



2026 Southwest Monsoon Ends with 12.6% Rainfall Deficit, Highlighting Regional Water and Agricultural Risks

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Recent Developments:

- According to the **India Meteorological Department**, the 2026 southwest monsoon ended with **759.4 mm rainfall**, compared with the long-period normal of **868.6 mm**, representing a **12.6% deficit**.
- The 2026 monsoon was the **lowest-rainfall southwest monsoon since 2015** and among the weakest monsoon seasons of the 21st century.
- The **East and Northeast India region received 1,017.1 mm rainfall**, its lowest southwest-monsoon rainfall since the IMD rainfall series began in **1901**.
- The deficient monsoon has implications for **agriculture, soil moisture, reservoirs, groundwater recharge, hydropower, rural incomes and food security**, although the impact varies substantially across regions because monsoon rainfall is spatially and temporally uneven.
- IMD had anticipated below-normal rainfall during 2026. Its April forecast estimated seasonal rainfall at **92% of the Long Period Average**, with a model error of $\pm 5\%$; its May update retained a below-normal outlook.

Indian Monsoon: Basic Concept:

Meaning and Mechanism:

- The **Indian monsoon** is a seasonal reversal of atmospheric circulation associated with differential heating of land and ocean and the resulting changes in pressure distribution.
- During summer, intense heating of the Indian subcontinent creates a broad **low-pressure region**, while comparatively cooler oceanic areas maintain relatively higher pressure, helping draw moisture-laden winds toward the land.
- The southwest monsoon is therefore not simply a rainfall event but a large-scale **ocean-atmosphere-land circulation system** influenced by thermal conditions, pressure gradients, jet streams, ocean temperatures and intra-seasonal oscillations.

Onset and Withdrawal:

- The southwest monsoon normally advances over Kerala around the beginning of June and progressively covers most of India during June and July.
- Its principal rainy season extends from **June to September**, although the timing and intensity of rainfall vary across regions.
- The withdrawal generally begins from **northwestern India in September** and progresses southward during September and October.
- The **northeast monsoon**, also called the retreating or winter monsoon, becomes important mainly from October to December and supplies significant rainfall to **Tamil Nadu, Puducherry, coastal Andhra Pradesh and adjoining southern regions**.

Why the 2026 Monsoon Matters:

Regional Rainfall Anomaly:

- The national seasonal deficit masks strong **regional contrasts**, which are more important for agricultural and water-resource planning than the all-India average alone.
- The exceptionally low rainfall over East and Northeast India is significant because the region normally receives substantial monsoon precipitation and supports major river systems, rainfed agriculture and ecologically sensitive landscapes.
- A deficient monsoon can reduce soil-moisture availability and groundwater recharge while increasing dependence on irrigation and stored water.

Monsoon Variability:

- Monsoon rainfall is characterised by **active and break phases**, during which rainfall intensity changes significantly over different parts of the country.
- The distribution of rainfall across weeks and regions can be more consequential than the seasonal aggregate because prolonged dry spells during crop-sensitive stages can damage agricultural productivity even when seasonal rainfall appears adequate.
- IMD therefore assesses rainfall at daily, weekly and seasonal scales against the **Long Period Average**, rather than relying only on the national seasonal total.

Major Factors Affecting the Indian Monsoon:

El Niño–Southern Oscillation:

- **El Niño** refers to periodic abnormal warming of sea-surface temperatures in the central and eastern equatorial Pacific Ocean and is a major global climate phenomenon affecting atmospheric circulation.
- During El Niño, weakened trade winds and redistribution of warm Pacific waters modify tropical atmospheric circulation and can adversely influence the Indian summer monsoon.
- IMD reported **El Niño conditions over the equatorial Pacific during 2026** and indicated that they were expected to strengthen during the southwest monsoon season.
- El Niño can also influence global temperature patterns and the probability of extreme weather events, although its effects are not identical in every year because other oceanic and atmospheric factors interact with it.

Indian Ocean Dipole:

- The **Indian Ocean Dipole** is an irregular oscillation of sea-surface temperature gradients between the western and eastern tropical Indian Ocean.
- It has **positive, negative and neutral phases**.
- A positive Indian Ocean Dipole generally involves relatively warmer waters in the western Indian Ocean and cooler conditions near the eastern Indian Ocean, potentially supporting the Indian monsoon by altering atmospheric circulation.
- A negative phase can have the opposite influence, while a neutral phase indicates the absence of a strong east-west temperature gradient.
- IMD considered **neutral Indian Ocean Dipole conditions** during the 2026 southwest monsoon.

Madden-Julian Oscillation:

- The **Madden-Julian Oscillation** is an eastward-moving tropical disturbance involving coupled variations in **convection, clouds, winds and atmospheric pressure** near the equatorial belt.

- It generally propagates eastward at approximately **4–8 metres per second** and completes a global circuit in roughly **30–60 days**, although its timescale can extend to about 90 days.
- The oscillation alternates between phases of enhanced and suppressed convection, influencing rainfall over the Indian Ocean and the Indian subcontinent.
- During favourable phases, enhanced convection can support stronger monsoon activity, while suppressed phases can contribute to reduced rainfall over affected regions.
- IMD monitored the Madden-Julian Oscillation during 2026 because its phase and amplitude can influence short-term monsoon variability.

Western Disturbances:

- **Western Disturbances** are extra-tropical weather systems that generally originate in the Mediterranean and adjoining West Asian region and move eastward with the mid-latitude westerlies.
- They are particularly important for **winter precipitation over northwestern India**, including rainfall and snowfall in the western Himalayas.
- Their interaction with monsoon systems can occasionally influence rainfall distribution, temperature and severe-weather conditions over northern India.

Somali Jet:

- The **Somali Jet** is a strong cross-equatorial low-level wind system that develops over the western Indian Ocean during the southwest monsoon season.
- It transports large quantities of **moisture from the Arabian Sea toward the Indian subcontinent** and is an important component of the monsoon circulation.
- A stronger low-level jet can enhance moisture transport and contribute to stronger rainfall over parts of western and peninsular India.
- Its interaction with the **Western Ghats, Arabian Sea and monsoon trough** influences regional rainfall patterns.

Monsoon and Indian Agriculture:

Rainfed Agriculture:

- Agriculture remains highly sensitive to monsoon variability because a substantial share of India's cultivated area depends on rainfall rather than assured irrigation.
- According to the Government, **rainfed agriculture accounts for nearly 60% of India's net sown area** and contributes approximately **40% of total food production**, making rainfall management important for food security.
- The timing of rainfall affects **sowing, germination, crop establishment, nutrient availability and crop growth**, while excessive rainfall can cause flooding, waterlogging and crop damage.

Kharif and Rabi Linkages:

- Adequate southwest monsoon rainfall directly supports **Kharif crops** such as rice, pulses, maize, cotton, soybean and groundnut.
- Monsoon rainfall also replenishes **reservoirs, groundwater and soil moisture**, thereby influencing irrigation availability for the subsequent Rabi season.
- A deficient monsoon can therefore create agricultural effects beyond the June–September season.

Current Agricultural Implications:

- Government Kharif data during 2026 showed that crop-wise sowing responses varied across commodities, demonstrating that rainfall effects depend on crop requirements, irrigation availability, regional conditions

and market incentives.

- The economic effect of a deficient monsoon therefore cannot be inferred from rainfall alone; **crop diversification, irrigation coverage, reservoir storage, soil moisture and regional rainfall distribution** must also be considered.

Monsoon and the Indian Economy:

Agriculture–Economy Linkage:

- A favourable monsoon can improve agricultural output, farm incomes and rural demand, while rainfall deficits can affect crop production, input demand and rural purchasing power.
- Agricultural performance influences the wider economy through **food prices, rural consumption, employment, input industries and demand for agricultural commodities**.
- The monsoon therefore operates as an important transmission channel between climatic conditions and macroeconomic outcomes.

Inflation and Food Security:

- Rainfall deficits can reduce production of rainfall-sensitive crops and create upward pressure on **food inflation**, particularly when supply is already constrained.
- Conversely, excessive rainfall can also raise food prices by damaging crops, disrupting transport and reducing market arrivals.
- Government responses can include buffer-stock management, irrigation support, crop diversification, agricultural advisories and targeted contingency measures.

Water and Energy Security:

- Monsoon rainfall determines the replenishment of **reservoirs, groundwater and river systems**, making it central to drinking-water and irrigation planning.
- Hydropower generation also depends on water availability in reservoirs and river basins.
- A deficient monsoon can therefore create simultaneous pressure on **agriculture, drinking water and energy systems**, particularly in water-stressed regions.

Climate Change and Monsoon Variability:

Changing Rainfall Characteristics:

- Climate change does not simply imply that India will receive uniformly less monsoon rainfall; it can alter the **intensity, timing, spatial distribution and frequency of extreme rainfall and dry spells**.
- A warming atmosphere can hold more moisture, potentially increasing the intensity of heavy rainfall events, while changes in circulation can alter the distribution of rainfall across regions.
- This makes adaptation increasingly dependent on managing **rainfall variability and extremes**, rather than focusing only on seasonal rainfall totals.

Forecasting Challenges:

- Indian monsoon prediction remains difficult because several interacting processes operate across **land, ocean and atmosphere** at different spatial and temporal scales.
- IMD has identified challenges associated with representing monsoon low-pressure systems, intra-seasonal variability, ocean-atmosphere interactions and climate-change-related changes in models.
- Forecasting capability is being strengthened through **high-resolution satellite observations, numerical weather prediction, data assimilation, coupled climate models, multi-model ensembles, high-performance computing, artificial intelligence and machine learning** under initiatives including Mission Mausam.

Policy Measures for Monsoon Resilience:

Water Management:

- **Watershed development, rainwater harvesting, groundwater recharge and efficient irrigation** can reduce dependence on uncertain rainfall.
- Micro-irrigation technologies such as drip and sprinkler systems can improve water-use efficiency, particularly in water-stressed agricultural regions.
- Reservoir operations should increasingly incorporate seasonal forecasts and real-time rainfall information.

Climate-Resilient Agriculture:

- Farmers can reduce rainfall risk through **drought-tolerant and short-duration crop varieties, crop diversification, contingency planning and improved soil-moisture management**.
- Climate-resilient varieties and integrated farming systems can improve resilience against rainfall variability.
- The Government has expanded climate-resilient agriculture measures and reported the release of **2,996 climate-resilient crop varieties between 2014 and 2025** under the National Agricultural Research System.

Weather Information Services:

- Timely **weather forecasts, agrometeorological advisories and early-warning systems** can help farmers modify sowing, irrigation, fertiliser application and harvesting decisions.
- Improved district-level and block-level forecasts can make climate information more actionable than broad seasonal predictions alone.
- Satellite observations, radar networks, automatic weather stations and numerical models should be integrated into increasingly localised early-warning systems.

Significance for UPSC:

GS-I: Geography:

- The Indian monsoon demonstrates the interaction of **pressure systems, differential heating, jet streams, ocean-atmosphere circulation and relief features**.
- Important concepts include the **monsoon trough, Inter-Tropical Convergence Zone, Somali Jet, Western Disturbances, El Niño, Indian Ocean Dipole and Madden-Julian Oscillation**.

GS-III: Agriculture and Economy:

- Monsoon variability affects **Kharif production, irrigation, food prices, rural incomes, groundwater recharge, reservoir levels and hydropower generation**.
- Rainfed agriculture makes monsoon resilience a major component of India's food and livelihood security.

GS-III: Environment and Disaster Management:

- Extreme rainfall, droughts, floods and prolonged dry spells require **climate adaptation, disaster-risk reduction and ecosystem-based water management**.
- Integrated forecasting and early-warning systems can reduce the human and economic costs of weather extremes.

Way Forward:

Building Monsoon Resilience:

Kamaraj IAS Academy

Plot A P.127, AF block, 6 th street, 11th Main Rd, Shanthi Colony, Anna Nagar, Chennai, Tamil Nadu 600040

Phone: **044 4353 9988 / 98403 94477 / Whatsapp : 09710729833**

- India should shift from rainfall-deficit response to **anticipatory climate-risk management** based on seasonal forecasts, sub-seasonal prediction and local weather intelligence.
- Agricultural planning should combine rainfall forecasts with information on **soil moisture, reservoir storage, groundwater levels and crop water requirements**.
- Water management should prioritise basin-level planning, aquifer recharge, efficient irrigation and protection of wetlands and watersheds.
- Climate-resilient agriculture should combine **crop diversification, resilient seeds, insurance, irrigation efficiency and timely weather advisories**.
- Forecasting systems should continue integrating **satellite data, high-performance computing, numerical models and artificial intelligence** to improve forecast accuracy and lead time.

Value Addition for UPSC:

- **2026 southwest monsoon rainfall:** 759.4 mm.
- **Long-period normal:** 868.6 mm.
- **Seasonal deficit:** 12.6%.
- **Lowest national monsoon rainfall since:** 2015.
- **East and Northeast rainfall:** 1,017.1 mm.
- **East and Northeast record:** Lowest southwest-monsoon rainfall since 1901.
- **Southwest monsoon season:** June–September.
- **Northeast monsoon:** October–December, particularly important for Tamil Nadu and adjoining southern regions.
- **Major teleconnections:** El Niño–Southern Oscillation, Indian Ocean Dipole and Madden-Julian Oscillation.
- **Important circulation feature:** Somali Jet.
- **Major extra-tropical system:** Western Disturbance.
- **Rainfed agriculture:** Nearly 60% of India's net sown area and approximately 40% of total food production.
- **UPSC GS-I linkage:** Indian climatology, monsoon mechanism, atmospheric circulation and ocean-atmosphere interactions.
- **UPSC GS-III linkage:** Agriculture, food security, water resources, inflation, climate change, disaster management and economic growth.