Lesson - 7

Monsoon System of Bharat

Climate of Bharat is termed as monsoon climate because monsoons play a major role in its climate. Due to its dominant role, attempts are always made to predict about monsoons. Since the economy of our country depends upon monsoons, its prediction is necessary too. But it is essential to make predictions on unanimously acceptable and logical base, so that it may be accurate. Various hypothesis about the origin of monsoons have come up from time to time. It is pertinent to understand them.

Concept of Monsoon

The word monsoon has originated from the arabic word **Mausim**, meaning weather or season. As a matter of fact monsoons are seasonal winds. These winds blow from land for six months and from ocean for another six months. Our country remains under the effect of monsoonal winds throughout the year. Therefore, its climatic conditions are mainly determined by these winds. Our agriculture, agro-based industries and other related economic aspects depend upon climate. Hence economy of Bharat is a **Gamble in Monsoons**. There are various hypothesis about the origin of monsoons -

1. Classical Hypothesis

This hypothesis is related to the distribution of land and sea and their variable characteristics of grasping and loosing heat. Land areas are heated and cooled rapid by, while water is heated and cooled slowly. Low pressure develops over land due to rapid heating in summer season, while water

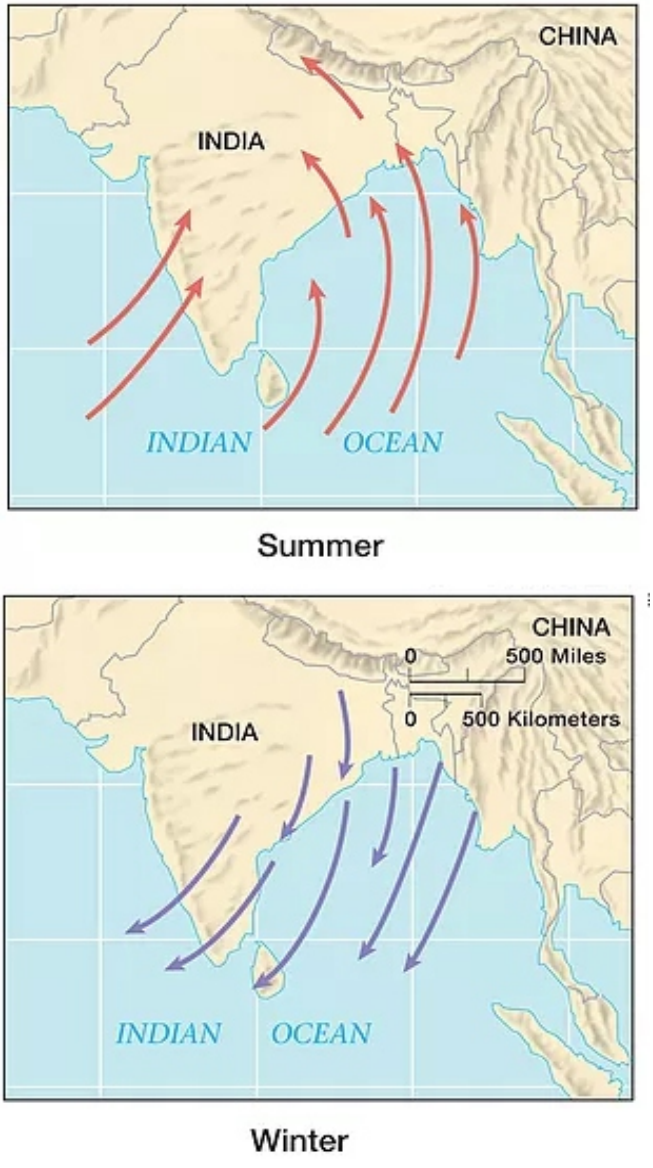

Fig.7.1 : Origin of Monsoon in Summer & Winter

remains cooler due to slow heating which creates, high pressure there. Consequently, winds start blowing from ocean towards land. These winds are humid because they originate from oceanic areas. Therefore, these winds provide widespread rains.

Wind direction turns opposite due to the reversal of the mechanism in winter season. High pressure develops over land due to its fast cooling and low pressure develops over oceanic areas which remain warmer due to longer retention of heat. Therefore winds start blowing from land towards ocean. These winds are dry because they originate over land. Therefore, usually these winds do not provide rains.

Thus **summer monsoon** and **winter monsoon** originate due to the reversal of weather conditions according to seasons.

2. Inter-tropical Convergence Hypothesis

German climatologists **Flohn** hypothesized that a **Front** is generated by the meeting of both the trade winds which blow towards equatorial low pressure. The **front** is the basis of the genesis of monsoons. The front shifts northwards in summer season. The resulting cyclonic movement provides rainfall in the form of summer monsoon. In winter season, not only the front shifts southwards but the influence of sub-tropical high pressure also increases in Bharat due to southward shifting of the pressure belts. Consequential anticyclonic conditions create north-east monsoon. Thus, according to Flohn, the seasonal reversal in the direction of monsoonal winds in not due to seasonal reversal of thermal conditions but it is due to the resetting of trade winds as part of the global wind system. This view about the origin of monsoons is also known as **Flohn's Hypothesis** (Fig. 7.2).

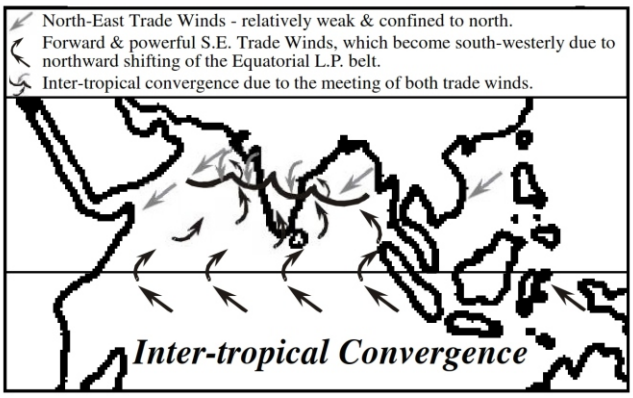

Fig.7.2 : Inter-tropical Convergence According to Flohn

3. Cyclonic Hypothesis of Spate

Australian geographer Spate believed that monsoonal winds result from the origin of cyclones. The cyclones originate by frontogenesis resulting from the meeting of different air masses. He held that the process of frontogenesis is very powerful in summer season. The fronts attract moist winds from oceanic areas. Contrarily, Spate held that these fronts happen to be weak and shallow in winter season.

4. Jet Stream Hypothesis

There are many geographical facts inherent in the hypothesis. In this hypothesis, monsoonal origin is ascribed more to the air circulation

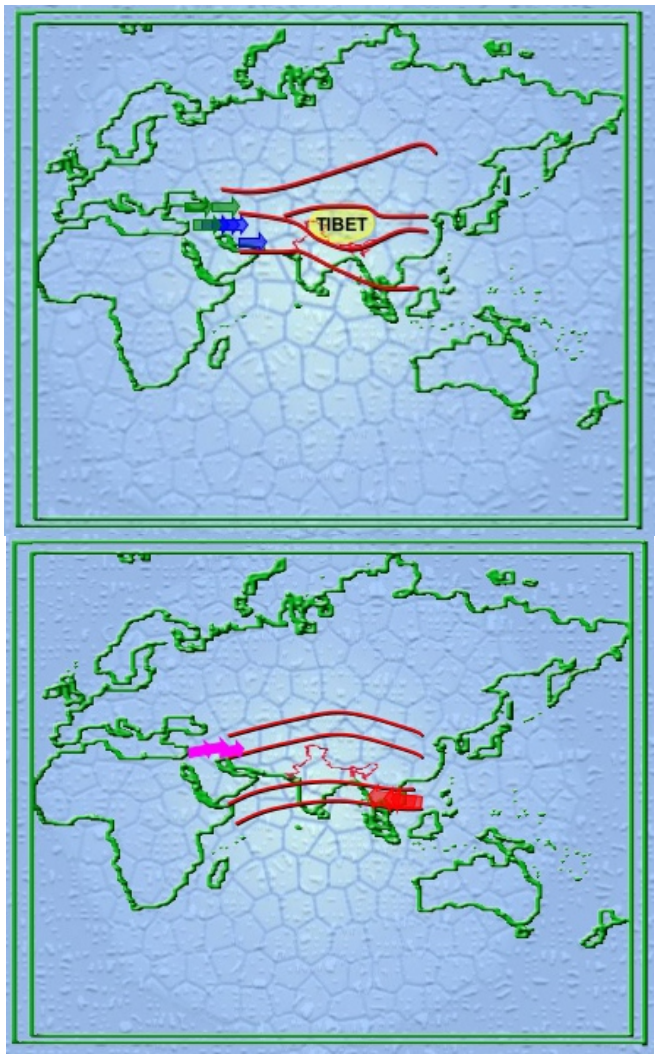

Fig.7.3 : Summer and Winter Jet Stream

prevalent in the **Troposphere** than only to the surface climatic conditions. Tropospheric air movement is also known as **Upper Air Circulation**. A fast speed air current, known as **Jet Stream**, exists in the upper air circulatory system. Jet stream is an important component of the upper air circulation prevailing over Himalayan and Tibetan region. Scientists such as Koteshwaram, Pant, Ramamurthy, Ramaswami, Flohn, Hamilton etc. have assumed a strong correlationship of Jet stream with the monsoons. Hamilton established the correlation between conditions of the entire troposphere and monsoons, while other scientists relate it with only the lower troposphere.

As a part of the upper air circulation, Jet Stream **blows from west to east**. Its track fluctuates with seasons. In summer season, its entire path is limited to the north of Tibet plateau (Fig. 7.3). With the shifting of pressure belts and winds belts southwards in winter season, the track of Jet Stream also shifts southwards. But due to the presence of plateau of Tibet, the Jet Stream is bifurcated. One branch blows north of Tibet plateau and the other branch blows south of it (Fig. 7.1).

In winter season, the sun shifts southwards and shines vertically over the Tropic of Capricorn. Resultantly, all the pressure belts and correspondingly all the wind belts shift southwards. The track of Jet Stream also shifts southwards in this season. Southwardly shifted track of Jet Stream is bifurcated due to the situation of Tibet plateau. Its northern branch blows to the north of the plateau. This branch is relatively feeble. Second branch blows south of Tibet plateau. The southerly track shifts between 20° to 25° north latitudes due to southward shifting of the wind belts in this season. Climatologists are of the view that this branch is responsible for the genesis of winter monsoons. This branch of Jet Stream also facilitates the arrival of the cyclonic disturbances from the north-west in Bharat in winters.

In summer season, the sun shifts northwards or it shines vertically over the Tropic of Cancer. Resultantly, all the pressure belts and correspondingly all the wind belts also shift northwards. Hence, the entire flow of Jet stream starts blowing to the north of Tibet plateau in a single path. The gap created by the northward shift of Jet Stream is filled by the winds blowing northwards from Indian Ocean. This is the process of the genesis of summer monsoons.

5. El Nino - La Nina Hypothesis

Some climatologists have hypothesized that the **oceanic temperature condition near Peruvian coast in southern Pacific Ocean** is an important determinant factor in the genesis of Bhartiya monsoon. These scientists are of the view that ocean water temperature condition near Peruvian coast in southern Pacific Ocean **during Christmas** plays an important role. The situations arise when this temperature fluctuates between 2° to 4°C above or below the normal. The condition of **fluctuation above the normal** is known as **El Nino Effect**. Contrarily, temperature condition **below the normal** is known as **La Nina Effect**. Since these abnormal conditions occur around Christmas, these have been termed as **Children of Christ** by the climatologists.

It has been hypothesized that **El Nino conditions weaken the process of the genesis of Bhartiya monsoon**. Contrarily, **La Nina conditions strengthens the monsoonal genesis in Bharat**.

Mechanics of El Nino Effect - Pressure conditions are affected by the increase of temperature above the normal near Peruvian coast in southern Pacific Ocean. Pressure becomes lower than the normal due to rise in temperature. It has been assumed that it affects the global pressure system and the wind system. The **push factor** for the south-east trade winds weakens near Peruvian coast due to the pressure lowered below the normal. Instead, the pull factor (to attract the south-east trade winds) become effective. Resultantly, the flow of the south-east trade winds towards Asia also weakens. This, in turn, creates the probabilities of

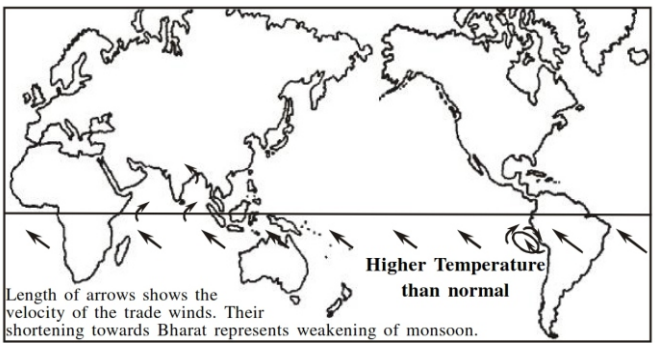

Fig.7.4 : Weak Monsoons During El Nino

delay or weakening of the summer monsoons in Bharat. The process has been explained in figure 7.4.

Mechanics of La Nina Effect - Pressure rises above the normal when the temperature decreases below the normal near Peruvian coast in southern Pacific Ocean. Resultant high pressure strengthens the **push factor**, so that the probabilities of early and/or powerful genesis of the summer monsoons increase. The process has been explained in figure 7.5

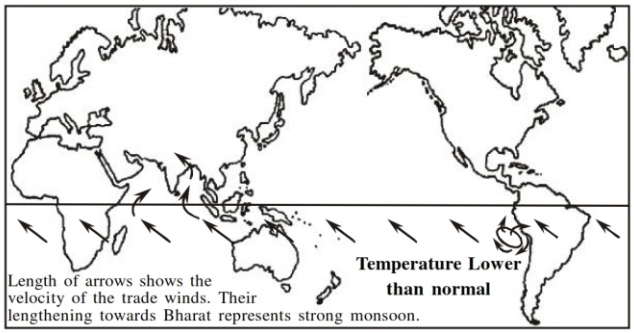

Fig.7.5 : Strong Monsoons During La Nina

Bharat is an agricultural country, hence monsoons carry special significance for us. Several types of uncertainties are inherent in the process of monsoons. Sometimes it sets-in too late and sometimes too early. Sometimes it weakens too soon and sometimes it remains effective for long. Sometimes it is very powerful and sometimes it remains very weak. The rainfall pattern of our country is affected by these uncertainties. It affects the agricultural production directly and the entire economy indirectly. Hence, Bhartiya economy is called as **gamble of monsoons**. Scientists are attempting to gain more and more knowledge about the genesis of monsoons. In the process of such attempts, many hypothesis have come forward from time to time, but no hypothesis is capable of providing unanimously acceptable explanation till now.

Important Points

1. The word monsoon owes it's origin from Arabic word **mausim**.
2. Various hypothesis are prevalent about the origin of monsoons.
3. Classical hypothesis is based on the variable thermal conditions developing on water-bodies and land.
4. Inter-tropical Convergence hypothesis was propounded by Flohn. He hypothesized that monsoons originate due to the convergence of the two trade winds.
5. Spate's hypothesis about the origin of monsoons is based on the frontogenesis due to the meeting of different air masses.
6. Many scientists hold the Jet Stream flow as the part of upper air circulation and deviations in its track responsible for the genesis of monsoons.
7. In the upper air circulation, Jet Stream blows from west to east.
8. The flow of Jet Stream remains totally confined to the north of Tibet plateau in summers. In winters, its track is bifurcated due to the presence of Tibet plateau when it shifts southwards. The two tracks spread north and south of the plateau.
9. The condition of temperature higher than the normal near Peruvian coast in south Pacific Ocean is known as El Nino and lower than the normal is known as La Nina. Since these conditions develop around Christmas, these are called as **Child of Christ**.
10. Late arrival and weak monsoons are imagined under El Nino effect.
11. Early arrival and strong monsoons are imagined under La Nina effect.

Exercise

Multiple Choice Questions

1. Jet Stream is the part of –
   (A) Various air-masses
   (B) Fronts
   (C) Cyclones
   (D) Upper air circulation

2. Traditional hypothesis about the origin of monsoons is–
   (A) Jet Stream hypothesis
   (B) Inter-tropical Convergence hypothesis
   (C) Classical hypothesis
   (D) El Nino - La Nina effect.

3. The scientist who propagated the origin of monsoons from frontogenesis is –
   (A) Spate (B) Flohn
   (C) Hamilton (D) Koteshwaram.

Very Short Answer Type

4. Which of the winds combine to form inter-tropical convergence?
5. Jet Stream is the part of which circulation?
6. What is meant by Child of Christ?

Short Answer Type

7. What is formed by the meeting of various air-masses?
8. Why is Jet Stream bifurcated during winter season?
9. What is La Nina effect?

Essay Type

10. Explain in detail the Jet Stream hypothesis about the origin of monsoons.
11. Give a detailed explanation of the role of El-Nino and La Nina in the genesis of monsoons.

Skill

12. Draw labelled sketches to show the tracks of Jet Stream during different seasons.

Answer Key

1. (D), 2. (C), 3. (A).