



Impact of Climate Change on Indian Monsoon

For Prelims: Climate Change, Flooding, Droughts, Indian Ocean Dipole, Monsoon depression.

For Mains: Impact of Climate Change on Indian Monsoon.

Why in News?

Recently, Research has shown that global warming, triggered by [Climate Change](#), increases the fluctuations in the [monsoon](#), resulting in **both long dry periods and short spells of heavy rains**.

- The Year 2022 has seen the **second highest extreme events since 1902**. An alarming case as incidents of [floods](#) and [droughts](#) have increased.

What are the Impacts of Climate Change on Indian Monsoon?

▪ **Contrasting Rainfall Patterns:**

- A shift in the track of monsoon systems has been seen such as low pressure and **depression travelling south of their position and flash floods**.
 - Monsoon depression originally refers to a low-pressure **system affecting the North Indian Ocean and the Bay of Bengal** in summer. It encompasses a **relatively large area and the diameter of closed isobar** can be as wide as 1000 km.
- Madhya Pradesh, Gujarat, Rajasthan and parts of Maharashtra have recorded excess rainfall in 2022, in contrast, **West Bengal, Jharkhand and Bihar did not receive normal rains**.
- August 2022 too saw two back-to-back depressions forming in the Bay of Bengal and traveling across Central India.
- While summer monsoon rainfall each year is unique, there has been a **large regional and temporal variability in rainfall in 2022**.

▪ **Causes:**

- Persistence of intense [La Nina conditions](#), the abnormal warming of East Indian Ocean, negative [Indian Ocean Dipole \(IOD\)](#), southward movement of most of the monsoon depressions and lows and pre-monsoon heating over the [Himalayan region](#) and melting glaciers.
 - IOD is defined by the difference in sea surface temperature between two areas (or poles, hence a dipole) – a western pole in the Arabian Sea (western Indian Ocean) and an eastern pole in the eastern Indian Ocean south of Indonesia.
 - The IOD affects the climate of Australia and other countries that surround the **Indian Ocean Basin, and is a significant contributor to rainfall variability in this region**.

▪ **Impacts:**

- **Kharif Crops:**
 - One of the major impacts of changes in track of monsoon systems can be seen on kharif crops, particularly rice production. They form a significant share of more than

- 50% of total food grain production during this period.
- The fall in Kharif output **may keep rice prices at elevated levels.**
- Bihar, West Bengal and Uttar Pradesh, which account for a third of the country's total rice production, have been **highly deficit despite an active monsoon current in July and August.**
- **Quality of Grains:**
 - These uneven distribution rains may impact the quality of the grain as well **as the nutrition value may vary.**
 - According to a study, 'Climate change, the monsoon, and rice yield in India', very high temperatures (> 35°C) induce heat stress and affect plant physiological processes, leading to **spikelet sterility, non-viable pollen and reduced grain quality.**
- **Food security:**
 - Monsoon rainfall became **less frequent but more intense in India** during the latter half of the 20th century.
 - Scientists and food experts believe that a better rainfall scenario could have helped increase the harvest.
 - However, India's hundreds of millions of rice producers and consumers are being affected negatively with these unprecedented changes which are also raising concerns over **food security.**

Way Forward

- India needs **to invest more resources in better prediction of Monsoon forecast** in order to achieve reliability and sustainability.
- With a warming climate, more moisture will be held in the atmosphere, leading to heavier rainfall, consequently, inter-annual variability of the monsoon will increase in future. **The country needs to prepare for this change.**
- Thus, to secure and bring sustainability to the climate pattern of India we need to **take effective and timely steps not just at the domestic front** (National Action Plan on Climate Change) but **also at the international front** (UN Framework Convention on Climate Change), as we live in a shared world with a shared future.

UPSC Civil Services Examination Previous Year Question (PYQ)

Prelims

Q. With reference to 'Indian Ocean Dipole (IOD)' sometimes mentioned in the news while forecasting Indian monsoon, which of the following statements is/are correct? (2017)

1. IOD phenomenon is characterised by a difference in sea surface temperature between tropical Western Indian Ocean and tropical Eastern Pacific Ocean.
2. An IOD phenomenon can influence an El Nino's impact on the monsoon.

Select the correct answer using the code given below:

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

Ans: (b)

Exp:

- The Indian Ocean Dipole (IOD) is an atmosphere ocean coupled phenomenon in the tropical Indian Ocean (like the El Nino is in the tropical Pacific), characterised by a difference in Sea-Surface Temperatures (**SST**).
- A '**positive IOD**' is associated with **cooler than normal sea-surface temperatures** in the

eastern equatorial Indian Ocean and warmer than normal sea-surface temperatures in the western tropical Indian Ocean.

- The opposite phenomenon is called a **'negative IOD', and is characterised by warmer than normal SSTs in the eastern equatorial Indian Ocean and cooler than normal SSTs in the western tropical Indian Ocean.**
- Also known as the Indian Nino, it is an irregular oscillation of sea-surface temperatures in the Indian Ocean in which the western Indian Ocean becomes alternately warmer and colder than the eastern part of the Indian Ocean. **Hence, statement 1 is not correct.**
- The IOD is one aspect of the general cycle of global climate, interacting with similar phenomena like the El Nino-Southern Oscillation (ENSO) in the Pacific Ocean. An IOD can either aggravate or weaken the impact of El Nino on Indian monsoon. If there is a positive IOD, it can bring good rains to India despite of an El Nino year. **Hence, statement 2 is correct.**
- **Therefore, option (b) is the correct answer.**

Mains

Q1. 'Climate change' is a global problem. How India will be affected by climate change? How Himalayan and coastal states of India will be affected by climate change? **(2017)**

Q2. What characteristics can be assigned to monsoon climate that succeeds in feeding more than 50 percent of the world population residing in Monsoon Asia? **(2017)**

Q3. How far do you agree that the behaviour of the Indian monsoon has been changing due to humanizing landscape? Discuss. **(2015)**

Source: TH

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