

# RSTV

## INDIAN MONSOON



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### Context

- While **torrential rains** have caused floods in rivers at several places destroying infrastructure and extracting a heavy toll on life, the opposite is being witnessed, with large areas suffering drought and shortage of water.
- Several districts have had **extreme changes** in rainfall patterns over the last weeks of August 2022. As many as 163 districts in Tamil Nadu, pockets of South India and parts of the Indo-Gangetic plain in Uttarakhand, Bengal and Haryana went from witnessing **excess rainfall to deficient rainfall** in the week ending August 2022.
- During the same period, 167 districts in Gujarat, Madhya Pradesh, Chhattisgarh, Maharashtra and Odisha went from deficient to excess rainfall.
- Rainfall for the country as a whole for July 2022 was 327.7 mm, 17% more than the **long period average** making it the second highest since 2001 after 2005.

### About Indian Meteorological Department (IMD)

- India Meteorological Department was **established in 1875**. It is the National Meteorological Service of the country and the principal government agency in all matters relating to **meteorology and allied subjects**.

- To take meteorological observations and to provide current and **forecast meteorological information** for optimum operation of weather-sensitive activities like agriculture, irrigation, shipping, aviation, offshore oil explorations, etc.
- To **warn against** severe weather phenomena like tropical cyclones, norwesters, dust storms, heavy rains and snow, cold and heat waves, etc., which destroy life and property.
- To provide **meteorological statistics** required for agriculture, water resource management, industries, oil exploration and other nation-building activities.
- To conduct and promote **research in meteorology** and allied disciplines.

The pattern of the Indian season has changed over the years, specifically the 2022 monsoon season. Almost one-half of India i.e., 163 districts have witnessed deficient to excessive rainfall and the other half has gone from excessive to deficient rainfall.

### What are the Indian Metrological Department (IMD) statistics regarding monsoon 2022?

- As per the IMD, the 2022 southwest monsoon pattern was a typical monsoon pattern of a **good monsoon**. Considering the pattern of the monsoon, the IMD has categorised it as **normal to excess monsoon**.
- Over 29 **metrological subdivisions** out of 36 had normal to excess monsoon in 2022. It includes the subdivisions in Central India, Peninsular India and Northeast India. But at the same time several metrological subdivisions like Uttar Pradesh (UP), Bihar, West Bengal, Jharkhand, Nagaland, Manipur, Tripura and Kerala experienced deficient rainfall in 2022.
- In Kerala the deficiency of about 21% was not so serious but it was 40% in Western UP and about 47% in Eastern UP, 41% in Bihar, 27% in Jharkhand and 30% in West Bengal.
- The **Gangetic plain** from Western UP to West Bengal has experienced the most **deficient rainfall** and its impact on the region. In West Bengal late July received normal rainfall. Therefore, the intensity of deficient rainfall was maximum at UP followed by Bihar.
- On the other hand, **floods** have been experienced in the **Central part** of the country and the **coastal regions** starting from Odisha to Gujarat. This was mainly due to low-pressure systems or depressions developed over the Bay of Bengal and moved towards Odisha and Rajasthan.

IMD explained two significant things; first, is the number in terms of how the monsoon progressed over the period between June to August 2022 almost across the country. Second, is the changing pattern of monsoon i.e., the development of low-pressure zones.

### Is this change in the monsoon pattern unique to 2022 or is it a recurring phenomenon?

- Monsoon is a **large-scale circulation**; it shows large inter-annual variation and also the intra-seasonal variation within the season itself. It was 92% of the **long-period average** with 8% deficient in the month of June, 10% excess in the month of July and 17% excess in the month of August. That is part of the intra-seasonal variation.
- But if we consider the **data for the 100 years** – the total amount of rainfall for the country as a whole does not show a trend, but it shows the rising trend in different parts of the country.
  - For example, the total amount of rainfall in the monsoon season over the North-Eastern states and some parts of eastern India including UP and Bihar shows a decreasing span of rainfall. At the same time, the western part of India like Kutch and Rajasthan shows a rising trend in rainfall activity during the monsoon season.

- Within the season itself, though the total amount of rainfall remains almost the same there is a **changing pattern in the distribution of rainfall** within the season. The number of light and moderate days of rain is decreasing. At the same time, the number of heavy rainfall days is increasing which is causing the threat of floods.
- The year-to-year variability and the **variability of the season** itself have also increased and thus leading to frequent droughts and floods.

#### What could be the possible reasons for such variability in the season?

- As per the **Assessment of Climate Change over the Indian Region** report by the Ministry of Earth Science (MoES) and similarly the Intergovernmental Panel on Climate Change (IPCC) in its **6<sup>th</sup> Assessment Report** highlighted two major things:
  - First, with an increase in greenhouse gas (GHG) emissions, there is an increase in **global warming** or increase in atmospheric temperature. This led to high evaporation in the Arabian Sea and Bay of Bengal and hence, developed the low-pressure zones and other climate change-induced weather events.
  - Second, the occurrence of **extreme weather events** is unprecedented in the observed record and will increase with increasing global warming, according to the Sixth Assessment report from the Intergovernmental Panel on Climate Change (IPCC).
- This makes us discuss three points:
  - **Weakening of monsoon:** Due to the increase in global warming or atmospheric temperatures, the evaporation at sea level has changed. This has disturbed the air circulation.
  - **Too much or too little water:** As per the last 100 years' data, there was a 30-year decrease in rainfall, then a 30-year increase in rainfall and then again, a 30-year decrease in rainfall.
  - **Rainy days:** As per the 2022 monsoon, June was deficient in some regions, July witnessed heavy rainfall, then August again was deficient in the same region. This explains the pattern of the monsoon has not just changed but has also become unpredictable.
- In the last 100 years there was an increase in the intensity of rainfall and it will further increase in the next 100 years. But the rainy days will decrease.

#### The change in monsoon pattern i.e., deficient and excess rainfall is due to the global warming

- There are three main aspects of climate change:
  - **Science of climate change**
  - **Adaption towards climate change**
  - **Mitigation aspect of climate change**
- **IMD** is dealing with the 'science of climate change and also gave three aspects
  - Detection of climate change, whether the climate is real or not
  - If the climate change is really what is the attribution or reason for that
  - Projection, like what is going to happen in the next 50 years.
- The first and foremost **impact of climate change** is extreme weather events. Globally the intensity of rainfall in the tropical region has increased due to the impact of climate change.
- With an increase in temperature the **water holding capacity** in the atmosphere also increases and at the same time the atmosphere becomes more unstable and hence more frequent rainfall. This increase in the occurrence of low-pressure development.
- During the 2022 monsoon season, around 13 low-pressure zones developed in India including five **monsoon depressions**. A total of 57 days of the occurrence of low pressure is found in the monsoon season of 2022.

- As per the trends from 1901, it has been analysed that the frequency of monsoon depressions has decreased but the frequency of **low-pressure systems has increased**.
- There has also been an increase in **sea surface temperature** and this also pumps up the moisture into the atmosphere and hence also contributes to changing the pattern of air circulation. This also explains why there has been an increase in the formation of cyclones over the Arabian sea region.
- Weather events related to another season (winter and summer) have also recorded the change in pattern. The rising frequency and intensity of **heat waves** are also due to an increase in atmospheric temperature.
- However, every weather event is attributed to climate change, for example, the occurrence of frequency of rainfall can be attributed to climate change but not the total amount of rainfall.

### Recent extreme weather events recorded in many Asian and European countries explain that climate change is a global phenomenon

- Heavy snowfall in Madrid, Spain; Cyclone Ana, Fiji; Winter storms, Texas; Dust storm, China; Flooding, Australia; High temperature, Moscow; Heat dome, USA; Bootleg fire, USA; etc. were examples of extreme weather events all over the globe.
- However, climate change has a major impact on tropical countries. The **temperature of the earth** is rapidly increasing and that increase in temperature is infecting the monsoon circulation. In India, since 1951, the **monsoon circulation** has weakened especially in the regions like Western Ghats & Indo-Gangetic regions and simultaneously the incidents of localised heavy rainfall have increased.
- The increased temperatures also increased the duration of the **dry spells** between the rainy days during the monsoon. Hence, the climate was already changing naturally but with an increase in emission of GHGs, the warm earth has fastened this change.

### The way ahead

- The debatable thing here is; whether the effect on the Indian monsoon is local or global. The Indian monsoon is affected by the **global situation**. The coast of Latin American country, Peru has been affecting the Indian climate specifically monsoon in association with 'El Nino' or 'La Nina'.
- Since it's a global situation, it needs **global action**. In the Conference of Parties (CoP 26), India asked the developed nations to show their contribution as developing countries like India need to balance economic growth with the environment to eradicate poverty.

Since the middle of the 20<sup>th</sup> century, India has been witnessing a rise in average temperature; a decrease in monsoon precipitation; a rise in extreme temperature and rainfall events, droughts, and sea levels; and an increase in the intensity of severe cyclones, alongside other changes in the monsoon system. There is compelling scientific evidence that human activities have influenced these changes in regional climate.

Human-induced climate change is expected to continue apace during the twenty-first century. To improve the accuracy of future climate projections, particularly in the context of regional forecasts, it is essential to develop strategic approaches for improving the knowledge of Earth system processes and to continue enhancing observation systems and climate models.



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