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LA NINA IN 2025: INDIAN PERSPECTIVE

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ABSTRACT

This study aims to make a prediction of La Nina event in the year 2025, on the basis of climatological data and effects of previous La Nina events occurred in the past years from 1973-2022. La-Nina is designated as cooler sea surface temperature as compared to the average in the central and eastern Pacific Ocean and has a global impact on the monsoon of many countries including India. The result shows that there is high chances that India will face La-Nina in 2025.This study also shows some evidences in the support of the prediction. Effects of the predicted La-Nina event in 2025 may lead to above average rainfall in the eastern India and below average rainfall in the western India. My research paper is based on historical data and current trend and result should be considered as probabilistic forecast but not a definite prediction. Further research is required for confirmation of this prediction.

1. INTRODUCTION

1.1 *El Nino* -Also known as male Christ child is an oscillation in the southern Pacific Ocean due to weakening of the trade winds because of cold upwelling.

1.2 *La Nina*- Also known as female Christ child is an oscillation in southern Pacific Ocean due to increase in intensity of the trade winds. It causes surface temperature low than average in Central and eastern equatorial pacific ocean.

1.3 Effects of la Nina-

1. It may cause flood in India if La-Nina is stronger.
2. May increase rainfall in Indonesia and Australia.
3. May decrease rainfall in Peru and Chile.
4. Can cause drought in California.

1.4 IOD- It is similar type of condition of ENSO appeared in Indian Ocean called Indian Ocean dipole explained in 1999.

1.5 There are two types of IOD –

- Positive IOD- It can cause flooding or good rainfall in India.
- Negative IOD-It can cause severe drought or decrease rainfall in India.

When there is a positive IOD, it is good for India but extreme conditions are there in Australia. Similarly, when there is a negative IOD, it is good for Australia but cause extreme conditions in India.

1.6 There are 4 possible conditions in India context-

•Whenever there is a combination of El Nino in the Pacific Ocean and positive IOD, India gets average rainfall.

•Whenever there is a combination of El Nino in Pacific Ocean and negative IOD, India have severe drought condition.

•Whenever there is La Nina in Pacific Ocean and positive IOD, India goes through severe floods.

•Whenever there is combination of La Nina and negative IOD, India gets average rainfall.

2. OBJECTIVE

The main objective of this research is to provide a probabilistic forecast of La Nina event in 2025 for India.

The question rises that "Will India faces La Nina in 2025?"

3. METHODOLOGY

This research is descriptive and analytical study of la Nina and its impact on Indian climate. It is an attempt to predict the La Nina in India in the year 2025.

The study is primarily based on the authentic and credible secondary data sources and no primary data is collected for this study. These secondary sources include:

• The reports and publications of the Indian Meteorological Department (IMD),

• The journals and papers related to the climate

• The press release and other official reports of climate monitoring organizations such as Indian Meteorological Department and National Centers for Environmental Prediction (NCEP).

This study aims at identifying the recurring patterns and their similar effects on the climate of India. For this purpose, six major la Nina events of past 100 years have been selected to analyze and to find out similarities in their impacts on Indian climate.

Regardless of the systematic approach, there are certain limitations of this research, such as

• All data is collected from IMD reports and government official website and no primary data has been included in this study.

• This is only a predictive study which may also be wrong in future as no strong evidences are found.

Thus, it is needed to elucidate the findings of this paper very cautiously and consider them as a probabilistic evaluation rather than a definite forecast.

4. CONDITIONS FOR LA-NINA

4.1 *TRADE WINDS*- Trade winds are also called the "Tropical Easterlies". These are the compatible winds that blow from east to west in the equatorial region of the Earth. They become stronger than normal during La-Nina event and push warm surface water towards the west across the Pacific Ocean which proves to be responsible for cold upwelling.

4.2 *ATMOSPHERIC PRESSURE*- Atmospheric Pressure is also called "Air Pressure" or "Barometric Pressure". It is the force which is exerted by the weight of air above a surface. In La -Nina climate pattern, atmospheric pressure is lower than normal over the Western Pacific Ocean and higher than normal over the Eastern Pacific Ocean. This leads to strengthen the trade winds.

4.3 *SEA SURFACE TEMPRATURE*- It simply refers to the temperature of the uppermost layer of the ocean. During La Nina event, sea surface temperature becomes cooler than normal in Eastern and Central Pacific Ocean because the trade winds push warm water towards West. As a result, it brings Cold water from the deeper ocean layers to the surface making a rise in surface water. This process is known as upwelling.

5. CASE STUDY OF PAST LA-NINA EVENTS

5.1 The La Nina event has historically displayed a great impact on the climate conditions of countries at global level.

Primarily, the event of 1973-76 was identified by strong trade winds and a low sea surface temperature in the Central and Eastern Pacific Ocean which increased rainfall in some regions and drought in others, with a notable increase in agricultural productivity, especially the Kharif crops.

5.2 The event of 1988-89 had put forward variant and contradictory effects which involve flood in Bangladesh and drought in Midwest United States. India had experienced plentiful rainfall which was significantly above-normal.

5.3 The event of 1998-2000 caused a universal floods in many countries like South Asia, North India and Bangladesh, whereas some parts of South America including Peru and Ecuador had witnessed significant drought.

5.4 The event of 2007-2008 brought flood in some states of India such as Bihar and Assam, which ultimately boosted the overall agricultural productivity of India.

5.5 The event of 2010-12 also resulted into flood in Indo-Gangetic Plains and caused a delay in Rabi crop sowing season.

5.6 And the most recent Triple-dip La Nina event of 2020-22 brought an above average monsoonal rainfall and intensified Cyclone Tauktae which struck Gujarat on May 17, 2021.

6. EVIDENCE OF LA-NINA - CURRENT CLIMATIC CONDITIONS OF INDIA (FACTS)

According to the reports of IMD (Indian Meteorological Department), there are evidences which shows that the central and Southern regions of India faced above-average monsoonal rainfall in the year 2024, while on the other hand the Northern region was cooler than the usual temperature.

The statistical data of IMD showed that India as a whole, have witnessed an above-average monsoonal rainfall of 7.6% in the year 2024 with an above normal rainfall in the areas such a North-West India, Central India and Peninsula region.

While some of the states i.e. Rajasthan, Gujarat, Western region of Uttar Pradesh, Maharashtra, Telengana and Andhra Pradesh witnessed an increased rainfall, regions like East and North-East India which includes states like Punjab, Bihar and West Bengal went through a below normal rainfall according to the reports of IMD.

Cooler than normal temperature is a key factor which shows the effects of La-Nina in India. In a press released report by IMD, it was claimed that regions like Himachal Pradesh, Uttarakhand, Jammu & Kashmir, Haryana, Punjab, Western region of Uttar Pradesh have witnessed a lower than usual temperature in the year 2024 which clearly strengthens the above argument.

After evaluating all the facts and evidences, we can say that the effects of la Nina were seen in India since December 2024 and thus there are high chances that this event may put some effects on Indian monsoon till the month of March 2025.

7. EFFECTS OF LA NINA IN INDIA

The arrival of La Nina in India in 2025 will bring significant effects on the climate conditions and shall greatly impact the agriculture and economy of the nation.

Chill winters, high monsoonal rainfall may lead to increase crop yields especially the Rabi crops that are the winter crops. Although La Nina in the year 2024-25 is comparatively weaker than the past La Nina events so it will not bring too much impact on the other countries but would it will surely be beneficial for India.

Additionally, Good rainfall shall boost the hydropower and water availability and thus it will lead to enhance the productivity of some areas. This is the main dominating factor which can directly and positively affect the agriculture and economy of the country. Thus, La Nina shall increase the yielding of crop by providing good amount of rainfall and thus it will very positively affect the economy of the nation as a whole.

However, it may lead to increase the flood risk and can disrupt harvesting in certain areas which can cause disruption in some areas causing economic loss. But, it will surely increase the yielding of crop by providing good amount of rainfall and thus it will very positively affect the economy of the nation as a whole.

8. CONCLUSION

This research provides a chance-based prediction of La Nina event in 2025, on the basis of all the historical statistics and the latest reports of the meteorological department. The analysis suggests that there is high chance of La Nina in India in 2025 which may bring significant changes in the monsoonal conditions of India. It shall

also affect the pattern of rainfall in various regions such as increased rainfall in the Eastern regions and decreased rainfall in Western regions.

The findings present both the positive and negative effects of La Nina. The positive impacts includes enhancing the crop yields, boosting the hydropower and benefiting the economy through enhancement of agricultural productivity and the negative impact involves increasing the risk of flood, disruption of harvesting in some areas and disruption of infrastructure.

Although the study strongly presents the evidences of occurrence of La Nina in 2025, it acknowledges the probabilistic approach because climate forecasting is a very complex task which majorly depends upon the multiple influencing factors such as IOD, atmospheric pressure variations and the global climatic monitoring. Thus further research and continuous monitoring is needed to refine the forecast. In this uncertain situation, some proactive and productive planning is essential to meet the challenges of the hour, if the prediction proves to be right.

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