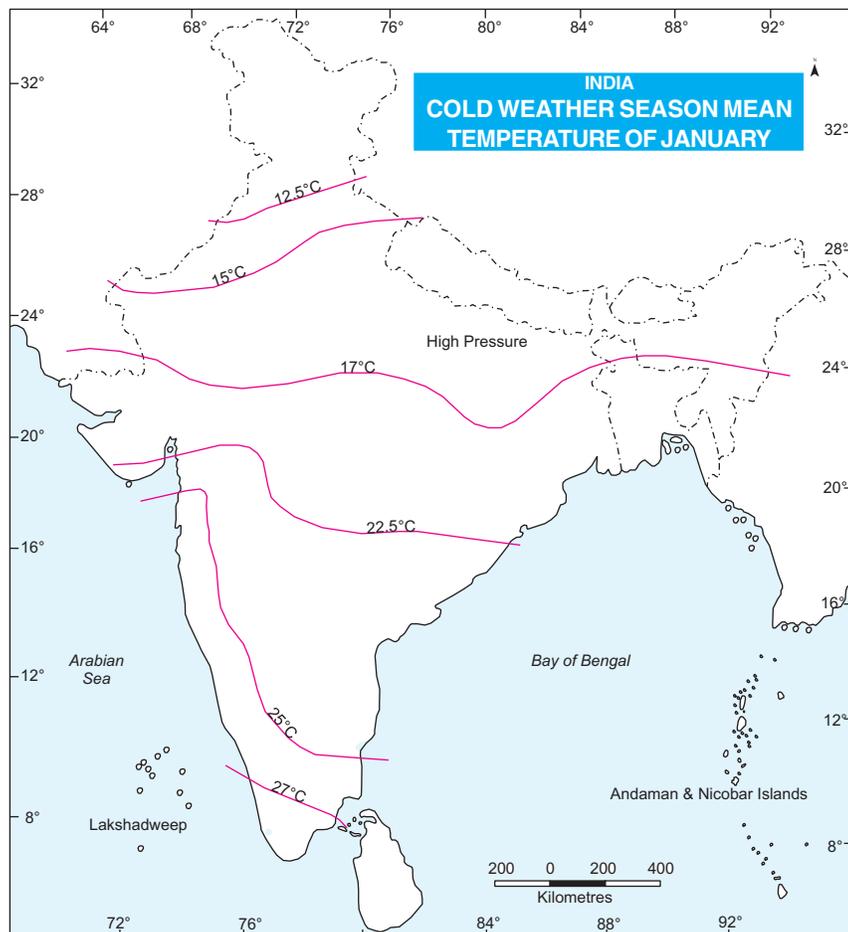


Figure 10.5 Mean Temperature of January



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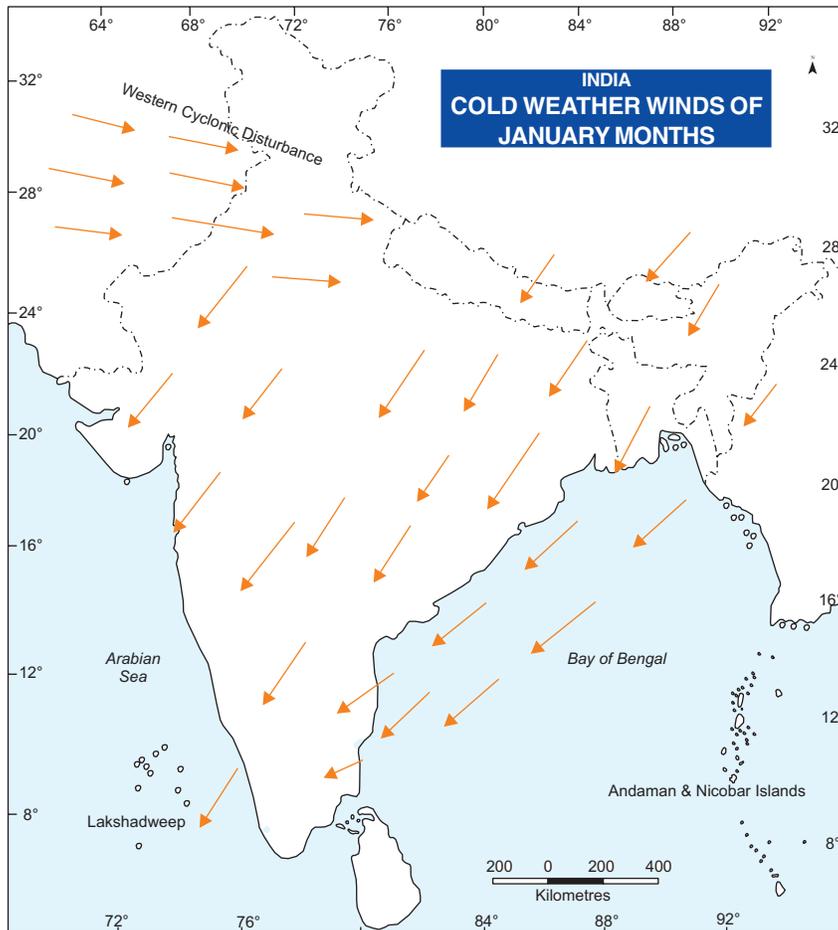


Figure 10.6 Direction of winds in January

and January are the coldest months and the average temperature in North is (12° to 15°C) and in South (25°C). Frost is common in the North and North-West India. There is light rainfall in this region due to Western disturbances. Higher slopes of the Himalayas experience snowfall. During the winter season, North-East trade winds prevail over India. They blow from land to sea. Hence, for most part of the country, it is a dry season. However, the Tamil Nadu coast receives winter rainfall due to these winds. A part of North-East trade winds blow over Bay of Bengal. They gather moisture which causes rainfall in the coastal Tamilnadu while the rest of the country remains dry. In the northern part of the country the weather is marked by clear sky, low temperatures and low humidity. The winter rainfall is very important for the cultivation of 'Rabi' crops.

- (b) **Hot Weather Season:** By the end of February the temperature starts rising. So from March to May it is hot weather season. We find high temperature in plains, western part of India and in the central part of peninsular India. In Northern plains, thus, an elongated low pressure which is called monsoonal trough created here, which extends from Jaisalmer in western Rajasthan to Jharkhand and parts of Odisha to the East. However, over Indian Ocean south



of the equator high pressure belt begins to develop in this season. In North-West India, afternoon dust storms are common. During summer, very hot and dry winds blow over North Indian plains. They are locally called ‘Loo’. Exposure to these hot winds may cause heat or sun stroke. This is also the season for localized thunderstorms, associated with violent winds, torrential downpours, often accompanied by hail. In West Bengal, these storms are known as the ‘Kaal Baisakhi’ (calamity for the month of Baisakh). 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’.

- (c) **Advancing South West Monsoon Season:** After the scorching heat of summer season people eagerly wait for the rains which can give them relief. Farmers wait for the rains so that they can prepare their fields for the next cropping season *Kharif*. June to September are the months of advancing South-West monsoon season. By the end of May the monsoon trough further intensifies over north India due to high temperature in the region. The General direction of the wind during this season is from South-West to north-east. These winds

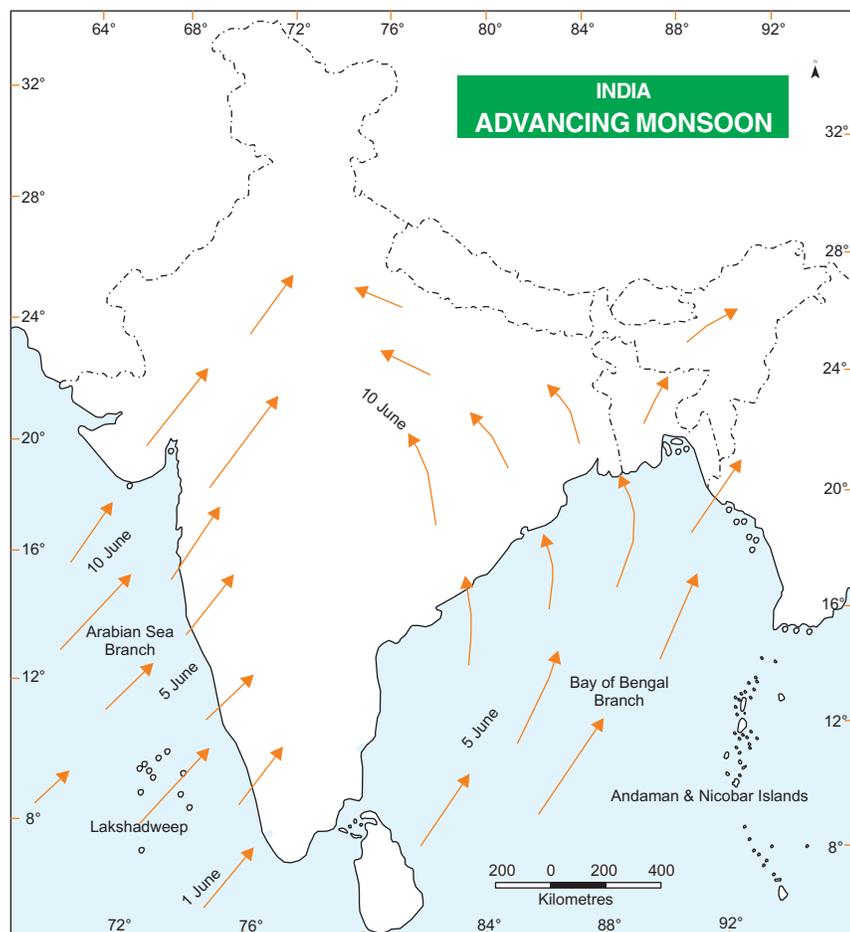


Figure 10.7 Advancing Monsoon of India

are strong and blow at an average velocity of 30 km per hour. These moisture laden winds first hit at Andaman and Nicobar Islands in the last week of May and Kerala coast in the first week of June with violent thunder and lightning. This South-West monsoon that flows in to India brings about a major change in its weather. Two branches of south-west monsoon originate from: (i) Arabian Sea and (ii) Bay of Bengal.

The Arabian Sea Branch obstructed by Western Ghats gives heavy rainfall on the Western side of Western Ghats. It reaches Mumbai by 10th June (*See Fig. 10.7*). When this branch crosses the Western Ghats and reaches the Deccan Plateau and parts of Madhya Pradesh, it gives less rainfall as it is a rain shadow region. Further, this branch reaches in Northern Plain by 20th June.

The monsoon winds that move from Bay of Bengal strike Andaman and Nicobar islands North-Eastern states and coastal areas of West Bengal and covers the whole of India by the 15th of July. They cause heavy rainfall in the region. However, quantity of rainfall decreases as they move towards West over the Northern plains. For examples rainfall at Kolkata is 120 cm, Allahabad 91 cm and Delhi 56cm. You must have seen that rainfall does not continue for several days. The monsoon tends to have 'breaks' in its rainfall which causes wet and dry spells. This means that monsoon rains occur only a few days at a time. Rainless dry spells occur in between. As the monsoon comes after the hot and dry summer season, the rainfall brings down the temperature. We can see this decline is from 5°C to 8°C between mid June and mid July. This is the time when many parts of India face floods also. This is mainly because of heavy rainfall and our inability to manage our water resources more systematically. On the other hand there are many areas that experience drought conditions during this season.



ACTIVITY 10.3

Collect the information from the newspapers and other sources and find out which parts of India are regularly affected by the floods and droughts. Also paste the newspaper cuttings as a sample. Identify name the reasons and collect the information about the most recent.

- (d) **Retreating or Post Monsoon Season:** October and November are the months of post (or retreating) monsoon season. The temperatures during September-October start decreasing in north India. Monsoonal trough also becomes weak over North-West India. This is gradually replaced by a high pressure system. The South-West monsoon winds weaken and start withdrawing gradually from North Indian Plains by November. In October the weather remains humid and warm due to continuing high temperature and moist land in



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month of October. In Northern plains hot and humid weather becomes oppressive at this time. It is commonly called ‘October Heat’. However, towards the end of October, temperature starts decreasing, making nights pleasant. This is also the time of cyclonic storms which develop in the Bay of Bengal as the low pressure of North India shifts to this area. These storms create havoc in coastal areas of Odisha, Andhra Pradesh and Tamil Nadu, especially in the deltas of Mahanadi, Godavari and Krishna rivers.

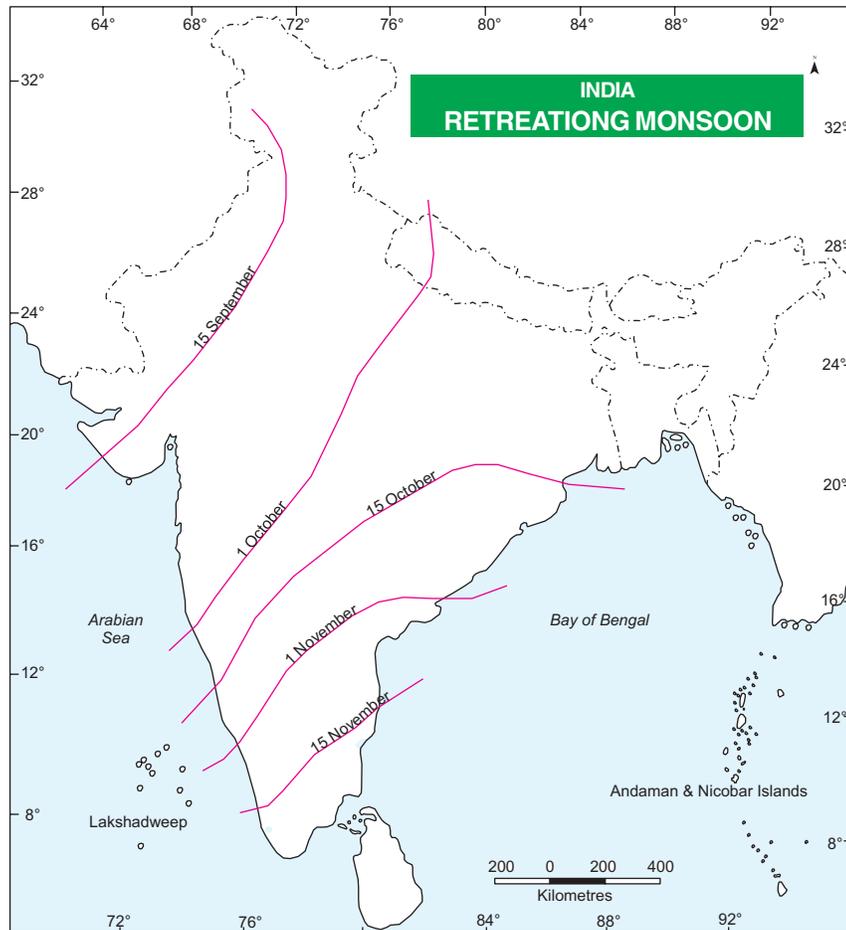


Figure 10.8 Retreating Monsoon



INTEXT QUESTIONS 10.3

Choose the correct answer:

- (i) The hot and dry wind blowing in the northern plain in the summer are called—
 - (a) Kaal Baisakhi
 - (b) Loo
 - (c) Trade winds
 - (d) All of the above

- (ii) Which mountain range acts as a barrier in the path of the Arabian Sea branch?
 (a) Aravallis (c) Western Ghats
 (b) Eastern Ghats (d) Raj Mahal hills
- (iii) The tropical cyclones of the Bay of Bengal usually occurs during
 (a) South-west monsoon (c) Retreating monsoon season
 (b) Hot weather season (d) Cold weather season
- (iv) Which place would be the hottest one in March?
 (a) Delhi (c) Deccan Plateau
 (b) Shillong (d) Punjab
- (v) Monsoons are called
 (a) Seasonal winds (c) Permanent winds
 (b) Temporary winds (d) Local winds

Seasons, its cycle, causes and effects were now clear to Mona and Raju. Only one question remained unanswered. If the monsoons came in a particular area for certain duration so it means the rainfall distribution in India was uneven? Try to find the answer with the help of Rainfall distribution map.

10.4 DISTRIBUTION OF RAINFALL

Rainfall in India is highly uneven over a period of time in a year. As we move from East to West in Northern plains, we observe that in central India rainfall decreases. In peninsular region, India's rainfall decreases from coast to interior parts. In North-East India, the rainfall increases with altitude. India is the unique example of rainfall distribution with marked contrasts. Both, one of the rainiest and driest places of the world are located in India itself. Can you think why? Spatial variations in rainfall in India can be shown under the following headings. Observe the given map and find out the states under the given categories –

- (a) Areas of heavy rainfall (more than 200cm): Maximum rainfall in India occurs in the western coast, sub Himalayan regions of north-east and Garo, Khasi and Jaintia hills of Meghalaya.
- (b) Area of Moderate rainfall (100-200cm): Areas receiving 100 to 200cm rainfall in India include some parts of the Western Ghats, West Bengal, Odisha and Bihar and many states.
- (c) Areas of Low rainfall (60 to 100cm): This is the region of low rainfall, which includes parts of Uttar Pradesh, Rajasthan, interior deccan plateau.
- (d) Areas of Inadequate rainfall (Less than 60cm): This is region of scanty rainfall. The western part of Rajasthan and Gujarat, Laddakh and south central part receives a rainfall of less than 20cm.



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ACTIVITY 10.4

List out the festivals of India in the table given below. Also find out which season is economically significant in your area and why?

<i>List of the festivals</i>	<i>Areas where celebrated</i>	<i>Date and month</i>	<i>Season</i>	<i>Economically Significant</i>

Do you see co-relation between seasons of festivals and harvest seasons. Please provide one reason.

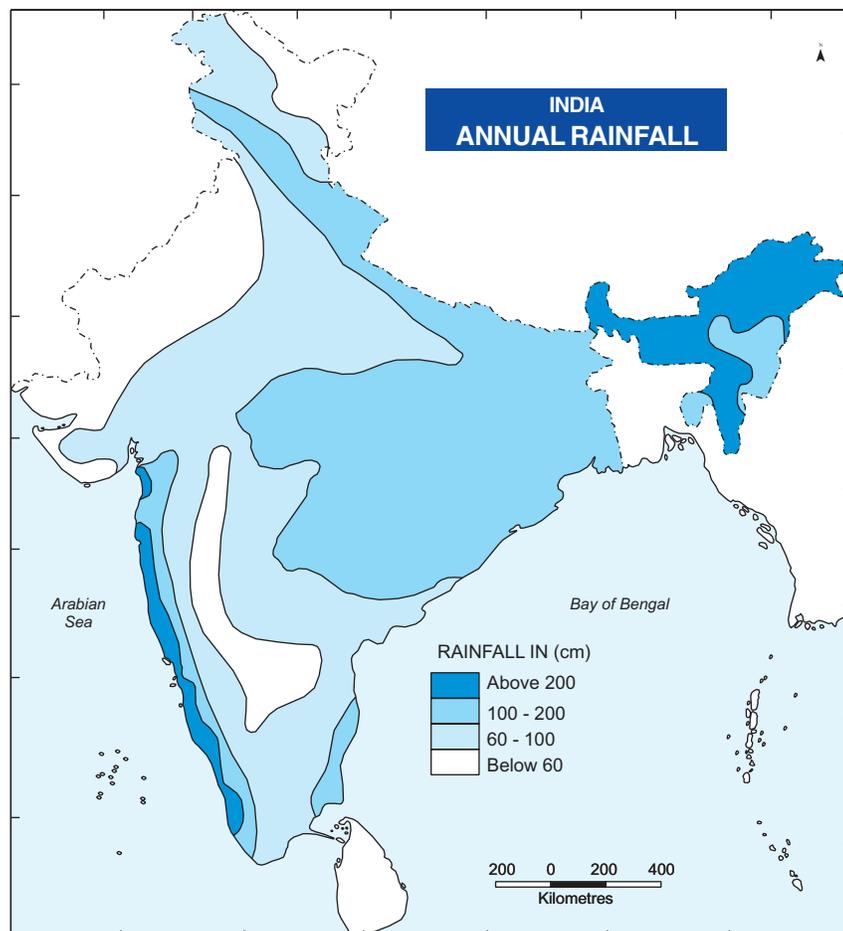


Figure 10.9 Annual Rainfall of India

10.5 SOCIO-CULTURAL LIFE

You are now well aware about the cycle of seasons but a second thought comes to our mind what do the relationship between the seasons and our life? Are they so important that they affect our life? The answer is 'yes'. They do affect our social and cultural life. As India is an agricultural country the main economic activity of agriculture is totally dependent on the cycle of seasons. The time of *Kharif* crop is advancing monsoon season and harvesting is post monsoon season. *Rabi* crop is grown in winter and *zaid* crop is at the end of winter season. Floods and droughts are hindrances in the economic growth of the nation as our economy is agro based economy.

All our activities are related with the seasons. As winter season comes the days become shorter and we start purchasing woollen clothes. Groundnuts, almonds and calorie rich food become very important in our diet. In spite of cold weather people celebrate many festivals like *Makar Sankranti* in many states, *Lohri* in Punjabi and *Pongal* in Tamil Nadu in the month of January. *Basant Panchami* is also celebrated in the month of February in which people pray for good harvest. Summer season is very dry but it reminds us of juicy fruits, ice creams and variety of drinks. What are the fruits available in this season? *Holi* and *Baisakhi* are the main festivals of the season. By the end of summer farmers start preparing their fields so that they can welcome the rains. This is the time when people of Kerala celebrate *Onam* which coincide with their harvest season. Post Monsoon is the harvesting time. It is also a festival time of *Dushera*, *Durga Pooja* and *Diwali* which are celebrated all over India.

10.6 GLOBAL ENVIRONMENTAL CHANGES AND ITS IMPACT ON INDIAN CLIMATE

After studying this lesson you must have understood that India is fortunate to have four clear seasons' summer, winter, spring and monsoon. However, these days one can notice disturbance in the cycle of seasons. This is due to global warming which is a burning topic of today's world. It has a significant political, social and economic impact that may affect almost every aspect of our lives and lifestyles. The global warming has a serious impact on world's climate and India cannot escape it. Don't you think that it is important for everybody to know about it and think how each one of us can contribute in reducing its extent?

Let us understand what is global warming. During the last decades of urbanization, industrialization and population growth the atmosphere has been polluted. Human activities increase the amount of carbon dioxide, Chloro Floro Carbon (CFC) and other dangerous gases. About 51% of the solar energy is absorbed by the earth's surface, which increases its temperature. The rest of the heat is reflected back in to the atmosphere. This helped in maintaining temperature. But now due to pollution some of the reflected heat is trapped by green house gases (GHGs), mainly carbon



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Climate

dioxide. It has increased the temperature of the Earth's surface. There is evidence to show that CO₂ levels are still increasing. Many countries have signed a convention to reduce GHGs under the U.N. framework. However, the current international agreements are still not effective enough to prevent the significant changes in climate.

We already know that 70% of Indians are working in agriculture sector. Any change in temperature will have an adverse effect on agriculture. This will have a serious social and economic impact on India. After reading the chapter we can clearly see that climate plays a very important role in Human life. Our food, our festivals, and our economy everything is closely linked with the cycle of seasons. If the seasons are favourable, human life will be good and comfortable. Since the state of the weather affects agriculture, health, transportation etc it is important that all of us make some change in our lifestyle to reduce CFC and other harmful gases.



ACTIVITY 10.5

Keep a diary of events about natural calamities such as earthquakes, cyclones and geographical events. Record them with name of the event, date and their impact.



INTEXT QUESTIONS 10.4

1. Why do we find the rainfall distribution in India highly uneven?
2. Name the three regions of India receiving lowest rainfall.
3. Name the months of *Kharif* and *Rabi* season.
4. When do we have the *zaid* season?
5. Which human activities are responsible for global warming?



WHAT YOU HAVE LEARNT

- Climate of India is affected by many factors like location, distance from the sea, altitude, mountain ranges, direction of surface winds and upper air currents.
- India has a special system of reversal of winds which is known as monsoon and it comes with a system.
- India has a cyclic system of season and it has four main seasons. They are winter, summer, advancing monsoon and retreating monsoon.
- Seasons play an important role in our day to day life and affect our activities and eating habits.
- Global warming influences Indian climate also.



TERMINAL EXERCISES

1. Describe any five factors which are responsible for affecting the climate? Explain with the help of examples for each factor.
2. Differentiate between climate and weather.
3. How are winds and their directions responsible for affecting the climate? Explain by giving examples.
4. Define monsoon. Identify the main reason which is responsible for moving trade winds in opposite direction?
5. Mention any four characteristics of cold weather season.
6. List any four main features of hot weather season?
7. By giving examples explain the effects of the global warming in India. What are the causes behind it?



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ANSWERS TO INTEXT QUESTIONS

10.1

- (a) Tropic of cancer, $23\frac{1}{2}^{\circ}$ N
- (b)
 - Influenced by sea
 - (i) Mumbai
 - (ii) Chennai
 - Not influenced by sea
 - (iii) Lucknow
 - (iv) Delhi
- (c) Himalayan Mountain Ranges
- (d) Winds are coming from North-East. Since they are coming from land, they are dry and unable to give rain to the country.

10.2

1. Rajasthan, Punjab, Haryana, Uttar Pradesh, Bihar, Jharkhand, West Bengal, Madhya Pradesh and Chhattisgarh and parts of Odisha.
2. Kerala.



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3. South to North and North-East and North-West.
4. (a) Mumbai: 4 months (c) Delhi: 4 months
(b) Nagpur: 4 months (d) Shillong: 6 months

10.3

1. (i) (b) Loo
(ii) (c) Western Ghats
(iii) (c) Retreating monsoon season
(iv) (c) Deccan Plateau
(v) (a) Seasonal Winds

10.4

1. When monsoon winds enter from the coast, they give the maximum rain there. When they reach the central or northern regions, they become dry, resulting less rainfall.
2. Regions of low rainfall –
 1. Northern leh-ladakh region
 2. Western Rajasthan
 3. South-Central part
3. *Kharif* – June and July *Rabi* – October and November
4. From the end of the winter season i.e. March to May.
5. Urbanization, Industrialization, Deforestation, burning of fossil fuels, etc.