

BRIEF REVIEW OF THE CLASS: (1:14 PM)

- **Indian Monsoon:**
- It is the **seasonal reversal of winds** experienced over the Indian subcontinent between Summer and Winter.
- Initially, it was referred to as a larger version of Land and Sea Breeze, but later on over a period of time, considering other factors, we developed a modern theory.
- The modern theory can be experienced by using the varying conditions between different seasons.

CHARACTERISTICS OF MONSOON: (1: 17 PM)

- **Refer to the map.**
- **In winter:**
- The entire **Northern plain is under the influence of low temperature**, which results in **high pressure** and leads to the **formation of anticyclonic conditions**.
- These circulations are strengthened by the **presence of a Subtropical westerly jetstream** which gets bifurcated into the North of the Tibetan Plateau and another one towards the South.
- This **enhances the surface anti-cyclonic circulation** causing these winds to blow away from land towards the sea, from the Northeast direction, resulting in winds, known as the **Northeast Monsoon**. These **do not cause precipitation over the land**.
- However, a **part of it coming from the Bay of Bengal picks up moisture** and causes **precipitation over the Coromandel coast**.

- As the **temperature starts to rise** in the next season during Spring, the **overall condition changes**, and the Northeast winds also become weak.
- When **the Subtropical Westerly Jet stream shifts towards the north** of the Tibetan Plateau, **large-scale convection starts** in this region.
- The conventional rainfall takes place which we call **Pre-monsoon showers** (Kal Baisakhi, Cherry Blossom, Norwester, etc), and we experience **loo in the Northern Plains**.
- A **very strong low-pressure cell**, strongest along the region will cause the entire ITCZ to shift towards the north of the equator (**Monsoon Trough**).
- The monsoon trough will **attract the trade winds from the south** and as it crosses the equator, it **turns right under the influence of Coriolis force** and comes from south west direction.
- As it **picks moisture from the ocean**, it causes heavy precipitation over the Indian subcontinent.
- By the beginning of **September**, the **shift of ITCZ downwards brings the Northernmost extension of Southwest winds downwards**, which we called, the **retreat of monsoon**.
 - 1) The **onset** of monsoon is **gradual** and **withdrawal is more gradual**. → from 1st Sept. to 1st Nov.
 - 2) The **duration** of the monsoon decreases from **sea to land towards the North**.
 - 3) **Temporal Variation**, i.e. variation of rainfall with time along the particular location.
 - 4) **Spatial Variation**, i.e. variation of rainfall from one region to another.

→ from June 1st to July 15th

DISTRIBUTION OF RAINFALL DURING MONSOON: (1:37 PM)

- The onset of monsoon **begins at Kerala Coast.**
- The monsoon winds are **divided into 2 branches:**
 - 1. Bay of Bengal Branch.
 - 2. Arabian Sea Branch.
- **1. Bay of Bengal Branch:**
 - It **moves parallel to the Coromandel coast resulting in no precipitation**, along Tamil Nadu, and the lower Andhra coast.
 - From Northern Circars, rainfall starts to increase towards West Bengal.
 - Along the **Ganga - Brahmaputra Delta**, results in **good rainfall**.
 - Further **North**, it is **bifurcated into 2 branches towards East and West** by the Himalayan mountains.
 - a) The **Eastern branch hits the Meghalaya Plateau**, at a right angle causing very heavy precipitation. *almost 1000cm*
 - b) The **Western branch** moves around the **Northern Ganga Plains**.
 - The **precipitation decreases from East to West** along the Ganga Plains.
 - These **winds coming from the East** are called **Purvaiya** around certain regions of **Bihar and Uttar Pradesh**.
 - As these winds move **towards the Himalayas**, they get **uplifted causing heavy rainfall**.

- **2. Arabian Sea Branch:**
- It hits the western ghats at a right angle causing heavy precipitation along the western side.
- Along the **Eastern side**, the descending winds result in a **rain shadow effect**, creating dry conditions along **Karnataka, Maharashtra, and Telangana**.
- The Arabian Sea Branch **advances towards Gujarat**, and rises **parallel to Aravallis**, causing **very little Precipitation in Rajasthan**.
- The Arabian Sea Branch **meets** the Bay of Bengal branch near Agra, and **the combined branches** cause **precipitation along western Uttar Pradesh, Haryana, Punjab, Himachal Pradesh, Uttarakhand, Jammu and Kashmir, and Ladakh**.
- Refer to the video clip (2:14 PM)

Agumbe (Karnataka) in the western Ghats, receives precipitation of more than 1000 cm (Cherrapunji of South India).

WESTERN DISTURBANCES: (2:21 PM)

- It is active **between October to April**, mainly during Winter.
- The Northern Plains experience **cold and dry conditions** along with **strong westerly jet streams**.
Sub-tropical
- The Mediterranean region during this time receives rainfall due to onshore westerlies and temperate cyclones.
- The **Subtropical Westerly Jet Stream** along the Mediterranean region **picks up the moisture content and low-pressure conditions and is brought to India**.
- When these **winds accumulate** near the Northwest Himalayas, **it causes precipitation**.
- The **Precipitation due to Western disturbance increases from West to East along Ganga Plains**.
↑ precipitation decreases when monsoon of Arabian sea branch moves from east to west.
- **Significance of Western Disturbance:**
- It causes sudden rainfall, during dry conditions of Winter, it results in an abrupt decrease in temperature in the Northern Plains as well as snowfall in the Himalayas.
- It is **good for winter crops like wheat and Mustard**.
- It may result in **cloud bursts** and flash floods. For **example**: 20 times in Leh.

IMPACT OF EL-NINO, LA-NINA, IOD, AND MJO ON INDIAN MONSOON: (2:40 PM)

- Refer to Oceanography.

RECENT CHANGES IN MONSOON: (2:41 PM)

- **Changes observed:**

- a) Delay onset every year in 2002, except for a few years.
- b) Delayed withdrawal.
- c) Increase in the occurrence of breaks.
- d) Increase in spatial variation.
- e) Decrease in the average monsoon rainfall.

- **Implication:**

- a) Impact on the Agriculture season.
- b) Delay in the withdrawal causes floods (**2018 Patna Floods**).
- c) Delay in onset and positive IOD leads to the formation of Cyclones (**Cyclone Biparjoy**).
(June 1st week)
- d) Water disputes.

- **Possible causes:**

- a) Global changes in temperature conditions due to global warming.
- b) Variation of sea surface temperatures.
- c) Decreased monsoon depressions in the Bay of Bengal.
- d) Increase in occurrence of El Nino, and related phenomenon.


CLIMATIC REGIONS OF INDIA: (2:51 PM)

- **a) Monsoon with short dry season:** West Coast of India, south of Goa.
- **b) Monsoon with dry summer:** Coromandel coast of Tamil Nadu.
- **c) Tropical Savannah:** Most of the Peninsular Plateau, south of the Tropic of Cancer.
- **d) Semi-arid steppe climate:** North-western Gujarat, some parts of western Rajasthan and Punjab.
- **e) Hot Desert:** Extreme western Rajasthan.
- **f) Monsoon with Dry winter:** Ganga Plain, Eastern Rajasthan, Northern Madhya Pradesh, and most of Northeast India.
- **g) Cold humid winter with short summer:** Arunachal Pradesh.
- **h) Polar Type:** Jammu&Kashmir, Himachal Pradesh, and Uttaranchal.

SOILS OF INDIA: (3: 19 PM)

- All Indian soils are **poor in Nitrogen**.
- **Iron is abundant** in Red soil and laterite soil.
- **Humus content is rich** in Forest soil, Black soil, and Peaty soil.
- **1. Alluvial Soil:**
 - a) Immature soil with no differences in layers particularly in young alluvial soil.
 - b) Deficient in Nitrogen and Humus.
 - c) Regions: Northern and Coastal Plains.

- **2. Black Soil:**

- a) It is formed due to weathering of Basaltic magma from Deccan Traps.
- b) It is black in color due to the presence of Titaniferous Magnetite.
- c) It is rich in Humus, and deficient in Nitrogen and phosphorus.
- d) The most important characteristic is it forms cracks when dry and is sticky when wet.
- e) It is also known as Self **ploughing** soil.  **tilling**
- f) It is highly porous but low in permeability.
- g) Regions: Maharashtra, Northern Karnataka, Parts of Telangana, Western MP, Southern Gujarat.

- **Laterite Soil:**

- a) Found in regions of high temperature and high precipitation, where heavy leaching is common.
- b) Rich in Iron, and aluminium.
- c) Poor in Silica, bases, humus, and Nitrogen.
- d) It is acidic in nature.
- e) It is suitable for plantation crops.
- f) Regions: Western side of western ghats, Meghalaya, parts of Odisha, and Aravallis.

- **Red Soil:**

- a) Found in the peninsular region with moderate to low ~~precipitory~~ ^{precipitation} region.
- b) The parent rock material is granite and Gneiss (metamorphic form of granite).
- c) Rich in iron, aluminium, and magnesium.
- d) Poor in nitrogen, humus, and phosphorus.
- e) Regions: Southern Karnataka, Southern Andhra Pradesh, parts of Tamil Nadu, Eastern Madhya Pradesh, Chattisgarh, Jharkhand, Odisha, and parts of North East.

- **Arid Soil:**

- a) Present in regions of high evaporation.
- b) It is due to high evaporation and low precipitation, causing low salinization.
- c) Deficient in Nitrogen and Humus.
- d) Region: Western Rajasthan, and parts of Punjab and Haryana due to flood irrigation practice.

- **Montane and Forest soil:**

- a) It is rich in organic matter due to slow decomposition.
- b) It is acidic in nature along the mountainous region, and the soil is thin.
- c) Regions: Himalayas, Parts of western ghats, parts of Vindhya, and Satpura.

↙
use for rice cultivation in which
water evaporates leaving
behind salinity.

- **Peaty Soil:**

- a) It is found in regions, submerged in ~~waterfalls~~^{water} for a longer duration.
- b) Rich in organic matter.
- c) Mainly found along the coastal regions, along the deltas.
- d) Region: West Bengal, Odisha, Andhra Pradesh, Tamil Nadu, and Kerala.

- **Refer to handouts.**

ECONOMIC AND HUMAN GEOGRAPHY: (3:49 PM)

- 1. Water resources.
- 2. Natural Vegetation.
- 3. Agriculture.
- 4. Minerals and Energy Resources.
- 5. Industries and Transportation.
- 6. Human Geography.

WATER RESOURCES:

1. OCEANIC RESOURCES: (3:58 PM)

- Oceanic resources can be classified as:
- a) Mineral resources:
- I. Dissolved Mineral:
- All types of salt (Magnesium, Calcium, Bromine, etc).
- II. Deposited mineral:
- Do not get dissolved in the ocean but sink in the water.
- Gets deposited near the Continental shelf (Sand, gravels, mud, silt, REE (Rare Earth Elements), Pearls, Sea shells,) and Oceanic basins (Polymetallic nodules and polymetallic sulphide).
- Sand comes under the control of the state.
- India has large deposits of REE in Monozite sand. ← found in depositional coast like Kerala coast and eastern coast.
- Sea shells are important for cement industries.
- Polymetallic sulphides are found along the volcanic belts.

found in sediments layer under continental shelf.

found on that petroleum.

- **b) Energy resources:**

- **Petroleum, and Natural Gas.**

- **Coal.** ← plants get buried and due to anarobic condition they get converted into coal.

- Wave.

- Tidal.

- Wind.

using temperature difference of Epilimnion and Hypolimnion.

- **OTEC (Ocean Thermal Energy Conversion).**

- **Thorium.** (world's largest deposit found in India which is around 45 percent.)

- Heavy Water (D₂O), is mainly extracted from oceans.

- **c) Food Resources:**

- Fish.

- Prawns.

- Crabs.

- Seaweeds

used as coolant in nuclear resources.

- **d) Water Resources:**

- Fresh water can be extracted from Reverse osmosis and electrodialysis.

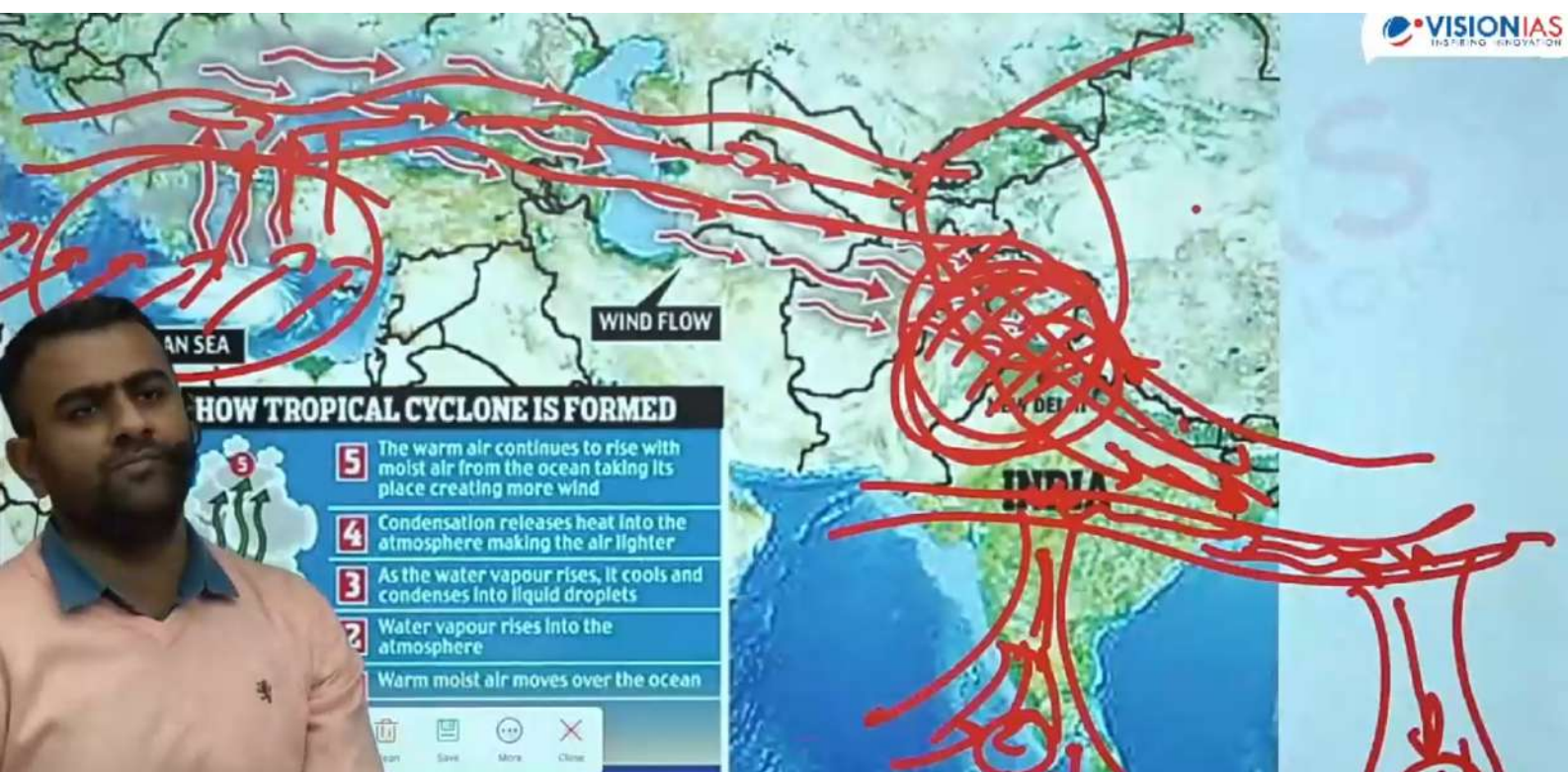
- **e) Services Resources:**

- Trade

- Transportation, etc.

Tourism

TOPIC OF NEXT CLASS: CONTINUATION OF WATER RESOURCES AND NATURAL VEGETATION.



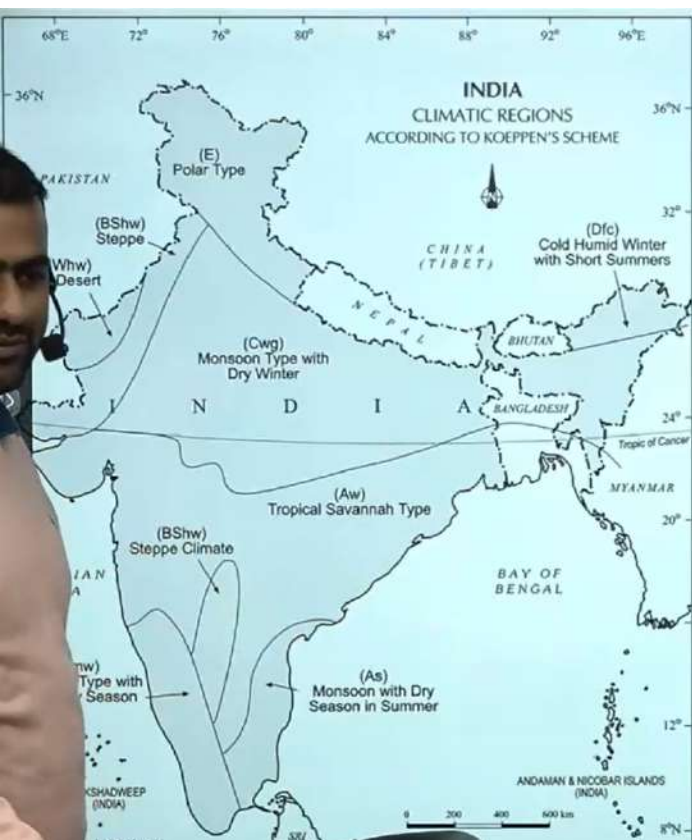


Table 4.1 : Climatic Regions of India According to Koepfen's Scheme

Type of Climate	Areas
Amw Monsoon with short dry season	West coast of India south of Goa
As - Monsoon with dry summer	Coromandel coast of Tamil Nadu
Aw - Tropical savannah	Most of the Peninsular plateaus, south of the Tropic of Cancer
Bwhw - Semi-arid steppe climate	North-western Gujarat, some parts of western Rajasthan and Punjab
Bwhw - Hot desert	Extreme western Rajasthan
Cwg - Monsoon with dry winter	Ganga plain, eastern Rajasthan, northern Madhya Pradesh, most of North-east India
Dfc - Cold humid winter with short summer	Arunachal Pradesh
E - Polar type	Jammu and Kashmir, Himachal Pradesh and Uttaranchal

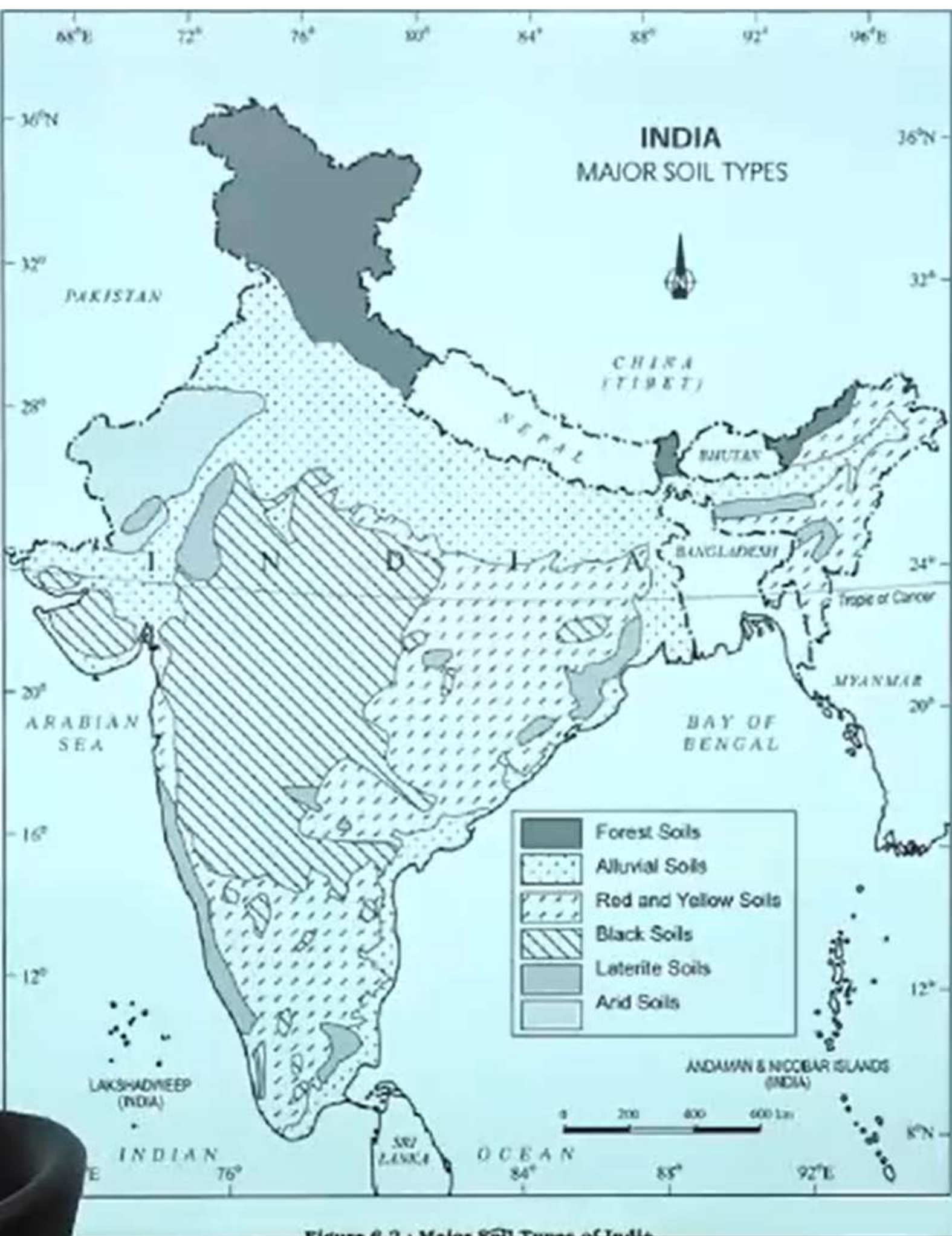


Figure 6.2 - Major Soil Types of India

