



## Advancement of El Nino is a concern for Indian Agriculture in 2023-24

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<https://doi.org/10.5281/zenodo.8283220>

### Abstract

In March 2023, the World Meteorological Organization (WMO) warned of a likely global temperature spike due to the warming El Nino event. Few climate models also predicted that the approaching El Nino phase may lead to severe heat waves and droughts in several countries across South and Southeast Asia, including India. The El Nino is the above-average sea-surface temperatures that periodically develop across the east-central equatorial Pacific. El Nino has historically been the cause of a lot of droughts, floods and storms. It disrupts the usual supply of moisture and causes incessant rains and floods in some places and severe droughts in others. It last occurred in 2018-2019, and happens irregularly with intervals of about two to seven years. The India Meteorological Department (IMD) delivered its first long-range forecast on 11<sup>th</sup> April for this year's monsoon and stated that there would be about 60 % chance for the onset of El Nino during May-July, rising to 70-80 % during July-September period. The IMD will also be providing agro-meteorological advisory services and forecast for each of India's 700-odd districts based on different rainfall scenarios. India can overcome the impact inflicted by El Nino by implementing contingency plans at the district level and initiatives like introducing seeds of late sowing variety, water conservation and management, keeping a check on the monsoon while maintaining natural water bodies will help in transforming the agricultural industry and making it resilient enough to deal with challenges like El Nino. Additionally, promoting sustainable farming is essential as it focuses on environmentally-friendly techniques and can help in reducing El Nino's impact on the Indian agricultural landscape and crop yield. It is vital that the government and policymakers come up with protocols and initiatives that can protect India against its reliance on rainfall and minimize El Nino's impact.

**Key words:** El Nino, Events, Impact on Indian monsoon and agricultural production

### 1. Introduction

The agriculture sector continues to constitute a significant portion of the Indian economy with a 17.7% share in gross value added as of 2019–20 and 44% share in the total work force. During the last three decades, agricultural output has grown at a trend growth rate of 3% per year while population has grown at 1.6% (Chand, 2017). The agricultural production of India has been continuously rising and has reached almost 290 million tonnes in 2019; but India continues to have an under nourished population of approximately 14% (Von Grebmer *et al.*, 2020). Therefore, the absolute quantity of food



grains demand will continue to increase with rising population to achieve food and nutritional security, which is imperative for India to achieve the zero-hunger goal by 2030. On the other hand, Indian agriculture majorly depending on monsoon rains and these rains are shifting due to climate change and altering the agricultural production systems. The immense influence of climatic stressors, particularly the spatial and temporal rainfall variability, continues to keep the seasonal and annual yield from Indian agriculture uncertain. For instance, loss of farm revenue due to extreme temperatures and rainfall shocks is estimated to be ~12% for monsoon (*kharif*) and ~6% for winter (*rabi*) crops with more impacts on unirrigated systems. Similarly, extreme temperatures caused a farm revenue loss of 4% during *kharif* and 5% during *rabi* (The Economic Survey, 2018). Negative anomalies of monsoon seasonal precipitation and number of rainy days during 1966-2010 are highly correlated with negative anomalies of *kharif* and *rabi* food grain yield (Prasanna, 2014). The situation will be worst due the likelihood occurrence of El Nino in the Pacific Ocean for the year 2023-24. In March 2023, the World Meteorological Organisation (WMO) warned of a likely global temperature spike due to the warming El Nino event. Now, climate models also seem to be in sync, as they predicted that the approaching El Nino phase may lead to severe heat waves and droughts in several countries across South and Southeast Asia, including India. In this paper, we enlightened the formation of El Nino and impact on distribution of rainfall in India.

## 2. El Nino

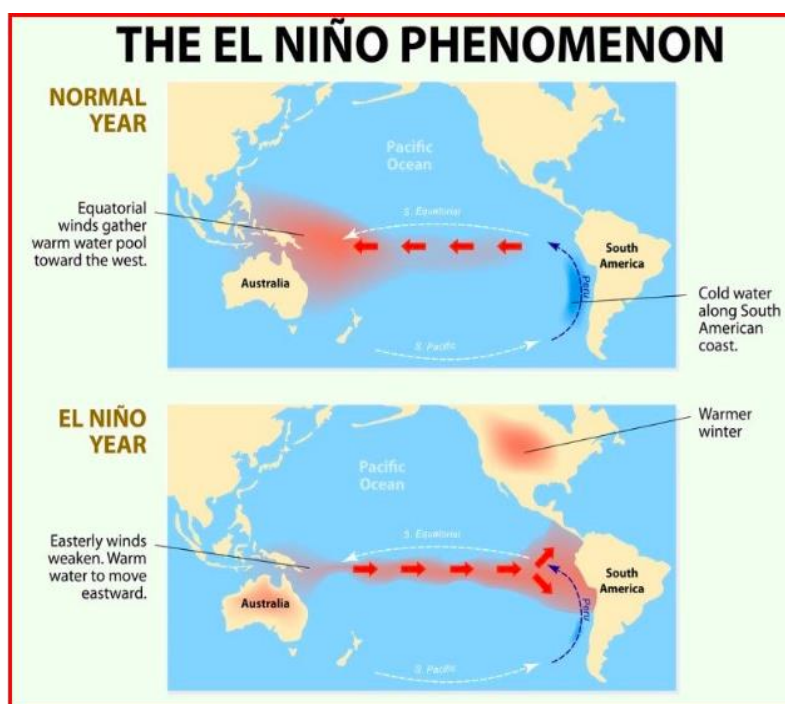
El Nino means (Spanish for 'the Christ Child') to a warming of the ocean surface. South American fishermen first noticed periods of unusually warm water in the Pacific Ocean in the 1600s. According to the National Oceanic and Atmospheric Administration (NOAA) **El Nino** refers to the above-average sea-surface temperatures that periodically develop across the east-central equatorial Pacific. It represents the warm phase of the El Nino Southern Oscillation (ENSO) cycle. El Nino has historically been the cause of a lot of droughts, floods and storms. It last occurred in 2018-2019, and happens irregularly with intervals of about two to seven years.

### 2.1 Events occurred during El Nino

One of the events of El Nino is that it causes the trade winds to weaken. The trade winds blow from east to west along the equatorial region and it brings a lot of the rains in inland areas. As the warm waters move eastward, across the entire Pacific due to weakened trade winds and gravity, it affects rainfall patterns in the west. Countries like South East Asian countries like India, Ethiopia, Guatemala, Somalia, Indonesia etc have been the worst hit by droughts, floods, storms and fires during these extreme weather changes. However, the monsoon is not solely dependent on the trade winds. The



extreme summer heat causes the air over the landmass to rise, causing a vacuum and allowing moisture-laden air from over the sea to rush in. When this air tries to climb the Himalayan barrier, the cooler temperatures precipitate heavy rain clouds that bring succor to the parched land beneath. Further the other event is Indian Ocean Dipole or IOD. When the sea surface temperature in the eastern Indian Ocean is lower than normal, while the sea surface temperature in the western Indian Ocean is higher than normal, it is said to be a negative IOD. A positive IOD is when the exact opposite happens. While a negative IOD brings an abundance of rain to Australia and Indonesia, a positive IOD means a good monsoon in India. The resultant El Nino phenomenon disrupts the usual supply of moisture and causes incessant rains and floods in some places and severe droughts in others.



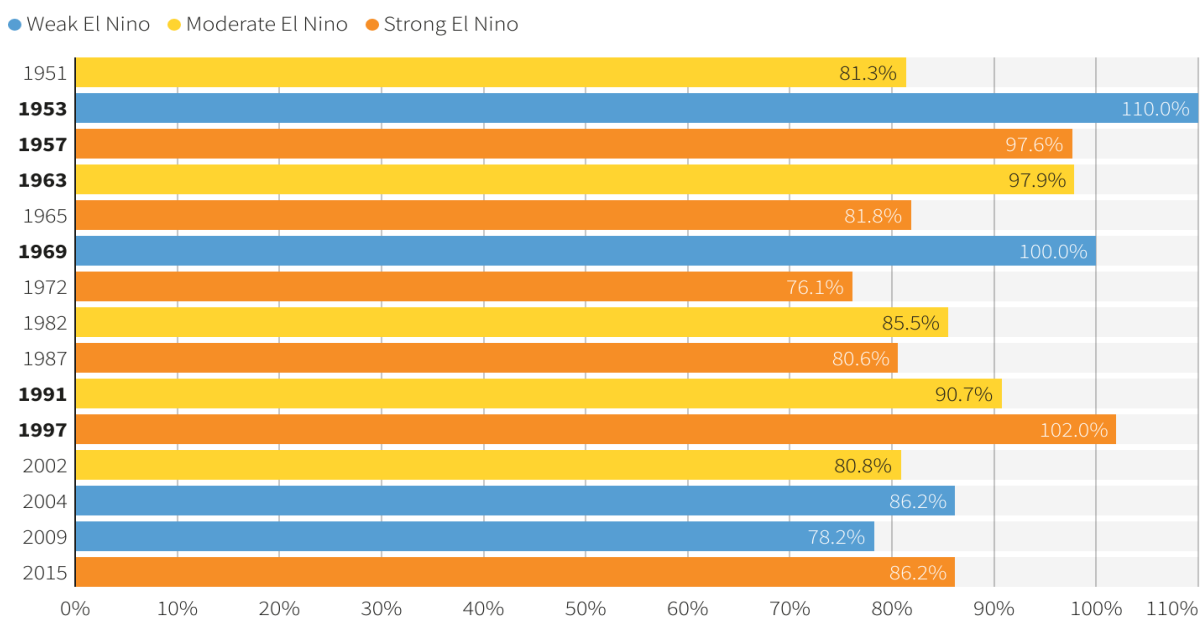
## 2.2 Correlation between El Nino and monsoon rain

The correlation between El Nino and Indian monsoon rainfall is significant, despite occasional instances when India gets normal or above-normal rain during El Nino years. Over the past seven decades, the El Nino weather pattern occurred 15 times, with India experiencing normal or above-normal rainfall in six instances. However, a contrasting trend has emerged in the last four El Nino years, with India consistently facing drought conditions and rainfall falling below 90% of the long period average.



## Correlation between El Nino and Indian monsoon rains

Rainfall departure between June to September.



Source: Indian Meteorological Department

### 3. History of El Nino in Indian Condition

Some examples of the devastating impact of the El Nino in the Indian subcontinent are the droughts of 1877 and 2015. In 1877, the country saw miserable monsoons and failing rains. With droughts and deaths from starvation getting hold of the country from all sides, over 5 million Indians died in that famine. In 2015, coupled with agricultural loss, around 2,500 people died due to heat strokes. According to reports, between 2001 and 2020, India saw seven El Nino years. Of these, four resulted in droughts (2003, 2005, 2009-10, 2015-16). These years also saw *kharif* or summer-sown farm output decline by 16%, 8%, 10% and 3%, stoking inflation. *Kharif* harvests account for nearly half of the country's annual food supply and nearly half of all the droughts that occur in India tend to be associated with an El Nino.

The El Nino of 2006 too did not have a major impact on the monsoon because of a positive IOD. The relationship between El Nino, IOD and the Indian summer monsoon, however, is quite complex. The strong El Nino of 2015 led to a delayed, and eventually, insufficient monsoon and droughts on the east coast though preceded by floods in Gujarat and Assam. A strong positive means a one-degree difference in temperature between the western and eastern parts of the ocean. This year, the difference is 0.1 degree according to the most recent data available.



#### 4. El Nino impact on Indian monsoon and agricultural production

The India Meteorological Department (IMD) delivered its first long-range forecast on April 11 for this year's monsoon and stated that there would be about 60 % chance for the onset of El Nino during May-July, rising to 70-80 pc during July- September period. This year, El Nino is predicted to hit after a triple dip La Nina event. A triple dip La Nina, which is the opposite of an El Nino as it is characterized by cooler currents, is a rare rather unpredictable weather pattern where warmer waters get pushed towards Australia and Asia. Though, IMD has predicted that the effects of the El Nino will only be noticeable in the second half of the year and forecasted lower-than-normal rains which will affect the agricultural sector. The rising atmospheric temperatures have also been a cause of concern with looming fears of heat strokes. Which in turn resulted to droughts and lower crop yields, it can affect incomes, trigger inflation and drive migration. It will also impact fish production, possibly leading to loss of livelihoods. On the other hand, there are some indications that El Nino can suppress tropical cyclone formation in the Bay of Bengal.

Indian agrarian economy depends heavily on monsoon for good yield. El Nino events are detrimental to crops and even lead to yield damage further leading to rising food prices. This year, it is expected that El Nino may impact the weather conditions in the country and, in turn, affect the agriculture sector. Unusual rains in March this year have already disrupted agricultural activities in India. Hence, India will likely receive below-normal monsoon rains and unpredictable rainfall, with the El Nino phenomenon taking over the global scenario. This year, with El Nino's occurrence, if rainfall is impacted, then crops like rice sugar, cereals, pulses, etc., may be affected and this can lead to a shortage of essential food items, further causing inflation. The states of Punjab, Haryana, Rajasthan and Uttar Pradesh will witness below-normal levels of rainfall during the second half of the monsoon season. The IMD will also be providing agro-meteorological advisory services and forecast for each of India's 700-odd districts based on different rainfall scenarios, Krishi Vigyan Kendras, a network of federally-run farm centers.

#### 5. Present Condition

The World Meteorological Organization stated that there is a 60 per cent chance for a transition from ENSO-neutral to El Nino during May-July 2023, and this will increase to about 70 per cent in June-August and 80 per cent between July and September. The development of an El Nino will most likely lead to a new spike in global heating and increase the chance of breaking temperature records.

#### 6. Conclusion

The India Meteorological Department (IMD) has predicted a normal monsoon this year, or at least 96 per cent of the nationwide average rainfall of 87cm. In fact, El Nino events are usually linked



with weaker monsoon performances over the Indian subcontinent. This could possibly weaken the southwest monsoon season, which brings around 70% of the total rainfall India receives and on which most farmers still depend. India can overcome the impact inflicted by El Nino by implementing contingency plans at the district level. Initiatives introducing seeds of late sowing variety, water conservation and management, and keeping a check on the monsoon while maintaining natural water bodies will help in transforming the agricultural industry and making it resilient enough to deal with challenges like El Nino. Additionally, promoting sustainable farming is essential as it focuses on environmentally-friendly techniques and can help in reducing El Nino's impact on the Indian agricultural landscape and crop yield. It is vital that the government and policymakers come up with protocols and initiatives that can protect India against its reliance on rainfall and minimize El Nino's impact.

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