

Physical Features of India

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Introduction

- The name "**India**" originates from the Indus River.
- It is the **seventh-largest** country in the world and the **second-largest in Asia**.
- India is situated in the Northeastern Hemisphere.
- Due to its diverse physiography, climate, natural vegetation, mineral resources, and human geography, India is often referred to as a "**Subcontinent**."

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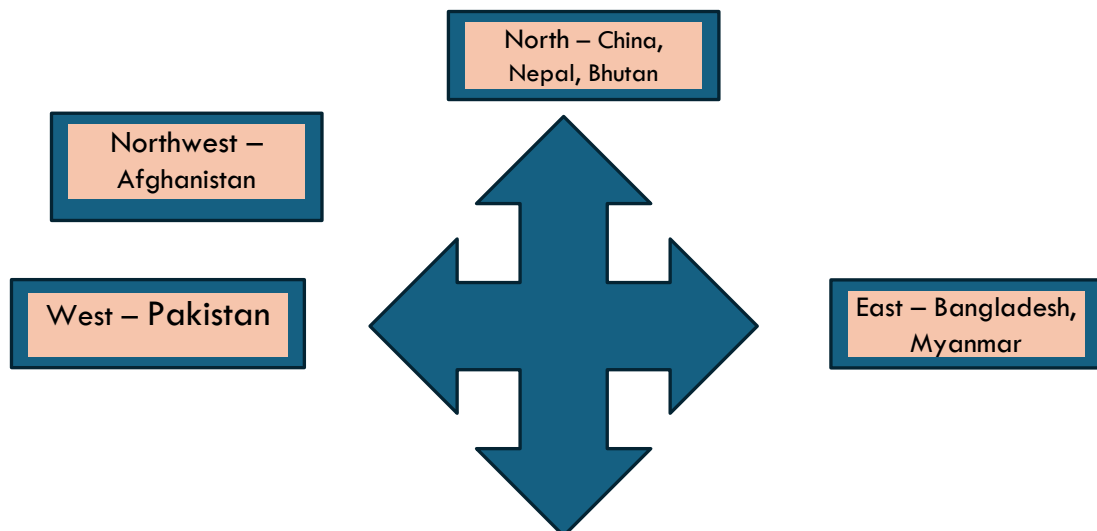
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Feature	Specification
Area	3,287,263 km ² (~2.4% of world land area)
North–South Extent	3,214 km (Indira Col → Kanyakumari)
East–West Width	2,933 km (Rann of Kutch → Arunachal)
Latitudinal Span	8°4' N to 37°6' N (mainland)
Southernmost Point	Indira Point , ≈ 6°45' N - in the Andaman and Nicobar Islands.
Southernmost point of mainland India	Cape Comorin (Kanyakumari)
Total Land Border	~15,200 km
Longest Border	Bangladesh – ~4,096 km
Shortest Border	Afghanistan – ~106 km
long coastline	6,100 km
Total coastline, including islands	7,516.6 km.
land borders	17 Indian states
coastal boundaries.	9 states
State Borders	Uttar Pradesh shares borders with the most states (8 states).
Indian states bordering only one state	<ol style="list-style-type: none"> 1. Sikkim (borders West Bengal) 2. Meghalaya (borders Assam)

Boundaries of India



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Border Lines Between India and Neighboring Countries

Neighboring Country	Border Line Name	Border Length (km)
Pakistan	Radcliffe Line	3,323 km
Bangladesh	Burbach Line	4,096.7 km
China	McMahon Line	3,380 km
Bhutan	Indo-Bhutan Border	699 km
Afghanistan	Durand Line	106 km
Sri Lanka	Palk Strait	30 km
Myanmar	Indo-Burma Border	1,643 km
Nepal	Indo-Nepal Border	1,236 km

Physical and Climatic Characteristics

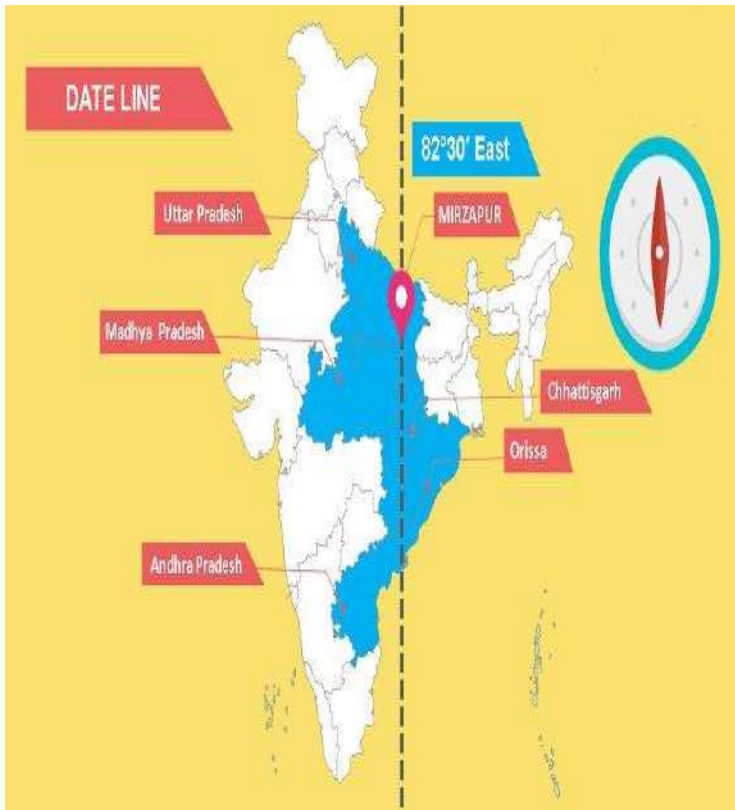
India is geographically separated from the rest of Asia by the Himalayan mountain range.

- The country's climate is predominantly influenced by tropical monsoons.
- The Himalayas act as a natural barrier, preventing cold temperate air masses from penetrating the region.
- Despite low winter night temperatures, clear skies and intense sunlight during the day contribute to significant temperature increases.

Time Difference Between Gujarat & Arunachal Pradesh

- **Longitude span:** $\sim 29^{\circ}18'$ ($\approx 30^{\circ}$) from Gujarat to Arunachal Pradesh.
- **Time rotation rate:** 1° longitude = 4 minutes.
- **Total difference:** $29.3^{\circ} \times 4 \text{ min} \approx 117 \text{ minutes}$ ($\sim 1 \text{ h } 57 \text{ min}$), rounded to 2 hours.
- **Effect:** Sun rises ~ 2 hours earlier in Arunachal Pradesh compared to Gujarat.

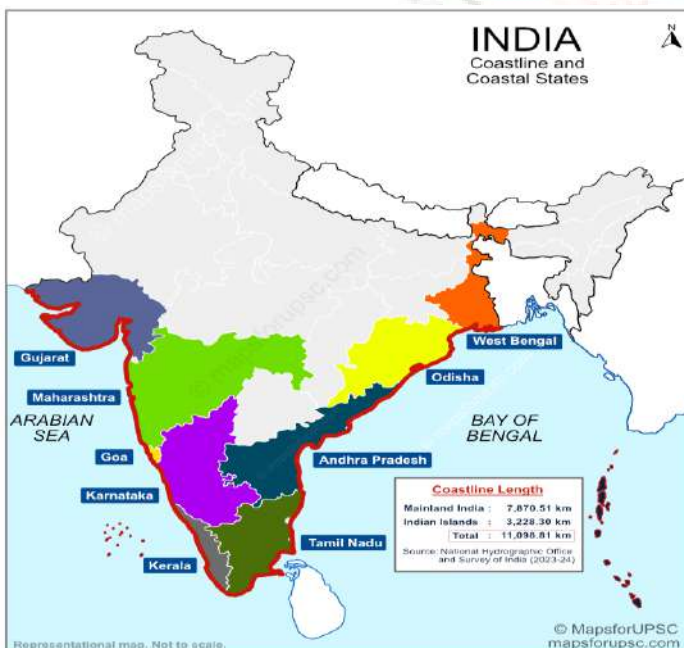
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Indian Standard Meridian & IST

- **Standard Meridian:** 82°30' E — passes near Mirzapur (Allahabad), Uttar Pradesh.
- **Time zone:** Entire country follows IST = UTC +5 h 30 min.
- **Why one zone:** India's 30° east–west spread would naturally give a ~2-hour solar time difference; using a single central meridian keeps things uniform

Coastal States of India



India has nine coastal states, namely:

1. Gujarat
2. Maharashtra
3. Goa
4. Karnataka
5. Kerala
6. Tamil Nadu
7. Andhra Pradesh
8. Odisha

Tropic of Cancer in India

The Tropic of Cancer ($23^{\circ}30' N$) passes through the middle of India, dividing the country into two halves.

- It crosses through eight states:
 - ❖ Gujarat – Jasdan
 - ❖ Rajasthan – Kalinjarh
 - ❖ Madhya Pradesh – Shajapur
 - ❖ Chhattisgarh – Sonhat
 - ❖ Jharkhand – Lohardaga
 - ❖ West Bengal – Krishnanagar
 - ❖ Tripura – Udaipur
 - ❖ Mizoram – Champhai

The Tropic of Cancer also passes through Jabalpur in Madhya Pradesh.

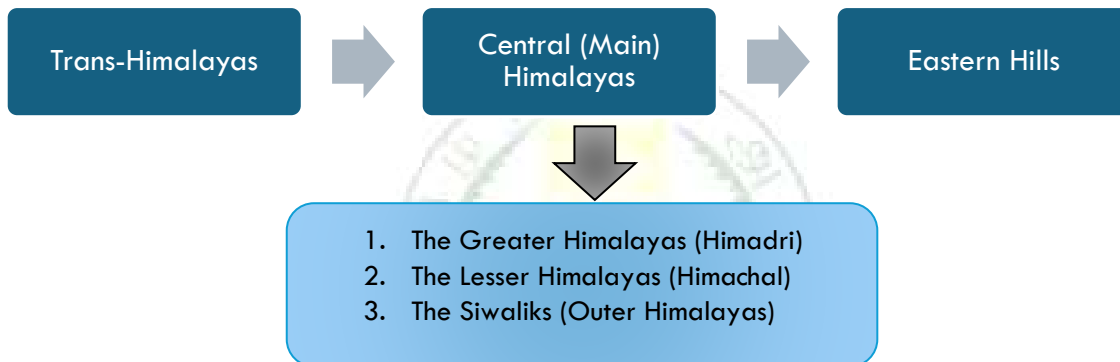
Physiographic Divisions of India



The Himalayan Mountains

- Among the youngest and tallest fold mountains, the Himalayas were formed millions of years ago by the collision of the Indian and Eurasian plates—still rising ~5 mm/year
- **“Himalaya” means “Abode of Snow”** in Sanskrit
- They stretch in a **grand arc from the Pamir Knot—the “Roof of the World”** connecting to Central Asia—eastwards across ~2,500 km

The Northern Mountains act as a natural barrier and are divided into three sub-divisions:



Trans-Himalayas (Tibetan Himalayas):

- North of the main Himalayas, across Jammu & Kashmir and Tibet.
- Includes Zaskar, Ladakh, Kailash, and Karakoram ranges.
- Composed of ancient granites and marine fossils from the Tethys Sea

Central (Main) Himalayas – a three-tier structure:

- **Greater Himalayas (Himadri):** Continuous highest range (avg. 6,000 m), containing world's tallest peaks like Everest (8,849 m) and Kanchenjunga (8,586 m), with large glaciers
- **Lesser Himalayas (Himachal):** Mid-range (3,500–4,500 m), including Pir Panjal, Dhauladhar, Mahabharat; hosts popular hill stations (Shimla, Darjeeling)
- **Outer Himalayas (Siwaliks/Shiwaliks):** Foothills (600–1,500 m), 10–50 km wide, formed from alluvial debris; includes fertile Duns (west) and Duars (east) valleys

Prominent Peaks in the Himalayas



Greater Himalayas (Himadri)

- **Location & Profile:** Northmost, most continuous belt; avg. width ~25 km, elevation ~6,000 m (20,000 ft)
- **Climate:** Receives less rainfall than the middle and foothill ranges; blocks cold northern winds and draws heavy monsoon moisture on its southern slopes .
- **Features:**
 - Rises the world's tallest peaks, including Mt. Everest (8,848 m) and Kanchenjunga (8,586 m)
 - **Hosts major glaciers:** Gangotri, Yamunotri, Siachen (the world's longest non-polar glacier, ~76 km)

Lesser Himalayas (Himachal / Middle Himalayas)

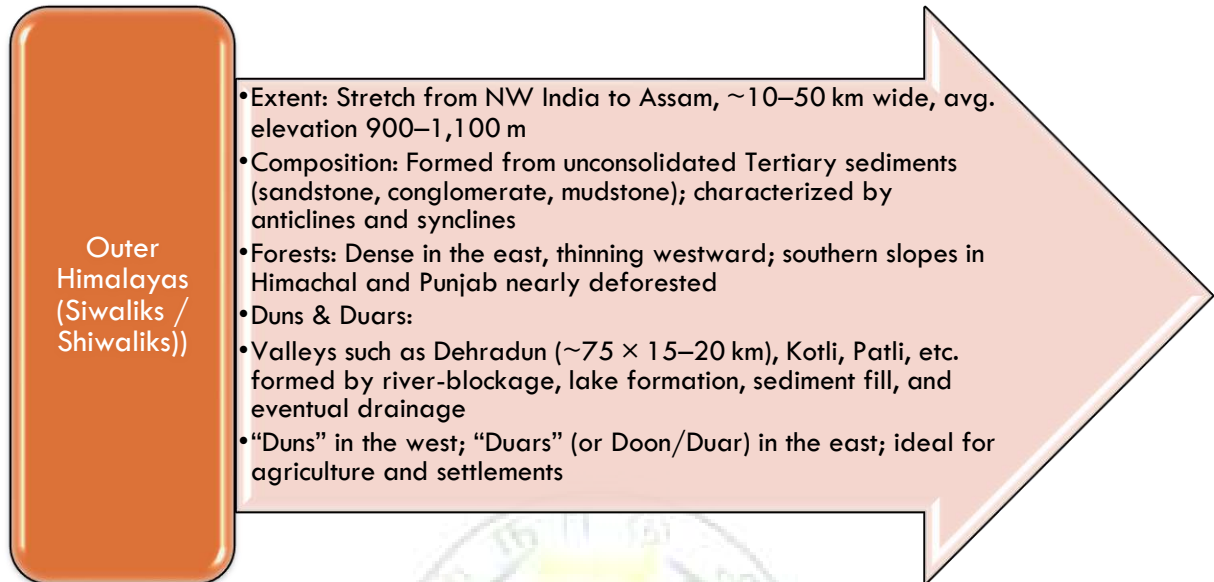
- **Dimensions:** Up to ~80 km wide in places, averaging 3,500–4,500 m in elevation
- **Geology:** Composed of slate, limestone, quartzite, and crystalline rocks like granite and gneiss .
- **Ranges & Tourism:**
 - Includes Pir Panjal, Dhauladhar, Mahabharat, Nag Tibba
 - **Famous hill towns:** Shimla, Mussoorie, Nainital, Almora, Ranikhet, Darjeeling

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Major Passes in the Lesser Himalayas

- Pir Panjal Pass - Jammu & Kashmir Jammu
- Banihal Pass - Jammu & Kashmir
- Rohtang Pass - Himachal Pradesh



Purvanchal Hills (Eastern Hills)

- These hills are eastern extensions of the Himalayas, mainly along the India-Myanmar border.
- Some extend inside India, forming important hill ranges.

Importance of the Himalayas

- **Monsoon Barrier:** Blocks Southwest Monsoon Winds, causing heavy rainfall in North India.
- **Natural Border:** Acts as a protective barrier for the Indian subcontinent.
- **Source of Major Rivers:** Home to perennial rivers such as Indus, Ganga, Brahmaputra, and their tributaries.
- **Tourism & Pilgrimage:** Houses famous hill stations and pilgrim centers like Amarnath, Kedarnath, Badrinath, and Vaishno Devi.
- **Climate Protection:** Prevents cold winds from Central Asia, protecting India from severe winters. fauna.

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The Great Northern Plains



1. The Rajasthan Plains

- Arid and semi-arid region.
- Home to salt lakes like Sambhar Lake and Pushkar Lake.

2. The Punjab-Haryana Plains

- Formed by the deposition of the Sutlej, Beas, and Ravi rivers.
- Known for highly fertile land and extensive agriculture.

3. The Ganga Plains

- Extends from the Yamuna River in the west to Bangladesh in the east.
- Covers about 3.75 lakh sq. km.
- Highly fertile, densely populated agricultural region.

4. The Brahmaputra Plains

- Covers about 56,275 sq. km.
- Features alluvial fans and marshy tracts due to seasonal floods.
- Rich biodiversity along the Brahmaputra River.



1. The Bhabar Plain

- Made of gravel and unsorted sediments from Himalayan rivers.
- High porosity causing small streams to disappear underground.
- Located along the foothills of the Himalayas, from Punjab to Assam.

2. The Tarai Tract

- Zone of excessive dampness, thick forests, and rich wildlife.
- Streams re-emerge from the Bhabar region, creating marshy conditions.
- Located south of the Bhabar belt, stretching from Uttarakhand to Assam.

3. The Bhangar Plains

- Older alluvial plains above the floodplain.
- Formed by ancient river deposits with calcareous concretions.
- Found in the upland areas of the Ganga and Yamuna plains.

4. The Khadar Plains

- New alluvial deposits found along riverbanks.
- Replenished annually with silt from floodwaters during the monsoon season.
- Highly fertile, suitable for intensive agriculture.
- Found along the Ganga, Yamuna, and Brahmaputra rivers.

5. The Deltaic Plains

- Triangle-shaped fertile land at the mouth of the Ganga and Brahmaputra rivers.
- Sundarban Delta is the largest and fastest-growing delta in the world.
- Soil types include old mud, new mud, and marshy land.
- Upland areas are called 'Chars' and marshy areas are called 'Bills'

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The Peninsular Plateaus

- ✓ Lies to the south of the **Great Northern Plains**.
- ✓ Covers around 16 lakh sq. km (about half of India's total area).
- ✓ **Anaimudi (2,695 m)** is the **highest point** in the plateau.
- ✓ Located between the Narmada River and the Northern Great Plains.
- ✓ **Gurushikhar (1,722 m)** is the **highest peak**.
- ✓ The Chhota-Nagpur Plateau is the eastern part of the Central Highlands, located in the northeastern Indian Plateau.

Minor Plateaus in the Peninsular Plateau

Malwa Plateau

- ❖ Forms a triangular area between the Vindhyan Hills, Aravalli Range, and Madhya Bharat Pathar.
- ❖ Drained by rivers: Narmada, Tapi, Mahi (Arabian Sea), Chambal, Betwa (Bay of Bengal).
- ❖ Characterized by black soils, rolling terrain, and Chambal ravines.

Baghelkhand Plateau

- ❖ Located north of the Maikal Range, made of limestones, sandstones, and granite.
- ❖ Elevation ranges from 150 m to 1,200 m.
- ❖ Divides the Son and Mahanadi drainage systems.

Chotanagpur Plateau

- ❖ Located in northeastern India, mainly in Jharkhand.
- ❖ Features radial drainage (e.g., Damodar, Subarnrekaha).
- ❖ Coal fields like Gondwana are located here.

Meghalaya Plateau

- ❖ Includes Shillong Plateau and Karbi Anglong Plateau.
- ❖ Features Garo Hills, Khasi-Jaintia Hills, and Mikir Hills.
- ❖ Highest point: Shillong (1,961 m).

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● Maharashtra Plateau

- ❖ Located in Maharashtra, part of the Deccan Plateau.
- ❖ Composed mainly of basaltic rocks (Deccan Traps).
- ❖ Rolling plain appearance due to weathering.

● Karnataka Plateau

- ❖ Also known as the Mysore Plateau.
- ❖ Elevation: 600-900 m, dissected by rivers from the Western Ghats.
- ❖ Highest peak: Mulangiri (1,913 m).

● Marwar Plateau

- ❖ Divided into Malnad (hill country) and Maidan (rolling plains).
- ❖ Located in eastern Rajasthan, west of the Aravallis.
- ❖ Elevation: 250-500 m above sea level.
- ❖ Composed of sandstone, shales, and limestones.

● Telangana Plateau

- ❖ Elevation: 500-600 m, higher in the south.
- ❖ Drained by rivers: Godavari, Krishna, Penneru.

● Chhattisgarh Plain

- ❖ A saucer-shaped depression drained by the Mahanadi River.
- ❖ Elevation: 250 m (east) to 330 m (west).

Deccan Plateau

- 📖 **Area:** ~500,000 km²
- 📐 **Borders:** Surrounded by hill ranges (Satpura–Vindhya north; Ghats east & west)
- 🏔️ **Elevation:** ~600 m avg (500 m north → 1,000 m south)
- 🌊 **Slope:** West → East, helping rivers flow eastward
- 🧱 **Division:** Rivers create smaller plateaus within

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Feature	Western Ghats (Sahyadri)	Eastern Ghats (Poorvadri)
Continuity	Continuous, parallel to Arabian Sea coast	Disconnected hills—north, gap, reappear in south
Elevation Trend	Increases from north (~900 m) to south (~2,695 m)	Varies—higher in north and south, lower mid-section
Major Peaks	Anamudi (2,695 m), Doda Betta (2,637 m)	Mahendra Giri (1,501 m), Jindhagada (1,690 m), Biligiri Rangan (1,279 m)
Orientation	North–South along west coast	Southwest–Northeast along east coast
Key Geographical Gap	Palghat Gap divides Sahyadris	Interrupted between Godavari & Krishna, etc.

Aravalli Range

- ❖ Orientation & Extent: Stretches NE–SW for about 670 km, from Delhi through Haryana and Rajasthan, ending near Palanpur, Gujarat
- ❖ Antiquity: One of the oldest folded mountain ranges in the world—formed during the Proterozoic, now heavily eroded over millions of years

Elevation:

- ❖ Typically: 400–900 m across most of the range
- ❖ Mount Abu plateau: rises to ~1,158 m
- ❖ Guru Shikhar: highest peak at 1,722 m

Extent in Terrain:

- ❖ More continuous and prominent south of Ajmer (up to ~900 m)
- ❖ Less defined (discontinuous ridges) near Haryana and Delhi
- ❖ Actually extends beneath the alluvial plains up to Haridwar

Vindhya Range:

- ❖ Overlooks the Narmada Valley, rising as an escarpment along the northern edge of the Narmada-Son Trough.

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❖ Extends east-west for over 1,200 km, from Jobat (Gujarat) to Sasaram (Bihar), running parallel to the Narmada Valley.
❖ General elevation: 300-650 m.
❖ Composed mainly of horizontally bedded ancient sedimentary rocks.
❖ Extends eastwards as the Barner and Kaimur hills.
❖ Acts as a watershed between the Ganga system and the river systems of South India.
❖ Rivers like Chambal, Betwa, and Ken rise within 30 km of the Narmada.

Satpura Range:

❖ Runs east-west, south of the Vindhyas, between the Narmada and Tapi rivers, parallel to them.
❖ Stretches for about 900 km.
❖ Parts of the range are folded and uplifted, forming a structural uplift or "horst."
❖ Dhupgarh (1,350 m) in the Mahadev Hills is the highest peak.
❖ Amarkantak (1,127 m) is another important peak.

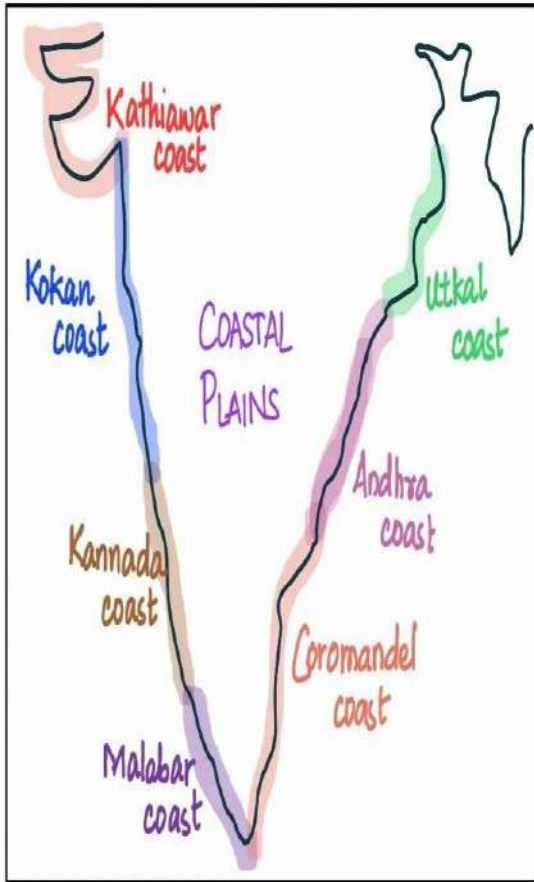
Coastal Plains:

India's coastal plains

Feature	Eastern Coastal Plains	Western Coastal Plains
Width	Wider (35–200 km)	Narrower (10–65 km)
Delta formation	Large delta systems (Mahanadi, Godavari, etc.)	Smaller rivers, estuaries
Rainfall pattern	Receives NE monsoon (esp. south)	Receives SW monsoon (heavy)
Coastal type	Mostly emergent	Mostly submergent, some emergent
Ecology & economy	Rich in agriculture, fisheries, biodiversity	Known for ports, fishing, backwaters, minerals

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Eastern Coastal Plains

- ✓ **Utkal Coast** (Chilika Lake → Kolleru Lake) – Heavy rainfall; grows rice, coconut, banana; features Mahanadi delta and Chilika Lagoon
- ✓ **Andhra Coast** (Kolleru → Pulicat) – Fertile plains from Godavari–Krishna basins; includes Pulicat Lagoon
- ✓ **Coromandel Coast** (Pulicat → Kanyakumari) – Dry summers, wet winters via northeast monsoon

Western Coastal Plains

- ✓ **Kachchh & Kathiawar Coast** – Formerly gulf regions; includes Great & Little Rann; seasonal flooding
- ✓ **Konkan Coast** (Daman → Goa) – Rice and cashew farming, heavy SW monsoon rainfall
- ✓ **Kanara Coast** (Mormugao → Mangalore) – Rich in iron ore; moderate width
- ✓ **Malabar Coast** (Mangalore → Kanyakumari) – Known for lagoons and backwaters (e.g., Vembanad), major tourist and navigation regions

The Islands

Major Island Groups in India

- ❖ Andaman and Nicobar Islands
- ❖ Lakshadweep Islands

Andaman and Nicobar Islands:

✓ Volcanic origin, located in the Bay of Bengal.

✓ It Comprises 572 islands.

✓ Area: 8,249 sq. km.

✓ Capital: Port Blair.

✓ **Divided into two groups:**

○ Andaman (North): 25 inhabited islands.

○ Nicobar (South): 13 inhabited islands.

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✓ Car Nicobar: Northernmost island.
✓ Geologically, islands consist of tertiary sandstone, limestone, and shale resting on basic and ultrabasic volcanoes.
✓ Barren Island: India's only active volcano.
✓ Narcondam Island: An extinct/dormant volcano.
✓ Coral reefs and dense forests cover many of the islands.
✓ Saddle Peak (737 m) in North Andaman is the highest peak.
✓ Ten Degree Channel separates Andaman from Nicobar.
✓ Indira Point: Southernmost tip, part of Nicobar.

Lakshadweep Islands:

✓ Located in the Arabian Sea, consisting of:
○ Amindivi Islands.
○ Laccadive Islands (including Kavaratti).
○ Minicoy.
✓ Known collectively as Lakshadweep (means "one lakh islands").
✓ Area: 32 sq. km.
✓ Capital: Kavaratti.
✓ 27 islands, 11 inhabited.
✓ Separated from the Maldivian Islands by the Eight Degree Channel.
✓ Pitt Island: Uninhabited, has a bird sanctuary.
✓ Formerly divided into Laccadive, Minicoy, and Amindivi.
✓ Renamed Lakshadweep in 1973.

Water Resources - Rivers

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- Drainage Systems Based on Origin
- Drainage Systems Based on Type of Drainage
- Himalayan Rivers in Detail
- Peninsular Rivers:
- Central Government**
- Initiatives in River**
- Conservation**

Introduction

➤ The total area drained by a river and its tributaries is called the drainage basin.

➤ India's drainage systems can be categorized into two primary origins:

Himalayan Rivers and Peninsular Rivers, and also by types:

- Coastal Rivers
- Inland Drainage.

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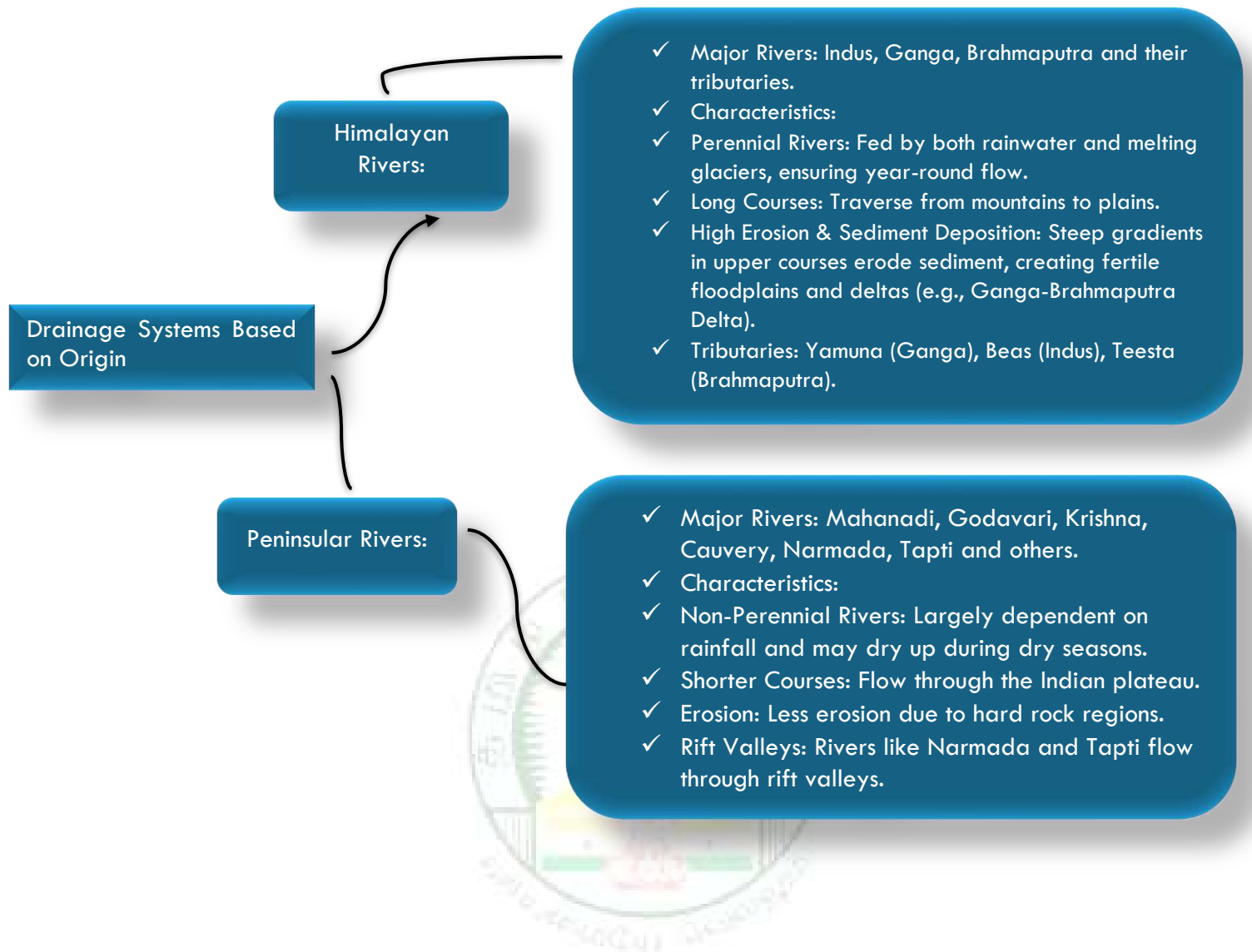
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Drainage Systems Based on Type of Drainage:

Himalayan Rivers, Deccan Rivers, and Coastal Rivers

Himalayan Rivers	<ul style="list-style-type: none"> • Large perennial river systems like Ganga, Brahmaputra, and Indus.
Deccan Rivers:	<ul style="list-style-type: none"> • Flow from central and southern Indian plateau, forming deltas (east-flowing rivers) or estuaries (west-flowing rivers like Narmada, Tapti).
Coastal Rivers	<ul style="list-style-type: none"> • Short rivers draining directly into the sea. Examples include rivers • in Kerala (e.g., Periyar).

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Inland Drainage Basin (Endorheic Basin)

Inland Rivers

- Inland Rivers: These do not drain into seas or oceans but into inland basins, salt lakes, or deserts. Example: Sambhar Lake (Rajasthan) and Luni River (Rann of Kutch)

The Bay of Bengal Drainage (East Flowing Rivers):

- Major Rivers: Ganga, Brahmaputra, Mahanadi, Godavari, Krishna, Kaveri, Subarnarekha.
- Flow Direction: Rivers flow from west to east, draining into the Bay of Bengal.
- Features:
 - Long course and large deltas (e.g., Ganga-Brahmaputra Delta, Godavari Delta).
 - Large basin areas.

The Arabian Sea Drainage (West Flowing Rivers):

- Major Rivers: Narmada, Tapi, Sabarmati, Mahi, Periyar.
- Features:
 - Shorter course.
 - Form estuaries (e.g., Narmada, Tapi).
- Flow Direction: Rivers flow from east to west, draining into the Arabian Sea.

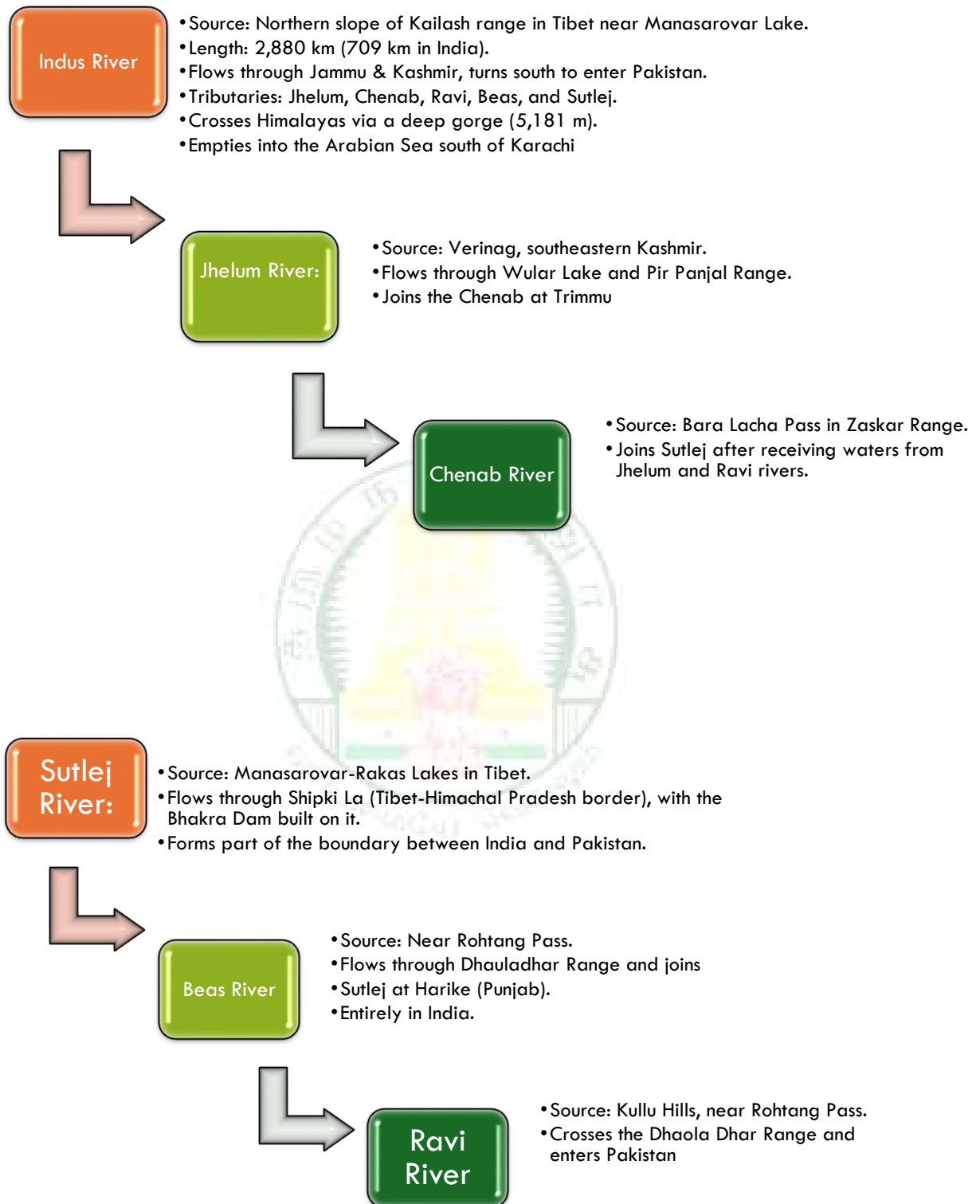
Special Case: Narmada and Tapi

- Both flow almost parallel in central India, emptying into the Arabian Sea.
- The Narmada flows through a rift valley between Vindhya and Satpura ranges, and Tapi flows further south, also through a rift valley.

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Himalayan Rivers in Detail:



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Indus Water Treaty:

- Signed: 19th September 1960 between India and Pakistan.
- Allocation: India is allocated only 20% of the Indus River system's total discharge for its use.

The Ganga River:

- ✓ Largest Drainage System in India.
- ✓ **Origin:** The river originates as Bhagirathi from the Gangotri Glacier in Uttarkashi district, Uttarakhand, at an elevation of 7,010 m.
- ✓ **Length:** 2,525 km.
- ✓ **Tributaries:** ○ From the north: Gomti, Gandak, Kosi, Ghagra. ○ From the south: Yamuna (largest tributary), Son, Chambal.
- ✓ Known as Padma in Bangladesh.
- ✓ Forms the Sundarbans Delta with the Brahmaputra before draining into the Bay of Bengal.

Ganga River Characteristics:

- ✓ At Devprayag, the Alaknanda River joins Bhagirathi to form the Ganga.
- ✓ Pollution: Ranked as the fifth most polluted river in the world (2007).

- ✓ Major Tributaries of Alaknanda:
 - ✓ East Trishul at Karnaprayag.
 - ✓ Pindar from Nanda Devi.
 - ✓ Mandakini/Kali Ganga at Rudraprayag.
 - ✓ Dhauliganga.

- ✓ Major Tributaries of Bhagirathi:
 - ✓ Bheling.
 - ✓ Bishenganga

- ✓ The Ganga enters the plains at Haridwar and meets the Yamuna at Prayagraj.
- ✓ At Farakka, it bifurcates into Bhagirathi-Hugli and Padma-Meghna.
- ✓ The Brahmaputra joins the Padma-Meghna at Goalundo.

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- ✓ Ganga-Brahmaputra Delta:
- ✓ Largest Delta in the World.
- ✓ Area: 58,752 sq km.
- ✓ Known for frequent flooding and being low-lying, highly indented by coastline

Yamuna River:

- Largest Tributary of the Ganga.
- **Origin:** Yamunotri Glacier on Bandarpunch Peak, Uttarakhand, at an elevation of 6,000 m.
- Flows through Nag Tibba, Mussoorie, and Shivalik Ranges.
- Joins the Ganga at Triveni Sangam in Prayagraj.
- **Length:** 1,376 km.
- Tons River is a major tributary, joining the Yamuna below Kalsi.

Tributaries:



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Chambal River

- Origin: Janapao Hills, Vindhya Range.
- Join the Yamuna.
- Length: 1,050 km.
- Dams: Gandhi Sagar, Rana Pratap, Jawahar Sagar, and Kota Barrage.
- Key feature: Forms badland topography

Banas River

- A tributary of the Chambal, joins near Sawai Madhopur

Sind River

- Origin: Vidisha Plateau, Madhya Pradesh.
- Joins the Yamuna after flowing for 415 km.

Betwa River

- Origin: Bhopal district, Vindhya Range.
- Joins the Yamuna near Hamirpur.
- Tributary: Dhasan

Ken River

- Origin: Barner Range, Madhya Pradesh.
- Joins the Yamuna near Chila

Son River

- Origin: Amarkantak Plateau near the Narmada source.
- Joins the Ganga near Danapur, Bihar

Ramganga River

- Origin: Garhwal district, Uttarakhand.
- Joins the Ganga at Kannauj

Ghaghra River

- Source: Gurla Mandhata peak, Tibet.
- Known as Karnaili in Nepal.
- Tributaries: Sarda, Sarayu (Sarju), Rapti

Kali River

- Origin: High glaciers of the trans-Himalaya.
- Forms boundary between Nepal and Kumaon.
- Joins the Ghaghra

DEPARTMENT OF EMPLOYMENT AND TRAINING

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Gandak River	<ul style="list-style-type: none"> • Origin: Tibet-Nepal border at 7,620 m. • Tributaries: Kali Gandak, Mayangadi, Bari, Trishuli. • Joins the Ganga at Hajipur, Bihar
Burhi Gandak River	<ul style="list-style-type: none"> • Origin: Western slopes of Sumesar hills. • Joins the Ganga near Monghyr
Kosi River	<ul style="list-style-type: none"> • Known as Saptkaushiki. • Originates in eastern Nepal. • Joins the Ganga near Kursela. • Forms three main streams: Tumar, Arun, Sun Kosi. • Prone to flooding, known as the 'Sorrow of Bihar'.

The Brahmaputra River:

Regions and Names:

- ❖ **Tibet:** Known as Tsangpo (meaning "The Purifier").
- ❖ **China:** Referred to as Yarlung Zangbo and Jianguin.
- ❖ **Assam Valley:** Flows as Dihang or Siong, south of Sadiya, and is known as Brahmaputra.
- ❖ **Bangladesh:** Called the Jamuna River, and when combined with the Ganga, it forms the Padma River. The merged flow later joins Meghna and creates a large estuary before entering the Bay of Bengal.

Origin and Course:

- ❖ The Brahmaputra originates from the Chemayungdung Glacier of the Kailash Range, located east of Lake Mansarovar in Tibet at an elevation of about 5,150 m.
- ❖ Known as Tsangpo in Tibet, it flows for about 2,900 km (with 900 km in India).
- ❖ It enters India through the Dihang Gorge in Arunachal Pradesh.
- ❖ **Tributaries:** ○ Tista, Manas, Barak, and Subansiri.

Course & Characteristics:

- ❖ Begins as Tsangpo in Tibet, receiving tributaries like Raga Tsangpo and Ngangchu.
- ❖ Turns southward around Namcha Barwa (7,756 m), entering India and cutting through the Dihang Gorge to emerge in the Assam Valley near Sadiya.
- ❖ It flows as Siong and then Dihang in Assam before becoming known as the Brahmaputra from Sadiya onward.

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❖ **North Bank Tributaries:** Subansiri, Kameng, Dhansiri, Raidak, Tista (historically a Ganga tributary).

❖ **South Bank Tributaries:** ○ Dibang, Lohit, Kolong.

Physical Characteristics:

❖ **Braided Channel:** The river has a shifting channel due to heavy silt load and meandering patterns.

❖ **Width:** The river reaches nearly 16 km at Dibrugarh, where it forms several islands, including Majuli, which is the world's largest river island.

❖ **Flooding:** Known for disastrous floods due to monsoonal rains and heavy sediment flow, earning it the nickname "River of Sorrow."

❖ **Navigation:** It is navigable for 1,384 km up to Dibrugarh, facilitating inland water transport.

Bangladesh Flow:

❖ The Brahmaputra enters Bangladesh near Dhubri, flowing as Jamuna for about 270 km.

❖ It joins the Ganga at Goalundo and the combined flow is referred to as the Padma.

❖ The river eventually merges with the Meghna and forms a broad estuary before entering the Bay of Bengal.

Characteristics of Himalayan Rivers

Long and Wide: The Himalayan rivers are typically long and have wide channels

Navigable in Middle and Lower Courses: While they are mostly not navigable in the upper reaches, the middle and lower courses are accessible for transportation.

Perennial: These rivers flow year-round, as they are fed by snowmelt and rainfall.

Unsuitable for Hydro Power: The steep gradients of the rivers make them difficult for hydro power generation

Peninsular Rivers:

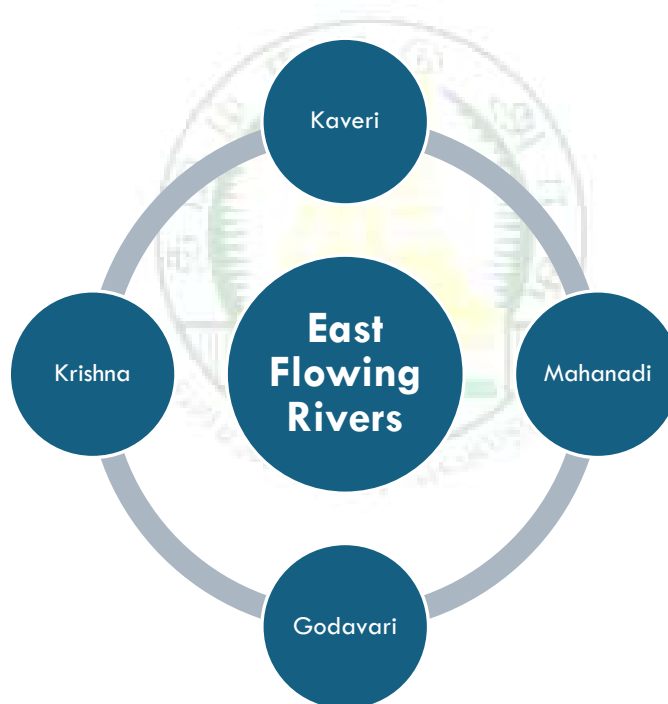
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Seasonal Rivers: Rivers in the Peninsular India are typically non-perennial and flow mainly during the monsoon season. • They are divided into

- ❖ East Flowing Rivers
- ❖ West **Flowing Rivers**

East Flowing Rivers



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Mahanadi

- ✓ **Origin:** Near Sihawa in Raipur district, Chhattisgarh.
- ✓ **Length:** 851 km.
- ✓ **Tributaries:** ○ Seonath, Telen, Sandur, Chitartala, Genguti, Nun.
- ✓ **Course:** After receiving the Seonath River, it turns east and flows into Odisha, eventually emptying into the Bay of Bengal.
- ✓ **Major Infrastructure:**
 - Hirakud Dam: Located at Sambalpur, it's one of India's largest dams, forming a 55 km long lake.
- ✓ **Key Urban Centers:** Raipur, Durg, Cuttack.
- ✓ **Industries:** Iron & Steel (Bhilai), Aluminum factories (Hirakud, Korba).
- ✓ **Flooding:** The Mahanadi is one of the most active silt-depositing rivers in the Indian subcontinent.

- ✓ **Nickname:** "Dakshin Ganga" (Southern Ganga).
- ✓ **Origin:** Trimbakeshwar, Nasik district, Maharashtra.
- ✓ **Length:** 1,465 km.
- ✓ **Tributaries:** ○ Left Bank: Dharna, Penganga, Wainganga, Wardha, Pranahita, Pench, Kanha, Sabari, Indravati. ○ Right Bank: Pravara, Mula, Manjra, Peddavagu, Maner (Manjra is the longest right bank tributary at 724 km).
- ✓ **Delta Formation:** The river divides into two branches at Rajahmundry: Vashishta Godavari (west) and Gautami Godavari (east), forming one of India's largest deltas before entering the Bay of Bengal.
- ✓ **Lake:** Kolleru Lake is located in the delta region.
- ✓ **Importance:** The Godavari basin covers multiple states, including Maharashtra, Telangana, Andhra Pradesh, Chhattisgarh, and Odisha.

Godavari

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Krishna

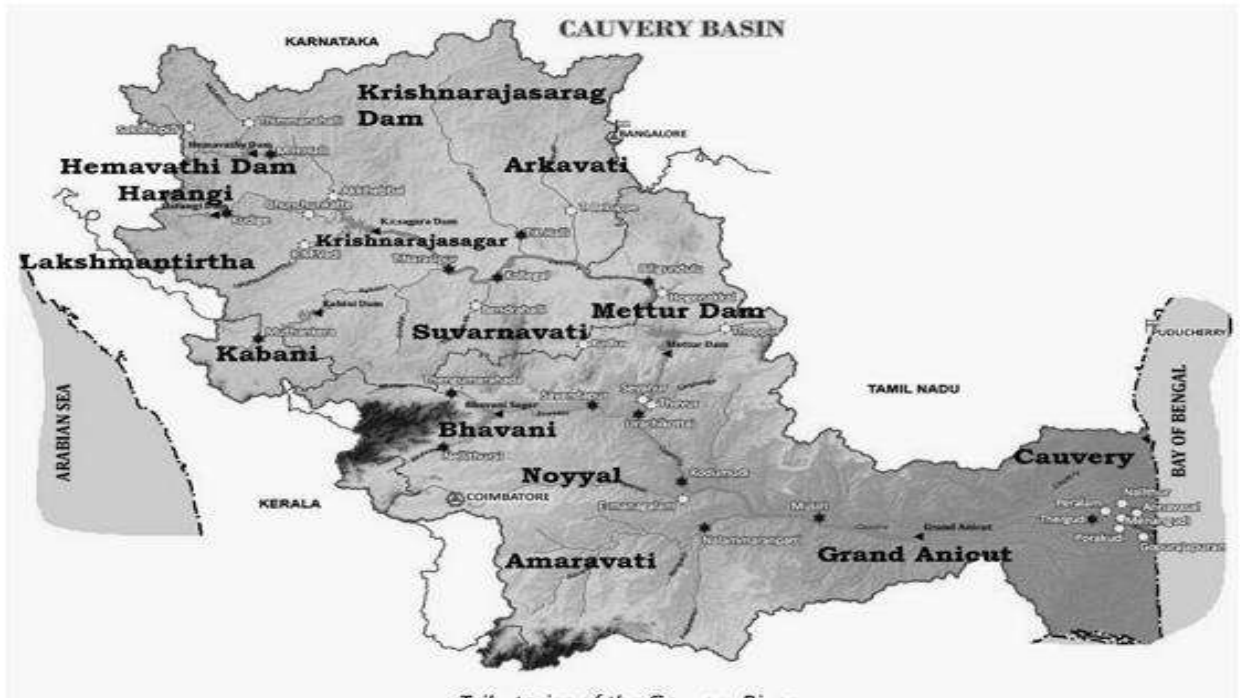
- ✓ **Origin:** A spring at Mahabaleshwar, Western Ghats, Maharashtra.
- ✓ **Length:** 1,400 km.
- ✓ **Tributaries:** ○ Right Bank: Ghatprabha, Malprabha, Tungabhadra. ○ Left Bank: Bhima, Musi, Munneru.
- ✓ **Key Features:** ○ Koyna River is a significant tributary, with the Koyna Dam responsible for the 1967 earthquake.
- ✓ **Major Projects:** Tungabhadra, Ghataprabha, Nagarjunasagar, Malaprabha, Bhima, Bhadra, Telugu Ganga.
- ✓ **Hydro Power:** Key stations include Koyna, Tungabhadra, Sri Sailam, Nagarjuna Sagar.
- ✓ **Economic Importance:** Rich in mineral deposits, it holds great potential for industrial development.

- ✓ **Nickname:** "Dakshin Ganga" due to its spiritual significance.
- ✓ **Source:** Talakaveri, Brahmagiri Range, Kodagu, Karnataka (elevation: 1,341 m).
- ✓ **Basin Area:** 81,000 sq km (spanning across Tamil Nadu, Karnataka, Kerala, and Puducherry).
- ✓ **Tributaries:** ○ Left Bank: Harangi, Hemavati, Shimsha, Arkavati.
- ✓ **Key Features:**
 - Right Bank: Lakshmantirtha, Kabbani, Suvarnavati, Bhavani, Noyil, Amaravati.
 - Shivanasamudra Waterfalls (101 m high), utilized for hydroelectric power generation.
 - Mekedatu: A wide gorge, also known as "Goats Leap".
 - Hogenakkal Falls: The river takes a southerly course and enters the Mettur Reservoir.
- ✓ **Delta Formation:** It splits into two branches near Srirangam Island, forming the Cauvery and Vennar rivers after crossing the Grand Anicut.

Kaveri

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- ✓ Alternative Name: Also known as Uttara Pinakini.
- ✓ Course: Flows eastward, draining into the Bay of Bengal.
- ✓ Total Length: 597 km from origin to outfall.

- ✓ Source: Rises in the Chenna Kesava hills of the Nandidurg range, Chikkaballapura district, Karnataka.

Pennar River

- ✓ Basin Area: Extends over Andhra Pradesh and Karnataka.
- ✓ Tributaries
 - Left Bank: Jayamangali, Kunderu, Sagileru.
 - Right Bank: Chiravati, Papagni, Cheyyeru

- ✓ Basin Boundaries:
 - North: Erramala range.
 - East: Nallamala and Velikonda ranges (Eastern Ghats).
 - South: Nandidurg hills.
 - West: Narrow ridge separating it from the Vedavati valley (Krishna Basin).
- ✓ Other notable ranges: Seshachalam (famous for Red Sanders) and Paliconda ranges.

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Subarnarekha
River

- ✓ **Origin:** Ranchi Plateau, Jharkhand.
- ✓ **Course:** Forms the boundary between West Bengal and Odisha in its lower reaches.
- ✓ **Length:** 395 km.
- ✓ **Outflow:** Joins the Bay of Bengal, forming an estuary between the Ganga and Mahanadi deltas.

Brahmani
River

- ✓ **Formation:** Created by the confluence of the Koel and Sankh rivers near Rourkela.
- ✓ **Length:** 800 km.
- ✓ **Basin Geography:** ○ North: Bounded by the Chhotanagpur plateau. ○ West and South: Mahanadi basin. ○ East: Bay of Bengal.
- ✓ **Flow:** Passes through Jharkhand, Chhattisgarh, and Odisha, draining into the Bay of Bengal.

Ponnaiyar River

- ✓ **Characteristics:** A small stream confined to the coastal area.
- ✓ **Regions Covered:** Flows through Tamil Nadu, Karnataka, and Andhra Pradesh.
- ✓ **Basin Boundaries:** ○ North-West and South: Various ranges of the Eastern Ghats (Velikonda, Nagari, Javadu, Shevaroy, Chitteri, Kalrayan). ○ East: Bay of Bengal.

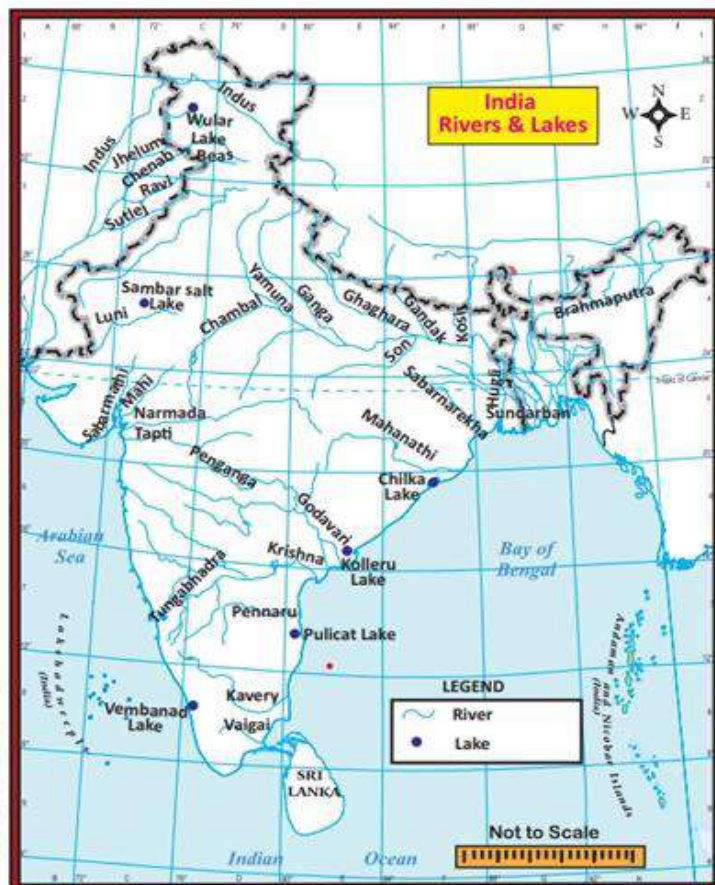
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Vaigai River

- ✓ Location: South of the Cauvery delta.
- ✓ ● Significance: The longest stream among several in the region between the Cauvery and Kanyakumari
- ✓ ● Basin Geography:
 - West: Bounded by Varushanadu, Andipatti, Cardaman, and Palani hills.
 - East: Palk Strait and Palk Bay

West Flowing Rivers of Peninsular India:



- ✓ **Fewer and Smaller:** West-flowing rivers are fewer in number and shorter compared to east-flowing rivers.
- ✓ **Flow Mechanism:** These rivers flow through geological faults created by tectonic activity from the formation of the Himalayas.
- ✓ **No Deltas:** Unlike east-flowing rivers, they do not form deltas but estuaries when reaching the Arabian Sea.
- ✓ **Silt & Sediment:** Limited sediment transport due to the rivers flowing over hard rocks, which also restricts delta formation.

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Narmada river

Tapti river

Sabarmati river

Mahi river

Luni river

Narmada River

Source	Amarkantak Plateau, Madhya Pradesh (elevation: 1,057 m).
Right Bank	Hathni River, Orsang River, Barna River, Kolar River.
Left Bank	Smaller tributaries draining from the northern slopes of the Satpura Range.
Estuary	Forms a 27 km long estuary before outfalling into the Arabian Sea through the Gulf of Cambay.
Significance	The largest among the west-flowing rivers in Peninsular India.
Length	1,312 km. Basin Area: 98,796 sq km

Tapti River

Source	Multai, Betul district, Madhya Pradesh (elevation: 752 m).
Length	724 km. ● Basin Area: 65,145 sq km.
Tributaries:	Right Bank: Suki, Gomai, Arunavati, Aner. Left Bank: Vaghur, Amravati, Buray, Panjhra, Bori, Girna, Purna, Mona, Sipna.
Physical Regions	Hilly regions like the Satpura and Ajanta hills, and fertile plains of Khandesh suitable for agriculture
Outfall	Drains into the Arabian Sea through the Gulf of Cambay.

Sabarmati River:

Origin	Formed by the combined streams of the Sabar and Hathmati rivers, from the Aravalli hills, Udaipur, Rajasthan
Length	371 km. ● Basin Area: Saurashtra and Gujarat
Tributaries	Left Bank: Wakal, Hathmati, Vatrak. ○ Right Bank: Sei.
Basin Boundaries	Bounded by Aravalli hills (north), Rann of Kutch (west), and Gulf of Khambhat (south).
Rainfall	Ranges from 100 cm in the southern part of the basin to minimal rainfall in Saurashtra.

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Mahi River:

Origin	Vindhya Range, Madhya Pradesh (elevation: 500 m).
Length	583 km. ● Basin Area: Spans across Madhya Pradesh, Rajasthan, and Gujarat.
Geographical Boundaries:	North/North-West: Aravalli hills. ○ East: Malwa Plateau. ○ South: Vindhya Range. ○ West: Drains into the Gulf of Khambhat.
Hydropower Projects	Mahi Bajaj Sagar Dam and Kadana Dam.
Outfall	Flows into the Arabian Sea.

Luni River:

Origin	Western slopes of the Aravalli range, near Ajmer.
Significance	It is the only major river basin in Western Rajasthan, an arid zone.
Course	Flows southwest through Rajasthan, ultimately draining into the Rann of Kutch where it disappears in the marshes.
Physical Characteristics	The river tends to widen due to erodible banks and a sandy riverbed.
Length	511 km.

South Indian Rivers Characteristics:

- ✓ Origins: These rivers primarily originate from the Western Ghats.
- ✓ Nature: Short and narrow, typically non-perennial.
- ✓ Usage: Excellent for hydroelectric power generation but not suitable for navigation

Central Government Initiatives in River Conservation

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Namami Gange

Objective: This flagship program is dedicated to the comprehensive conservation of the Ganga River, addressing multiple aspects like Pollution control , Sewage treatment , Riverfront development

Focus Areas: Cleaning the river, creating sustainable sewage treatment plants, and developing riverfronts along the Ganga for cultural, recreational, and ecological purposes.

National River Conservation Plan (NRCP)

Objective

- NRCP aims to improve the water quality of major rivers in India by focusing on:
- Sewage treatment plants
- Pollution control measures
- Community participation
- Environmental sustainability

Focus Areas

- Cleaning the river, creating sustainable sewage treatment plants, and developing riverfronts along the Ganga for cultural, recreational, and ecological purposes

River Basin Management Plans

Objective: Developed for major river basins, these plans focus on integrated and sustainable management of water resources, addressing concerns such as:

- Water availability
- Water quality
- Ecosystem health

Goal: Ensuring the effective management of river systems, enabling conservation and sustainable usage of water across river basins.

Clean Ganga Fund

Objective

• Objective: A special fund set up to support projects focused on cleaning and rejuvenating the Ganga River.

Use

• The fund is dedicated to initiatives that enhance water quality and bring about effective solutions for pollution control.

Sujalam Sufalam Yojana

Objective: This scheme is focused on the improvement of water resource management, which includes:

- Construction of water bodies
- Irrigation infrastructure
- Maintenance of water systems for better usage and sustainability.

Other Initiatives

- ✓ **Amrit Sarovar Mission:** Focuses on conservation and rejuvenation of water bodies across India.
- ✓ **Small River Rejuvenation & Conservation Plan:** This is a localized initiative to conserve and rejuvenate small and lesser-known rivers.
- ✓ **Mission Water Conservation:** Encourages water conservation efforts across various regions.
- ✓ **Mass Awareness Programs:** These initiatives help create public awareness about the importance of river conservation.
- ✓ **National Water Awards:** Awards given to recognize excellence in water conservation efforts.
- ✓ **Weekly Water Heroes Contest:** A community-driven initiative aimed at encouraging individuals and groups to take action for water conservation.

Transportation & Communication

Table of content

- ✚ Means of Transport
- ✚ Roads in India
- ✚ Indian Railways
- ✚ Water Transport in India
- ✚ Communication

Introduction:

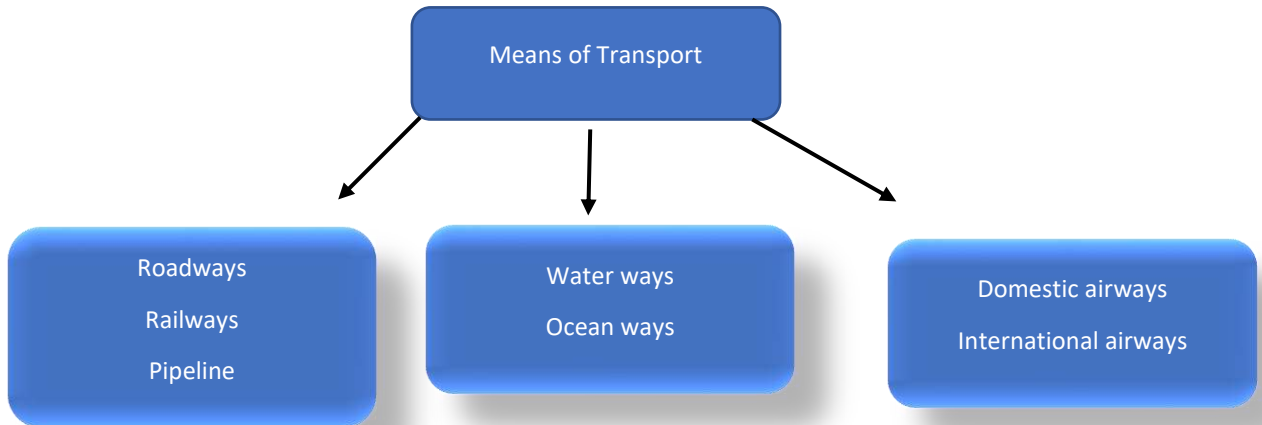
• Transport is indeed a vital component of any country's infrastructure, serving as a lifeline for economic activities and facilitating the movement of people and goods. Here's an overview of the three major means of transport.

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Director,

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Roadways in India

Road Density

- Densest – Northern Plains
- **Challenging** – Mountainous regions
- **Highest Density** – Kerala
- **Lowest Density** – Jammu & Kashmir

Classification of Roads

National Highways (NH)

- Connect major cities/states
- High-speed, long-distance
- Central Govt

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State Highways (SH)

- Within state, major districts
- State Govt

District Roads

- Rural ↔ Highways
- Local/District authorities

Rural Roads (Village Roads)

- Connect villages
- Rural development

Border Roads

- Border security, strategic use
- BRO (Border Roads Organisation)

International Highways

- Link with neighboring countries
- Trade & travel

Importance of National Highways

- **Backbone** of road transport
- Connect: **Major Cities, State Capitals, Ports, Rail Junctions, Industrial Zones, Tourist Centers**
- Maintained by: **Central Government (NHAI)**

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Shortest National Highway:

- H 548: This highway is 5 km long, making it the shortest National Highway in India.

Andaman and Nicobar Islands:

- NH 4: Known as the Andaman Trunk Road, this highway is located in the Andaman and Nicobar Islands.

East-West National Highway

- NH 27: This highway runs from Porbandar in Gujarat to Silchar in Assam, serving as an important east-west corridor.

States with the Largest Length of National Highways:

- Maharashtra has the largest network of National Highways in India, followed closely by Uttar Pradesh.

Atal Tunnel:

- on October 2020, the Atal Tunnel was inaugurated, known as the world's longest
- highway tunnel at 9.02 km. It connects Manali with Lahaul-Spiti, significantly enhancing accessibility to the region.

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National Highways Development Programme (NHDP)

- **Launched:** 1998
- **Objective:** To develop roadways matching international standards for smooth and efficient traffic flow.
- **Administered by:** National Highways Authority of India (NHAI), created by an Act of Parliament in 1988.
- **Scope:** Covers development, maintenance, and administration of national highways.

Setu Bharatam Programme

- **Launched:** March 4, 2016
- **Budget:** ₹102 billion
- **Goal:** Eliminate all railway crossings on national highways by 2019 to enhance safety and traffic efficiency.
- **Managed by:** Ministry of Road Transport and Highways

Green Highways (Plantation, Transplantation, Beautification & Maintenance) Policy, 2015

- **Aim:**
 - Reduce air pollution and dust.
 - Improve air quality.
 - Prevent soil erosion.
- **Strategy:** Tree and shrub plantation along national highways.

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Golden Quadrilateral

Backbone of road transport
Connect: **Major Cities, State Capitals, Ports, Rail Junctions, Industrial Zones, Tourist Centers**
Maintained by: **Central Government (NHA)**
Lanes: 4 to 6

Corridor
✓ Delhi-Mumbai
✓ Mumbai-Chennai
✓ Kolkata-Chennai
✓ Delhi-Kolkata

North-South & East-West Corridors

- North-South: Srinagar → Kanyakumari
- East-West: Silchar → Porbandar
- Intersection: Jhansi
- Objective: Faster freight & passenger movement

Expressways

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Important Expressways:

- Mumbai–Pune Expressway
- Kolkata–Dumdum Airport Road
- Durgapur–Kolkata Road
- Yamuna Expressway (connects Delhi to Agra via Greater Noida)

Industrial Corridors



Bharatmala Pariyojana

- **Launched:** Centrally Sponsored
- **Rank:** 2nd largest after NHDP
- **Target:** 34,800 km of new roads
- **Phase-I Approval:** October 2017
- **Outlay:** ₹5.35 lakh crore
- **Focus:**
 - Economic Corridor Development
 - Border & International Connectivity Road
 - Port Connectivity
 - Greenfield Expressways

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Objectives of Bharatmala

- Improve **efficiency of freight and passenger movemen**
- Optimize existing **road network**
- Enhance **connectivity to backward and tribal areas**
- Reduce **logistics cost**
- Integrate with **Sagarmala, industrial corridors, logistics parks**

NHAI (National Highways Authority of India)

- **Established:** 1995 (autonomous)
- **Under:** Ministry of Surface Transport
- **Responsible for:** NH maintenance, development, tolling

Indian Railways

- **First railway line** in India was introduced in **1853**, connecting **Bombay (Mumbai) to Thane**.
- **Nationalization** occurred in **1951**, unifying various regional systems under **Indian Railways (IR)**.
- Today, Indian Railways is:
The **world's largest** railway network under one management.
The **largest in Asia**.
Known for monumental structures like Chhatrapati Shivaji Terminus and heritage hill railways (e.g., Darjeeling, Nilgiri).

DEPARTMENT OF EMPLOYMENT AND TRAINING

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Railway Zones

Indian railways is geographically organized into zones. At present, there are 18 railway zones

Railway Zones	Headquarters
Northern Railway (NR)	Delhi
North-Western Railway (NWR)	Jaipur
North-Eastern Railway (NER)	Gorakhpur
North-East Frontier Railway (NEFR)	Guwahati
North-Central Railway (NCR)	Allahabad
Southern Railway (SR)	Chennai
South-Western Railway (SWR)	Hubli
South-East Railway (SER)	Kolkata
South-East Central Railway (SECR)	Bilaspur
South-Central Railway (SCR)	Secunderabad
Western Railway (WR)	Mumbai
West-Central Railway (WCR)	Jabalpur
Eastern Railway (ER)	Kolkata
East Coast Railway (ECR)	Bhubaneswar
East-Central Railway (ECR)	Hajipur
Central Railway (CR)	Mumbai
Metro Railway	Kolkata
South Coast Railway	Visakhapatnam

DEPARTMENT OF EMPLOYMENT AND TRAINING

TNPSC - UNIT II: GEOGRAPHY MIND MAP

Classification of Indian Railways:

Broad Gauge

- The distance between rails in broad gauge is 1.676 m, covering 46,807 km and accounting for 74.14% of the total length of rail routes in the country.

Metre Gauge

- The distance between rails in meter gauge is 1 m, with a total length of 13,290 km, constituting 21.02% of the total route length.

Narrow Gauge

- The distance between rails in narrow gauge is 0.762 m or 0.610 m, covering 3,124 km and accounting for 4.94% of the total length of Indian railways.

Metro Rail:

City	Year of Inception
Delhi	2002
Bengaluru	2011
Gurgaon	2013
Jaipur	2015
Chennai	2015
Hyderabad	2015
Kochi	2017
Lucknow	2017
Ahmedabad	2019
Nagpur	2019
Noida	2019
Kanpur	2021

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Mumbai–Ahmedabad Bullet Train Project

- ✓ Project: India's first bullet train route.
- ✓ Initiative: Part of the Make in India programme.
- ✓ Station Launch: Surat station to open by 2023.
- ✓ Operational Start: Expected by 2026

Railway in Kashmir

- ✓ Project: Jammu–Udhampur–Srinagar–Baramulla Railway Link (JUSBRL).
- ✓ Total Length: 345 km (from Jammu to Baramulla).
- ✓ Purpose: Integrates Kashmir with the Indian rail network.

Vande Bharat Express (Train 18)

- **Type:** India's first **indigenously built** semi-high-speed train.
- **Designed by:** Integral Coach Factory (ICF), Chennai.
- **Launched:** February 15, 2019.
- **Make in India Initiative.**
- **Composition:** 16 coaches, 1,128 seating capacity.
- **First Route:** Delhi to Varanasi

Mountain Railways of India (UNESCO & Heritage Sites)

1. Darjeeling Himalayan Railway (West Bengal):

- 2 ft (610 mm) narrow-gauge.

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2. Nilgiri Mountain Railway (Tamil Nadu):

- Steam locomotives since **1908**.

3. Kalka–Shimla Railway (Himachal Pradesh):

- 2 ft 6 in (762 mm) gauge; scenic route.

4. Matheran Hill Railway (Maharashtra):

- 20 km from **Neral to Matheran**, Western Ghats.

5. Kangra Valley Railway (Himachal Pradesh):

- 164 km from **Pathankot to Nagar**.

Water Transport in India

- Oldest mode of transport
- Fuel-efficient & eco-friendly
- Ideal for heavy/bulky cargo
- 95% trade by volume
- 70% trade by value
- Top 20 merchant fleets globally
- 12–13 major ports, ~200 minor ports
- Bulk cargo movement
- Coastal shipping
- International & domestic trade
- Cheaper than road/rail
- Environmentally friendly

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Ports in India

✓ Located in **9 coastal states**:
Kerala, Karnataka, Maharashtra, Goa, Gujarat, West Bengal, Odisha, Andhra Pradesh, Tamil Nadu

✓ **Major Ports (13)**

✓ **Managed by Central Govt**

✓ **India ranks:**

2nd in Asia (Ship-owning)

✓ **16th globally**



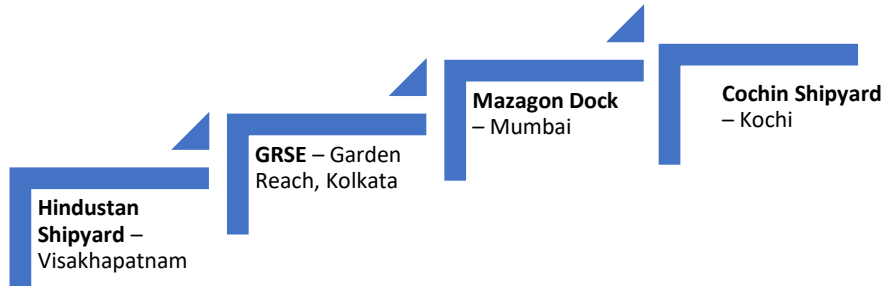
Minor Ports (200+)

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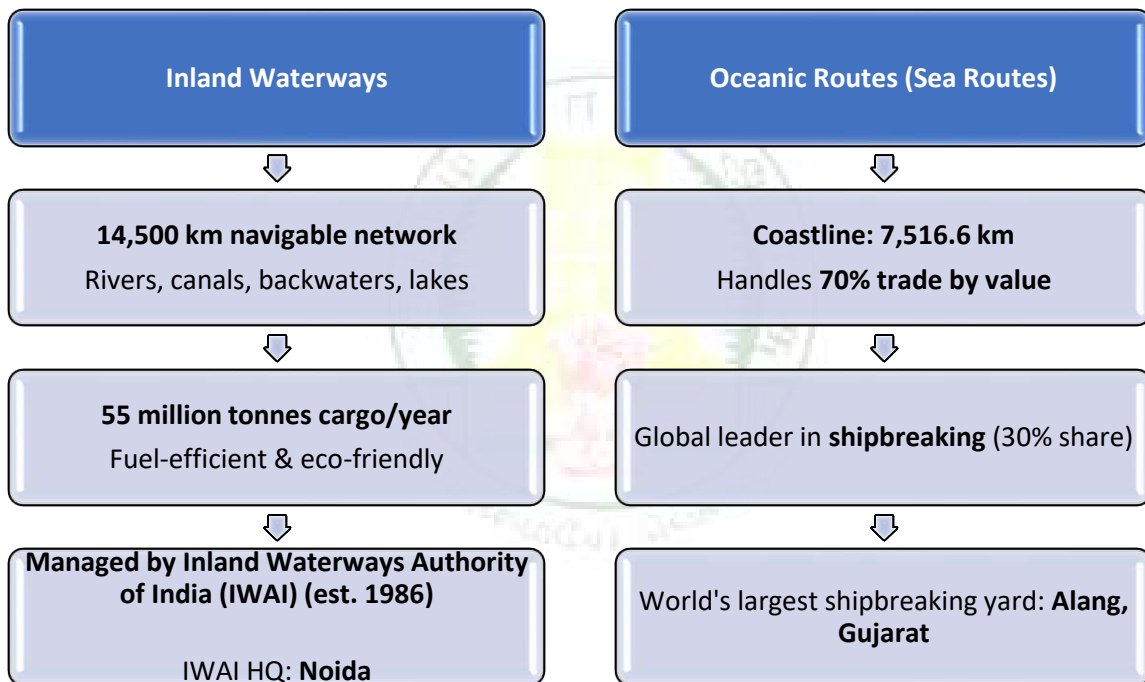
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Managed by State Govts

Shipyards in India



Types of Waterways



Communication

- The postal service
- The postal service was opened to the public in the country in 1837.
- The first Indian postal stamp was issued in 1852 in Karachi.
- Introduced the Quick Mail Service in 1975
- The Quick Mail Service functions on the basis of the system of PIN (Postal Index Number) code which was introduced in 1972.

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- Mass Communication Systems
- Electronic Media: Radio broadcasting in India was started in 1923 by the Radio club of Bombay.
- It was named as All India Radio (AIR) in 1936 and again it was renamed as Akashwani in 1957.
- Satellite Communication
- Indian Space Research Organization (ISRO) established in 1969.
- INSAT-1B launched on 30th August 1983 is the first communication satellite in INSAT series.



Soil and Its Importance

Table of content

- 📌 Introduction
- 📌 Indian Soils
- 📌 Soil Profile (Soil Horizons)
- 📌 Types of Soils
- 📌 Alluvial soil
- 📌 Black soils
- 📌 Red soils
- 📌 Laterite soils
- 📌 Forest and Mountain Soils
- 📌 Desert soils
- 📌 Saline and Alkaline Soils
- 📌 Peaty and Marshy Soils

Introduction:

- Soil is the top layer of the Earth, supporting plant growth, water cycle, and nutrient recycling.
- Formed by weathering of rocks and decomposition of plants/animals.
- Made up of minerals, organic matter, water, and air.

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Indian Soils

- Formed over millions of years by **rock weathering and erosion**.
- Influenced by regions like the **Deccan Plateau, Gangetic Plain, Himalayas, and coastal plains**.

Soil Profile (Soil Horizons):

A soil profile shows the different layers of soil, each with special features.

Horizon	Main Features	Colour
O-Horizon	Organic layer of dead leaves and plants	Dark brown/black
A-Horizon (Topsoil)	Rich in nutrients & humus; key for plants	Dark
B-Horizon (Subsoil)	More minerals, less organic matter; harder	Lighter
C-Horizon	Partly weathered rock; base for soil formation	Depends on rock
R-Horizon (Bedrock)	Solid rock base	Rock color

Types of Soils

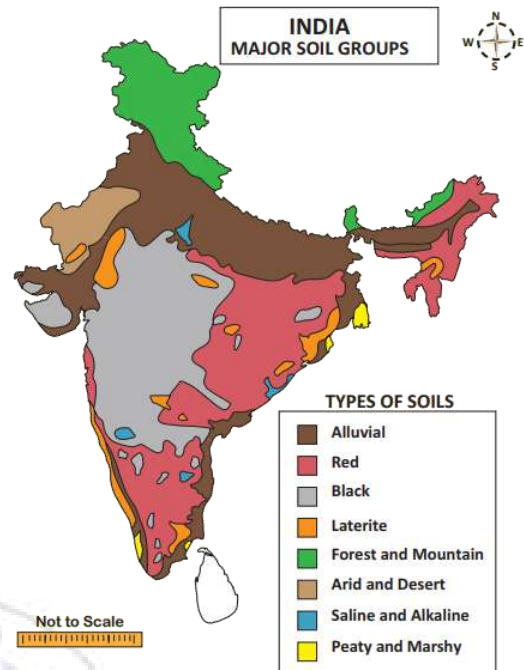
The Indian Council of Agriculture Research (ICAR) set up in 1929 divides the Soils of India into the following eight major Groups

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They are,

- Alluvial soil
- Black soils
- Red soils
- Laterite soils
- Forest and mountain soils
- Arid and desert soils
- Saline and alkaline soils
- Peaty and marshy soils



Alluvial soil:

Characteristics

- Khadar – light coloured, more siliceous.
- Bhangar – the older alluvium composed of lime nodules and has clayey composition. It is dark in color.
- Formation - sediments deposited by streams and rivers when they slowly lose
- Chemical properties - rich in potash, phosphoric acid, lime and carbon compounds but poor in nitrogen
- Nature –Sandy-loam-silt-clay profile shows no marked differentiation

Distribution

- Ganga and Brahmaputra valleys, Uttar Pradesh, Punjab, Haryana, Bihar, West Bengal, and east coast river mouths.

Crops

- They are mostly flat and regular soils and are best suited for agriculture.
- They are best suited to irrigation and respond well to the canal and well/tube-well irrigation.
- They yield splendid crops of rice, wheat, sugarcane, tobacco, cotton, jute, maize, oilseeds, etc..

Black soils:

Characteristics

- **Formation** - Derived from basalts of Deccan trap.
- **Color** - The black color is due to the presence of a small proportion of titaniferous magnetite or iron and black constituents of the parent rock.
- In Tamil Nadu and parts of Andhra Pradesh, the black color is derived from crystalline schists and basic gneisses.
- Various tints of the black color may be found in this group of soils.
- Nature - Sticky when wet with high degree of moisture retentivity

Distribution

Maharashtra, Malwa plateau, Kathiawar, Telangana, northern Karnataka.

Crops

- These soils are best suited for cotton crops. Hence these soils are called regur and black cotton soils.
- Other major crops grown on the black soils include wheat, jowar, linseed, virginia tobacco, castor, sunflower and millets.
- Cotton, Millets, Tobacco, Sugarcane.

Red soils:

Characteristics

- Formation - decomposition of ancient crystalline rocks like granites and gneisses and from rock type
- The red color is due to the presence of iron oxide.
- The colour is more due to the wide diffusion rather than the high percentage of iron oxide content.
- Chemical properties - rich in minerals such as iron and magnesium. Deficient in nitrogen, humus, phosphoric acid and lime.
- Crops growing Wheat, Rice, Cotton, Sugarcane and Pulses

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Distribution:

- These soils mostly occur in the regions of low rainfall.
- They occupy about 3.5 lakh sq km (10.6 per cent) of the total area of the country.
- These soils are spread on almost the whole of Tamil Nadu.
- Eastern Deccan plateau, Kerala, Tamil Nadu, Karnataka, Chota Nagpur plateau.

Crops

- Wheat, Rice, Cotton, Sugarcane, Pulses.

Laterite soils:

Characteristics

- * **Formation** - formed in the regions where alternate wet and hot dry conditions prevail. It is formed by the process of leaching
- * **Chemical properties** - Composed mainly of hydrated oxides of iron and aluminum,
- * **Nature** - More acidic on higher areas poor in high level, cannot retain moisture.

Distribution

- * Laterite soils lack fertility due to intensive leaching.
- * When manured and irrigated, some laterites are suitable for growing plantation crops like tea, coffee, rubber, cinchona, coconut, arecanut, etc.
- * In some areas, these soils support grazing grounds and scrub forests.
- * Assam hills, Kerala, Karnataka, Eastern Ghats, Odisha.

Crops

- * Coffee, Rubber, Cashewnut, Tapioca.

Forest and Mountain Soils:

Characteristics:

- Differ from region to region depending on Climate.
- These soils occupy about 2.85 lakh sq km or 8.67% of the total land area of India.
- They are mainly heterogeneous soils found on the hill slopes covered by forests.
- Formation – due to mechanical weathering caused by snow, rain, temperature variation
- Chemical properties – The forest soils are very rich in humus.
- They are deficient in potash, phosphorus and lime.
- They require a good deal of fertilizers for high yields.
- Nature – light, sandy, thin and found with the pieces of rock.

Distribution:

- Coniferous belts of J&K, Himachal, Uttarakhand, Sikkim, Eastern and Western Ghats.

Crops:

- Coffee, Tea, Rice, Maize, potato, Barley, Tropical Fruits and various types of Spices.

Saline and Alkaline Soils:

Characteristics:

- Formation – formed due to ill drainage which Causes water logging, injurious salts are transferred from subsurface to the top soil by the capillary action, it causes the salinisation of soils
- Chemical properties – Liberate Sodium, Magnesium and calcium salts and sulfurous acid.
- Nature – It consists of an excess of sodium salts and mineral fragments which are weathering.

Distribution:

- Andhra Pradesh, Karnataka, drier parts of Bihar, UP, Haryana, Punjab, Rajasthan, Maharashtra.

Crops:

- Generally unsuitable due to excess salinization.

Desert soils:

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Characteristics

- **Formation** – Due to prevalence of the dry Climate, high temperature and accelerated evaporation, the soil is dry, it also lacks humus content due to the absence of vegetative cover
- **Chemical properties** –High Percentages of soluble salts, alkaline with varying degree of calcium carbonate and are poor in organic matter; rich enough in Phosphate though poor in nitrogen
- **Nature** – light in color, low humus, friable structure, low in moisture

Distibution

- Rajasthan, Northern Gujarat, Southern Punjab.

Crops

- Phosphates and nitrates make these soils fertile wherever moisture is available.
- There is a possibility of reclaiming these soils if proper irrigation facilities are available.
- In large areas, only the drought resistant and salt tolerant crops such as barley, cotton, millets, maize and pulses are grown.

Peaty and Marshy Soils:

Characteristics:

- Formation – formed in humid regions from the Organic matter.
- Chemical properties – Deficient in potash and Phosphate.
- Nature – Contain a considerable amount of Soluble salts and 10-40 percent of organic matter and a high proportion of vegetable matter.

Distribution:

- Kerala (Kottayam, Alappuzha), coastal Odisha, Tamil Nadu, Sundarbans, Bihar, Uttarakhand.

Crops:

- Paddy, Jute

Population Density and Distribution

Table of Content

- ❖ Population Growth
- ❖ Population Distribution
- ❖ Population Density
- ❖ Population Composition
- ❖ Urbanization
- ❖ Total Fertility Rate (TFR)
- ❖ Tamil Nadu – Demographic and Administrative Data (2011 Census)

Introduction

- ✓ India is the second most populous country in the world (after China) with a population of 1,210 million (2011).
- ✓ India's population is larger than the combined population of North America, South America, and Australia.
- ✓ A large population puts pressure on resources and is linked to various socio-economic problems.

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The Theory of Demographic Transition

Proposed by Frank W. Notestein

First Census is conducted in 1872

First Complete and Synchronous Census conducted in 1881

World Population day – 11th July - From 1987

National Population Day – February 9th

700th crore baby of the World is Nargis

15th Census is conducted in 2011. It is seventh census after Independence

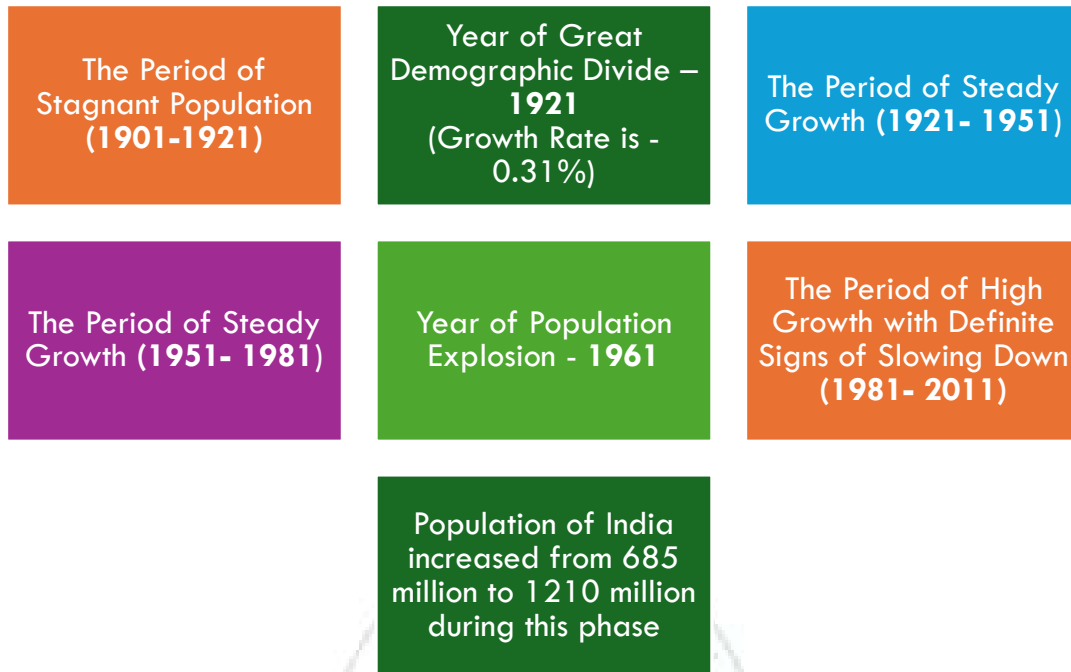
Theme: Our Census; Our Future

2011 Census - 1,21,01,93,422 (17.5% of the World)

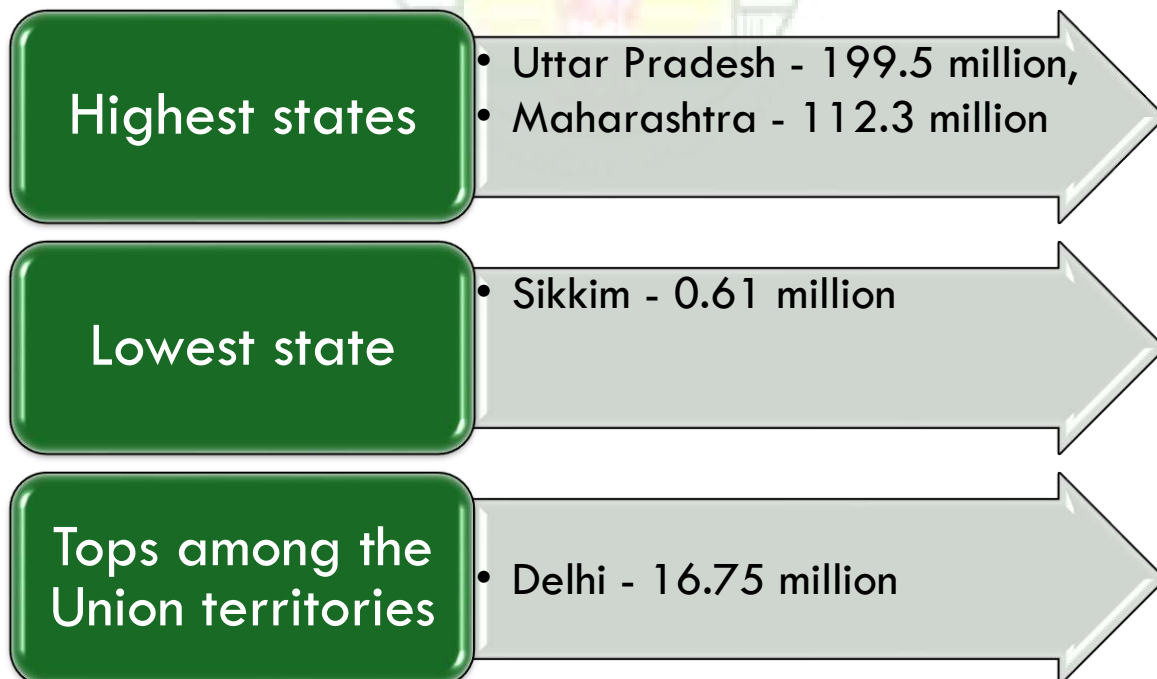
Total population of Uttar Pradesh, Maharashtra is greater than the population of United States

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Population Growth



Population Distribution



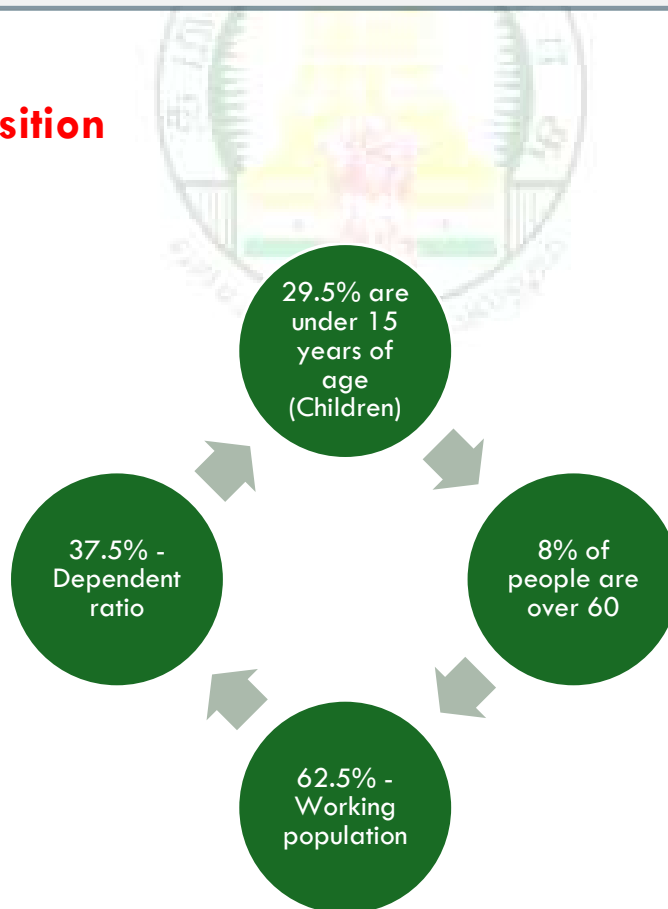
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Population composition

Population composition refers to the characteristics such as age, sex, marital status, caste, religion, language, education, occupation etc.

Age composition



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Sex Ratio:

- Sex ratio is defined as the number of females per 1000 male population
- Sex ratio of India -940 Females Per 1000 Males.
- This suggests that the size of female population is lower than males.
 - a. 1084 – Kerala (Highest sex ratio)
 - b. 1037 – Puducherry
 - c. Daman and Diu – 618 (Lowest sex ratio)

Literacy Rate:

The people who are able to read and write are known as literates.

The percentage of literate people to the total population is termed as literacy rate.

There has been a steady improvement in the literacy levels in India

India's literacy rate - 74.04% . Male - 82.14% . Female - 65.46% .

It shows that still there is a vast gap (16.68%) between the male and female literacy rates.

Kerala - 93.91% (Highest)

Lakshadweep - 92.28% (Second)

Bihar - 63.82 % (Lowest)

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Urbanization:

- The process of society's transformation from rural to urban is known as urbanization.
- The level of urbanization is measured in terms of percentage of urban population.
- Urban Population - 27.82% in 2001 and 31.16% in 2011
- Most Urbanized State – Goa - 62.17%
- Least Urbanized State - Himachal Pradesh - 10.04%
- Most Urbanized Union territory - Delhi

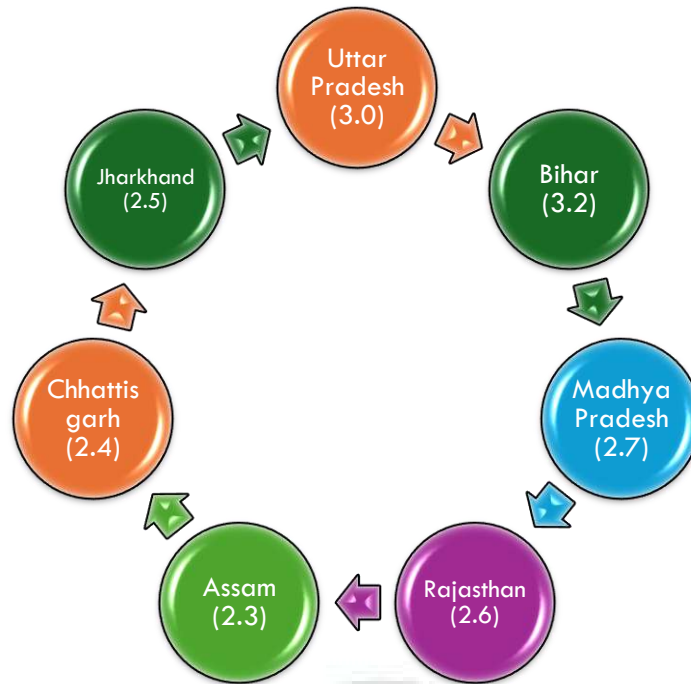
Total Fertility Rate (TFR):

- The Total Fertility Rate (TFR) represents the average number of children a woman is expected to have by the end of her reproductive age. It is a critical indicator of population growth trends.

States with Higher TFR:

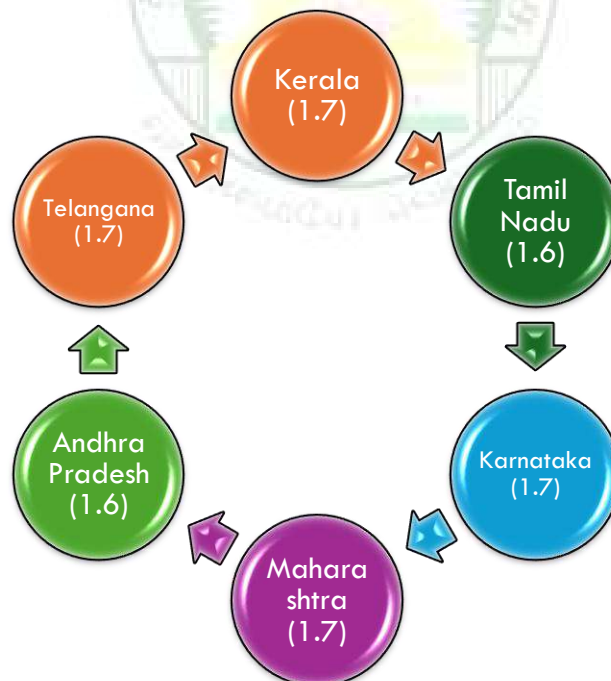
- Seven states have recorded TFRs higher than the national average of 2.2:

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States with Lower TFR:

- Well-off southern states recorded TFR below the replacement rate:



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Tamil Nadu Demographic and Administrative Data (2011 Census)

Category	Value/TopDistricts
Sex Ratio (females/1000males)	995
Child Sex Ratio	946
Population Density (/km ²)	555
Overall Literacy Rate	80.09%
Male Literacy Rate	86.77%
Female Literacy Rate	73.44%
Total Population (2011)	72 million
State's Area Rank in India	11th largest
State's Population Rank in India	7th most populous

Ranking of Districts by Population Size

Rank	District
------	----------

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1	Chennai
2	Kancheepuram
3	Vellore
4	Thiruvallur
5	Salem

Ranking of Districts by Sex Ratio

Rank	District	Sex Ratio
1	Nilgiris	1041
2	Thanjavur	1031
3	Nagapattinam	1025
4	Thoothukkudi	1024
5	Tirunelveli	1024

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Districts with the Lowest Sex Ratio

Rank	District	Sex Ratio
1	Dharmapuri	946
2	Salem	954

Ranking of Districts by Literacy Rate

Rank	District
1	Kanyakumari
2	Chennai
3	Thoothukkudi
4	Nilgiris
5	Kancheepuram

Lowest Literacy Rate

Rank	District
1	Krishnagiri
2	Viluppuram
3	Ariyalur
4	Dharmapuri

Largest Districts by Area

Rank	District
1	Viluppuram
2	Tirunelveli
3	Tiruvannamalai
4	Vellore

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Dindigul

Smallest Districts by Area

Rank	District
1	Karur
2	Ariyalur
3	Nilgiris
4	Perambalur



Forest and Wildlife

Table of content

- Types of forests in India
- Tropical Evergreen Forest
- Tropical Deciduous Forest
- Tropical Dry Forest
- Semi-desert Vegetation
- Mountain Forest
- Alpine Forest
- Tidal Forest
- Coastal Forest
- Riverine Forest
- Wildlife
- The Indian Board for Wildlife (IBWL)
- Biosphere Reserves in India

Introduction:

Natural vegetation means plants that grow on their own without human help. In India, the types of natural vegetation vary because of differences in climate, soil, and land features:

1. **Climate:** India has many kinds of weather. Areas with a lot of rain, like the Western Ghats and Northeast India, have thick forests. Dry places like Rajasthan have few plants that can survive with little water.
2. **Soil:** Soil types affect what plants grow. Rich alluvial soil in the Gangetic plains helps many plants grow. Sandy soil in deserts supports only a few tough plants.
3. **Topography (Land Features):** The shape and height of land also matter. Mountains like the Himalayas and Western Ghats have different kinds of forests due to changes in height and weather. Plains and coastal areas have different types of plants.

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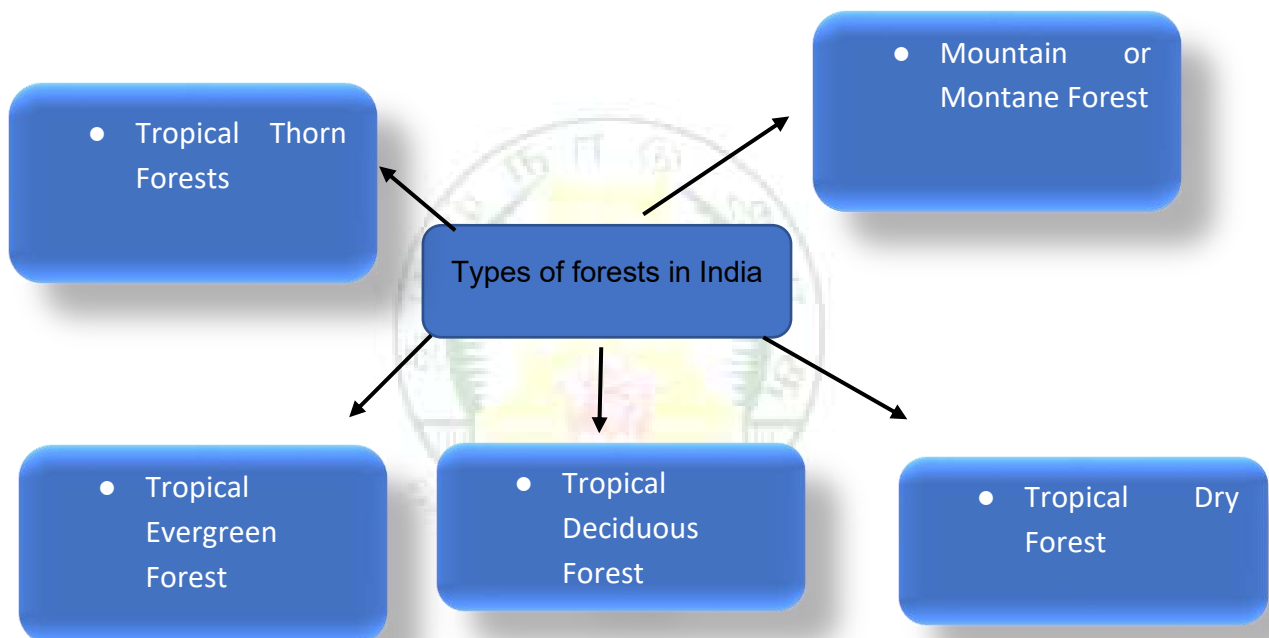
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Green Cover in India

- Total Forest & Tree cover – 8,02,088 sq. k.m – (24.39%)
- Total Forest cover – 7,08,273 sq.km
Tree cover – 93,815 sq km



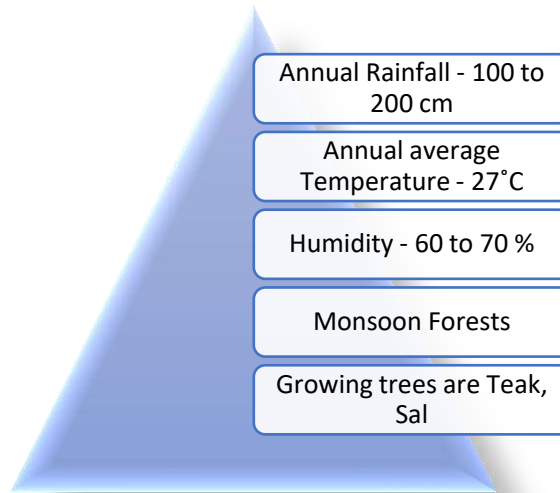
Tropical Evergreen Forest

- Annual Rainfall is 200 cm or more
- Annual average Temperature is 22°C more
- Humidity exceeds 70%
- Growing Trees are Rubber, Ebony, Rosewood, Coconut, Bamboo, Cinchona, Cedar

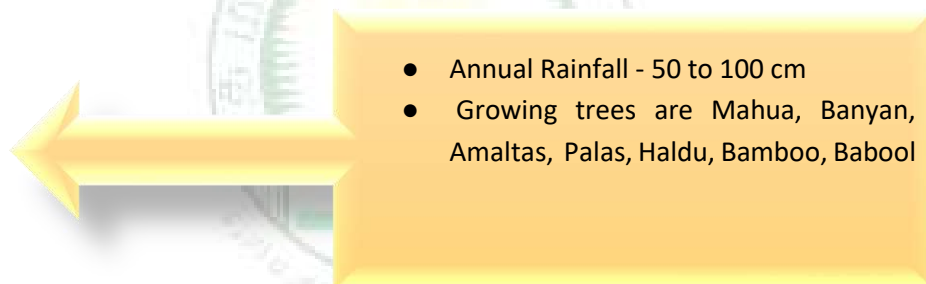
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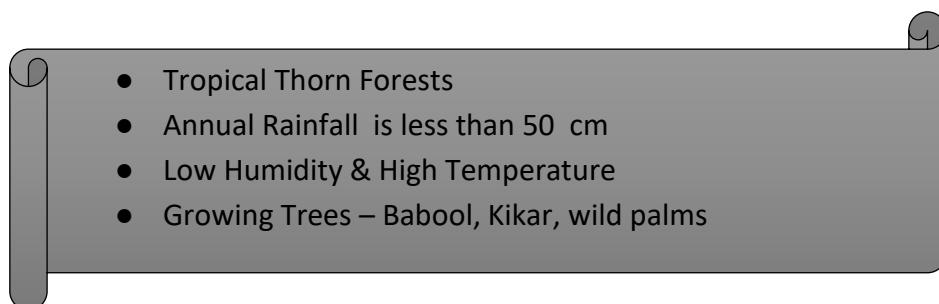
Tropical Deciduous Forest



Tropical Dry Forest



Semi-desert Vegetation



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Mountain Forest

Eastern Himalayan forest

- Annual Rainfall more than 200 cm
- Height - 1200-2400 m
- Growing trees are Sal, Oak, Laurel, Amura, Chestnut
- Oak, birch, silver, fir, pine, spruce and juniper are the major trees found at the altitude of 2400 to 3600m

Western Himalayan Forest

- Upto 900 m - semi desert vegetation
- 900 - 1800 m – chir tree
- 1800 - 3000 m – semi temperate coniferous forests
- The other important trees of this region are sal, semal, dhak, jamun and jujube

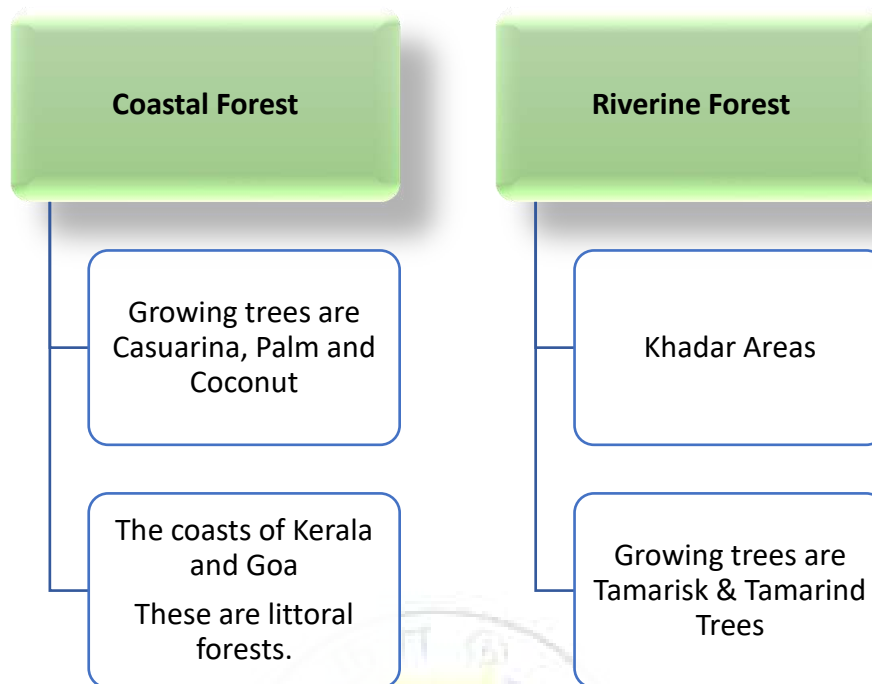
Alpine Forest

- It occurs all along the Himalayas with above 2400 m altitude. These are purely coniferous trees.
- The Eastern parts of the Himalayas have a large extent of these forests.
- Growing trees are Oak, Silver, Fir, Pine, Juniper

Tidal Forest

- Delta or Swamp forests
- Deltas, Estuaries and Creeks prone
- Delta of the Ganga-Brahmaputra

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Wildlife

India has a rich and diversified wildlife. The Indian fauna consists of about 81,251 species of animals out of the world's total of about 1.5 million species.

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Species	81,251
Invertebrates	6500
Molluscs	5000
Fishes	2546
Birds	1228
Mammals	458
Reptiles	446
Amphibians	204
Panthers	4
Insects	60,000

The Indian Board for Wildlife (IBWL)

It was constituted in 1952 to suggest means of protection, conservation and management of wildlife to the government

The Government of India enacted the Wildlife (Protection) Act in 1972 with the objective of effectively protecting the wildlife of the country and to control poaching, smuggling and illegal trade in wildlife and its diversities

To preserve the country's rich and diverse wildlife a network of 102 National Parks and about 515 Wildlife Sanctuaries across the country have been created.

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Biosphere Reserves in India

- Biosphere reserves are protected areas of land coastal environments
- The Indian government has established 18 Biosphere Reserves
- In India Project Tiger was launched in April 1973 with the aim to conserve tiger population in specifically constituted “Tiger Reserves” in India.
- Eleven of the eighteen biosphere reserves (Gulf of Mannar, Nandadevi, the Nilgiris, Nokrek, Pachmarhi, Simlipal, Sundarbans Agasthiyamalai, Great Nicobar, Kanjanjunga and Amarkantak) of India fall under the list of Man and Biosphere programme of UNESCO.

S.No.	Biosphere reserves	state
1	Achanakmar-Amarkantak	Madhya Pradesh, Chattisgarh
2	Agasthiyamalai	Kerala
3	Dibru Saikhowa	Assam
4	Dihang Dibang	Arunachal Pradesh
5	Great Nicobar	Andaman and Nicobar Islands
6	Gulf of Mannar	Tamil nadu
7	Kachchh	Gujarat
8	Kanchenjunga	Sikkim
9	Manas	Assam
10	Nanda Devi	Uttarakhand

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11	The Nilgiris	Tamil nadu
12	Nokrek	Meghalaya
13	Pachmarhi	Madhya Pradesh
14	Simlipal	Odisha
15	Sundarbans	West Bengal
16	Cold desert	Himachal Pradesh
17	Sesahachalam hills	Andhra Pradesh
18	Panna	Madhya Pradesh



Agriculture pattern

Table of content

- ✓ **Types of Farming**
- ✓ **Cropping Seasons in India**
- ✓ **Irrigation**
- ✓ **Major Crops Cultivated in India**
- ✓ **Livestock**
- ✓ **Fisheries**

Introduction:

- The agriculture in India employs more than 50 percent of the population of the country and accounts for about 25 percent of the national income.
- Agriculture in India is determined by a set of factors. Some of the important factors:
 1. Physical factors: relief, climate and soil.
 2. Institutional factors: Size of farm holdings, land tenure, and land reforms.
 3. Infrastructural factors: Irrigation, power, transport, credit, market, insurance and storage facilities.
 4. Technological factors: High yielding varieties of seeds, chemical fertilisers, insecticides and machinery.

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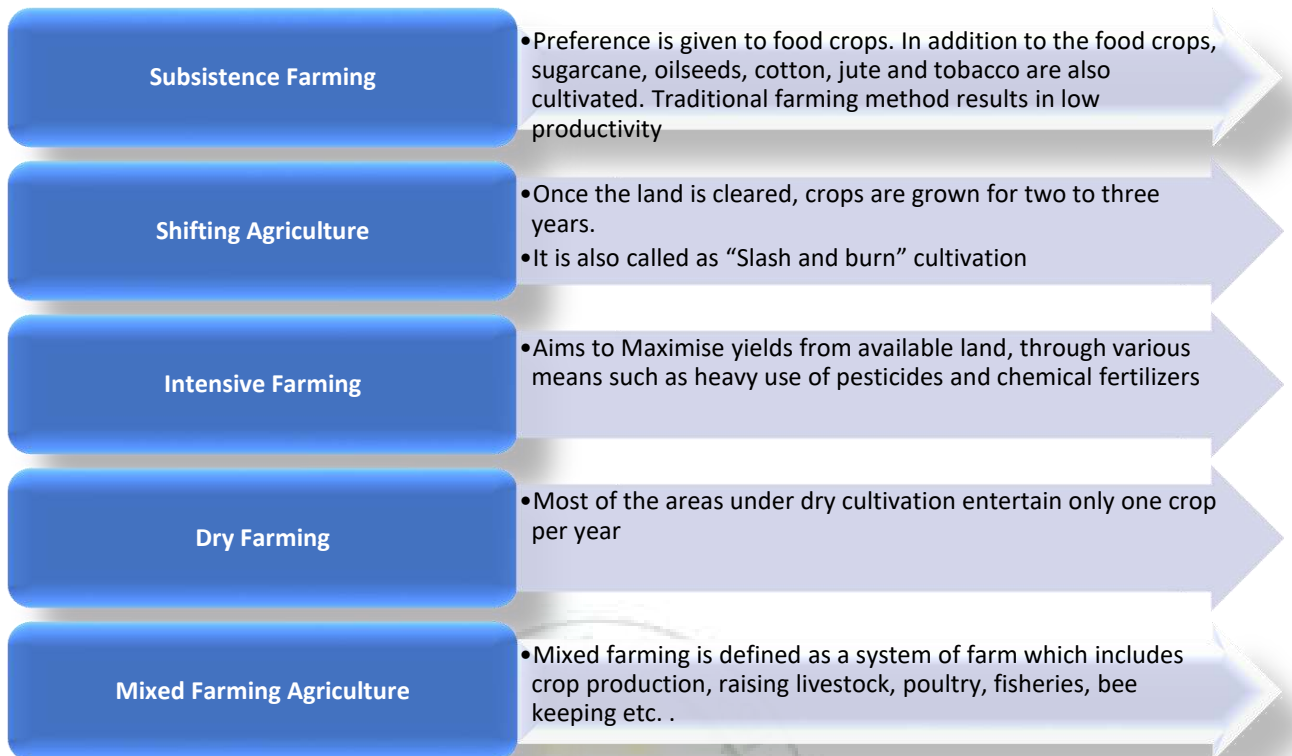
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Types of Farming



Different names of shifting agriculture in different regions in India

Name	Place
Jhum	Assam
Poonam	Kerala
Podu	Andhra Pradesh, Odisha
Beewar, Mashan, Penda, Beera	Various Parts of Madhya Pradesh

Cropping Seasons in India

Cropping Seasons	Northern States- Major crops cultivated	Southern States- Major crops cultivated

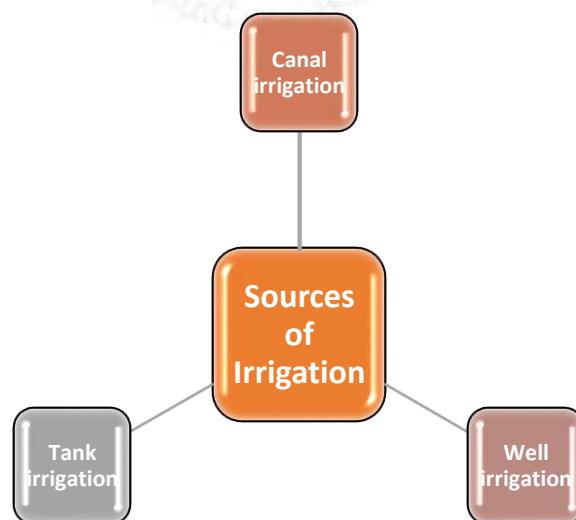
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Kharif Season June– September	Rice, Cotton, Bajra, Maize, Jowar, Tur	Rice, Ragi, Maize, Jowar, Groundnut
Rabi Season October–March	Wheat, Gram, Rapeseeds, Mustard, Barley	Rice, Maize, Ragi, Groundnut, Jowar
Zaid Season April–June	Vegetables, Fruits, Fodder	Rice, Vegetables, Fodder

Irrigation

- Watering of agricultural plants through artificial means is called irrigation.
- Being a hot country with seasonal and irregular rainfall, it always needs irrigation to carry out agricultural activities during dry period.



Canal Irrigation

	<ul style="list-style-type: none">● It is the second most important source of irrigation in our country.● Percentage of area under canal irrigation in our country is 24%.● The canals are of two types:<ul style="list-style-type: none">▪ Inundation Canals: In this, water is taken out directly from the rivers without making any kind of barrage or dam▪ Perennial Canals: These are developed from perennial rivers by constructing barrage to regulate the flow of water.● About 60 percent of the canal irrigated area falls in the northern plains of India.

Well Irrigation

- A well is a hole or trough, usually vertical, excavated in the earth for bringing Ground water to the surface.
- Wells are of two types:
 - **Open wells:** This type of irrigation is widely practiced in the areas where groundwater is sufficiently available.
 - **Tube Wells:** Tube wells are developed in the areas of low water table, sufficient power supply and soft subsurface geological units.
- Well irrigation is the most important source of irrigation as it contributes about 62 percent of net irrigated area in India.
- The top of percentage of areas under well irrigation -Uttar

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Tank Irrigation:

- Irrigation by tanks is a very old system in India.
- The tank irrigation is popular in the peninsular India due to the following reasons:
 - The undulating relief and hard rocks make difficult to dig canals and wells.
 - Natural depressions serve as reservoirs.

Top state of tank Irrigation-Tamil Nadu

Modern irrigation methods:

- **Drip System:** This is introduced by Israel country.70% of water can be saved by this irrigation system
- **Rain Gun:** used to serve for crops which used to grow up to 4 feet or high also typical usage of Rain guns are in sugarcane, maize crop.
- **Central-pivot irrigation:** It is also called waterwheel and circle irrigation. It is a method of crop irrigation in which equipment rotates around a pivot and crops are watered with sprinklers
- 2015-Prime Minister Krishi Sinchayee Yojana: Improve On-farm water use efficiency to reduce wastage of water.

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Major Crops Cultivated in India

Food Crops

Rice

- Rice is an indigenous crop.
- India is the second largest producer of rice in the world after China.
- It is mainly a tropical crop, growing mainly with mean temperatures of 24°C and annual rainfall of 150 cm.
- Deep fertile clayey or loamy soils are suited well for rice cultivation.

Wheat

- Wheat is the second most important food crop of the country, after rice.
- It accounts for 22 percent of the total area and 34 percent of the total production of food grains in the country.
- It requires 10-15°C at the time of sowing and 20-25°C at the time of ripening of grains.

Jowar

- Jowar is the third important food crop of our country.
- It is an indigenous plant of Africa.
- The plant has a tendency to grow in adverse climatic conditions.

Bajra

- Bajra is an indigenous plant of Africa.
- This forms the staple food for poor people.
- Its stalks are used as fodder for cattle and for thatching roofs.

Barley

- Barley is one of the important cereals of our country. Besides, being poor man's diet, it is used for making barley water, beer and whiskey.

Pulses

- Pulses include a large number of crops which are mostly leguminous and rich in vegetable protein.
- India is the largest producer of pulses.

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Cash Crops

Sugarcane

- India is the second largest producer in the world.
- India is ranked third in sugar production in the world after Cuba and Brazil.
- At the state level, Uttar Pradesh is the leading producer of sugarcane

Cotton

- It provides raw material to the largest industry of India.
- India ranks second next to China in the production of cotton.

Jute

- It is a tropical fibre crops, grows well in the alluvial soil
- West Bengal is the leading state both in cultivation and production of jute.

Oil Seeds

- Oil seeds, the premier source of fat in the Indian diet .
- Gujarat is India's largest oilseeds producing state.
- In groundnut production, India is the second largest producer in the world after China.

Plantation Crops

Tea

- Tea is an evergreen plant that mainly grows in tropical and subtropical climates.
- Two major varieties of tea are cultivated in India.
- They are i) Bohea originated from China and ii) Assamica from India.

Coffee

- Coffee is grown in shade.
- India is the 7th largest producer of coffee globally.
- Karnataka is the leading producer of coffee in India.

Rubber

- Rubber plantations were first established in Kerala in 1902.
- It needs hot and wet climatic conditions (temperature above 20°C and rainfall above 300cm).

Spices

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Kerala is the leading producer of spices in India.

Horticulture Crops

- It refers to the cultivation of fruits, flowers and vegetables.
- India is in the second position in the production of fruits and vegetables

Livestock

- Livestock is an integral component of the farming system in India.
- Livestock sector contributes approximately 4 percent of national GDP and 25.6 percent to agriculture GDP.
- First Livestock Census in India was conducted with the title of Dairy Cattle Census in 1919.
- Following this, the 19th Livestock census was conducted in October 2012 and it takes place at every five years

Cattle

Cattle constitute 37.3 percent of livestock population in India.
India has second largest cattle population after Brazil at World level.

Goats

- The goat is the poor man's cow providing milk, meat, skin and hair.
- It is the main source of meat for the country.
- Rajasthan records first with 16 percent followed by Uttar Pradesh and Bihar

Buffaloes

Uttar Pradesh Uttar Pradesh has the highest number of buffaloes (28.2%) followed by Rajasthan (9.6%) and Andhra Pradesh (7.9%).

Dairy, Meat and Wool Production

- The total production of milk in our nation is 163.7 million tonnes.
- The leading producer was Uttar Pradesh followed by Rajasthan and Madhya Pradesh in total milk production.
- Uttar Pradesh is the leading producer in meat production.
- The leading state in the wool production is Rajasthan

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Fisheries

Inland or Fresh Water Fisheries

About 50 percent of the country's total fish production comes from the inland fisheries and Andhra Pradesh is the leading producer in India.

Marine or Sea Fisheries:

Kerala leads in the marine fish production in India.

List of important Agricultural Revolutions in India

Revolution	Related Product
Yellow Revolution	Oil seed Production (Especially Mustard and Sunflower)
Blue Revolution	Fish Production
Brown Revolution	Leather / Cocoa / Non-Conventional Products
Golden Fibre Revolution	Jute Production
Golden Revolution	Fruits / Honey Production / Horticulture Development
Grey Revolution	Fertilizers
Pink Revolution	Onion Production / Pharmaceuticals / Prawn Production
Evergreen Revolution	Overall Production of Agriculture
Silver Revolution	Egg Production / Poultry Production
Silver Fibre Revolution	Cotton
Red Revolution	Meat Production / Tomato Production

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Round Revolution	Potato
Green Revolution	Food Grains
White Revolution	Milk Production



Monsoon, rainfall, weather, and climate

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- ✚ Climate of Tamil Nadu
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- ✚ Monsoon in Tamil Nadu

Introduction

➤ Climate is the long-term average of weather conditions in a region, usually measured over 30+ years.

➤ Key Elements: It includes temperature, humidity, precipitation, wind, and atmospheric pressure.

➤ Difference from Weather: Unlike daily-changing weather, climate describes consistent patterns that influence nature and human life.

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Director,

Department of Employment and Training.

Factors Influencing Climate

Latitude

India's location from 8° 4'N to 37° 6'N leads to climatic diversity.
South of Tropic of Cancer: Tropical, hot year-round.
North of Tropic: Subtropical, with clear seasonal variation.

Altitude

Temperature decreases by 6.5°C per 1000 m altitude.
Mountainous regions are cooler than plains.

Distance from Sea

Coastal regions: Moderate temperatures, high humidity and rainfall.
Inland regions: Extreme temperature fluctuations, less rainfall.

Monsoon Winds

Seasonal reversal: Southwest monsoon (heavy rain) and northeast monsoon (affects SE India).
Responsible for India's equable (moderate) climate.

Relief (Topography)

Himalayas block cold winds → warm northern winters.
Windward vs. leeward effect: Mangalore (280 cm rain), Bengaluru (50 cm).

Jet Streams

High-altitude winds that influence the onset of the monsoon.
Subtropical westerly jet is critical in shifting monsoon systems.

Monsoon System

"Monsoon" = season (Arabic origin).
Brings summer rain from SW, reverses in winter.
Central to India's seasonal climate pattern.

Climate of India

Climate Type & Seasons

- India has both tropical and subtropical climates.
- Four major seasons:
 - Winter (Jan–Feb)
 - Summer (Mar–May)
 - Southwest Monsoon (Jun–Sep)
 - Post-monsoon / Northeast Monsoon (Oct–Dec)

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Rainfall Patterns

- Monsoons create distinct wet and dry seasons.
- Rainfall varies extremely:
 - **Mawsynram & Cherrapunji:** ~1100 cm (wettest)
 - **Jaisalmer & Ladakh:** ~12 cm (driest)
- Southwest Monsoon (June–Sept) brings rain to most regions like the Ganga delta and Odisha.
- The Coromandel Coast remains mostly dry during this and gets rain from the Northeast Monsoon (Oct–Dec).
- Monsoon reaches Goa/Hyderabad/Patna by early June, and northwest India by early July.

Temperature Variations

- Thar Desert has scorching days and cold nights.
- Himalayan regions face extreme cold in winter, mild summers.
- Coastal areas have minimal temperature variation due to the ocean.
- In December, Jammu & Kashmir can drop to -40°C , while coastal areas remain at $20\text{--}25^{\circ}\text{C}$.
- Summers are intensely hot in plains and deserts; winters are moderate to severely cold depending on the region.

Seasons of India

Meteorologists recognize four distinct seasons in India:

- ✚ **Winter Season** (January – February)
- ✚ **Summer Season** (March – May)
- ✚ **Southwest Monsoon or Rainy Season** (June – September)
- ✚ **Northeast Monsoon Season** (October – December)

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Winter Season (January – February)

- Sun's rays fall on the Tropic of Capricorn, resulting in slanting rays over India and cool temperatures.
- Clear skies, low humidity, and large day-night temperature variations are common.
- Rainfall occurs in:
 - Western Himalayas, Tamil Nadu, Kerala, aiding winter crop cultivation.
- Pressure Pattern:
 - High pressure in the north; low pressure in the south.
 - Winds flow from NW to SE, but with low velocity.
- Western Disturbances (from the Mediterranean) bring:
 - Rain to Indus-Ganga plains, snowfall in Himalayas, cold waves and fog.
- Tropical Cyclones:
 - Rare, but some form in the Bay of Bengal and impact Tamil Nadu.
- Winter Monsoon Rain:
 - Affects Tamil Nadu, Andhra Pradesh, Karnataka, and Kerala.

Summer Season (March – May)

- Sun's rays shift northward, increasing temperatures from south to north.
- Very high temperatures in central and north India:
 - Southern India: 40–45°C
 - Rajasthan: Up to 48°C
 - Record: Alwar (50.5°C), Ganganagar (50.6°C)
- Coastal areas remain cooler due to maritime winds.
- Heatwaves:
 - Frequent in Rajasthan, Punjab, UP, Bihar.
 - Rare below 13°N latitude due to sea influence.
- Low pressure develops, especially in NW India, delaying monsoon.
- Hot winds:
 - Loo: Dry, dusty winds (30–40 km/h) blow across NW India.
 - Andhis: Dust storms in north India bring temporary cooling.
- Thunderstorms:
 - Norwesters (Kalbaisakhi) in Bengal & Assam — help tea/jute crops.
 - Mango showers in Kerala/Karnataka aid fruit ripening.
- Cyclones:
 - Frequent in Bay of Bengal, rare in Arabian Sea.
- Rainfall is limited, mostly in NE India and Kashmir (via western disturbances).

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Southwest Monsoon (June–September)

Key Features

- Onset: Begins in Kerala in early June; covers entire India by mid-July.
- Rainfall: Contributes 75% of India's annual rainfall.
- Burst: Arrives with thunder and lightning (called "burst of monsoon").

Two Branches

- Arabian Sea Branch:
 - Hits Western Ghats → heavy orographic rainfall (400–500 cm).
 - Leeward areas get little rain (30–50 cm); Rajasthan receives less due to Aravalli alignment.
 - Streams: Western Ghats, Central India (Narmada/Tapti), Rajasthan (low rainfall except Mt. Abu).
- Bay of Bengal Branch:
 - NE India stream: Heavy rain in Mawsynram & Cherrapunji.
 - Ganga Plain stream: Rain decreases from east to west.
 - Tamil Nadu stays dry due to rain shadow effect and parallel winds.

Breaks in Monsoon

- Occur in July–August; cause temporary dry spells.
- Caused by:
 - Northward shift of monsoon trough (ITCZ).
 - Cyclones drawing away moisture.

El Niño Effect

- El Niño warms Pacific Ocean → weakens Indian monsoon → drought.
- In winter El Niño, more cyclones form in Bay of Bengal.

Northeast Monsoon (October–December)

Formation

- Occurs after SW monsoon withdrawal.
- Wind reversal due to southward shift of pressure belts.
- Winds blow from northeast over Bay of Bengal → pick up moisture.

Rainfall Distribution

- Brings rain to Tamil Nadu (35% of annual), Andhra Pradesh, Kerala, and South Interior Karnataka.
- Linked with Bay of Bengal cyclones and depressions.

Weather Conditions

- Intense rainfall, strong winds, and coastal flooding.
- Drop in temperatures marks start of cooler weather.

Importance

- Crucial for Tamil Nadu agriculture, especially where SW monsoon is weak.
- Cyclones during this period can cause floods and severe damage.

Monsoon Winds and Seasons

Monsoons dominate India's climate, causing seasonal wind reversal and rainfall.

Two main types:

- **Southwest Monsoon (June–Sept):** Brings heavy rain across most of India.
- **Northeast Monsoon (Oct–Dec):** Brings rain mainly to **Tamil Nadu** and **SE Andhra Pradesh**.



Tropical Cyclones and Western Disturbances

Tropical Cyclones

Form in **Bay of Bengal** and **Arabian Sea**.

Strongest during **retreating monsoon (Oct–Nov)**; mainly affect **east coast**.

Western Disturbances

Come from the **Mediterranean Sea**.

Cause **winter rain and snow** in **North India and Himalayas**.

El Niño, La Niña, and ENSO

El Niño	La Niña	ENSO
<ul style="list-style-type: none">* Warming of central/eastern Pacific Ocean.* Weakens Indian monsoon, causes low rainfall and drought.* Reduces cyclone formation in Bay of Bengal.	<ul style="list-style-type: none">* Cooling of Pacific waters (opposite of El Niño).* Strengthens monsoon, causes heavy rain and flood risk.* More cyclones in Bay of Bengal.	<ul style="list-style-type: none">* Interaction between ocean temperatures and pressure systems in the Pacific.* During El Niño + Southern Oscillation, monsoon weakens, causing dry conditions in India.

The Indian Monsoon: Formation, Influencing Factors, and Theories

Southwest Monsoon – Formation & Factors

- Tibetan Plateau Heating: Creates low pressure, pulls moist winds.
- High Pressure near Madagascar: Pushes moisture-laden winds toward India.

Onset Influencers:

- Subtropical Jet Stream (STJ) shifts north.
- Tropical Easterly Jet brings ocean moisture.
- ITCZ moves north, guiding monsoon winds into India.

Intensity Influencers:

- Strength of pressure systems.
- Somali Jet & Current carry moisture.
- Walker Circulation & Indian Ocean Dipole affect rainfall spread.

Northeast Monsoon – Formation

- High-pressure zones over Tibet and Siberia push dry winds south.
- ITCZ shifts south, helping form northeast monsoon.
- Affects Tamil Nadu and southern India during Oct–Dec.

Theories Explaining Indian Monsoons

Classical Theory – Sir Edmund Halley

- Monsoon is like a giant land-sea breeze
- Summer: Land heats faster → low pressure → moist air from sea → rain.
- Winter: Land cools faster → high pressure → air flows to sea → dry winds (NE monsoon)
- Limitation: Doesn't explain monsoon variability, bursts, or delays.

Modern Theories

- Include jet streams, ocean currents, and global climatic phenomena
- El Niño & La Niña
- Indian Ocean Dipole (IOD)
- Walker Circulation

Distribution of Rainfall and Heatwaves in India

Rainfall Distribution in India

- Average Rainfall: ~118 cm annually; uneven across regions.

Rainfall Zones:

- Heavy Rainfall (>200 cm): Western coast, Assam, Meghalaya, Tripura, Nagaland, Arunachal.
- Low Rainfall (<100 cm): Rajasthan, Punjab, Haryana, Deccan Plateau (except TN coast).
- Moderate Rainfall (100–200 cm): Rest of India.

Key Influencing Factors:

- Moisture-laden Westerlies from Arabian Sea.
- Monsoon Trough shift:
 - Southward = More rain in central/south India.
 - Northward = More rain in Himalayas.
- Offshore Trough & Wind Shear Zone boost coastal and central rainfall.
- Cyclonic Systems from Bay of Bengal bring rain inland.

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Heatwaves in India

Definition & Criteria (IMD):

- High temperatures, mostly during March–June.
- Heatwave if:
 - Plains $\geq 40^{\circ}\text{C}$, Hilly $\geq 30^{\circ}\text{C}$, Coastal $\geq 37^{\circ}\text{C}$.
 - Deviation of $5\text{--}7^{\circ}\text{C}$ above normal or $>45^{\circ}\text{C}$ overall.

Causes:

- Hot, dry air & clear skies.
- Lack of moisture.
- Anticyclones trap heat.
- Climate change & vulnerable geography.

Impacts:

- Health issues: 730 deaths (2023).
- Water shortage, power demand surge.
- Crop damage, wildfires.

Climate of Tamil Nadu

General Climate	<ul style="list-style-type: none">• Tropical climate with high temperatures year-round.• Experiences three rainfall periods and a distinct dry season.
Rainfall Patterns	<ul style="list-style-type: none">• Advanced Rainfall – Pre-monsoon showers before the main monsoon.• Tropical Cyclone Rainfall – Oct–Nov cyclones from the Andaman Sea bring rain.• Northeast Monsoon (Oct–Dec) – Tamil Nadu's main rainy season, due to northeast winds and Bay of Bengal disturbances.
Dry Season	<ul style="list-style-type: none">• Feb to early June: Hot and dry.• Monsoon period: Mid-June to December, refills water sources.• Monsoon failure causes droughts due to rain dependence.
Agro-Climatic Zones	<ul style="list-style-type: none">• North-East Zone• North-West Zone• Western Zone

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Geographical Influence	<ul style="list-style-type: none"> Southern Zone High Rainfall Zone High Altitude Hilly Zone Cauvery Delta Zone (most fertile agricultural zone)
	<ul style="list-style-type: none"> Near Equator → Receives vertical sun rays, stays hot. East Coast → Tropical maritime climate (moderated by sea). Western Hills → Cooler due to elevation. Interior Areas → Hotter and drier due to low altitude and sea distance.

Seasons of Tamil Nadu

Tamil Nadu has **4 distinct seasons**, influenced by the **Sun's position**:

Season	Period
Winter	January – February
Summer	March – May
Southwest Monsoon	June – September
Northeast Monsoon	October – December

Winter (Jan–Feb)

- Sun's rays are slanting, resulting in cooler temperatures.
- Plains: 15°C–25°C; Hills: Below 5°C (Nilgiris may hit 0°C).
- Weather: Cold mornings, mist, dry conditions, no major rainfall.

Summer (Mar–May)

- Sun moves north, Tamil Nadu receives direct vertical rays.
- Temps range from 30°C to 40°C, sometimes higher.
- Weather: Hot, dry, occasional dust storms.
- Pre-monsoon showers (Mango Showers) in May.
- Convictional rain occurs in some areas.

Monsoons in Tamil Nadu

Tamil Nadu receives rainfall from **two monsoons**.

Southwest Monsoon (June–September)	Northeast Monsoon (Oct–Mid-December)
<ul style="list-style-type: none"> ➤ Formed due to low pressure over North India in summer. ➤ Brings heavy rain to most of India, but minimal rain to Tamil Nadu. <p>Why Less Rain in TN?</p> <ul style="list-style-type: none"> ➤ Western Ghats rain shadow effect blocks Arabian Sea winds. ➤ Rainfall Distribution: <ul style="list-style-type: none"> ○ Coimbatore Plateau: ~50 cm ○ Kanyakumari, Nilgiris, Tirunelveli: 50–100 cm ○ Eastern Tamil Nadu: Very scanty rain 	<ul style="list-style-type: none"> ➤ Caused by cold, dry winds from Central Asia, deflected toward Bay of Bengal. ➤ Known as "Retreating Monsoon". ➤ Main rainy season for Tamil Nadu, contributing 48% of annual rainfall. <p>Rainfall Distribution:</p> <ul style="list-style-type: none"> ➤ Coastal districts: ~60% of annual rain ➤ Interior TN: 40–50% ➤ East coastal TN: 100–200 cm ➤ Central/Northwest TN: 50–100 cm



Role of Cyclones

- Frequent Bay of Bengal cyclones bring heavy rain to coastal areas.
- Cyclones contribute to 50%+ of TN's rainfall, but also cause floods and crop damage