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Impact of El Nino in Tamil Nadu Agriculture – An overview

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Agriculture is highly dependent on weather and climate, with crop production relying on timely rainfall, favourable temperatures, and adequate water availability. Different climate phenomena affecting agriculture among them El Niño is one of the most influential. India is particularly vulnerable because nearly half of its cultivated area depends on monsoon rainfall. El Niño years are often associated with weak southwest monsoons, delayed sowing, moisture stress, reduced reservoir storage, and lower crop productivity. Tamil Nadu is especially sensitive because it depends on both the Southwest Monsoon for reservoir inflows and the Northeast Monsoon for much of its annual rainfall. Variability in these monsoon systems affects water availability and the production of major crops such as paddy, pulses, groundnut, maize, cotton, sugarcane, millets, coconut, and horticultural crops.

Fortunately, El Niño can be predicted several months in advance, allowing farmers to adopt timely measures such as appropriate crop planning, efficient water management, and climate-resilient farming practices. This article explains the science of El Niño, its global and regional impacts, and practical strategies to help farmers in Tamil Nadu prepare for and adapt to El Niño conditions.

The El Niño Phenomenon

The term El Niño, meaning *"The Little Boy"* or *"Christ Child"* in Spanish, was originally used by fishermen along the coasts of Peru and Ecuador to describe the appearance of unusually warm ocean waters during the Christmas season. Originating in the equatorial Pacific Ocean, it alters atmospheric circulation and influences rainfall and temperature patterns across the globe. As a result, El Niño causes droughts in some regions and floods in others, affecting agriculture, water resources, fisheries, ecosystems, and food security. During the strong 2015–16 El Niño event, nearly 60 million people worldwide experienced food insecurity.

Today, El Niño refers to the warm phase of the El Niño–Southern Oscillation (ENSO), a naturally occurring climate phenomenon caused by interactions between the tropical Pacific Ocean and the atmosphere. ENSO is one of the major drivers of year-to-year climate variability worldwide.

During an El Niño event, the trade winds become weak or may even reverse direction. As a result, the warm water moves back towards the central and eastern Pacific Ocean. This reduces the rise of cold, nutrient-rich water and causes sea surface temperatures to become much warmer than normal. The warmer ocean changes weather patterns around the world, leading to unusual rainfall, droughts, floods, and changes in temperature in many regions. El Niño events occur irregularly every 2–7 years, usually last 9th – 12th months and typically peak between November and January. Their intensity is classified according to sea surface temperature anomalies in the Niño 3.4 region of the equatorial Pacific Ocean.

El Niño Category	Sea Surface Temperature Anomaly (Niño 3.4 Region)
Weak	0.5–1.0°C
Moderate	1.0–1.5°C
Strong	>1.5°C

The intensity of an El Niño event largely determines the severity of its impacts. Strong El Niño episodes are often associated with droughts, floods, forest fires, coral bleaching, agricultural losses, disruptions to fisheries, and threats to food security. Major events, including **1982–83**, **1997–98**, and **2015–16**, caused significant environmental, social, and economic impacts across many regions of the world.

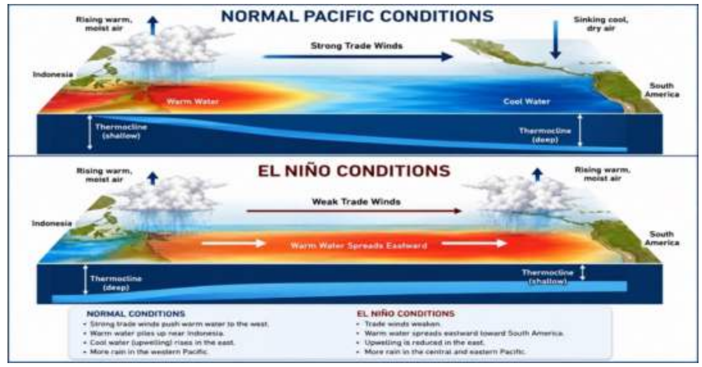

Figure 1. Normal Pacific Conditions versus El Niño Conditions.

El Niño vs Indian Agriculture

India is highly vulnerable to El Niño because nearly half of its net sown area depends on monsoon rainfall, and the Southwest Monsoon provides 70–80% of the country's annual precipitation. El Niño often weakens the monsoon, leading to below-normal rainfall, prolonged dry spells, and higher temperatures. Between 1951 and 2025, India experienced 17 El Niño events, with eight causing seasonal rainfall deficits exceeding 10%. The 2023 El Niño further highlighted these impacts through delayed monsoon onset, erratic rainfall, and heat waves that disrupted crop establishment (IMD, 2024).

Rainfed farming systems are particularly vulnerable, as reduced rainfall lowers soil moisture, limits irrigation water, and decreases crop yields, while livestock suffers from heat stress, fodder shortages, and water scarcity (IPCC, 2022). To address these risks, ICAR has developed district-level contingency plans and identified 111 high-priority agricultural districts for climate-resilient interventions, including drought-tolerant crop varieties, efficient water management, crop diversification, and timely weather advisories, making seasonal climate forecasting a key tool for agricultural risk management (ICAR, 2025).

Table 1. Major El Niño Years and Their Agricultural Impacts in India

El Niño Year	Monsoon Condition	Major Agricultural Impact
1982–83	Weak monsoon	Drought and reduced food grain production
1987	Severe drought	Significant decline in kharif production
1991–92	91% of LPA	About 7% reduction in kharif food grain production
2002	Rainfall deficit	Delayed sowing and yield loss
2009	Weak monsoon	Water shortages and crop failure in several regions
2015–16	Strong El Niño (86% of LPA)	Widespread drought and nearly 5% decline in agricultural production
2023	Erratic rainfall and heat waves	Delayed sowing, production uncertainty, and moisture stress

El Niño vs Tamil Nadu Agriculture

The impacts of El Niño vary across India depending on rainfall patterns, irrigation infrastructure, and cropping systems. In Tamil Nadu, agriculture is particularly sensitive because the state receives nearly half of its annual rainfall from the Northeast Monsoon while also relying on Southwest Monsoon inflows to replenish reservoirs and irrigation systems. Strong El Niño events are associated with greater rainfall variability, delayed monsoon onset, prolonged dry spells, and higher temperatures, affecting water availability and crop production (IMD, 2024; TNAU, 2023).

Reduced reservoir inflows, lower groundwater recharge, and limited irrigation during El Niño years increase water stress, especially for farmers dependent on tanks and wells. The Cauvery Delta is particularly vulnerable, where delayed water release from the Mettur Dam disrupts paddy cultivation. Other crops, including groundnut, pulses, maize, cotton, sugarcane, millets, coconut, and horticultural crops, also experience moisture stress and yield reductions. Higher temperatures further intensify evapotranspiration and livestock heat stress, making El Niño a major climate risk for agriculture and rural livelihoods in Tamil Nadu (ICAR, 2025; IMD, 2024).

District-wise Vulnerability to El Niño in Tamil Nadu

Based on the ICAR District-wise Contingency Plan (2026), Tamil Nadu districts are classified into three vulnerability categories according to their exposure to El Niño-related climatic risks.

Vulnerability Category	Districts
High	The Nilgiris

Medium	Perambalur, Dharmapuri, Ramanathapuram, Ariyalur, Virudhunagar, Krishnagiri, Vellore, Namakkal, Tiruchirappalli
Low	Madurai, Karur, Salem, Theni, Cuddalore, Sivaganga, Villupuram, Coimbatore, Tiruvannamalai, Pudukkottai, Tiruvallur, Kanchipuram

Although The Nilgiris is classified as the only highly vulnerable district, several districts in central and western Tamil Nadu fall under the medium vulnerability category and require advance contingency planning during El Niño years. Furthermore, districts categorized as lower vulnerability category may also experience localized impacts depending on rainfall distribution, reservoir storage, and irrigation availability.

Impacts of El Niño on Major Crops and Adaptive Measures

According to the ICAR District-wise Contingency Plan (2026), the severity of El Niño impacts varies among crops depending on their water requirements, growth stages, and management practices. The plan recommends adopting crop-specific contingency measures to substantially reduce production losses and enhance crop resilience.

Crop	Major Impact	Recommended Adaptation Measures
Paddy	Delayed nursery raising and transplanting, poor tillering, reduced grain filling, lower yield	Raise community nurseries, adopt Direct Seeded Rice (DSR), use short-duration varieties, practice Alternate Wetting and Drying (AWD), System of Rice Intensification (SRI), and provide life-saving irrigation.
Groundnut	Poor germination, reduced peg formation and pod yield	Use drought-tolerant short-duration varieties, treat seeds, adopt ridge-and-furrow planting, apply mulching, foliar spray of 1% KCl with micronutrients, and provide protective irrigation.
Maize	Delayed sowing, poor cob development and grain filling	Adopt short-duration hybrids, maintain optimum plant population, perform earthing-up, apply mulching, and spray 2% KCl during moisture stress.
Pulses	Poor flowering, flower drop and reduced pod formation	Use early-maturing varieties, apply 2% DAP or 1% urea as foliar spray, provide protective irrigation, apply mulching, and intercrop pigeon pea with millets.
Cotton	Flower shedding, reduced boll formation and higher sucking pest incidence	Grow drought-tolerant hybrids, maintain recommended spacing, apply mulching, spray 2% KCl, and provide protective irrigation during dry spells.

Sugarcane	Reduced cane growth, lower juice content and yield	Adopt drip irrigation, practice trash mulching, and maintain wider row spacing.
Millets	Comparatively drought tolerant, but yield declines under prolonged moisture stress	Promote pearl millet as a contingency crop, cultivate drought-tolerant finger millet and sorghum varieties, and diversify cropping systems.
Coconut	Reduced nut setting, button shedding and lower productivity	Adopt basin mulching, micro-irrigation, moisture conservation practices, and timely nutrient management.

Climate-Resilient Farmers Strategies

Although El Niño cannot be prevented, its adverse impacts can be minimized through timely planning and climate-resilient farming practices. Since seasonal climate forecasts are available several months in advance, farmers can make informed decisions on crop selection, sowing time, irrigation, and nutrient management. The ICAR District Agriculture Contingency Plans recommend rainwater harvesting, soil moisture conservation, drought-tolerant and short-duration crop varieties, integrated nutrient management, and efficient irrigation to improve resilience during dry years.

Adaptive Measures before the El Niño Season

- Monitor seasonal weather forecasts issued by the India Meteorological Department (IMD).
- Select drought-tolerant and short-duration crop varieties.
- Harden and treat seeds before sowing.
- Prepare community nurseries for paddy.
- Construct farm ponds and harvest rainwater.
- Store quality seeds and essential farm inputs.
- Diversify cropping systems to reduce production risks.

Adaptive Measures during El Niño

- Adjust sowing dates according to rainfall.
- Adopt ridge-and-furrow planting and practice mulching to conserve soil moisture.
- Shift to contingency crops such as millets, pulses, sesame, or fodder crops if rainfall is delayed.
- Use drip or sprinkler irrigation to improve water-use efficiency.
- Follow Alternate Wetting and Drying (AWD) and the System of Rice Intensification (SRI) in paddy.
- Apply foliar nutrient sprays (KCl, DAP, or urea) during prolonged dry spells.
- Provide life-saving irrigation during critical crop growth stages.
- Monitor pests and diseases regularly and adopt timely control measures.

Long-Term Adaptation

- Expand micro-irrigation systems.
- Improve soil organic matter and water-holding capacity.
- Promote drought-resilient crop varieties.
- Strengthen district-level contingency planning.
- Diversify farming through livestock, agroforestry, and integrated farming systems.
- Utilize weather-based agro-advisory services for informed decision-making.

Pre-El Nino Preparedness; Ten Essentials Strategies for farmers

S. No.	Action	Why It Matters
1	Monitor weather forecasts	Follow seasonal and district-level weather advisories to make timely crop management decisions.
2	Choose drought-tolerant and short-duration varieties	These varieties perform better under delayed monsoon and moisture stress conditions.
3	Plan sowing based on rainfall	Avoid early sowing; synchronize planting with the onset of effective monsoon rains to ensure better crop establishment.
4	Conserve water	Repair farm ponds, harvest rainwater, and adopt drip or sprinkler irrigation to improve water-use efficiency.
5	Improve soil moisture conservation	Practice mulching, ridge-and-furrow planting, and incorporate organic matter to reduce evaporation and retain soil moisture.
6	Diversify crops	Crop diversification and intercropping reduce the risk of complete crop failure during drought years.
7	Monitor crop health regularly	Early detection of moisture stress, pests, diseases, and nutrient deficiencies enables timely corrective action.
8	Adopt balanced nutrient management	Apply fertilizers based on soil test recommendations and use foliar nutrient sprays during drought stress.
9	Prepare for livestock management	Ensure adequate drinking water, conserve fodder, and plan for livestock care during prolonged dry spells.
10	Seek technical guidance	Stay connected with KVKs, ICAR institutes, Agricultural Universities, FPOs, and the Department of Agriculture for timely advisories and contingency measures.

Conclusion

El Niño is a recurring climate phenomenon that significantly influences agriculture by altering rainfall patterns, increasing temperatures, and reducing water availability. Although its impacts cannot be avoided, timely weather forecasts, climate-resilient crop varieties, efficient water management, crop diversification, and district-level contingency planning can substantially reduce production risks.

Building resilient agriculture requires close collaboration among farmers, researchers, extension agencies, and policymakers. By acting on early weather information and adopting appropriate adaptation measures, farmers can safeguard their livelihoods, improve resilience, and ensure sustainable agricultural production under future El Niño conditions.

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