UPSC Geography revision · Mechanism, onset, withdrawal, El Niño and the IOD

Monsoon in India



Goals

By the end of this session you can

- Explain the roles of the ITCZ and jet streams
- Trace the onset from Kerala to the whole country
- Describe the Arabian Sea and Bay of Bengal branches
- Explain breaks, withdrawal and October heat
- Link El Niño and the IOD to Indian rainfall

Why the monsoon matters

- Most of India gets 70–90% of annual rain in June–September
- Winds reverse: southwest in summer, northeast in winter
- Average annual rain: about 116 cm (IMD, 1971–2020)
- Onset timing shapes sowing and water planning

The benchmark IMD uses

87 cm

Long Period Average of June–September rain, 1971–2020

- IMD states forecasts as a percentage of this LPA
- 2026 season: 87% of LPA (April forecast 92% ±5%)

The older idea: differential heating

- April–May: the sun is overhead near the Tropic of Cancer
- Land heats fast; low pressure forms over northwest India
- The Indian Ocean heats slowly, so pressure stays higher
- Winds are drawn from sea to land, but this is incomplete

The ITCZ and the monsoon trough

- ITCZ: low-pressure belt where trade winds converge
- In July it lies near 20°N–25°N over the Gangetic plain
- Southeast trades cross the equator between 40°E and 60°E
- Coriolis force turns them into southwest winds
- In winter the ITCZ moves south and winds reverse

Jet streams and the onset

Westerly jet

- Lies south of the Himalayas before the monsoon
- Withdraws from the north Indian plain
- Linked to the northward shift of the ITCZ

Easterly jet

- Sets in along about 15°N
- Arrives only after the westerly jet withdraws
- Held responsible for the monsoon burst

Onset and the 'burst'

- Normal onset over Kerala: around 1 June
- Burst: sudden heavy rain with thunder and lightning
- Day temperatures fall 5–8 °C from mid-June to mid-July
- The monsoon approaches in two branches

Worked example

The monsoon's march north

- Thiruvananthapuram and Kochi: around 1 June
- Mumbai: around 11 June
- Delhi: around 27 June
- The whole country: around 8 July

Two branches of the southwest monsoon

Arabian Sea branch

- Western Ghats: 250–400 cm on the windward side
- Rain-shadow area east of the Ghats
- Other arms reach central India and Gujarat

Bay of Bengal branch

- Arakan Hills deflect it into West Bengal
- One arm moves west along the Ganga plains
- Another reaches the northeast and Mawsynram

Why Tamil Nadu stays dry in summer

- Its coast runs parallel to the Bay of Bengal branch
- It lies in the rain shadow of the Arabian Sea branch
- Its main rain comes in October and November
- Cyclonic depressions bring heavy rain to the east coast

Break in the monsoon

- A dry spell of one or more weeks within the season
- North India: few rain-bearing storms along the trough
- West coast: winds blow parallel to the coast
- Long breaks stress kharif crops

Withdrawal and the retreating monsoon

Withdrawal

- Starts from northwest India around 17 September
- Monsoon trough moves south with the sun
- Leaves most of India by about 15 October

Retreating season

- Clear skies and rising temperature
- Moist land plus heat gives 'October heat'
- Rainiest months for the eastern Peninsula

El Niño and the Southern Oscillation

- El Niño: warm water off Peru in the eastern Pacific
- Recurs roughly every three to seven years
- Indian monsoon rain is often suppressed in El Niño years
- Southern Oscillation: pressure difference, Tahiti versus Darwin
- Often, not always: other factors can offset it

Indian Ocean Dipole (IOD)

- IOD index: west minus east Indian Ocean sea-surface temperature anomaly
- Positive IOD: the western side is warmer
- A positive IOD tends to favour Indian monsoon rain
- IMD tracks Pacific and Indian Ocean temperatures

Quick check

Which of these usually favours a stronger Indian summer monsoon?

A. An El Niño in the eastern Pacific

B. A positive Indian Ocean Dipole

C. Westerly jet staying south of the Himalayas

D. Winds blowing parallel to the west coast

Summary

Revision takeaways

1. ITCZ shift and jet streams drive the southwest monsoon
2. Kerala around 1 June; whole country by about 8 July
3. Two branches: Arabian Sea and Bay of Bengal
4. Withdrawal starts around 17 September from the northwest
5. El Niño often weakens it; a positive IOD tends to help