

LESSON SLIDES

Monsoon in India

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

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
- India's average annual rainfall is about 125 cm
- 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
- April 2026 forecast: 92% of LPA, model error $\pm 5\%$

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

 Example

The monsoon's march north

- 1 Thiruvananthapuram and Kochi: around 1 June
- 2 Mumbai: around 11 June
- 3 Delhi: around 27 June
- 4 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

 Prelims practice

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

Revision takeaways

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