Available online at
http://agrospheresmagazine.vitalbiotech.org/

ISSN (E): 2582 – 7022

Agrospheres:e- Newsletter, (2026) 7(7), 04-10

Agrospheres™ e-Newsletter

Article ID: 1007

El Niño and the Monsoon: A Concern for Indian Agriculture

Chanchal Bhargava[1], Yogendra Singh[2]

[1]Senior Technical Assistant, JNKVV, KVK, Chhindwara
[2]Assistant Professor, Department of Genetics & Plant Breeding, JNKVV, Jabalpur)

*Corresponding Author
Chanchal Bhargava*

Article History
Received: 24.06.2026
Revised: 29.06.2026
Accepted: 04.07.2026

INTRODUCTION

El Niño is a natural climatic phenomenon in which the sea surface temperatures in the central and eastern Pacific Ocean become warmer than normal. This phenomenon influences weather patterns across the globe. In India, its most significant impact is observed on the southwest monsoon.

The Indian Summer Monsoon Rainfall (ISMR) is a complex atmospheric phenomenon that usually occurs from June to September and forms a vital component of the global monsoon system. It is characterized by strong south-westerly winds blowing over the northern Indian Ocean (NIO) and the South Asian subcontinent. ISMR contributes approximately 75% of India's annual rainfall, making it crucial for the agricultural sector, as nearly half of the country's cultivated land depends on monsoon precipitation. Any delay, deficiency, or irregularity in monsoon rainfall can significantly reduce agricultural productivity and threaten food security.

Monsoon rainfall also has a profound influence on agriculture, water resource management, and the overall socioeconomic conditions of the region. Although the interannual variability of ISMR is relatively low, with a standard deviation of about 10% of the mean, even small variations can have substantial economic consequences. This is because agriculture remains a key sector of the Indian economy, contributing approximately 19.9% to the country's Gross Domestic Product (GDP). Therefore, understanding and accurately predicting ISMR is essential for sustainable agricultural planning, water resource management, and economic stability.

ISSN (E): 2582 – 7022

Relationship Between El Niño and Indian Summer Monsoon Rainfall

Historically, many El Niño events have been associated with adverse impacts on the Indian Summer Monsoon Rainfall (ISMR). In general, the southwest (SW) monsoon over India tends to be weaker than normal during El Niño years. During the period 1951–2025, 17 El Niño events were recorded, of which 8 were associated with deficient ISMR (rainfall below normal by 10% or more). This indicates a significant inverse relationship between El Niño and ISMR, although the relationship is not one-to-one. Several of the remaining El Niño years also experienced below-average rainfall, even if they did not fall into the deficient category (Figure 1).

The influence of El Niño on monsoon rainfall is neither spatially nor temporally uniform. Its adverse effects are generally more pronounced during the latter half of the monsoon season, particularly in September, resulting in more frequent and severe water stress during the terminal growth stages of crops (Table 1). Spatially, the western half of the country—including northwest India, western India, and the Peninsular region—is more severely affected than the eastern parts. A composite analysis of monsoon rainfall during El Niño years reveals a distinct east–west gradient in rainfall deficiency across India.

Furthermore, the impact of El Niño varies across the four monsoon months. During June, rainfall deficiency is generally greater over northern and central India. In July, deficient rainfall extends to the South Peninsula, in addition to northwest, western, and northern India. During August, the deficiency becomes more pronounced over western India and the South Peninsula. By September, rainfall deficiency expands further, affecting the entire northwest, western, and central regions of the country. These temporal and spatial variations highlight the complex influence of El Niño on the Indian monsoon and its implications for agricultural productivity and water resource management.

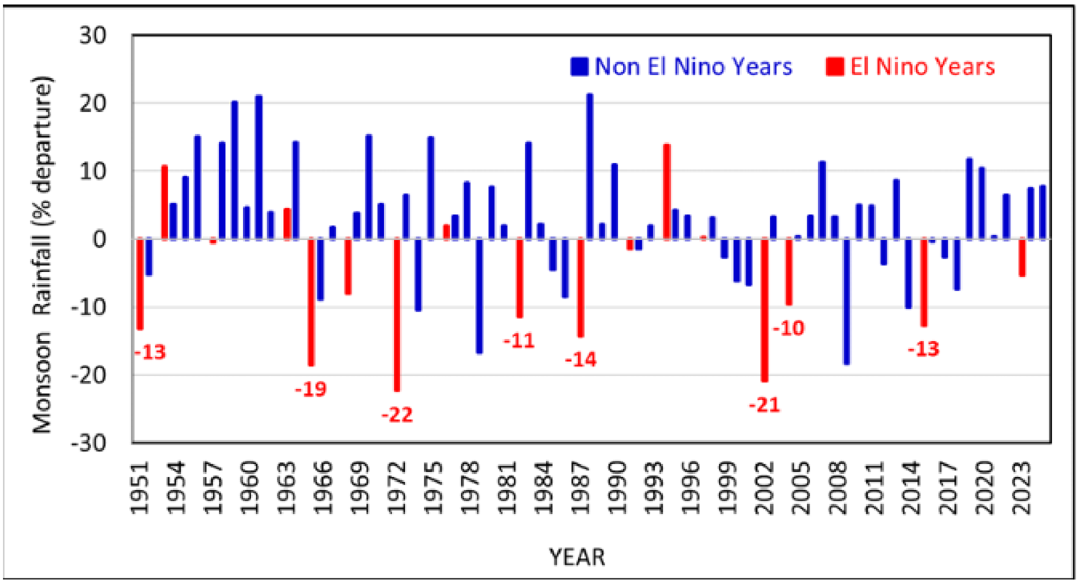


Figure 1: All India Southwest Monsoon Rainfall during El Niño and El Niño years
(Values of Rainfall anomly for deficient years -10% or lower have been given)

In the era of climate change, El Niño has emerged as an important natural phenomenon affecting global weather systems. For an agriculture-dependent country like India, its effects are particularly significant. El Niño develops due to the abnormal warming of the

ISSN (E): 2582 – 7022

surface waters of the Pacific Ocean, which alters atmospheric circulation and consequently affects the behavior of the Indian monsoon.

Table 1: South-west monsoon Rainfall Anomilities, % departure from LPA during El Niño years

Southwest monsoon Rainfall (parentage departure from LPA) during El Niño years						El Nino strength
YEAR	JUN	JUL	AUG	SEP	JJAS	
1951	-3.1	-11	-13.2	-26.6	-13.2	Weak El Nino
1953	-1.8	14.5	17.6	6.2	10.7	Weak El Nino
1957	-6.6	9	7.1	-21.6	-0.5	Moderate El Nino
1963	1	-8.4	24.6	-1.5	4.4	Weak El Nino
1965	-30.1	-4	-24.6	-22.5	-18.6	Moderate El Nino
1968	-10.5	10	-16	-23.3	-8	Weak El Nino
1972	-26.2	-27.2	-13.8	-23.2	-22.3	Moderate El Nino
1976	-4.8	4	15.1	-14.9	1.9	Weak El Nino
1982	-17.4	-17.8	8.3	-24.9	-11.4	Moderate El Nino
1987	-21.1	-21.5	-4.6	-10.3	-14.3	Moderate El Nino
1991	11.1	-1.2	2	-19.1	-1.4	Weak El Nino
1994	22.9	25.1	12.2	-11.3	13.9	Weak El Nino
1997	3.8	1.5	3.2	-10.2	0.2	Strong El Nino
2002	2.3	-50.6	-4.4	-19	-20.9	Weak El Nino
2004	0.6	-13.4	-0.8	-26.6	-9.6	Weak El Nino
2015	14	-14.4	-21.6	-22.6	-12.7	Moderate El Nino
2023	-7.5	12.8	-36.1	13.1	-5.3	Weak El Nino

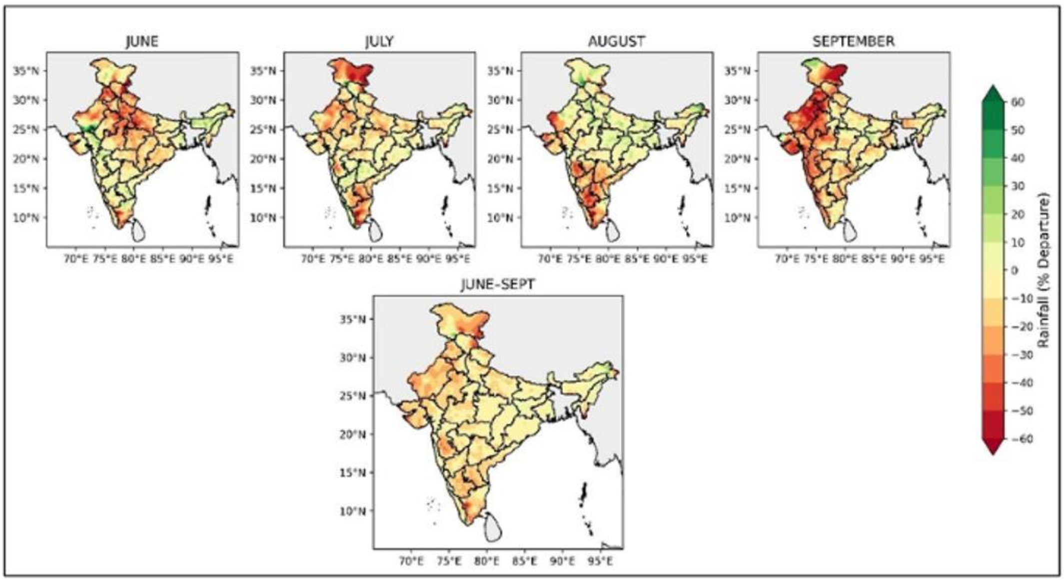


Figure 2: Composite rainfall of monsoon months and the season as a whole during El Niño years

ISSN (E): 2582 – 7022

Current El Niño Conditions and Outlook for the Monsoon 2026

The latest updates from the India Meteorological Department (IMD) and the World Meteorological Organization (WMO) indicate that El Niño conditions are currently present over the equatorial Pacific Ocean and are expected to strengthen further during the 2026 Southwest Monsoon season. The atmosphere has responded to the warming sea surface temperatures (SSTs), and the coupled ocean–atmosphere system now exhibits characteristics consistent with an established El Niño event. Forecasts from India's Monsoon Mission Coupled Forecast System (MMCFS) also project a continued intensification of El Niño conditions throughout the monsoon season.

During May 2026, sea surface temperatures were generally above normal across the central and eastern equatorial Pacific Ocean. Positive SST anomalies persisted over the far eastern Pacific, the Maritime Continent, and parts of the western Pacific. In addition, above-normal SSTs were observed across the tropical and extratropical regions of both the North and South Pacific Oceans (Figure 4a, b).

Seasonal forecasts of three-month averaged SST anomalies indicate that positive SST anomalies are likely to persist over the central equatorial Pacific during June–August (JJA) 2026. Thereafter, from July–September (JAS) 2026 onward, these positive anomalies are expected to intensify and expand eastward across the central and eastern equatorial Pacific Ocean. All ensemble members of the MMCFS consistently predict the persistence of El Niño conditions throughout the 2026 Southwest Monsoon season (Figure 5). Furthermore, probabilistic forecasts indicate a 100% likelihood of moderate to strong El Niño conditions during the southwest monsoon season (Figure 6).

The anticipated strengthening of El Niño during the 2026 monsoon season raises concerns regarding its potential influence on the spatial and temporal distribution of monsoon rainfall over India. Considering the historical inverse relationship between El Niño and Indian Summer Monsoon Rainfall (ISMR), continuous monitoring and improved seasonal forecasting will be essential for agricultural planning, water resource management, and disaster preparedness.

Table 2: State-wise priority districts likely to be impacted by El Niño

State	< 25% irrigation (High Priority)	25-50% irrigation (Medium Priority)	>50% irrigation (Low Priority)	Total number of districts
Andhra Pradesh	1	2	-	3
Arunachal Pradesh	4		-	4
Assam	8	2	2	12
Bihar	-	4	8	12
Chhattisgarh	10	2	-	12
Goa	-	2	-	2
Gujarat	1	6	16	23
Haryana	-	-	5	5
Himachal Pradesh	5	4	1	10
Jammu & Kashmir	4	1	-	5
Jharkhand	2	7	3	12
Karnataka	3	10	8	21
Kerala	7	2		9
Madhya Pradesh	4	3	34	41
Maharashtra	22	-	-	22
Manipur	5	-	-	5
Meghalaya	1	6	4	11
Mizoram	1	-	-	1
Nagaland	6	4	1	11
Orissa	6	2	-	8
Puducherry	1	-	2	3
Punjab	-	-	3	3
Rajasthan	2	7	17	26
Sikkim	1	-	-	1
Tamil Nadu	1	10	12	23
Tripura	1	1	-	2
Uttar Pradesh	-	1	8	9
Uttaranchal	9	-	4	13
West Bengal	6	-	-	6
Total no. of districts	**111**	**76**	**128**	**315**

ISSN (E): 2582 – 7022

Nearly half of India's agriculture depends on rainfall. Therefore, El Niño has become a major concern for farmers. Rainfed crops such as rice, maize, pulses, and oilseeds are among the most severely affected.

El Niño often weakens the southwest monsoon over India, resulting in below-normal rainfall and drought-like conditions. Consequently, the sowing of kharif crops such as soybean, cotton, rice, and maize is delayed, while crop production may decline by 15–50% depending on the severity of the event. Shortages of fodder also adversely affect livestock.

The reduction in monsoon rainfall primarily impacts rainfed farming. Crops such as soybean, cotton, pigeon pea (arhar), and rice experience delayed sowing and significant yield losses. Water levels in reservoirs decline during drought-like conditions, creating shortages for irrigation.

Insufficient water and fodder negatively affect livestock health, leading to reduced milk and meat production. Furthermore, hot and dry weather conditions encourage the spread of insect pests and crop diseases, reducing both the quality and quantity of agricultural produce.

Crop failures result in substantial economic losses for farmers. Small and marginal farmers are especially vulnerable because they often lack adequate financial and technological resources to cope with such climatic challenges.

To address these problems, a scientific and integrated approach to agriculture is essential. Farmers should adopt drought-tolerant crop varieties and promote water conservation technologies such as drip irrigation and sprinkler irrigation. Timely weather-based agricultural advisories should also be made available to farmers.

In addition, expanding farmer training programs, encouraging crop diversification, selecting crops that require less water, and adopting modern agricultural technologies are crucial measures. By modifying farming practices according to changing climatic conditions, the adverse impacts of El Niño can be significantly reduced.

Through the combined efforts of the government, agricultural scientists, and farmers, Indian agriculture can become more resilient, climate-smart, and sustainable.

Operational Framework for Managing El Niño-Induced Agricultural Risks

The operational framework for managing El Niño-induced agricultural risks follows a continuous cycle of Monitor → Analyze → Plan → Advise → Disseminate → Feedback → Refine, ensuring a dynamic, science-based, and farmer-centric response system across diverse agro-ecological regions. This integrated framework combines weather forecasting, crop monitoring, contingency planning, and advisory dissemination to minimize the adverse impacts of climate variability on agriculture.

The process begins with the India Meteorological Department (IMD), which serves as the primary source of weather and climate intelligence. IMD provides short-, medium-, and extended-range weather forecasts, seasonal rainfall outlooks, and early warnings of extreme weather events. During El Niño years, these forecasts become particularly important for identifying potential rainfall deficits, temperature anomalies, heat waves, and prolonged dry spells well in advance. Such timely information forms the basis for preparedness planning and enables proactive interventions by research institutions, extension agencies, and policymakers.

Complementing weather forecasts, the Mahalanobis National Crop Forecast Centre (MNCFC) provides satellite-based monitoring of crop and natural resource conditions. Using remote sensing techniques, MNCFC continuously assesses vegetation indices such as the Normalized Difference Vegetation Index (NDVI), soil moisture status, crop health, and drought progression. These real-time spatial assessments facilitate the identification of vulnerable districts and agro-ecological regions, thereby supporting the prioritization of

ISSN (E): 2582 – 7022

resources and implementation of targeted interventions for drought mitigation and crop protection.

The weather and resource information generated by IMD and MNCFC is subsequently integrated by the ICAR–Central Research Institute for Dryland Agriculture (CRIDA), which plays a pivotal role in agricultural contingency planning. CRIDA develops district-specific contingency plans tailored to various rainfall and drought scenarios. These plans recommend suitable alternative crops and varieties, revised sowing schedules, in-situ moisture conservation practices, supplemental irrigation strategies, fodder management, and other adaptive measures. By providing scientifically validated contingency options, CRIDA enhances the resilience of farming communities against delayed monsoon onset, prolonged dry spells, and seasonal rainfall deficits commonly associated with El Niño events.

Simultaneously, the All India Coordinated Research Project on Agrometeorology (AICRPAM) contributes crop–weather intelligence by developing crop-weather calendars and stage-specific crop management advisories. These advisories identify critical crop growth stages that are particularly vulnerable to moisture and temperature stress and recommend appropriate agronomic practices, including irrigation scheduling, nutrient management, pest and disease surveillance, and other adaptive interventions. Such recommendations enable farmers to make informed management decisions throughout the cropping season and reduce potential yield losses under adverse climatic conditions.

Together, the coordinated efforts of IMD, MNCFC, CRIDA, and AICRPAM establish a comprehensive decision-support framework for climate-resilient agriculture. Through continuous monitoring, scientific analysis, contingency planning, and timely dissemination of location-specific advisories, the framework strengthens preparedness and adaptive capacity, thereby enhancing agricultural resilience to El Niño-induced climate variability and supporting sustainable crop production.

Regional Implementation and Dissemination of Agrometeorological Advisories

The implementation of national agrometeorological advisories at the regional level is facilitated by the Agricultural Technology Application Research Institutes (ATARIs). ATARIs adapt and contextualize national advisories to suit regional agro-climatic conditions, cropping systems, and farming practices. They provide technical guidance to Krishi Vigyan Kendras (KVKs), monitor field-level implementation, organize capacity-building programmes, and strengthen coordination between research institutions and extension agencies. Their role is crucial in translating broad national recommendations into region-specific action plans that address local agricultural challenges.

At the state level, State Agricultural Universities (SAUs) provide scientific and technical support to the advisory system. Through research, validation, and refinement of climate-resilient technologies, SAUs assist KVKs in developing location-specific recommendations tailored to prevailing agro-climatic conditions. Their expertise ensures that advisories remain scientifically robust, technically sound, and responsive to emerging field challenges. In addition, SAUs contribute to technology assessment, frontline demonstrations, and dissemination of climate-smart agricultural practices aimed at enhancing resilience under climatic stress.

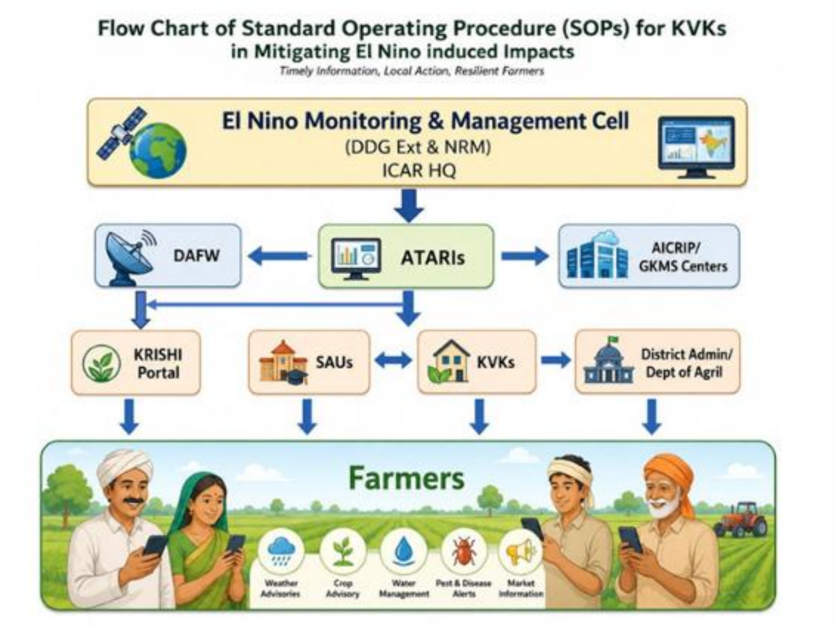
The Gramin Krishi Mausam Sewa (GKMS) Centres and All India Coordinated Research Project on Agrometeorology (AICRPAM) Centres generate location-specific agrometeorological advisories by integrating weather forecasts with information on crops, livestock, fisheries, and natural resource management. These advisories provide operational guidance on key farm management

ISSN (E): 2582 – 7022

decisions, including sowing time, irrigation scheduling, nutrient management, pest and disease control, livestock management, and weather-based risk mitigation. Timely dissemination of these advisories enables farmers to optimize resource use, improve input efficiency, and minimize production losses resulting from adverse weather events.

At the district level, the District Administration and the Department of Agriculture play a pivotal role in coordinating implementation and ensuring the last-mile delivery of advisories. Through convergence of government schemes, mobilization of extension personnel, facilitation of timely input supply, organization of farmer awareness programmes, and implementation of contingency measures, these institutions translate scientific advisories into practical field-level interventions. Their coordinated efforts ensure that adaptation strategies, relief measures, and resilience-building initiatives reach vulnerable farming communities in a timely and effective manner.

Collectively, the coordinated contributions of ATARIs, SAUs, GKMS Centers, AICRPAM Centers, District Administrations, and the Department of Agriculture establish a robust multi-tiered extension framework. This integrated system facilitates the effective dissemination of weather-based advisories and climate-resilient technologies, thereby strengthening farmers' adaptive capacity and enhancing agricultural resilience to El Niño-induced climate variability.



CONCLUSION

El Niño poses a significant challenge to the Indian monsoon and agriculture. However, its adverse effects can be minimized through scientific farming practices, efficient water conservation, weather-based crop management, and the effective implementation of government schemes. Collaborative efforts among farmers, scientists, and policymakers can help build a more sustainable, climate-resilient, and productive agricultural system for India.

Source: - The information is compiled from technical bulletin from ICAR & DARE, New Delhi entitled “Managing El Nino Risks in Indian Agriculture: Impacts and Standard Operating Procedure, dated 22 June 2026.