

1. Details of Module and its structure

Module Detail	
Subject Name	Geography
Course Name	Geography 02 (Class XI, Semester - 2)
Module Name/Title	Monsoon Climate: The Rhythm of Seasons in India – Part 3
Module Id	kegy_20403
Pre-requisites	Basic Concept about earth's revolution, seasons, air pressure and winds
Objectives	After reading this lesson, learners will be able to: <ul style="list-style-type: none">• Know the cause for the happening of different seasons.• Acquire knowledge about the different seasons in India.• Know about the temperature, rainfall and air pressure during the different seasons.• Differentiate between advancing monsoon and retreating monsoon.• Know the characteristics of different seasons in India.
Keywords	Earth's revolution, solar flux, advancing monsoon, retreating monsoon, high pressure, low pressure, Mango Shower, Blossom Shower, Nor Westers, Loo.

2. Development Team

Role	Name	Affiliation
National MOOC Coordinator	Prof. Amarendra P. Behera	CIET, NCERT, New Delhi
Program Coordinator	Dr. Rejaul Karim Barbhuiya	CIET, NCERT, New Delhi
Course Coordinator (CC) / PI	Prof. Tannu Malik	DESS, NCERT New Delhi
Course Co-Coordinator / Co-PI	Dr. Nidhi Gusain	CIET, NCERT, New Delhi
Subject Matter Expert (SME)	Mr. Rajeev Kumar Sinha	St. Xavier's Sr. Sec. School, Delhi-54
Review Team	Prof. B.S Butola	School of Social Sciences, JNU, New Delhi
Technical Team	Mr. Shobit Saxena Ms. Khushboo Sharma	CIET, NCERT, New Delhi CIET, NCERT, New Delhi

Table of Content:

1. Cause for the happening of different seasons.
2. Different seasons in India.
3. The temperature, rainfall and air pressure during the different seasons.
4. Differentiate between advancing monsoon and retreating monsoon.
5. The characteristics of different seasons in India.

A **season** is a division of the year marked by changes in weather, ecology, and the amount of daylight. On Earth, seasons are the result of Earth's revolution around the Sun and Earth's axial tilt relative to the ecliptic plane. In temperate and Polar Regions, the seasons are marked by changes in the intensity of sunlight that reaches the Earth's surface. Various cultures define the number and nature of seasons based on regional variations.

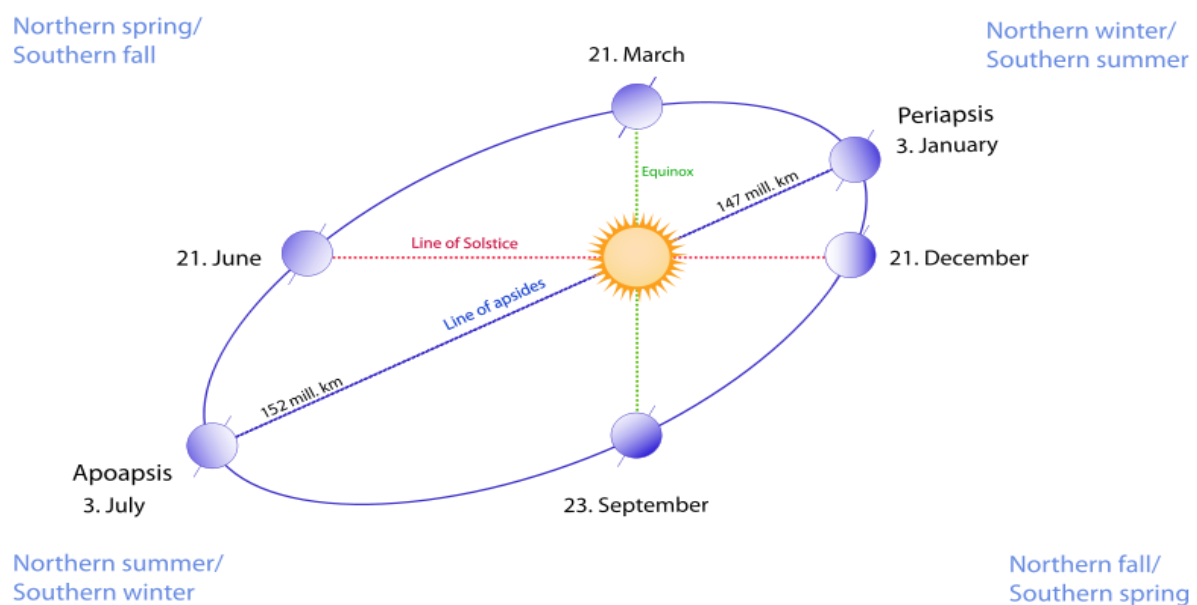


Fig 1: Earth's revolution and season

Source: <https://commons.wikimedia.org/wiki/File:Seasons1.svg>

During May, June, and July, the Northern Hemisphere is exposed to more direct sunlight because the hemisphere faces the Sun. The same is true of the Southern Hemisphere in November, December, and January. It is Earth's axial tilt that causes the Sun to be higher in the sky during the summer months, which increases the solar flux. (Solar flux is the concentrated sunlight, is a measure of how much light energy is being radiated in a given area) However, June, July, and August are the warmest months in the Northern Hemisphere while December, January, and February are the warmest months in the Southern Hemisphere.

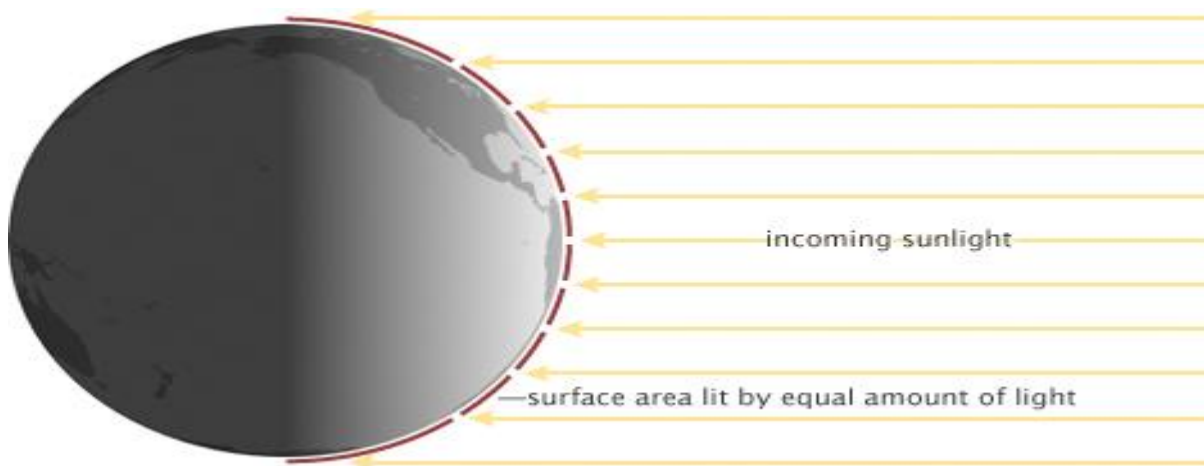


Fig 2: Solar flux

Source: <https://earthobservatory.nasa.gov/features/EnergyBalance/page2.php>

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?

The Rhythm of Seasons

The climatic conditions of India can best be described in terms of an annual cycle of seasons. The meteorologists recognise the following four seasons:

- (i) The cold weather season
- (ii) the hot weather season
- (iii) the southwest monsoon season
- (iv) The retreating monsoon season.

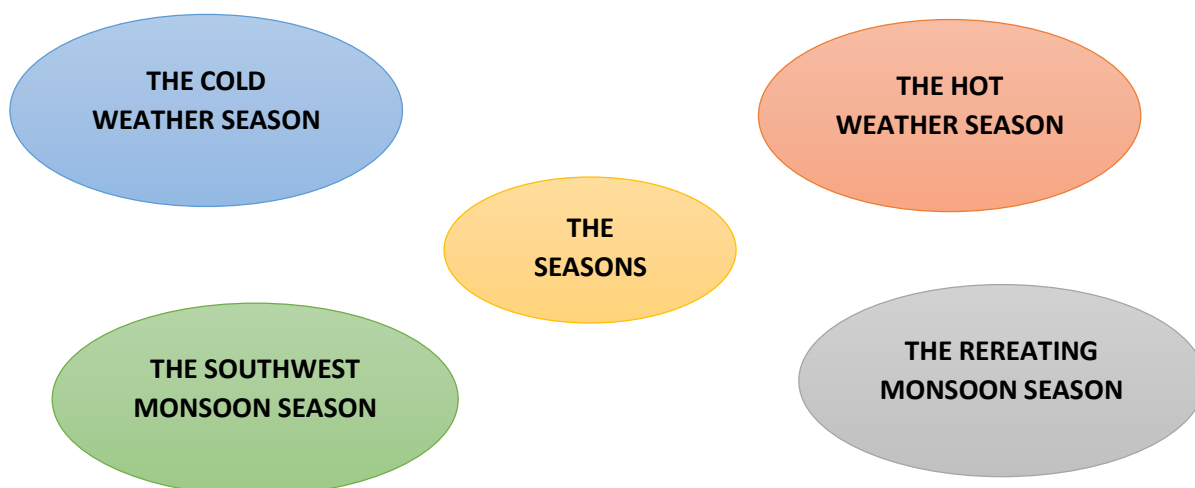


Fig 3: The Cold Weather Season

Temperature: Usually, the cold weather season sets in by mid-November in northern India. December and January are the coldest months in the northern plain. The mean daily temperature remains below 21°C over most parts of northern India. The night temperature may be quite low, sometimes going below freezing point in Punjab and Rajasthan. There are three main reasons for the excessive cold in north India during this season:

- (i) States like Punjab, Haryana and Rajasthan being far away from the moderating influence of sea experience continental climate.
- (ii) The snowfall in the nearby Himalayan ranges creates cold wave situation; and
- (iii) Around February, the cold winds coming from the Caspian Sea and Turkmenistan bring cold wave along with frost and fog over the northwestern parts of India.



Fig 4: Cold Weather

Source: <https://pxhere.com/en/photo/648821>

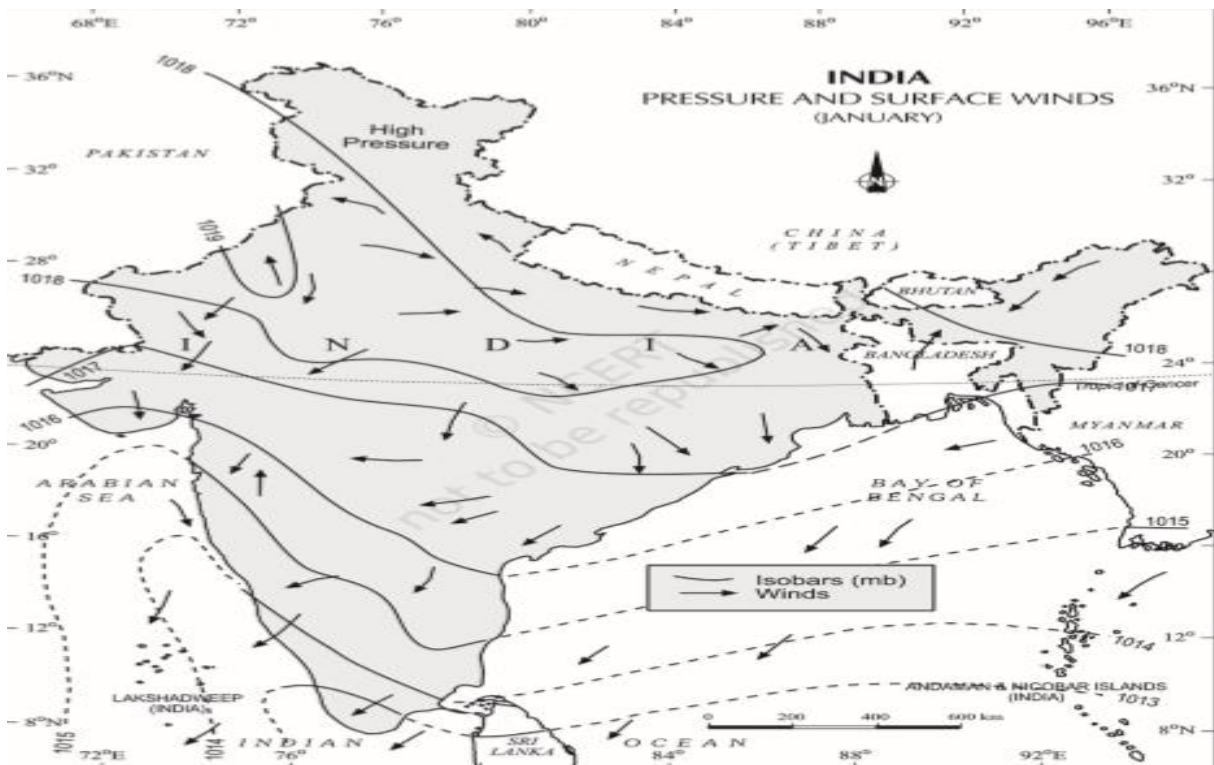
The Peninsular region of India, however, does not have any well-defined cold weather season. There is hardly any seasonal change in the distribution pattern of the temperature in coastal areas because of moderating influence of the sea and the proximity to equator. For example, the mean maximum temperature for January at Thiruvananthapuram is as high as 31°C, and for June, it is 29.5°C. Temperatures at the hills of Western Ghats remain comparatively low.



MAP: India: Mean Monthly Temperatures of the Day in January

Source: NCERT

Pressure and Winds: By the end of December (22nd December), the sun shines vertically over the Tropic of Capricorn in the southern hemisphere. The weather in this season is characterised by feeble high pressure conditions over the northern plain. In south India, the air pressure is slightly lower. The isobars of 1019 mb and 1013 mb pass through northwest India and far south, respectively.



Map: India – pressure and surface winds (January)

Source: NCERT textbook

As a result, winds start blowing from northwestern high pressure zone to the low air pressure zone over the Indian Ocean in the south. Due to low pressure gradient, the light winds with a low velocity of about 3-5 km per hour begin to blow outwards. By and large, the topography of the region also influences the wind direction. They are westerly or northwesterly down the Ganga Valley. They become northerly in the Ganga-Brahmaputra delta. Free from the influence of topography, they are clearly northeasterly over the Bay of Bengal.

During the winters, the weather in India is pleasant. The pleasant weather conditions, however, at intervals, get disturbed by shallow cyclonic depressions originating over the east Mediterranean Sea and travelling eastwards across West Asia, Iran, Afghanistan and Pakistan before they reach the northwestern parts of India. On their way, the moisture content gets augmented from the Caspian Sea in the north and the Persian Gulf in the south.

Rainfall: Winter monsoons do not cause much rainfall as they move from land to the sea. It is because firstly, they have little humidity; and secondly, due to anti cyclonic circulation on land, the possibility of rainfall from them reduces. So, most parts of India do not have rainfall in the winter season. However, there are some exceptions to it:

- (i) In northwestern India, some weak temperate cyclones from the Mediterranean Sea cause rainfall in Punjab, Haryana, Delhi and western Uttar Pradesh. Although the amount is meagre, it is highly beneficial for Rabi crops. The precipitation is in the form of snowfall in the lower Himalayas. It is this snow that sustains the flow of water in the Himalayan Rivers during the summer months. The precipitation goes on decreasing from west to east in the plains and from north to south in the mountains. The average winter rainfall in Delhi is around 53 mm. In Punjab and Bihar, rainfall remains between 25 mm and 18 mm respectively.
- (ii) Central parts of India and northern parts of southern Peninsula also get winter rainfall occasionally.
- (iii) Arunachal Pradesh and Assam in the northeastern parts of India also have rains between 25 mm and 50 mm during these winter months.
- (iv) During October and November, northeast monsoon while crossing over the Bay of Bengal, picks up moisture and causes torrential rainfall over the Tamil Nadu coast, southern Andhra Pradesh, southeast Karnataka and southeast Kerala.

The Hot Weather Season



Fig 5: hot weather

Source: <https://www.flickr.com/photos/jccarp/9077742176/>

Temperature: With the apparent northward movement of the sun towards the Tropic of Cancer in March, temperatures start rising in north India. April, May and June are the months of summer in north India. In most parts of India, temperatures recorded are between 30°-32°C. In March, the highest day temperature of about 38°C occurs in the Deccan Plateau while in April, temperature ranging between 38°C and 43°C are found in Gujarat and Madhya Pradesh. In May, the heat belt moves further north, and in the north-western part of India, temperatures around 48°C are not uncommon.



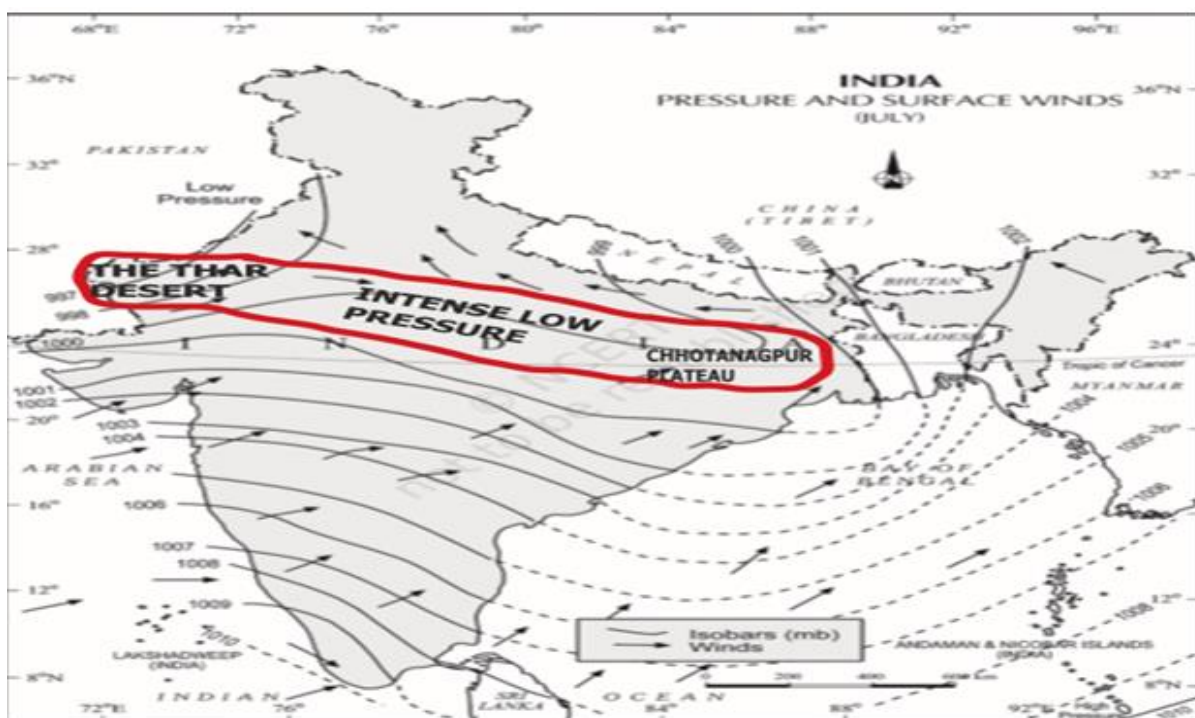
Map: India: Mean Monthly Temperature of the Day in July

Source: NCERT

The hot weather season in south India is mild and not so intense as found in north India. The Peninsular situation of south India with moderating effect of the oceans keeps the temperatures lower than that prevailing in north India. So, temperatures remain between 26°C and 32°C.

Due to altitude, the temperatures in the hills of Western Ghats remain below 25°C. In the coastal regions, the north-south extent of isotherms parallel to the coast confirms that temperature does not decrease from north to south rather it increases from the coast to the interior. The mean daily minimum temperature during the summer months also remains quite high and rarely goes below 26°C.

Pressure and Winds: The summer months are a period of excessive heat and falling air pressure in the northern half of the country. Because of the heating of the subcontinent, the ITCZ moves northwards occupying a position centred at 25°N in July. Roughly, this elongated low pressure monsoon trough extends over the Thar Desert in the north-west to Patna and Chhotanagpur plateau in the east-southeast.



MAP: India: Pressure and surface winds July

The location of the ITCZ attracts a surface circulation of the winds which are southwesterly on the west coast as well as along the coast of West Bengal and Bangladesh. They are easterly or southeasterly over north Bengal and Bihar. It has been discussed earlier that these currents of southwesterly monsoon are in reality 'displaced' equatorial westerlies. The influx of these winds by mid-June brings about a change in the weather towards the rainy season.

In the heart of the ITCZ in the northwest, the dry and hot winds known as 'Loo', blow in the afternoon, and very often, they continue to well into midnight. Dust storms in the evening are very common during May in Punjab, Haryana, Eastern Rajasthan and Uttar Pradesh. These

temporary storms bring a welcome respite from the oppressing heat since they bring with them light rains and a pleasant cool breeze. Occasionally, the moisture-laden winds are attracted towards the periphery of the trough. A sudden contact between dry and moist air masses gives rise to local storms of great intensity. These local storms are associated with violent winds, torrential rains and even hailstorms.

Some Famous Local Storms of Hot Weather Season

- (i) **Mango Shower:** Towards the end of summer, there are pre-monsoon showers which are a common phenomenon in Kerala and coastal areas of Karnataka. Locally, they are known as mango showers since they help in the early ripening of mangoes.



Fig 6: Mango Tree

Source: https://commons.wikimedia.org/wiki/File:Mango_Tree,_Mahendra_Highway.jpg

- (ii) **Blossom Shower:** With this shower, coffee flowers blossom in Kerala and nearby areas.



Fig 7: Coffee Flowers

Source: https://commons.wikimedia.org/wiki/File:Coffee_Flowers_Show.jpg

- (iii) **Nor Westers:** These are dreaded evening thunderstorms in Bengal and Assam. Their notorious nature can be understood from the local nomenclature of ‘Kalbaisakhi’, a calamity of the month of Baisakh. These showers are useful for tea, jute and rice cultivation. In Assam, these storms are known as “Bardoli Chheerha”.



Fig 8: Norwester

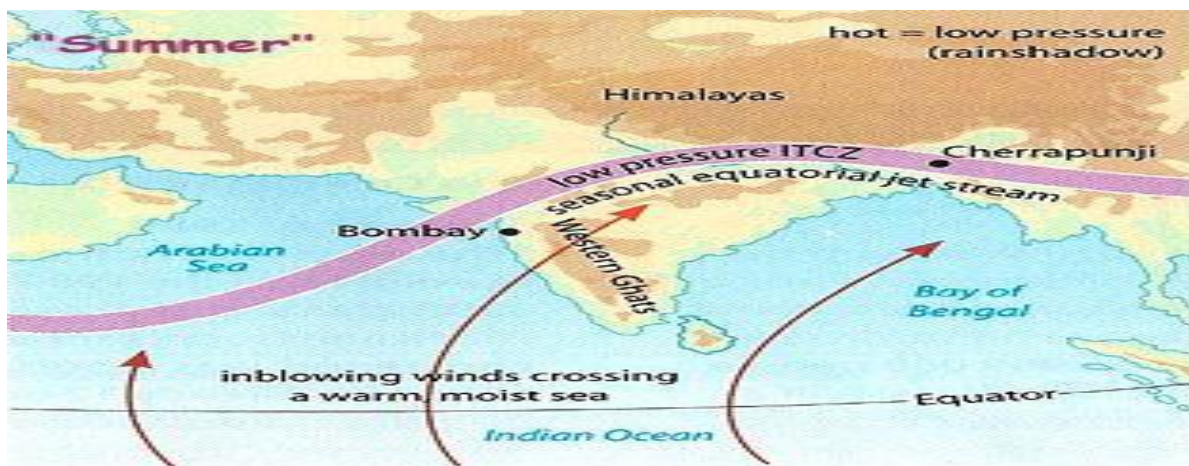
Source:

https://en.wikipedia.org/wiki/Norwesters#/media/File:Nor%E2%80%99wester_Kolkata_5959.JPG

- (iv) **Loo:** Hot, dry and oppressing winds blowing in the Northern plains from Punjab to Bihar with higher intensity between Delhi and Patna.

The Southwest Monsoon Season

As a result of rapid increase of temperature in May over the northwestern plains, the low pressure conditions over there get further intensified. By early June, they are powerful enough to attract the trade winds of Southern Hemisphere coming from the Indian Ocean. These southeast trade winds cross the equator and enter the Bay of Bengal and the Arabian Sea, only to be caught up in the air circulation over India. Passing over the equatorial warm currents, they bring with them moisture in abundance. After crossing the equator, they follow a southwesterly direction. That is why they are known as southwest monsoons.



Map: Southwest Monsoon

Source: <https://www.civildaily.com/wp-content/uploads/2016/12/Summer-ITCZ.png>

The rain in the southwest monsoon season begins rather abruptly. One result of the first rain is that it brings down the temperature substantially. This sudden onset of the moisture-laden winds associated with violent thunder and lightning, is often termed as the “burst” of the monsoons. The monsoon may burst in the first week of June in the coastal areas of Kerala, Karnataka, Goa and Maharashtra while in the interior parts of the country, it may be delayed to the first week of July. The day temperature registers a decline of 5°C to 8°C between mid-June and mid-July.

As these winds approach the land, their southwesterly direction is modified by the relief and thermal low pressure over the northwest India. The monsoon approaches the landmass in two branches:

- (i) The Arabian Sea branch
- (ii) The Bay of Bengal branch.

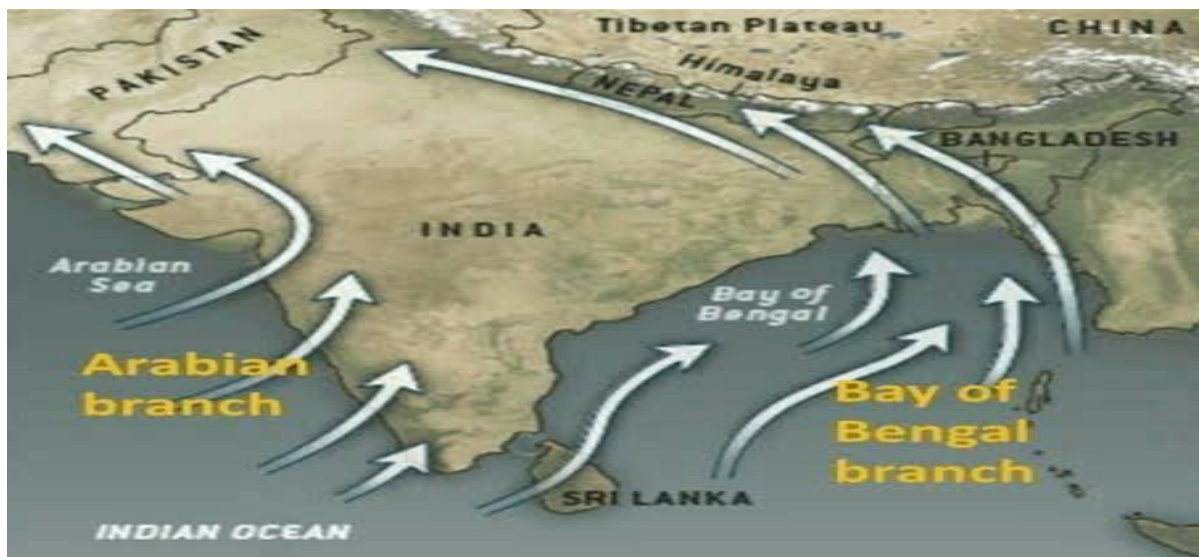


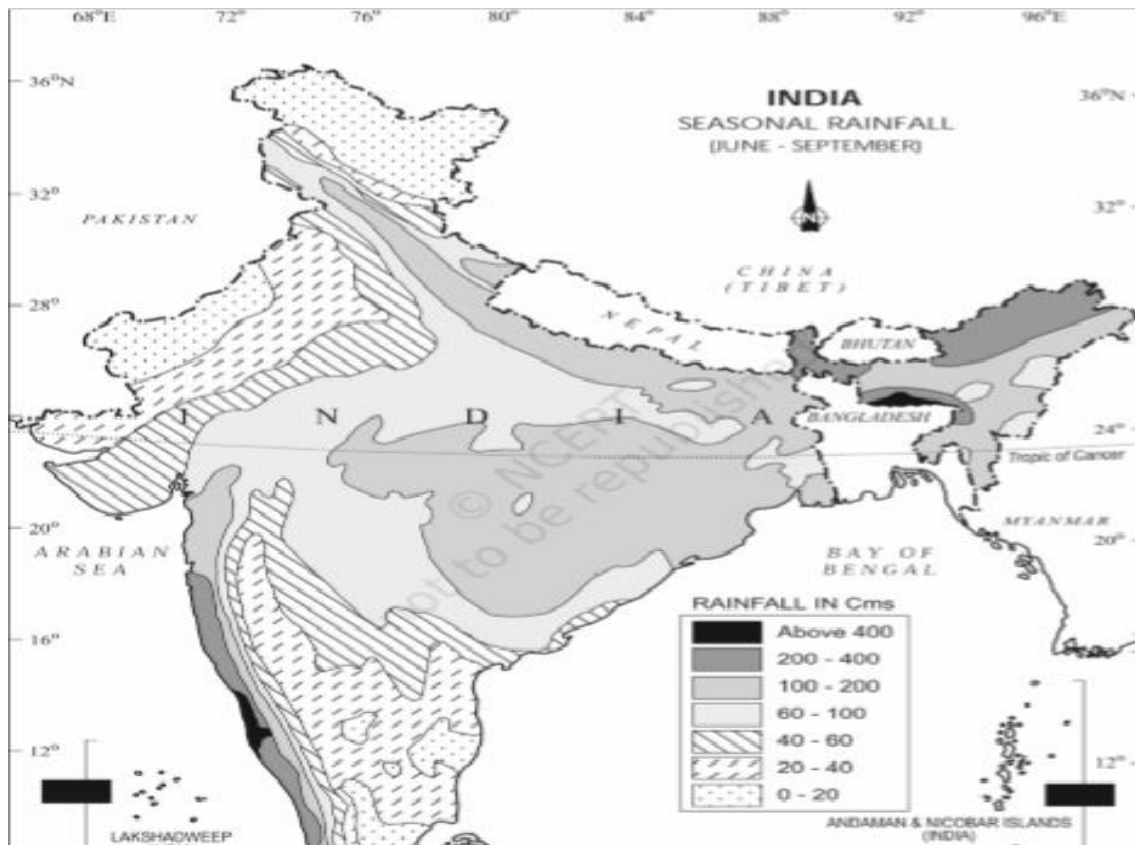
Fig 9: Branches of Southwest Monsoon

Source: <https://www.quora.com/What-is-the-Bay-of-Bengal-branch-of-SW-monsoon>

Monsoon Winds of the Arabian Sea

The monsoon winds originating over the Arabian Sea further split into three branches:

- (i) It's one branch is obstructed by the Western Ghats. These winds climb the slopes of the Western Ghats from 900-1200 m. Soon, they become cool, and as a result, the windward side of the Sahyadris and Western Coastal Plain receive very heavy rainfall ranging between 250 cm and 400 cm. After crossing the Western Ghats, these winds descend and get heated up. This reduces humidity in the winds. As a result, these winds cause little rainfall east of the Western Ghats. This region of low rainfall is known as the rain-shadow area.



Map: Seasonal Rainfall in India

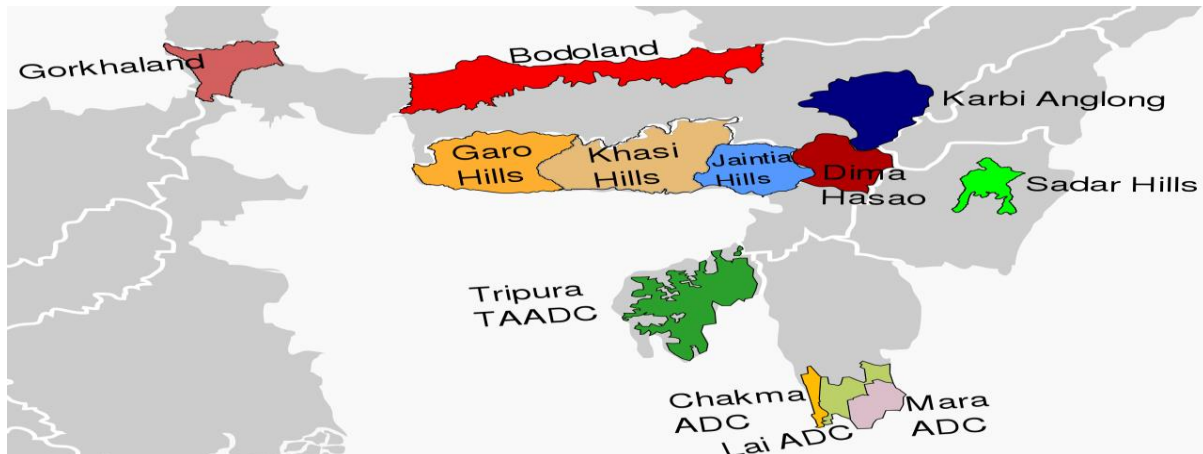
Source: NCERT

- (ii) Another branch of the Arabian Sea monsoon strikes the coast north of Mumbai. Moving along the Narmada and Tapi River valleys, these winds cause rainfall in extensive areas of central India. The Chhotanagpur plateau gets 15 cm rainfall from this part of the branch. Thereafter, they enter the Ganga plains and mingle with the Bay of Bengal branch.
- (iii) A third branch of this monsoon wind strikes the Saurashtra Peninsula and the Kachchh. It then passes over west Rajasthan and along the Aravalis, causing only a scanty rainfall. In Punjab and Haryana, it too joins the Bay of Bengal branch. These two branches, reinforced by each other, cause rains in the western Himalayas,

Monsoon Winds of the Bay of Bengal

The Bay of Bengal branch strikes the coast of Myanmar and part of southeast Bangladesh. But the Arakan Hills along the coast of Myanmar deflect a big portion of this branch towards the Indian subcontinent. The monsoon, therefore, enters West Bengal and Bangladesh from south and southeast instead of from the south-westerly direction.

From here, this branch splits into two under the influence of the Himalayas and the thermal low is northwest India. It's one branch moves westward along the Ganga plains reaching as far as the Punjab plains. The other branch moves up the Brahmaputra valley in the north and the northeast, causing widespread rains. Its sub-branch strikes the Garo and Khasi hills of Meghalaya. Mawsynram, located on the crest of Khasi hills, receives the highest average annual rainfall in the world.



Map: Important Hills in North Eastern India

Source:

https://upload.wikimedia.org/wikipedia/commons/1/10/NE_Autonomous_divisions_of_India.svg

Here it is important to know why the Tamil Nadu coast remains dry during this season. There are two factors responsible for it:

- (i) The Tamil Nadu coast is situated parallel to the Bay of Bengal branch of southwest monsoon.
- (ii) It lies in the rain shadow area of the Arabian Sea branch of the south-west monsoon.

Characteristics of Monsoonal Rainfall

- (i) Rainfall received from the southwest monsoons is seasonal in character, which occurs between June and September.
- (ii) Monsoonal rainfall is largely governed by relief or topography. For instance, the windward side of the Western Ghats register a rainfall of over 250 cm. Again, the heavy rainfall in the north-eastern states can be attributed to their hill ranges and the Eastern Himalayas.
- (iii) The monsoon rainfall has a declining trend with increasing distance from the sea. Kolkata receives 119 cm during the southwest monsoon period, Patna 105 cm, Allahabad 76 cm and Delhi 56 cm.

- (iv) The monsoon rains occur in wet spells of few days' duration at a time. The wet spells are interspersed with rainless interval known as 'breaks'. These breaks in rainfall are related to the cyclonic depressions mainly formed at the head of the Bay of Bengal, and their crossing into the mainland. Besides the frequency and intensity of these depressions, the passage followed by them determines the spatial distribution of rainfall.
- (v) The summer rainfall comes in a heavy downpour leading to considerable run off and soil erosion.
- (vi) Monsoons play a pivotal role in the agrarian economy of India because over three-fourths of the total rain in the country is received during the southwest monsoon season.
- (vii) Its spatial distribution is also uneven which ranges from 12 cm to more than 250 cm.
- (viii) The beginning of the rains sometimes is considerably delayed over the whole or a part of the country.
- (ix) The rains sometimes end considerably earlier than usual, causing great damage to standing crops and making the sowing of winter crops difficult.

Season of Retreating Monsoon

The months of October and November are known for retreating monsoons. By the end of September, the southwest monsoon becomes weak as the low pressure trough of the Ganga plain starts moving southward in response to the southward march of the sun. The monsoon retreats from the western Rajasthan by the first week of September. It withdraws from Rajasthan, Gujarat, Western Ganga plain and the Central Highlands by the end of the month. By the beginning of October, the low pressure covers northern parts of the Bay of Bengal and by early November, it moves over Karnataka and Tamil Nadu. By the middle of December, the Centre of low pressure is completely removed from the Peninsula.



Map: Retreating monsoon

Source: <https://www.quora.com/Which-state-receives-rainfall-from-north-east-monsoon>

The retreating southwest monsoon season is marked by clear skies and rise in temperature. The land is still moist. Owing to the conditions of high temperature and humidity, the weather becomes rather oppressive. This is commonly known as the 'October heat'. In the second half of October, the mercury begins to fall rapidly, particularly in northern India. The weather in the retreating monsoon is dry in north India but it is associated with rain in the eastern part of the Peninsula. Here, October and November are the rainiest months of the year.

The widespread rain in this season is associated with the passage of cyclonic depressions which originate over the Andaman Sea and manage to cross the eastern coast of the southern Peninsula. These tropical cyclones are very destructive. The thickly populated deltas of the Godavari, Krishna and Kaveri are their preferred targets. Every year cyclones bring disaster here. A few cyclonic storms also strike the coast of West Bengal, Bangladesh and Myanmar. A bulk of the rainfall of the Coromandal coast is derived from these depressions and cyclones. Such cyclonic storms are less frequent in the Arabian Sea.

In the end of this module it can be concluded that due to the revolution of the earth around the sun and its tilt on its own axis is causing different seasons in India. The peninsular India is not experiencing all these seasons due to its location and physiography. The four different seasons in India have different characteristics. The average time for each season varies from two to three months. These different seasons controls the human activities as well as the natural vegetation and wildlife. Due to these seasons India has unique biodiversity also.