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Himalayas

Formation of Himalayas

- 225 million years ago (Ma) India was a large island situated off the Australian coast and separated from Asia by the Tethys Ocean.
- The supercontinent Pangea began to break up 200 Ma and India started a northward drift towards Asia.
- 80 Ma India was 6,400 km south of the Asian continent but moving towards it at a rate of between 9 and 16 cm per year.
- At this time Tethys Ocean floor would have been subducting northwards beneath Asia and the plate margin would have been a Convergent oceanic-continental one just like the Andes today.
- From about 50-40 Ma the rate of northward drift of the Indian continental plate slowed to around 4-6 cm per year.
- This slowdown is interpreted to mark the beginning of the collision between the Eurasian and Indian continental plates, the closing of the former Tethys Ocean, and the initiation of Himalayan uplift.
- The Eurasian plate was partly crumpled and buckled up above the Indian plate but due to their low density/high buoyancy neither continental plate could be subducted.
- This caused the continental crust to thicken due to folding and faulting by compressional forces pushing up the Himalaya and the Tibetan Plateau.

The Northern And Northeastern Mountains

- The Himalayas are still rising by more than 1 cm per year as India continues to move northwards into Asia, which explains the occurrence of shallow focus earthquakes in the region today.

Characteristics Features

- The Himalayas form an arcuate curve convex to the south.
- This curved shape of the Himalayas is created due to the maximum push offered at the two ends on the Indian peninsula during its northward drift.
- In the north-west, it was done by Aravalis and in the Northeast by the Assam ranges

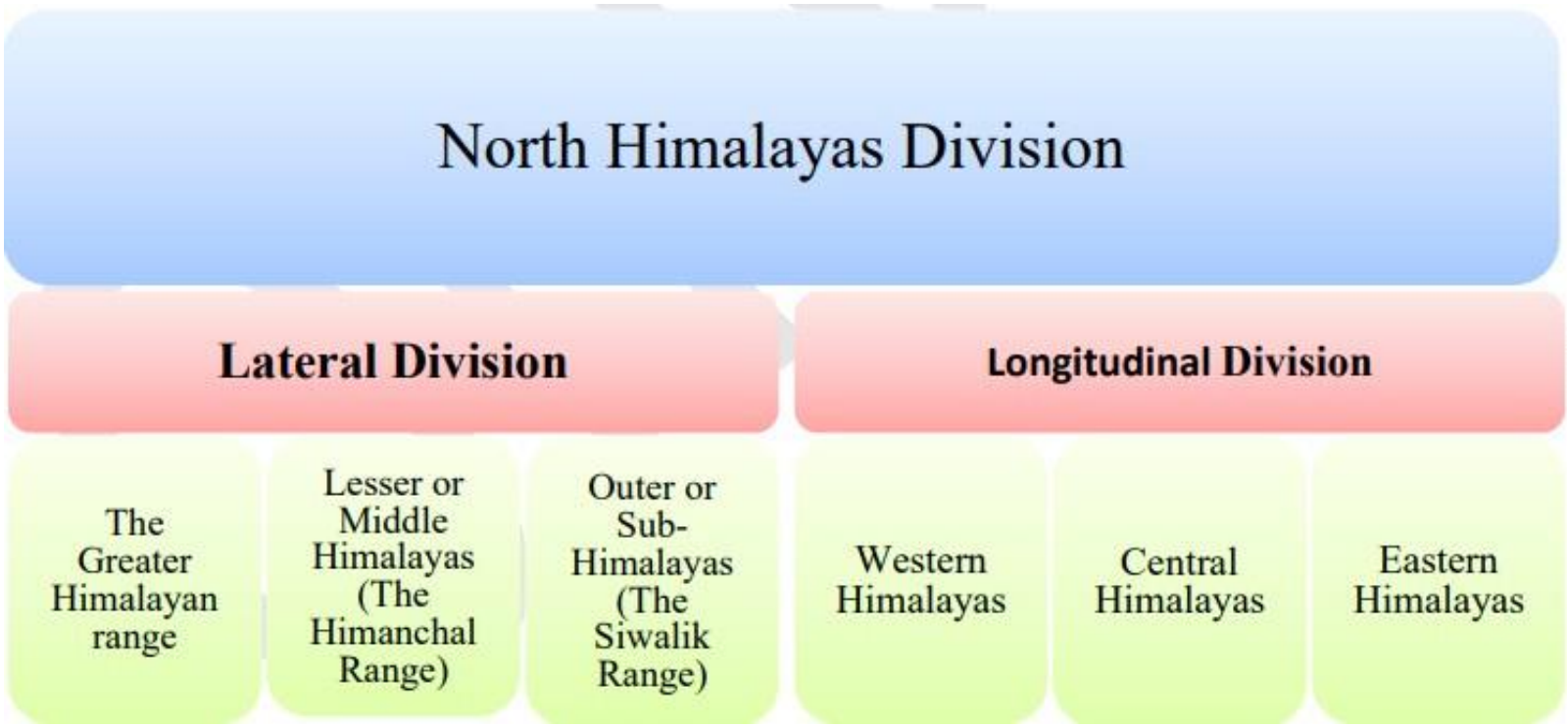
Himalayas

Syntaxial Bends of the Himalayas

- Himalayas extend in the east-west direction from the Indus gorge in the west to the Brahmaputra gorge in the east and take sharp southward bends at these gorges. These bends are called syntaxial bends of the Himalayas.
- The western syntaxial bend occurs near the Nanga Parbat
- The eastern syntaxial bend occurs near the Namcha Barwa

Division of Himalayas

- Himalaya Mountain Range can be categorized into western, central and eastern Himalayas
- Sometimes one more classification is added by including Tibetan Himalayas which include the southern edge of Tibetan Plateau.



- Western Himalayas include the area of Jammu & Kashmir, Pir Panjal, Ladakh and Baltistan, and Gilit region.
- The central Himalayas extends from Jammu & Kashmir to Sikkim and includes the area of Himachal, Garhwal, Punjab, and Nepal.
- The Eastern Himalayas extend from Sikkim to Assam and include the part of the range running in Bhutan, Arunachal Pradesh and Assam.

Himalayas

- The Himalaya Mountain Range can also be classified on the basis of height and they are as follow
    a. The Greater Himalayan range, which includes:
        - The Great Himalayas(Himadri)
        - The Trans-Himalayan range
    b. Lesser or Middle Himalayas (The Himanchal Range)
        - Outer or Sub-Himalayas (The Siwalik Range)

Himalayas

Himalayan Mountain Complex: Cross-sectional view from South to North

- The Himalayas are wider in the west than in the east.
  - The width varies from 400 km in Kashmir to 150 km in Arunachal Pradesh.
- The main reason behind this difference is that the compressive force was more in the east than in the west.
  - That is why high mountain peaks like Mount Everest and Kanchenjunga are present in the Eastern Himalayas.
- The ranges are separated by deep valleys creating a highly dissected topography.
- The southern slopes of the Himalayas facing India are steeper and those facing the Tibetan side are generally gentler.
- It contains some of the largest glaciers in the world and count goes as high as 15000 glaciers including Gangotri and Yamunotri glaciers.
- Rivers originating from Himalaya Mountain are perennial and they have water for almost every part of the year.
- Almost one-fifth of the world population depends on water from the Himalayan system.
- Himalayas Basin is drained by nearly 19 rivers and they can be grouped into three major river systems of Ganges, Indus, and Brahmaputra.
- Apart from rivers, the Himalayan range has a large number of freshwater lakes.
- Some important lakes include Tilicho, Pangong Tso, and Yamdrok Tso Lake.

The Trans-Himalayan range (Tibetan Himalaya).

- Most of the part of this Himalayan range lies in the Tibet and hence also called Tibetan Himalaya. This range lies in immediate north of Himadri with main ranges of

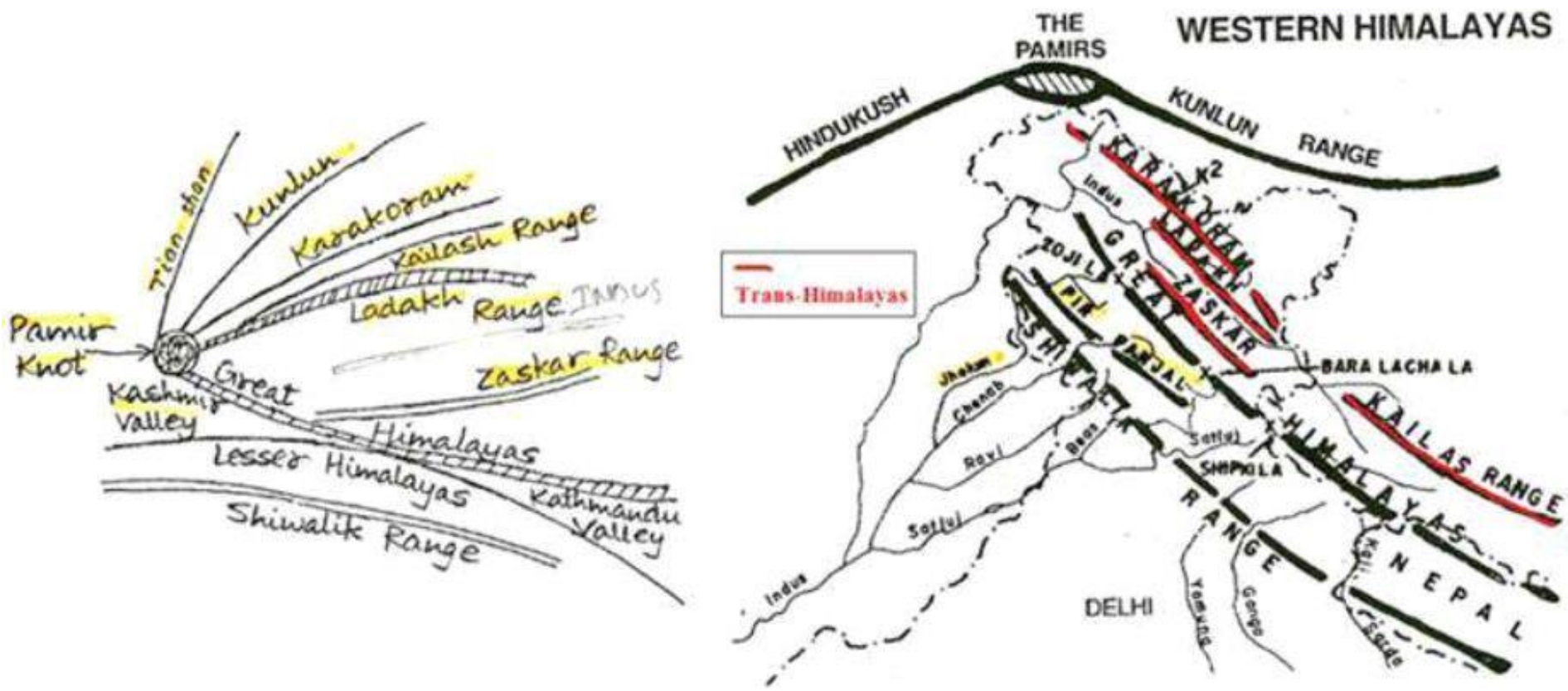
Zaskar

- It separate from the great Himalayan Range near 80o E longitudes and runs parallel to it.
- The Nanga Parbat (8126 mt) is the culmination of Zaskar range in

Himalayas

north-west but the adjoining Deosai Mountain may also be included in it.

- Ladakh range is in the north of the Zaskar range which runs parallel to it.



Karakoram (northmost range)

- It is also known as Krishnagiri which is situated in the northern most range of the Trans-Himalayan ranges.
- Home of 3rd largest glacier in the world and greater glacier outside the polar regions.
- It forms Frontier which China and Afghanistan.
- K2 (Godwin Austen) is the second highest peak in the world and highest in the Indian Territory lies here.

Ladakh

- It lies to the north of the Leh,
- It merges with the Kailash range in Tibet.

Himalayas

The Great Himalayas (Himadri)

- The highest and the northern most range of the Himalayas.
- The most continuous range consisting of the loftiest peaks with an average height of 6,000 metres.
- It contains all the prominent Himalayan peaks.
- Terminate abruptly at the syntaxial bend.
- The folds of Great Himalayas are asymmetrical in nature. The core of this part of Himalayas is composed of granite.
- The peaks are perennially covered with snow due to to the lofty heights (Hence Himadri).
- Almost all the prominent Himalayan peaks lies in this range like Mr Everest, Kanchenjunga, etc.
- Famous glaciers like the Gangotri and the Yamunotri lie here.
- Forests type → Needle leaved coniferous

Himalayas Range

- This range lies between the Shiwalik in the south and the Greater Himalayas in the north.
- Most rugged mountain system ranges mainly composed of highly compressed and altered rocks.
- The altitude varies between 3,700 and 4,500 metres and the average width is of 50 Km.
- It mainly consists of metamorphosed rocks.
- Gentle slopes of the eastern part of this range are covered with dense forests.
- The south facing slopes of this range are very steep and generally devoid of any vegetation.
- The north facing gentle slope of this range are covered by dense vegetation.
- Local names = Pir Panjal in Jammu and Kashmir; Dhauladhar in Himachal Pradesh.
- Most of the hill towns or resort towns are located in Himachal range for example Shimla, Mussoorie, Nainital, Darjeeling etc.

Himalayas

- All great valleys like Kashmir valley, Kangra valley, Kullu valley are present here.
- Forests type → Broad leaved evergreen

Outer or Sub-Himalayas (The Siwalik Range)

- The southernmost and outer most range of Himalayas which lies between the great plains and the Lesser Himalayas.
- It is also known as Manak Parbat in ancient times.
- They extend over a width of 10-50 Km and have an altitude varying between 900 and 1100 metres.
- These ranges are composed of unconsolidated sediments brought down by rivers from the main Himalayan ranges located farther north.
- These valleys are covered with thick gravel and alluvium.
- They are almost unbroken chain of low heels except for a gap of 80-90 km which is occupied by the valley of the Teesta river and Raidak river.
- Most of the Dun & Duars are located in this range
- Forests type → Deciduous type forests

Note:

Duns

- Duns are longitudinal valleys formed as a result of folding when Eurasian plate and Indian plate collided. They are formed between Lesser Himalayas and Shiwaliks. These valleys are deposited with coarse alluvium brought down by Himalayan rivers. These are known as Dun in the west and Duara in the East. Dehra Dun, Kotli Dun and Patli Dun are some of the well-known Duns.

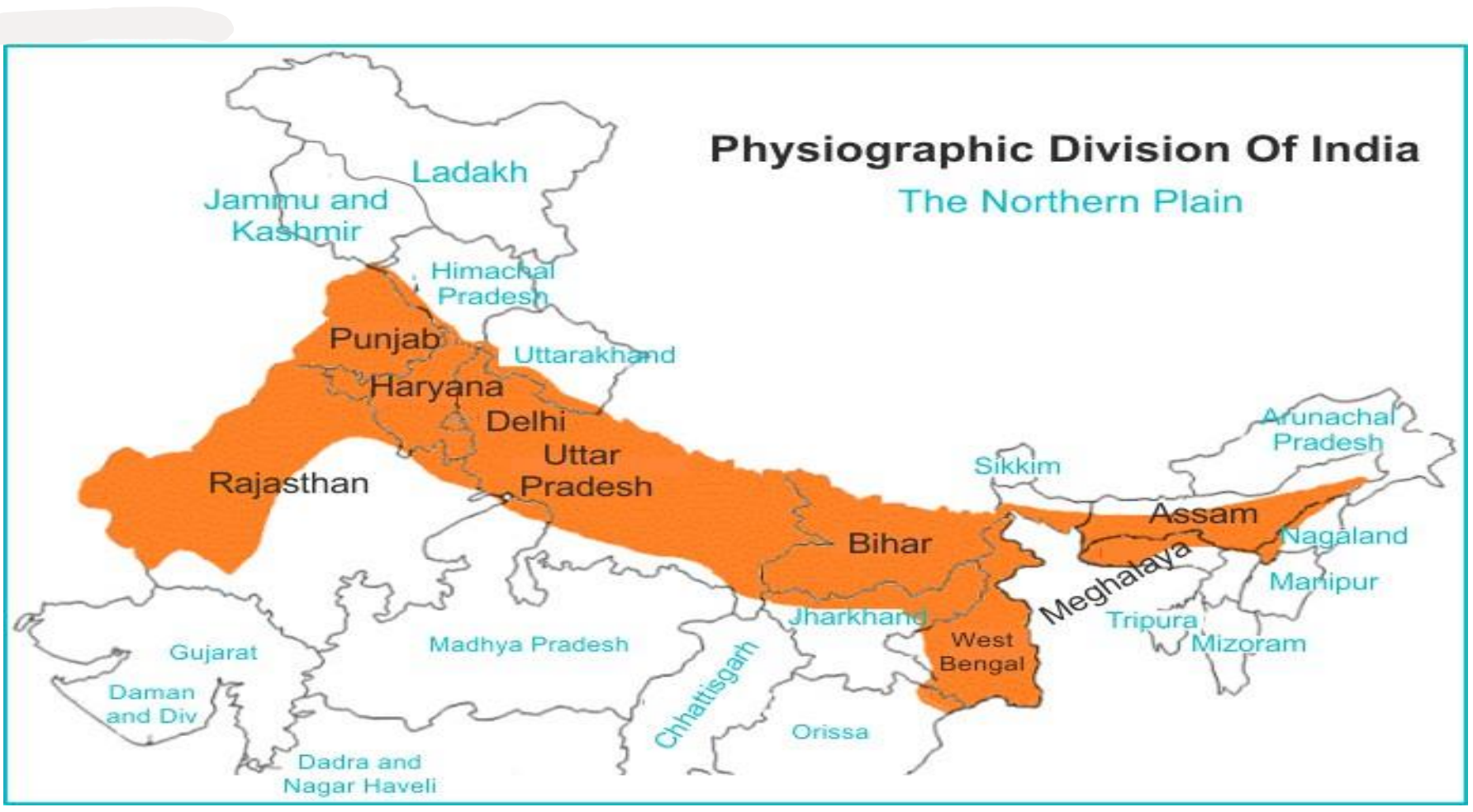
Chhos

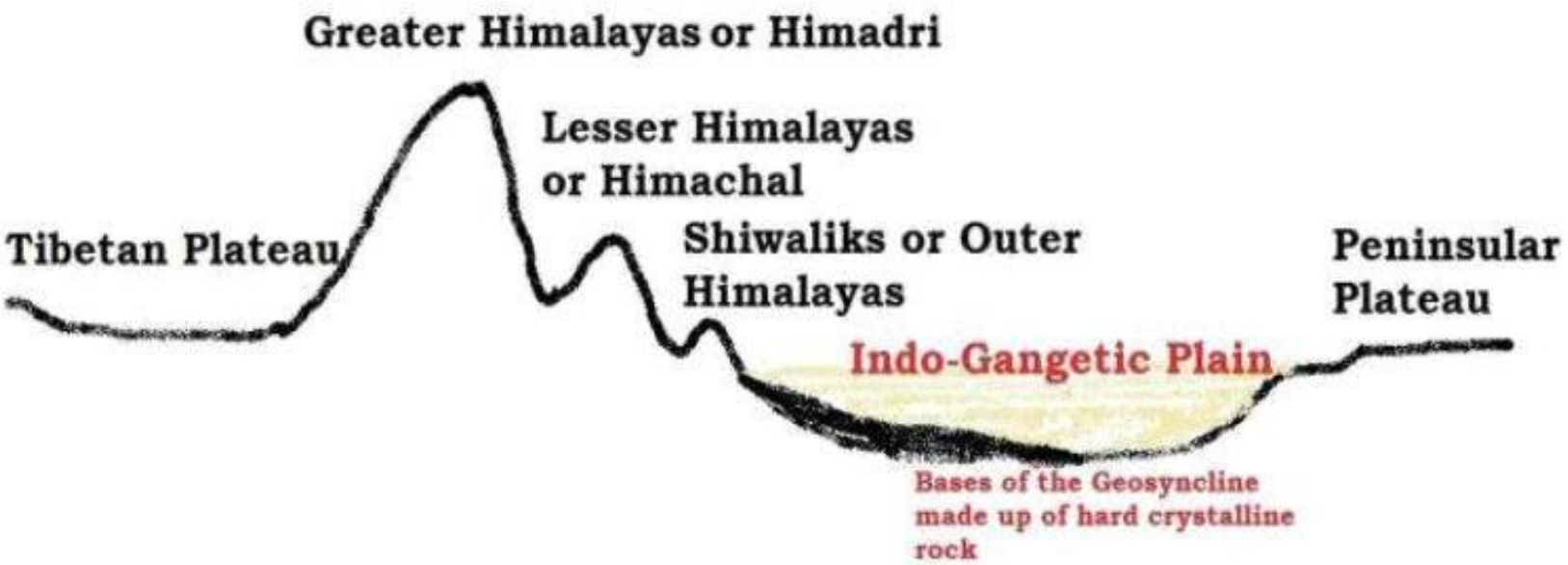
The eastern part of Shiwalik range up to Nepal is covered with thick forests whereas forest cover becomes thin in the west. The southern slopes of Shiwalik range in Punjab and Himachal Pradesh are almost devoid of forest cover and directed by seasonal streams. Such areas are locally referred to as Chhos, typical manifestation seen in Hoshiarpur district of Punjab.

Northern Plains

The great Northern Plains of India are an aggradation surface of extraordinary degree formed after the Himalayas.

They are relatively of recent origin and are accepted to have formed by the filling up of a depression resulting from the elevate on of the Himalayas, by deposition of silt brought by swift-flowing Himalayan rivers, started in Himalayas.





Elevation of the major physiographic divisions of India

Northern Plains

Development of Northern Plains

The formation of the Indo-Gangetic plain is firmly identified with the the formation of Himalayas.

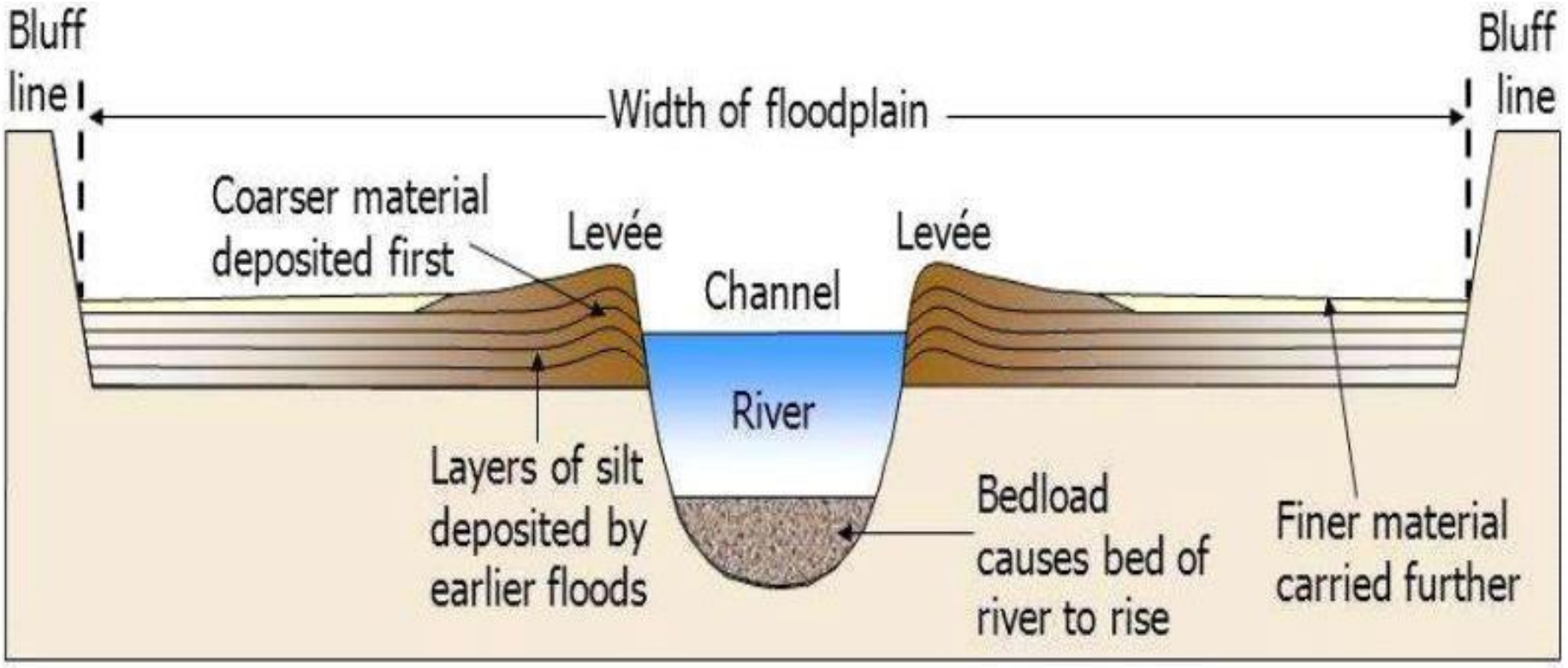
- Due to the uplift of the Himalayas in the Tethys Sea, the northern part of the Indian Peninsula got subsided and formed an enormous basin.
- That basin was loaded up with sediments from the rivers which originated from the mountains in the north and from the peninsula in the south.
- During recent times (since a few million years), depositional work of three major rivers viz., the Indus, the Ganga and the Brahmaputra have become transcendent.
- Consequently, this plain is also known as Indo Gangetic-Brahmaputra Plain

Highlights of Northern Plains

- The northern plain of India is shaped by three river systems, i.e. the Indus, the Ganga and the Brahmaputra; alongside their tributaries.
- Northern Plains are the biggest alluvial tract of the world.
- It extends for around 3,200 km from the mouth of the Indus to the mouth of the Ganga.
- The average width of these plains shifts in the range of 150 and 300 km. In general, the width of the northern plains increments from east to west (90-100km in Assam to about 500km in Punjab).
- The northern boundary is well marked by the Shiwaliks and the southern boundary is a wavy spotadic line along the northern edge of Peninsular India
- The western fringe is set apart by Sulaiman and Kirthar ranges.
- The thickness of the alluvium deposits also varies from place to place.
- The maximum depth of the alluvium up to the basement rocks is about 6,100m

Northern Plains

- Extreme horizontality of this tedious plain is its main feature
- Its normal elevation is about 200 m above mean sea level.
- The dreariness of the physical landscape is broken by the river bluffs, levees etc.
  - **Floodplain**: That part of a river valley, contiguous to the channel, over which a stream flows in times of a flood.
  - **Levee**: A raised bank flanking the channel of the river and remaining above the level of the flood plain.
  - **Bluff**: A river cut cliff or steep slant on the outside of a meander. A line of bluffs often denotes the edge of a previous floodplain.



Physiographic Division of Northern Plain

The Great North Indian plain is divided into following subdivisions on the basis of relief features:

- Bhabar Plains
- Tarai Tract
- Bhangar
- Khadar
- Delta Plains

Northern Plains

Bhabhar Belt

- It is a narrow, permeable, northernmost stretch of Indo-Gangetic plain
- It is around 8-16 km wide running in an east-west direction along the lower regions (alluvial fans) of the Shiwaliks
- They show a striking continuity from the Indus to the Teesta river
- Rivers descending from the Himalayas deposit their load along the lower regions in the form of alluvial fans
- These alluvial pebbly soils have combined to develop the bhabar belt
- The streams vanish once they come to the bhabar region in light of this porosity
- Subsequently, the region is set apart by dry river courses except in the rainy season
- The Bhabar belt is nearly limited in the east and broad in the west

Terai Belt

- Terai is an ill-drained, moist (damp) and thickly forested narrow tract to the south of Bhabar running parallel to it
- The Terai is around 15-30 km in width
- The underground streams of the Bhabar belt rappear in this belt.
- The Terai is more set apart in the eastern part than in the west on the grounds that the eastern parts get comparatively higher measure of precipitation
- The terai soils are silty and rich in nitrogen and organic matter but are inadequatete in phosphate

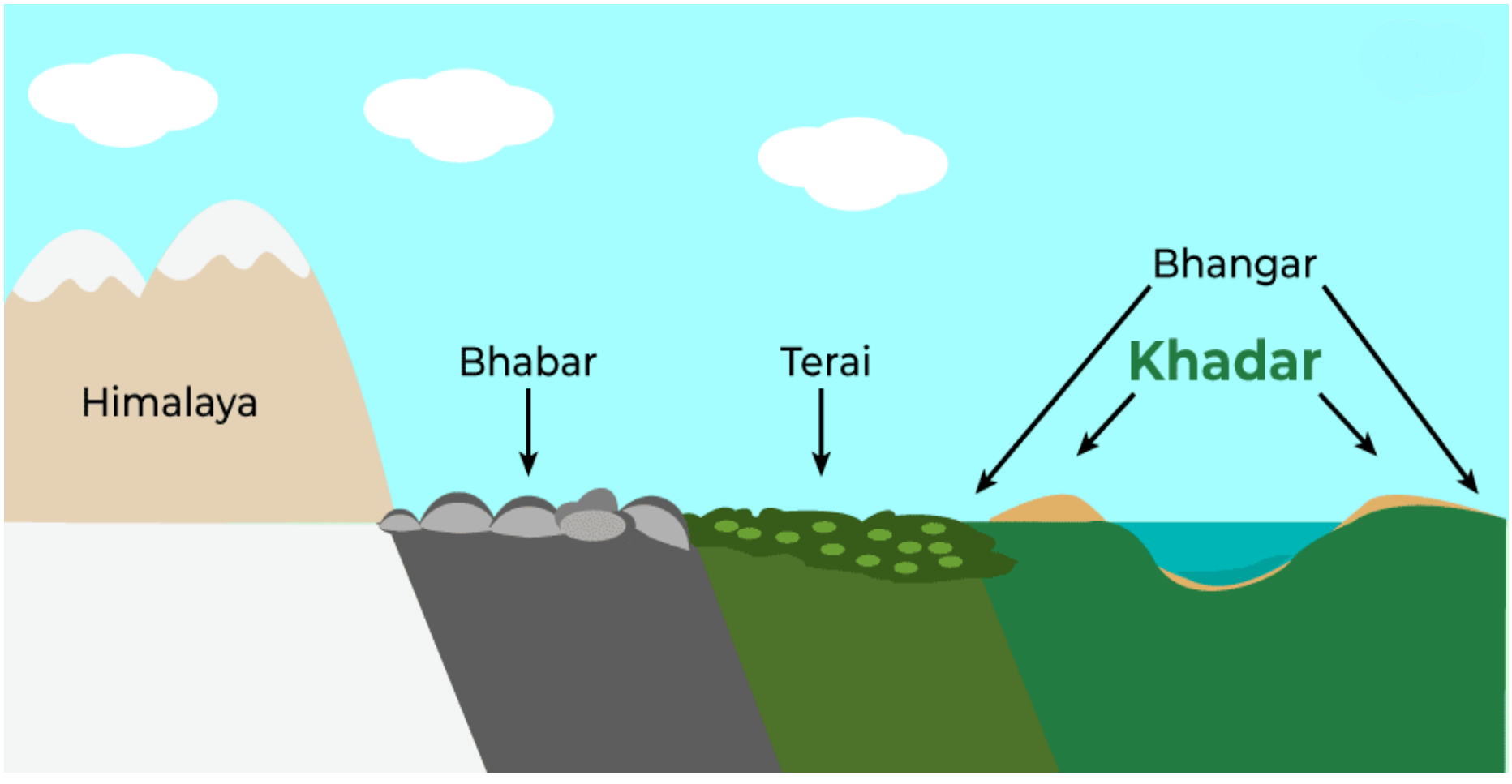
Bhangar Belt

- The Bhangar is the older alluvium along the river beds forming terraces higher than the floodplain
- The terraces are regularly impregnated with calcareous solidifications (beds of lime nodules) known as 'Kankar'
- Bhangar contains fossils of creatures like rhinoceros, hippopotamus, elephants and so forth.
- The soil is of an increasingly clayey sythesis and is generally dark coloured.

Northern Plains

Khadar Belt

- The Khadar is made out of newer alluvium and forms the floodplains along the river banks.
- A new layer of alluvium is deposited by river flood every year
- This makes them the most fertile soils of Ganges Plains
- They are sandy clays and loams, drier and more leached and less calcareous.



Indian Islands

Andaman and Nicobar Islands

- Andaman and Nicobar Islands were formed because of the crash between Indian Plate and Burmese Plate. They are the southward extension of Arakan Yoma range (Myanmar).
- This archipelago is made out of 265 big and small islands (203 Andaman islands + 62 Nicobar Islands)
- The Andaman and Nicobar Islands reach out from 6° 45' N to 13° 45' N and from 92° 10' E to 94° 15' E for a distance of around 590 km
- Duncan passage isolates Little Andaman from South Andaman
- The Great Andaman group of islands in the north is separated by the Ten Degree Channel from the Nicobar group in the south
- Port Blair, the capital of Andaman Nicobar Islands, lies in the South Andaman
- Among the Nicobar Islands, the Great Nicobar is the biggest and is only 147 km away from the Sumatra island of Indonesia.
- Great Nicobar is the southernmost island
- The Barren Island (the only active volcano in India) and Narcondam Islands (an extinct or dormant volcano), north of Port Blair, are volcanic islands
- A portion of the islands are bordered with coral reefs.
- Saddle peak (737 m) in North Andaman is the highest peak.

Indian Islands

Lakshdweep Islands

- Lakshadweep Islands are coral islands. These islands are a part Reunion Hotspot volcanic chain.
- The Lakshadweep Islands are a group of 25 small islands
- They are widely scattered about 200-500 km south-west of the Kerala coast
- Amindivi Islands are the northernmost while the Minicoy island is the southernmost
- Andrott is the biggest Island. Minicoy is the second biggest
- The vast majority of the islands have low height and do not rise more than five meters above sea level (extremely vulnerable to sea level rise)
- Their topography is flat and relief features such as hills, streams, valleys, etc. are missing

Some Other Important Islands

- Majuli: In Assam; World's largest freshwater island
- Salsette: India's most populous island. Mumbai city is located on this island
- Sriharikota: Satellite launching station of ISRO
- Pamban Island: Between India and Srilanka

Indian Deserts

Indian Deserts

- Location: North-West of Aravalli Hills
- It covers Western Rajasthan and extends to the adjacent parts of Pakistan
- Geological History:
  - During the mesozoic era, this region was under the sea.
  - The presence of dry beds of rivers (ex: Saraswati) shows that the region was once fertile.
  - Geologically, the desert area is a part of peninsular plateau region but on the surface it seems like an aggradational plain
- Features of Indian Desert
  - The desert is called the Marusthali (dead land) as this region has an arid climate with low vegetation spread.
  - The Eastern part of the desert is rocky, while its western part is covered by shifting sand dunes.
  - The most significant river 'Luni' here is a seasonal stream.
  - The lakes have brackish water which is the fundamental source of getting salt.

Indian Peninsula

Features

- The Peninsular Plateau is a one of the oldest and the most stable landmass of India composed mostly of the Archaean gneisses and schists.
- Roughly triangular in shape and lie in the south of the great plain of North India.
- It is bordered on all sides by the hill ranges:
  - North-west (extension of Aravalis) = Delhi ridge
  - East = Rajmahal hills
  - West = Gir range
  - South = Cardamom hills (constitute the outer extent of the peninsular plateau)
  - Outlier = Shillong and Karbi-Anglong plateau
- It covers a total area of about 16 lakh square kilometer (India as a whole is 32 lakh sq km).
- The average height of the plateau is 600-900 meter above sea level
- Most of the peninsular rivers flow from west to east indicating the general elevation of the plateau is from the west to the east.
- Narmada-Tapti are the exceptions which flow from east to west in a rift (rift is caused by divergent boundary).

Hill Ranges

1. Aravalli Hills

- The length of the Aravalis is 1100 km which extends from Delhi to Ahmedabad.
- They are one of the oldest fold mountains of the world and the oldest in India.
- Only a few peaks reach an elevation of above 1000m.
- Its highest peak is Guru Shikhar. It is on the 'Abu hills'. Mt. Abu is a famous hill station.
- Rivers Banas, Luni, Sabarmati are initiates from Aravallis.
- It contain several lakes such as Lake Sambhar (largest inland saline water body in India), Lake Dhebar, Lake Jaisamand, etc.

Indian Peninsula

2. Satpura Range

- Satpura hills are tectonic mountains formed as a result of folding and structural uplift
- With peaks more than 1,200m high, the Satpura Range includes the Mahadeo Hills to the north, the Maikala Range to the east, and the Rajpipla Hills to the west.
- The Satpura range is a block mountain which has Narmada river valley on its northern side and that of the Tapi on the western side.
- It stretches for a distance of about 900 km.
- Dhupgarh on Mahadev Hills (near Pachmarhi) is the highest peak of the Satpura range.
- Amarkantak is another important peak, highest of the Maikal hills, from where two prominent rivers, the Narmada and the Son originate.
- It is noteworthy that three rivers do originate from the three sides of the Maikal hills but only two rivers, the Narmada and the Son originate from Amarkantak and not the Mahanadi.
- Due to the presence of Gondwana rocks, these hills are rich in bauxite.
- The rivers in the Satpura range make several waterfalls like Dhuandhar waterfall on the Narmada river.

3. Vindhyan Range

- It runs parallel to the Narmada Valley in an east-west direction from Bharuch in Gujarat to Sasaram in Bihar for a distance of over 1,200 km.
- The general elevation of the Vindhyan Range is in between of 300 to 650 meters.
- Most parts of the Vindhayan Range are comprised of horizontally bedded sedimentary rocks of ancient age.
- They locally named as Panna, Kaimur, Rewa etc.
- This range acts as a divide between the Ganga system and the river systems of south India.

Indian Peninsula

4. Western Ghats (Sahyadris)
   - The Western present a stepped topography facing the Arabian Sea coast due to the horizontally bedded lavas.
   - From the Deccan plateau, they have a gentle slope towards their eastern edge and don't appear to be a tall range of hills.
   - Northern Section:
     - This section of the Western Ghats is located in Maharashtra and also known as the Sahyadris.
     - The average height of Sahyadris is about 1200 meter
     - Sahyadris are made of volcanic igneous rocks (Deccan lavas or Deccan Traps).
     - Godavari, Bhima, and Krishna are the main rivers of this section.
     - Some of the prominent peaks of the Sahyadris are - Kalasubai peak (the tallest peak of the Sahyadris), Salher peak, Harischandragarh peak etc.
   - Middle Section:
     - This section runs through Karnataka and Goa and terminates in the Nilgiris, where it joins the Eastern Ghats.
     - They are made of igneous and metamorphic rocks like the granite and gneiss.
     - Their average height is around 1200 meters and some of the prominent peaks such as Vavulmala, Kudremukh, Pushpagiri etc.
   - Southern Section:
     - This section comprising the Annamalai and Cardamom hill ranges.
     - Palghat gap is the largest gap in the Western Ghats (about 24 km wide) which separates the Nilgiris from the Annamalai hills.
     - Anaimudi peak is the highest point of peninsular India lying in the Annamalai hills.
     - The southernmost section of the Western Ghats is Agasthyamalai hills situated in Kerala and Tamil Nadu. The southernmost peak of peninsular India is Agasthamalai peak.

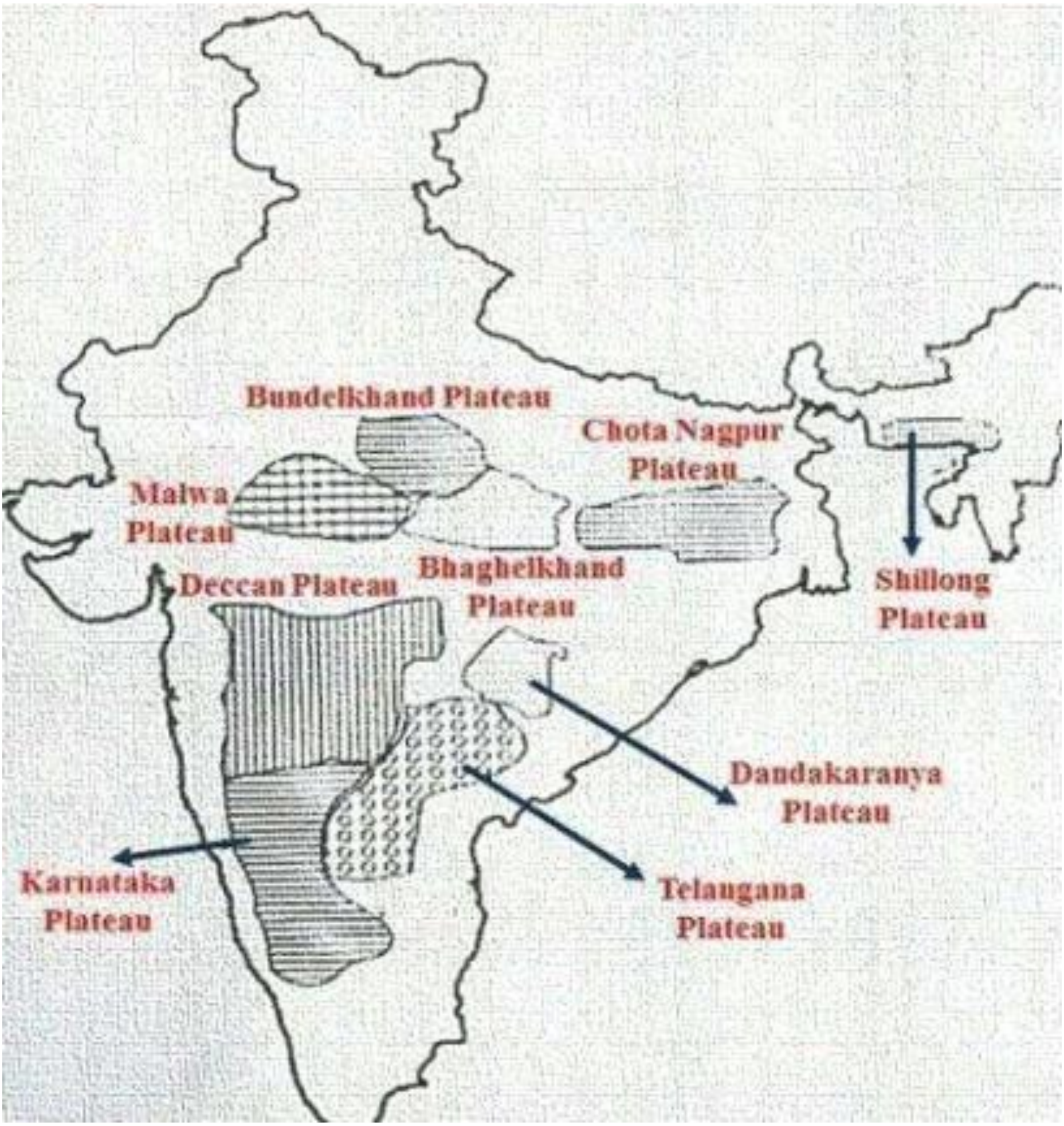
Indian Peninsula

5. Eastern Ghats
   - Eastern Ghats run almost parallel to the eastern coast of India leaving broad plains between their base and the coast.
   - It has been eroded than the Western Ghats. Therefore, it is of less height.
   - They are mainly comprising of Dharwar igneous and metamorphic rocks.
   - These hills lack structural and physiographic continuity unlike Western Ghats
   - Some prominent hills:
     - Andhra Pradesh = Velikonda hills, Palakonda hills, and the Seshachalam
     - Tamil Nadu = Javadi hills and Shevaroy hills
   - Eastern Ghats merge with the Western Ghats at the Nilgiris.

The Western Ghats	The Eastern Ghats
The Western Ghats lie on the western margin of the Deccan Plateau.	The Eastern Ghats lie on the eastern margin of the Deccan Plateau.
The Western Ghats are higher in elevation. Their average elevation is from 900 to 1600 metres.	The Eastern Ghats are lower in elevation. Their average elevation is 600 metres.
They have a continuous chain of mountains and can be crossed through passes only.	The mountain chains are not continuous and are denuded by the rivers which flow into the Bay of Bengal.
No major river has cut across them.	They have been cut across by major rivers like the Godavari, Mahanadi, Krishna and Kaveri.

Indian Peninsula

Plateaus



Indian Peninsula

Plateaus

1. Marwar or Mewar Plateau

- It is the plateau in eastern Rajasthan. (Marwar plain lie in the west of Aravalis whereas Marwar plateau lie in the east).
- The height is in between 250-500 meters above sea level and it slopes down eastwards.
- It contains sandstone, shales and limestones of the Vindhayan period.

2. Central Highlands

- Also known as Madhya Bharat Pathar
- It is a rolling plateau with sandstone containing rounded hills.
- Thick forests grow here
- Ravines or badlands of the Chambal river found in the north

3. Bundelkhand Plateau

- Yamuna river to the north, Malwa Plateau to the south, Vindhyan Ranges to the east and south-east and Madhya Bharat Pathar to the west.
- It is the old dissected (divided by a number of deep valleys) upland of the 'Bundelkhand gneiss' made up of granite and gneiss rocks.
- The height of the plateau is in the range of 300-600 meters.
- It has a drainage system into the Bay of Bengal.
- Streams like Betwa, Dhasan and Ken flow through the plateau.

4. Baghelkhand

- It is situated east of Maikala range and is made of limestone and sandstone on the west and granite in the east.
- The plateau has a general elevation of 150 meters to 1200 meters and has uneven relief.
- The main elements of Physiography are scarps of the Vindhyan sandstones between the Ganga plain and the Narmada-Son trough.

Indian Peninsula

5. **Malwa Plateau**
   - The Malwa Plateau roughly forms a triangle based on the Vindhyan Hills, bounded by the Aravali Range from the west and Madhya Bharat Pathar from the north and Bundelkhand from the east.
   - This plateau has two systems of drainage
     - Towards the Arabian sea (Narmada, Tapi and Mahi)
     - Towards the Bay of Bengal (Chambal and Betwa by joining the Yamuna)
   - The average elevation of the plateau is 500 meter

6. **Chotanagpur Plateau**
   - It's a continental plateau with an average elevation of the plateau is 700 meter above sea level.
   - It is spread in Jharkhand, northern part of Chattisgarh and Purulia district of West Bengal and parts of Odisha.
   - Damodar rift valley (DRV) is the most prominent structure of this plateau which possess Gondwana rocks making it one of the richest coal deposits of India viz., the Damodar Valley Coal Fields.

7. **Meghalaya or Shillong Plateau**
   - The peninsular plateau extends further east beyond the Rajmahal hills to from Meghalaya or the Shillong plateau.
   - An extension of the peninsular plateau is also visible in the northeast, locally known as the Meghalaya or the Shillong plateau, Karbi-Anglong Plateau and North Cachar Hills.
   - It is separated by a fault from the Chotanagpur Plateau and its western boundary more or less coincides with the Bangladesh border.
   - Three prominent hill ranges from the west to the east are the Garo, the Khasi and the Jaintia Hills.
   - Its average height is about 1500 meters above the mean sea level.
   - Cherrapunji and Mawsynram are the wettest places in India and are a part of the plateau located in the Khasi hills

Indian Peninsula

8. Kathiawar Plateau
   - Located in the Kathiawar region of Gujarat having many pipe-like volcanic openings which gave rise to many hill ranges such as the Girnar range, Junagarh range, Pavagarh range etc.
   - Lake Nalsarovar (a bird sanctuary) forms the Northeast boundary of the plateau.
   - To the north of Kathiwar plateau, Little Rann is situated.
   - It has some volcanic rocks in the form of Mandav hills and Balda hills.
   - Mt.Girnar = Highest point of Kathiawar plateau

9. Deccan Plateau
   - This is the largest unit of Peninsular Plateau of India covering an area of about 5 lakh sq km.
   - It is triangular in shape and is bordered by
     - the Satpura and the Vindhya in the north-west
     - the Mahadev and the Maikal in the north
     - the Western Ghats in the west
     - the Eastern Ghats in the east
   - Its average elevation is 600 m.
   - It rises upto 1000 meter in the south but dips to 500 meter in the north.
   - Its general slope is from west to east which is indicated by the flow of its major rivers like the Mahanadi, Godavari, the Krishna and the Cauvery. These rivers have further subdivided this plateau into a number smaller plateaus described as under:
     - The Maharashtra Plateau – it has typical deccan trap topography underlain by basaltic rock, the regur.
     - The Karnataka Plateau (also known as Mysore plateau) – divided into western hilly country region of 'Malnad' and plain 'Maidan'
     - Telangana Plateau

Indian Peninsula

Himalayan Region Vs Peninsular Plateau

The Himalayan Region	The Peninsular Plateau
Having a comparatively recent origin, it is made up of young fold mountains.	It is the oldest landmass of the Indian subcontinent; was part of the Gondwana land.
Consists of the loftiest mountains and deep valleys.	Consists of broad and shallow valleys, and rounded hills.
Formed due to the collision of the Indo-Australian and Eurasian plates.	Formed due to the breaking and drifting of the Gondwana land.
Composed of sedimentary rocks.	Composed of igneous and metamorphic rocks.
From the point of view of geology, this region forms an unstable zone.	This region forms a stable zone.
Major rivers like – the Indus, the Ganges and the Brahmaputra originate from the Himalayas.	Major rivers like – the Narmada and the Tapti, Godavari, Krishna and Kaveri originate from these hills.
Important hill stations like – Shimla, Mussoorie, Darjeeling, Nainital , etc. are found on the Himalayas.	Important hill stations like - Khandala, Panchgani, Ooty, Kodaikanal, etc. are found on the Peninsular Plateau.

Coastal Plains

Western Coastal Plains

- The western coast strip extends from the Gulf of Cambay to Kanniyakumari
- Starting from north to south, it is divided into:
  - Kachchh and Kathiawar coast
  - Konkan coast
  - Karnataka/Kanada coast
  - Kerala/Malabar cost
- It is made up of alluvium deposited by the short streams originating in the Western Ghats.
- It is dotted with a large number of coves (a very small bay), creeks (a narrow, sheltered waterway such as an inlet in a shoreline or channel in a marsh) and a few estuaries. (Marine Landforms).
  - The estuaries of the Narmada and the Tapi are the major ones.
- The Kerala coast (Malabar Coast) consist of some lakes, lagoons, and backwaters (Vembanad Lake is the largest).

Kutch and Kathiawar Region

- Kutch and Kathiawar are treated as an integral part of the Western Coastal Plains (because they are now leveled down) in spite they are an extension of Peninsular plateau (because there are tertiary rocks in the Kutch area and Kathiawar is made of the Deccan Lava)
- The Kutch Peninsula was an island surrounded by seas and lagoons later filled by sediment brought by the Indus River. It is turned into an arid and semi-arid landscape due to lack of rains in recent times.
- Great Rann is a salt-soaked plain in the north of Kutch. Its southern continuation is known as the Little Rann.
- The Kathiawar Peninsula lies to the south of the Kachchh, the Kathiawar Peninsula lies.

Coastal Plains

Gujarat Plain

- The Gujarat Plain lies in the east of Kachchh and Kathiawar and slopes in the direction of west and south west.
- It is formed by the rivers Narmada, Tapi, Mahi and Sabarmati. The plain includes the southern part of Gujarat and the coastal areas of the Gulf of Khambhat.
- The eastern part of this plain is fertile but the major part near the coast is covered by wind-blown loess (heaps of sand)

Konkan Plain

- The Konkan Plain is in the south of the Gujarat plain and extends from Daman to Goa.
- The Konkan coast is characterised by subduction and erosional features including cliffs, shoals, reefs and islands in the Arabian Sea.
- Thane creek around Mumbai is an important embayment which provides an excellent natural harbour.

Karnataka Coastal Plain

- Goa to Mangalore
- Kanada coast extends between Marmagaon and Mangalore
- The Kanada coast is narrow and indented
- The region is rich in iron deposits
- At some places, the streams originating in the Western Ghats descend along steep slopes and make waterfalls
- The Sharavati River makes an impressive waterfall known as Jog Falls of 271 meter height while descending over such a steep slope
- Marine topography is quite marked on the coast.

Kerala Plain

- The Kerala Plain or Malabar Plain is the coast extends between Mangalore to Kanyakumari.
- The coastal plains are low lying plain and relatively broad.
- The lakes, lagoons, backwaters, spits, etc. are the significant characteristic of the Malabar coast.

Coastal Plains

Eastern Coastal Plains of India

- It is found between the Eastern Ghats and the Bay of Bengal.
- It extends from the Ganga delta to Kanniyakumari.
- It is marked by well-developed deltas of rivers like the Mahanadi, the Godavari, the Krishna and the Cauvery.
- Chilka lake and the Pulicat lake (lagoon) are the important geographical features of east coast.
- The Eastern coastal plains are broader than the western coastal plains and are an example of emergent coastal plain.
- The continental shelf here extends up to 500 km into the sea making difficult to develop good natural harbours and ports in these regions.

Utkal Plain

- The Utkal Plain comprises coastal areas of Odisha including the Mahanadi delta.
- Chilka Lake is the most prominent physiographic feature of this plain. It is the biggest lake in the country.

Andhra Plain

- It is found in the south of the Utkal Plain and extends upto Pulicat Lake.
- Pulicat lake has been barred by a long sand spit known as Sriharikota Island (ISRO launch facility).
- Rivers Godavari and Krishna forms delta. The two deltas have merged with each other resulting a single physiographic unit.
- This part of the plain has a straight coast and lacks good harbours with the exception of Vishakhapatnam and Machilipatnam

Tamilnadu Plain

- The Tamil Nadu Plain stretches from Pulicat lake to Kanniyakumari along the coast of Tamil Nadu.
- Its average width is 100 km.
- The most important feature of this plain is the Cauvery delta where the plain is 130 km wide.
- The Cauvery delta is known as granary of South India because of the fertile soil and large scale irrigation facilities.

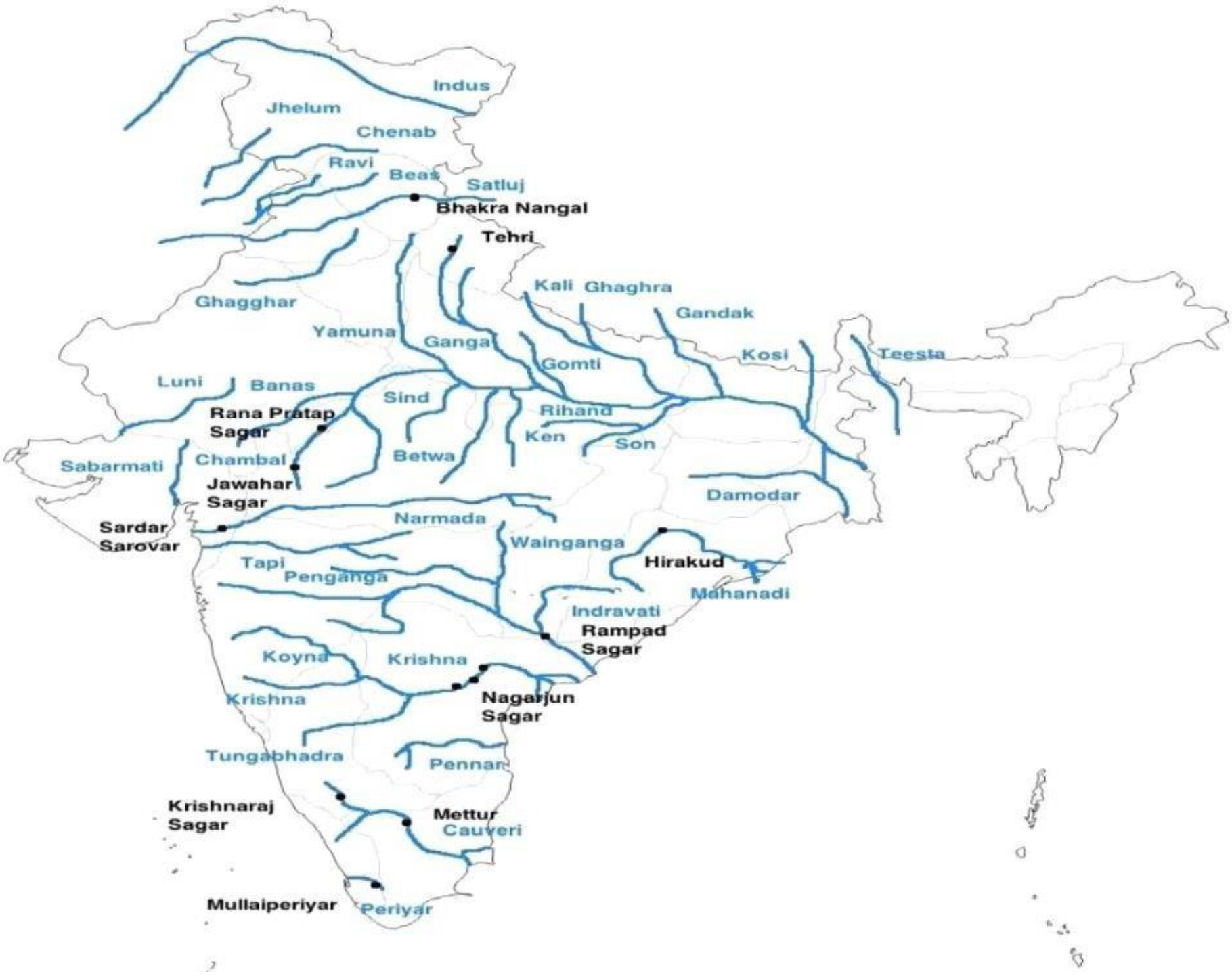
Coastal Plains

Western Vs Eastern Coastal Plains

Western coastal plain	Basis	Eastern coastal plain
They lie between western ghats and Arabian sea.	**Location**	They lie between eastern ghats and bay of Bengal.
They are narrow alluvial plain which are separate by hilly terrains.	**Width**	They are wider plain (80-120 km) with well developed deltas of the rivers.
The western coastal plains are further divided into two parts: Konkan coast, Malabar coast	**Further classification**	They are further divided as northern circus and coromandel coast.
They are known for lagoons estuary and kayals (backwater), which are known for fishing and Inland transportation.	**Known For**	They are known for deltas formed by the rivers and is more suitable for agriculture.
They receive rainfall from south-west monsoons.	**Rainfall**	They receive rainfall by retreating or north-west monsoon.
The important rivers are Narmada, Tapi	**Rivers**	The important rivers are Krishna, Kaveri, Mahanadi, etc.
They are submerged coast.	**Merging**	They are emergent coast.

Drainage System

Indian drainage system consists of a large number of small and big rivers. It is the outcome of the evolutionary process of the three major physiographic units i.e Great Himalayas, Peninsular Plateau, Western Ghats; and the nature and characteristics of precipitation.



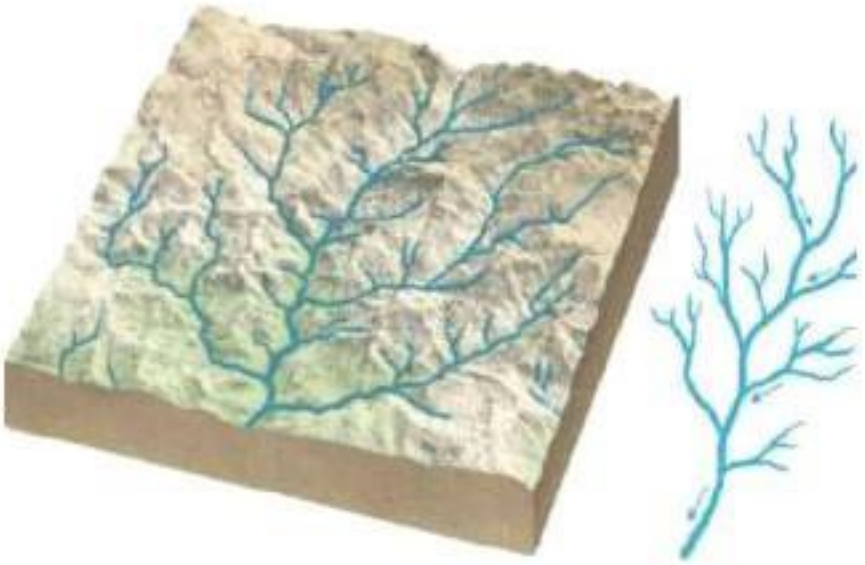
Drainage System

Basic Terms

- **Drainage system:** The flow of water through well-defined channels is known as drainage and the network of such channels is known as a drainage system.
- **Source of a river:** The beginning or start of a river.
- **Confluence:** The point at which two rivers or streams join.
- **Distributary:** The small river that branches out from the main river and then never meets again. It thus decreases the river's water volume. Distributaries are commonly found on deltas but are also important in the formation of alluvial fans and cones.
- **Tributary:** A stream or smaller river which joins a larger stream or river and thus increases its water volume.
- **Mouth:** The point where the river comes to the end, usually when entering a sea.
- **Catchment area:** It refers to all the area of land over which rain falls and is caught to serve a river basin.
- **Discharge:** The volume of water flowing in a river measured over time.
- **Watershed:** The boundary line separating one drainage basin from the other is called as the watershed area.

Types of Drainage Patterns

1. **Dendritic:** A drainage pattern which looks like tree branches with lots of twigs is known as a Dendritic drainage pattern. For example, the rivers of the northern plain.

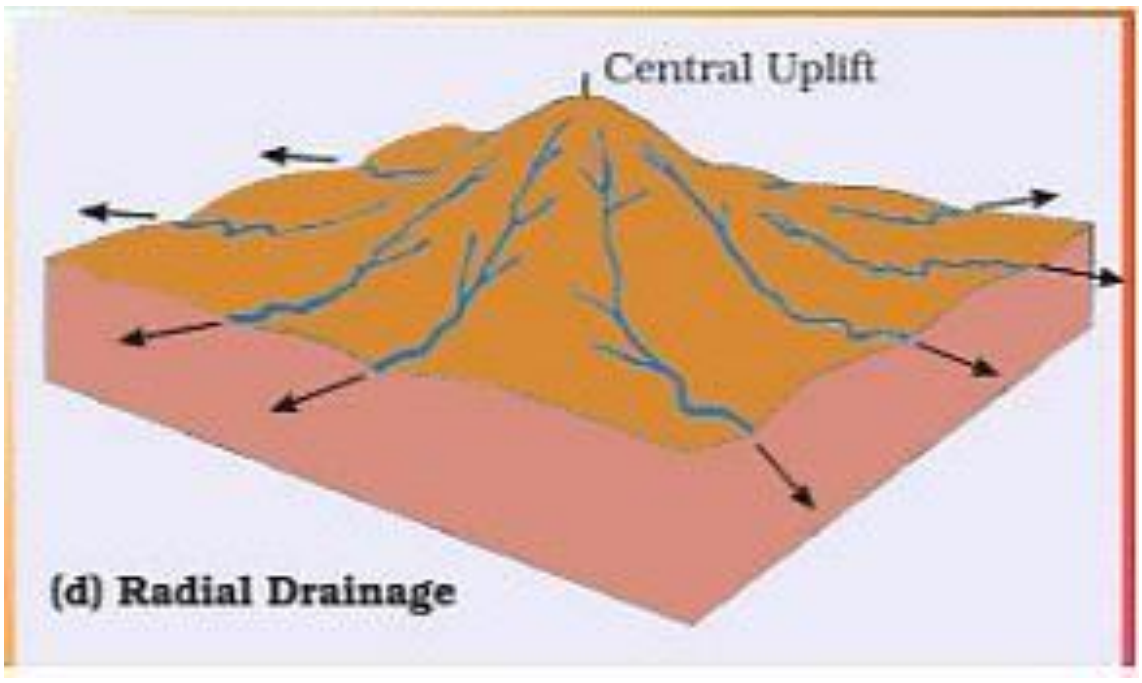


Dendritic Pattern

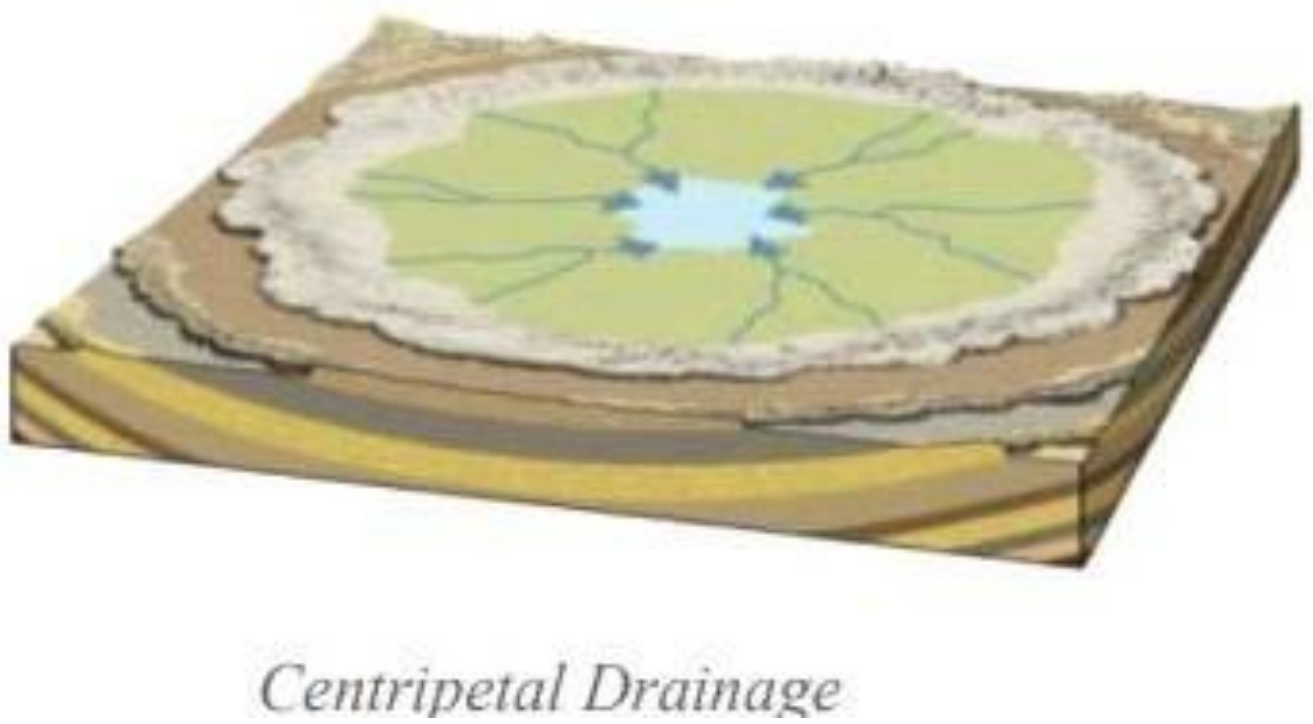
Drainage System

Types of Drainage Patterns

2. **Radial:** Radial drainage patterns form when rivers originate from a hill and flow in all directions. For example, the rivers originate from the Amarkantak.



3. **Centripetal:** Centripetal drainage pattern is formed when rivers discharge their waters from all directions into a lake or a depression.

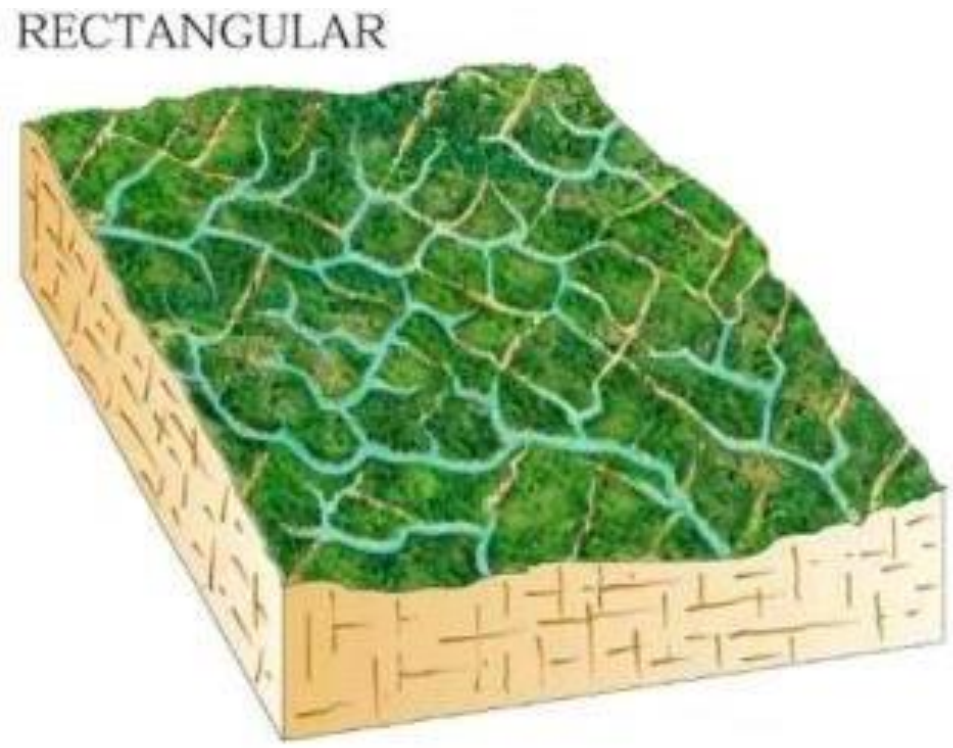


Centripetal Drainage

Drainage System

Types of Drainage Patterns

4. **Rectangular:** In rectangular drainage, both the main stream and its tributaries show right-angled bends. A rectangular drainage pattern develops on strongly joined rocky terrain. For example: streams found in the Vindhya Mountains of India.



Indus River System

- This river system includes the Indus and its tributaries like Jhelum, Chenab, Ravi, Beas, Sutlej
- It is one of the largest river basins of the world.
- The Indus originates from a glacier near Bokhar Chu in the Tibetan region at an altitude of 4,164 m in the Kailash Mountain range.
- After entering J&K, it flows between the Ladakh and the Zaskar Ranges. It is joined by the Zaskar River at Leh
- The Indus drains the largest number of glaciers of Himalayas, Ladakh, Zaskar, and Kailash.
- In Tibet, the Indus is known as Singi Khamban or the Lion's mouth.
- The Indus enters into Pakistan near Chillar in the Dardistan region.
- Major tributaries of Indus are Shyok, Gilgit, Zaskar, Hunza, Nubra, Shigar, Fasting, and Dras in the upper part.
- In the lower part, the Satluj, Beas, Ravi, Chenab, and Jhelum are the major tributaries of the Indus.
- Finally, the Indus discharges into the Arabian Sea near Karachi in Pakistan.

Drainage System

Jhelum River

- The Jhelum rises from a spring at Verinag situated at the foot of the Pir Panjal in Kashmir Valley
- It flows through Srinagar and the Wular lake before entering Pakistan through a deep narrow gorge. It joins the Chenab near Jhang in Pakistan.
- Dams: Mangla Dam, Uri Dam,Kishanganga Hydroelectric Plant

Chenab River

- The Chenab is the largest tributary of the Indus. It is formed by two streams, Chandra and Bhaga, which join at Tandi in Himachal Pradesh.
- Hence, it is also known as Chandrabhaga.
- Dams: Salal Dam, Pakal Dul Dam, Ratle Hydroelectric Plant, Dul Hasti Hydroelectric Plant

Ravi River

- It rises west of the Rohtang pass in the Kullu hills of Himachal Pradesh and flows through the Chamba valley of the state.
- Before entering Pakistan and joining the Chenab near Sarai Sidhu, it drains the area lying between the southeastern part of the Pir Panjal and the Dhauladhar ranges.
- Dams: Ranjit Sagar Dam, Chamera Dam

Beas River

- The Beas is another important tributary of the Indus, originating from the Beas Kund near the Rohtang Pass at an elevation of 4,000 m above the mean sea level.
- The river flows through the Kullu valley and forms gorges at Kati and Largi in the Dhauladhar range.
- It enters the Punjab plains where it meets the Satluj near Harike.
- Dams: Pong Dam, Pandoh Dam

Drainage System

Sutlej River

- The Sutlej originates in the Rakas lake near Mansarovar at an altitude of 4,555 m in Tibet
- It flows almost parallel to the Indus for about 400 km before entering India and comes out of a gorge at Rupar.
- It passes through the Shipki La on the Himalayan ranges and enters the Punjab plains. It is an antecedent river.
- It is a very important tributary as it feeds the canal system of the Bhakra Nangal project.

Drainage System

Ganga River System

- The Ganga river system is the largest river system in India
- Ganga basin covers 11 states viz., Uttarakhand, U.P., M.P., Rajasthan, Haryana, Himachal Pradesh, Chhattisgarh, Jharkhand, Bihar, West Bengal and Delhi.
- It rises in the Gangotri glacier near Gaumukh (3,900 m) in the Uttarkashi district of Uttarakhand. Here, it is known as Bhagirathi.
- It cuts through the Central and the Lesser Himalayas in narrow gorges.
- At Devprayag, the Bhagirathi meets the Alaknanda; hereafter, it is known as the Ganga. The Ganga enters the plains at Haridwar.
- It is joined by the Yamuna at Prayagraj (Allahabad)
- Important left bank tributaries of the Ganga
    - Ramganga
    - Gomati
    - Ghaghara
    - Gandak
    - Kosi
    - Mahananda
- Important right bank tributaries of the Ganga
    - Son
    - Yamuna

Drainage System

Tributaries of Yamuna

- Chambal River
- Banas River
- Sind River
- Betwa River
- Ken River
- Gandak River
- Ghaghra River
- Sharda River
- Kosi River
- Mahananda River
- Damodar River

Drainage System

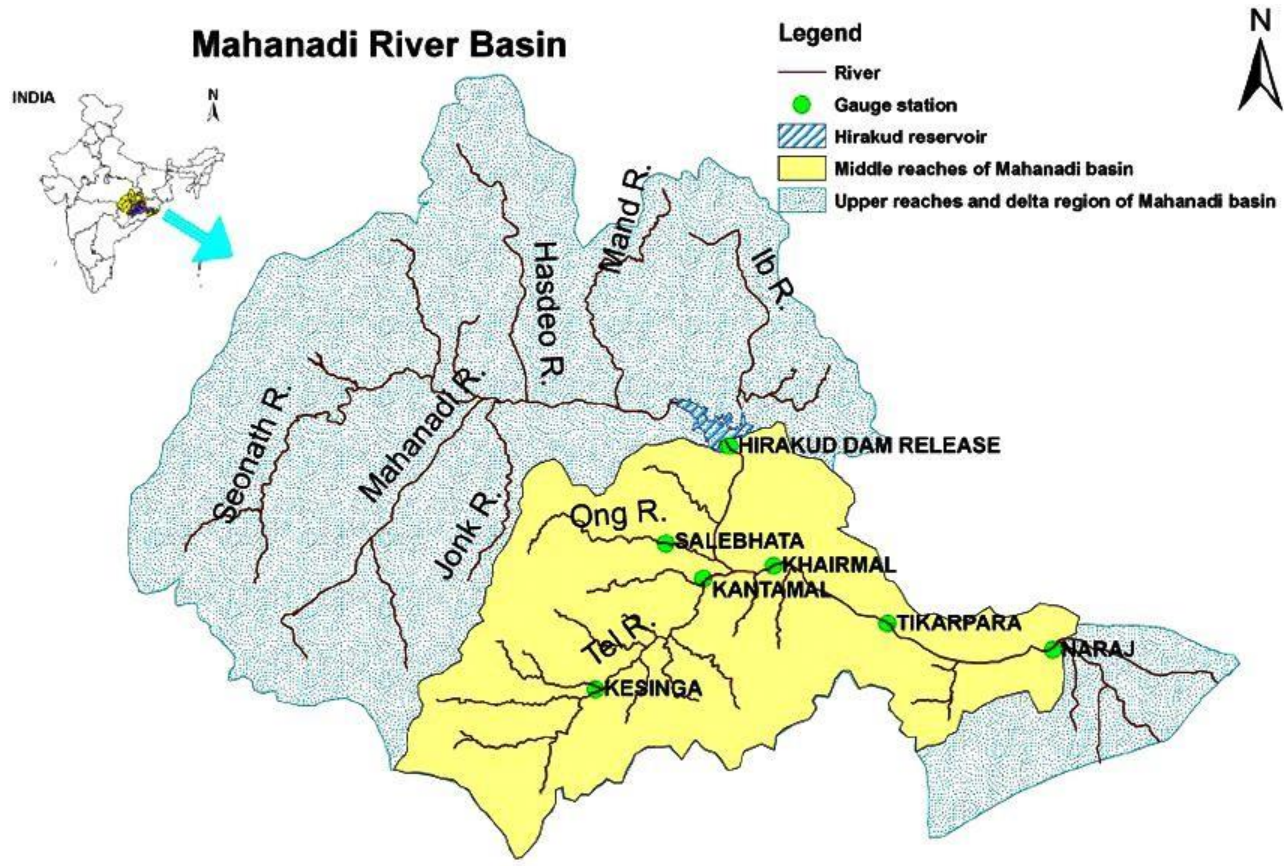
Brahmaputra River System

- The Brahmaputra, one of the largest rivers of the world, has its origin in the Chemayungdung glacier of the Kailash range near the Mansarovar lake.
- From here, it traverses eastward longitudinally for a distance of nearly 1,200 km in a dry and flat region of southern Tibet, where it is known asthe Tsangpo, which means 'the purifier.'
- The Tsangpo river emerges from the foothills under the name of Siang or Dihang. It enters India west of Sadiya town in Arunachal Pradesh.
- Flowing southwest, it receives its main left-bank tributaries, viz., Dibang or Sikang and Lohit; thereafter, it is known as the Brahmaputra.
- The Brahmaputra receives numerous tributaries in its 750 km long journey through the Assam valley.
- Its major left bank tributaries are the Burhi Dihing and Dhansari whereas the important right bank tributaries are the Subansiri, Kameng, Manas and Sankosh
- The Subansiri which has its origin in Tibet is an antecedent river.
- The Brahmaputra enters into Bangladesh near Dhubri and flows southward.
- In Bangladesh, the Teesta joins it on its right bank from where the river is known as the Jamuna.
- It finally merges with the river Padma, which falls in the Bay of Bengal.
- The Brahmaputra is well-known for floods, channel shifting and bank erosion.
- This is due to the fact that most of its tributaries are large, and bring a large number of sediments owing to heavy rainfall in its catchment area.
- Left Bank Tributaries: Dhansiri, Kapili, Barak
- Right bank tributaries: Subansiri, Jia Bhoraeli, Manas, Sankosh, Tista & Raidak

Drainage System

Mahanadi River

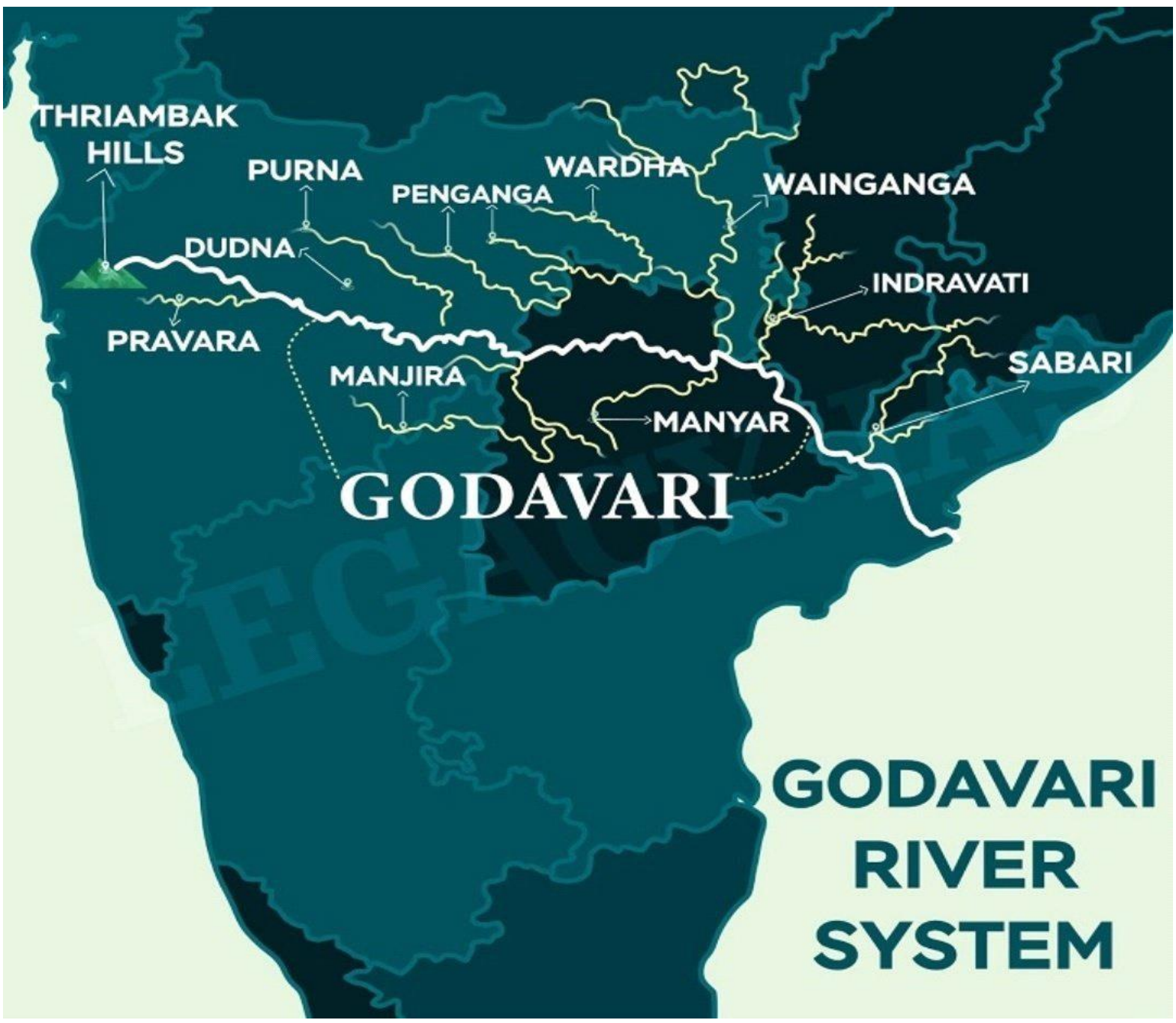
- The Mahanadi basin extends over states of Chhattisgarh and Odisha and comparatively smaller portions of Jharkhand, Maharashtra and Madhya Pradesh, draining an area of 1.4 lakh Sq.km
- The Mahanadi is one of the major rivers of the peninsular rivers, in water potential and flood producing capacity, it ranks second to the Godavari
- Other small streams draining directly into the Chilka Lake also forms the part of the Mahanadi basin
- At Sambalpur, the Hirakud Dam (one of the largest dams in India) on the river has formed a humanmade lake 35 miles (55 km) long
- It enters the Odisha plains near Cuttack and enters the Bay of Bengal at False Point by several channels
- Puri, at one of its mouths, is a famous pilgrimage site.
- Brahmani River is NOT a tributary of Mahanadi. It's a seasonal river that flows in Odisha. Together with the rivers Mahanadi and aitarani, it forms a large delta before entering into the Bay of Bengal at Dhamra
- The major tributaries of Mahanadi are Seonath,Jonk, Hasdo, Mand, Ib, Ong, Tel etc.



Drainage System

Godavari River

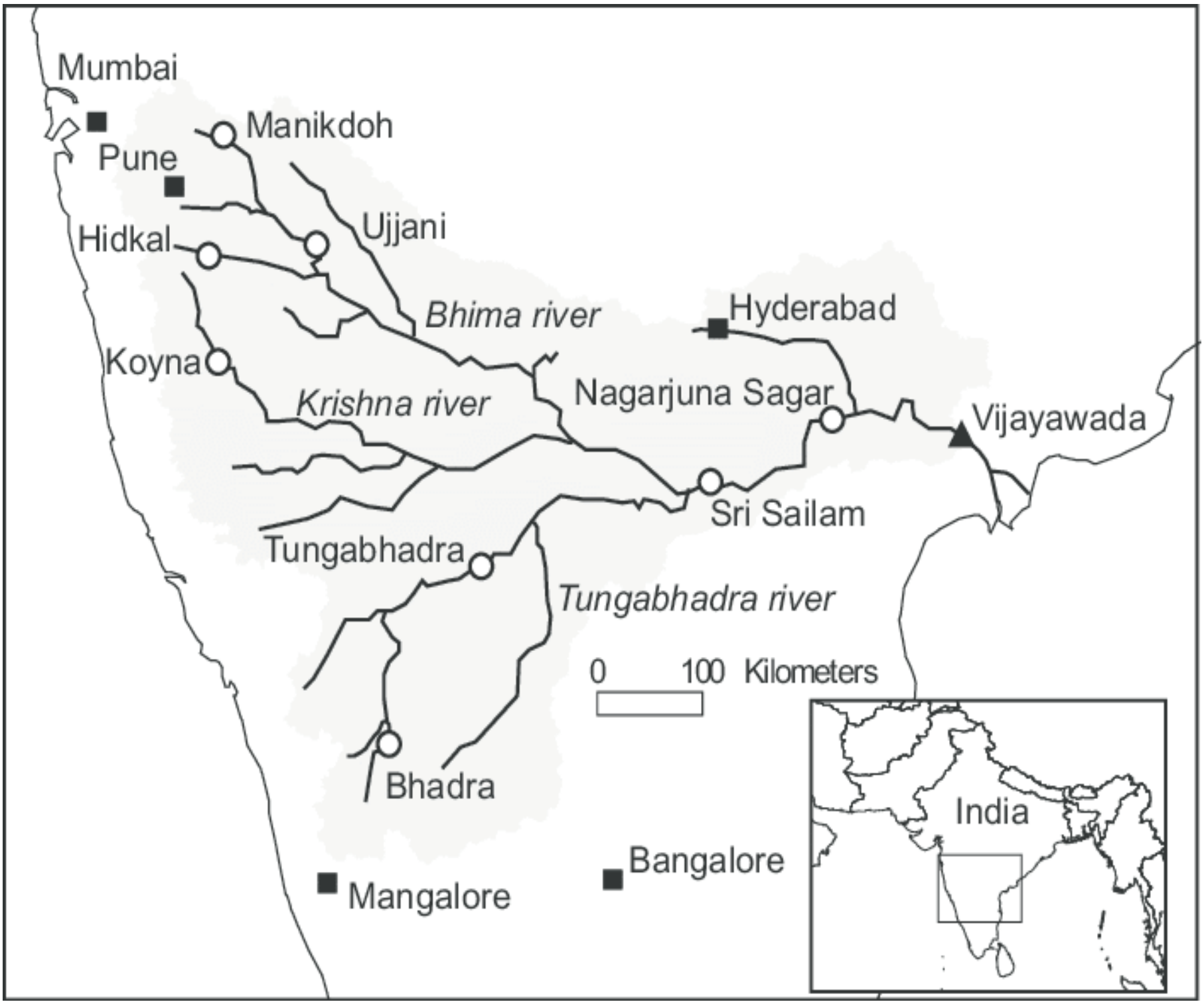
- The Godavari is the largest peninsular river system. It is also called the Dakshin Ganga.
- It rises in the Nasik district of Maharashtra and discharges its water into the Bay of Bengal.
- Godavari tributaries run through the states of Maharashtra, Madhya Pradesh, Chhattisgarh, Odisha and Andhra Pradesh.
- The Penganga, the Indravati, the Pranhita, and the Manjra are its principal tributaries.
- The Godavari is subjected to heavy floods in its lower reaches to the south of Polavaram, where it forms a picturesque gorge.
- It is navigable only in the deltaic stretch. The river after Rajamundri splits into several branches forming a large delta.



Drainage System

Krishna River

- The Krishna is the second-largest east-flowing Peninsular River which rises near Mahabaleshwar in Sahyadri. Its total length is 1,401 km.
- The Koyna, the Tungabhadra and the Bhima are its major tributaries
- Of the total catchment area of the Krishna, 27 per cent lies in Maharashtra, 44 per cent in Karnataka and 29 per cent in Andhra Pradesh.



Drainage System

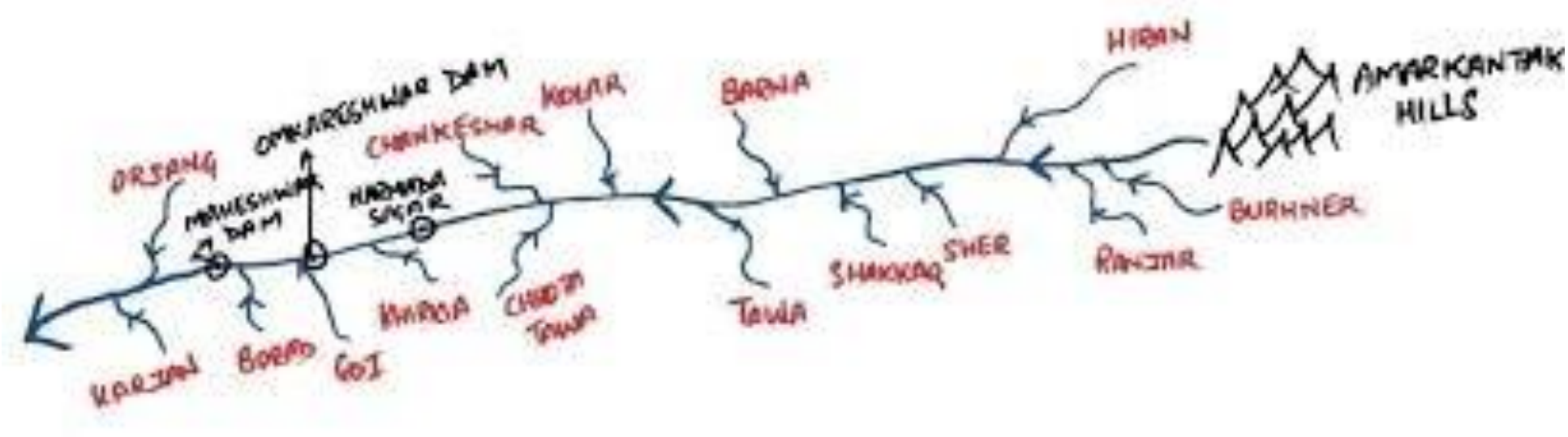
Kaveri River

- The Kaveri rises in Brahmagiri hills of Kodagu district in Karnataka.
- Its length is 800 km and it drains an area of 81,155 sq. km.
- Since the upper catchment area receives rainfall during the southwest monsoon season (summer) and the lower part during the northeast monsoon season (winter), the river carries water throughout the year with comparatively less fluctuation than the other peninsular rivers.
- About 3 percent of the Kaveri basin falls in Kerala, 41 per cent in Karnataka and 56 per cent in Tamil Nadu.
- It's important tributaries are the Kabini, the Bhavani and the Amravati.

Drainage System

Narmada River

- The Narmada originates on the western flank of the Amarkantak plateau at a height of about 1,057 m.
- While flowing in a rift valley between the Satpura in the south and the Vindhya range in the north, it forms a picturesque gorge in marble rocks and Dhuandhar waterfall near Jabalpur.
- After flowing a distance of about 1,312 km, it meets the Arabian Sea south of Bharuch, forming a broad 27 km long estuary. Its catchment area is about 98,796 sq. km.
- The Sardar Sarovar Project along with other dams has been constructed on this river under Narmada Multipurpose project.



Tapi River

- The Tapi is an important westward flowing river. It originates from Multai in the Betul district of Madhya Pradesh.
- Just like the Narmada, it flows in a rift valley south of Satpura range. It is 724 km long and drains an area of 65,145 sq. km.
- Nearly 79 per cent of its basin is in Maharashtra, 15 per cent in Madhya Pradesh and the remaining 6 per cent in Gujarat.
- Sabarmati and Mahi are the two famous rivers of Gujarat. They emerge from the Aravali range and flow into the Gulf of Khambhat into the Arabian Sea.

Soils

- Soil is the uppermost thin layer on the earth's crust comprising rock particles mixed with organic matter. The soil is one of the important components of the sustainability of an ecosystem because it is the vitally important natural medium for the growth of vegetation and thus it supports the lives on earth.

Major Factors that influence soil formation

Parent Material

- It is deposited by streams or derived from in-situ weathering. In this stage, soil acquires numerous properties like the mineral composition, the shade, the particle size and the chemical elements.

  For example

  - Black soil got its colour from lava rock
  - The peninsular soils mirror the parent rock
  - Sandy soils are derived from sandstone.

Climate

- It is one of the significant components in the formation of soil since it influences the pace of weathering of the parent rock.

Role of precipitation

- The variability in the precipitation alters the composition of the soil.
- For Example: Areas with little precipitation with high rate of evaporation prompted the accumulation of salts in the soil. The soils underlying tropical rain forests tend to be nutrient-poor due to concentrated intensive leaching because of heavy rains.

Role of temperature

It also plays a significant role since variancesin temperature causes contracting and expanding, frost action and general weathering in soils.

Soils

Biotic Factors (Flora, Fauna and Microorganisms)

- Biotic elements In conjunction with atmosphere, alters parent material to produce soil. For Example- Leguminous plants (such as beans, peas, and groundnuts) have nitrogen-fixing microscopic organisms. These plants take the nitrate ions directly from these nitrogen-fixing bacteria. It improves the fertility of soil by fixing atmospheric nitrogen to ammonia or ammonium.

Topography

- Topography redistributes the water arriving at the soil surface. Spillover fromuplands creates wetter conditions on the lowlands, in some cases saline swamps or organic soils. In this way, as a redistributor of the climate features, topography influences soil forms, soil distribution and the kind of vegetation at the site.

Time

- Soils can take numerous years to shape. Younger soils have some qualities from their parent material, however as they age, the expansion of organic matter, exposure to moisture and other cological factors may change its features. With time, they settle and are covered further beneath the surface, taking time to transform. In the end, they may change from one soil type to another.

Soil Profile (Soil Horizon)

- The soil profile is a vertical section of the soil that delineates all of its horizons. It extends from the soil surface to the parent rock material. The soil profile is comprised of layers, running parallel to the surface, called Soil Horizons. These layers are distinguished by their physical and chemical properties.

Classification of Soils of India

Alluvial Soil

- Mostly available soil in India (about 43%) covers an area of 143 sq. km.
- Widespread in northern plains and river valleys.
- In peninsular India, they are primarily found in deltas and estuaries.

Soils

- Humus, lime, and organic matter are present.
- Highly fertile.
- Indus-Ganga-Brahmaputhra plain, Narmada-Tapi plain etc are examples.
- They are depositional soil – transported and deposited by rivers, streams, etc.
- Sand content decreases from west to east of the country.
- New alluvium is termed as Khadar and old alluvium is termed as Bhangar.
- Color: Light Grey to Ash Grey.
- Texture: Sandy to silty loam or clay.
- Rich in: potash
- Poor in: phosphorous.
- Wheat, rice, maize, sugarcane, pulses, oilseed, etc. are cultivated mainly.

Red soil

- Seen mainly in low-rainfall areas.
- Also known as Omnibus group.
- Porous, friable structure.
- Absence of lime, kankar (impure calcium carbonate).
- Deficient in: lime, phosphate, manganese, nitrogen, humus, and potash.
- Color: Red because of Ferric oxide. The lower layer is reddish-yellow or yellow.
- Texture: Sandy to clay and loamy.
- Wheat, cotton, pulses, tobacco, oilseeds, potatoes, etc. are cultivated.

Black soil / regur soil

- Regur means cotton – the best soil for cotton cultivation.
- Most of the Deccan is occupied by Black soil.
- Mature soil.
- High water retaining capacity.
- Swells and will become sticky when wet and shrink when dried.
- Self-plowing is a characteristic of black soil as it develops wide cracks when dried.
- Rich in: Iron, lime, calcium, potassium, aluminum, and magnesium.

Soils

- Deficient in: Nitrogen, phosphorus, and organic matter.
- Color: Deep black to light black.
- Texture: Clayey.

Laterite soil

- Name from the Latin word 'Later' which means Brick.
- It becomes so soft when wet and so hard when dried.
- In the areas of high temperature and high rainfall.
- Formed as a result of high leaching.
- Lime and silica will be leached away from the soil.
- Organic matter in the soil will be removed fast by the bacteria as it is high temperature and humus will be taken quickly by the trees and other plants. Thus, humus content is low.
- Rich in: Iron and Aluminum
- Deficient in: Nitrogen, Potash, Potassium, Lime, Humus
- Color: Red color due to iron oxide.
- Rice, Ragi, Sugarcane, and Cashew nuts are cultivated mainly.

Desert / arid soil

- Seen under Arid and Semi-Arid conditions.
- Deposited mainly by wind activities.
- High salt content.
- Lack of moisture and Humus.
- Kankar or Impure Calcium carbonate content is high which restricts the infiltration of water.
- Nitrogen is insufficient and Phosphate is normal.
- Texture: Sandy
- Color: Red to Brown.

Peaty / marshy soil:

- Areas of heavy rainfall and high humidity.
- The growth of vegetation is very low.
- A large quantity of dead organic matter/humus which makes the soil alkaline.
- Heavy soil with black color.
- Peaty and marshy soils are found in areas with high water tables, such as the Kerala backwaters and parts of northeastern India. They have high organic content but can be acidic.

Soils

- These soils can support wetland agriculture and are suitable for rice and aquatic crops.

Forest soil

- Forest and hill soils are found in densely forested regions and higher altitudes. They are typically acidic and often have a shallow topsoil layer.
- These soils are essential for maintaining forest ecosystems but are not suitable for intensive agriculture.

Mountain soil:

- Immature soil with low humus and acidic.
- Mountain soils are found in hilly and mountainous regions, including the Himalayas. They are highly weathered and can vary in composition depending on local conditions.
- These soils are suitable for horticulture, tea, and temperate crops like apples and potatoes.

Saline and Alkaline Soils

- Saline and alkaline soils are found in coastal areas and arid regions. They have high levels of salts and alkalis, making them unsuitable for most crops.
- These soils can be reclaimed for agriculture through drainage and soil amendments.

Natural Vegetation

Tropical Wet Evergreen Forest Or Rain Forest

Distribution

- Western side of the Western Ghats (500 to 1370 metres above sea level).
- Some regions in the Purvanchal hills.
- In the Andaman and Nicobar Islands.

Climatic Conditions

- Annual precipitation exceeds 250 cm with a short dry season.
- The annual temperature is between 25°-27°C.
- The average annual humidity exceeds 77%.

Characteristics

- The trees of these forests do not shed their leaves together due to high heat and high humidity.
- Plants are Mesophytic and are adopted to neither too dry nor too wet type climate.
- Lofty: The trees have lofty height often reaching to 45-60 metres.
- All plants struggle upwards (most epiphytes) for sunlight resulting in a peculiar layer arrangement.
- The entire morphology looks like a green carpet when viewed from above.

Timber

- The timber of these forests is durable fine-grained Hardwood.
- The important species of these forests are mahogany, mesua, white cedar, jamun, canes, bamboo etc.

Tropical Semi-Evergreen Forest

- They are transitional forests lying in between tropical wet evergreen forests and tropical deciduous forests.
- They are comparatively drier areas in comparison to tropical wet evergreen forests.

Climatic Conditions

- Annual rainfall is in between 200-250 cm.
- Mean annual temperature fluctuates between 24°C to 27°C.
- The relative humidity is about 75%.

Natural Vegetation

- The dry season is long in comparison to tropical evergreen forests.

Distribution

- Western coast
- Assam
- Lower slopes of the Eastern Himalayas
- Odisha and Andamans.

Characteristics

- The semi-evergreen forests are less dense and are more gregarious (living in flocks or colonies) than the wet evergreen forests.
- These forests possess many species.
- Trees usually have buttressed trunks with abundant epiphytes.
- The important species are:-
  - Rosewood, mesua, laurel, thorny bamboo in Western Ghats
  - White cedar, mango, Indian chestnut, champa, etc. in Himalayan region.

Tropical Moist Deciduous Forests

Distribution

- It is found along the Western Ghats surrounding the belt of evergreen forests.
- Belt running along the Western Ghats surrounding the belt of evergreen forests.
- A strip along the Shiwalik range including terai and bhabar region.
- Regions of Manipur and Mizoram.
- Hills of eastern Madhya Pradesh and Chhattisgarh, Chota Nagpur Plateau, most of Odisha, parts of West Bengal, and Andaman and Nicobar islands.

Climatic Conditions

- Annual rainfall is in between 100 to 200 cm.
- Mean annual temperature is about 27°C
- The average annual relative humidity is in between 60-75%.
- Spring (season between summer and winter) and summer are dry.

Natural Vegetation

Characteristics

- The trees drop their leaves during the spring and early summer because of the insufficient moisture in the atmosphere.
  - The general appearance is bare in extreme summers (April-May).
- Tropical moist deciduous forests present irregular top storey (25 to 60 m), heavily buttressed trees, and undergrowth.
- These forests cover much larger area than the evergreen forests but major tracts under these forests have been cleared for cultivation.

Littoral and Swamp Vegetation (Mangrove Vegetation / Tidal Forests)

- mangrove vegetation found in the tidal deltas of Ganga, Mahanadi, Godavari and Krishna rivers.
- These areas have rainfall of more than 200cm.
- Important Tree Species are Sundari, Agar, Bhendi, Keora, Nipa.
- Turtles, crocodiles, gharials, and snakes are also found in these forests. Royal Bengal Tiger is the famous animal in these forests.
- Characteristic Features:
  - The trees are mainly evergreen.
  - Typically they produce tangled webs of arching roots that are exposed during low tides.
  - This vegetation is an adaptation to two conditions:
  - High water salinity
  - Flooded at regular intervals
- Prominent among these adaptations are the presence of stilt roots, buttress, pneumatophores etc.

Distribution

- Along the coasts of Tamil Nadu.
- These forests are found in the areas of relatively high temperature and small rainfall available only during summers.

Climatic Conditions

- Annual precipitation of about 100 cm
  - mostly from the north-east monsoon winds in October–December.
- Mean annual temperature is about 28°C.
- The mean humidity is about 75%.

Natural Vegetation

Characteristics

- Short statured trees up to the height of 12 meter with complete canopy.
- Dense distribution of mixed small evergreen and deciduous Trees of 10 to 15 meter height.
- Bamboos and grasses are not conspicuous absent.
- The important species are neem, jamun, tamarind, etc.
- Most of the land under these forests has been cleared for agriculture or casuarina plantations.

Distribution

- They occur in an irregular wide strip running from the foot of the Himalayas to Kanyakumari except in Rajasthan, Western Ghats and West Bengal.

Climatic Conditions

- Annual rainfall is 100-150 cm.
- These forests are found in areas having temperatures of 25-32°C and annual rainfall of 75-125 cm along with a dry season of about six months.

Characteristics

- These forests shed their leaves in the dry season like the moist deciduous forests.
  - The major difference is that they can grow in areas of comparatively less rainfall.
- They are transitional types with moist deciduous on the wetter side and thorn forests on the drier side.
- Chief characteristic feature of the forests is the open canopy of small (10-15 m high) trees and abundance of shrubs.
- The forests include a mixture of a few deciduous trees species rising up to a height of 20 metres.
- Enough light penetration to the ground permits the undergrowth.
- The important species are Teak, Sal, Laurel, Palas, Khair, Tendu, Amaltas, Bel, Axlewood etc.
- Large tracts of this forest have been cleared for agricultural purposes.

Natural Vegetation

- These forests have suffered from overgrazing, fire, etc.

Tropical Thorn Forest

Distribution

- These forests are distributed in western Rajasthan, Madhya Pradesh, south-western Punjab, western Haryana, Kachchh and neighbouring parts of Saurashtra.
  - Here they degenerate into desert type in the Thar desert.
- Such forests also grow on the leeward side of the Western Ghats covering large areas of Karnataka, Telangana, Andhra Pradesh, Maharashtra, and Tamil Nadu.

Climatic Conditions

- These forests are found in the areas of high temperature of 27-30° C and very low annual rainfall of 20-60 cm with long periods or dryness (Humidity is less than 50%).

Characteristics

- Scattered distribution of small (8-10 in high) mostly thorny trees with shrubs being more common than trees.
- The plants in these forests develop leaves only during the brief rainy season when grasses and herbs also become abundant and remain leafless for most of the year.
- Acacias and Euphorbias are very prominent.
- The Indian wild date is common. Some grasses also grow in the rainy season.

Montane Forests

- In mountainous areas, the decrease in temperature with increasing altitude leads to a corresponding change in natural vegetation.
- Mountain forests can be classified into two types, the northern mountain forests and the southern mountain forests.
- The Himalayan ranges show a succession of vegetation from the tropical to the tundra, which change in with the altitude.
- Deciduous forests are found in the foothills of the Himalayas. It is succeeded by the wet temperate type of forests between an altitude of 1,000-2,000 m.
- In the higher hill ranges of northeastern India, hilly areas of West

Natural Vegetation

Bengal and Uttaranchal, evergreen broad leaf trees such as oak and chestnut are predominant.

- Between 1,500-1,750 m, pine forests are also well-developed in this zone, with Chir Pine as a very useful commercial tree.
- Deodar, a highly valued endemic species grows mainly in the western part of the Himalayan range.
- Deodar is a durable wood mainly used in construction activity. Similarly, the chinar and the walnut, which sustain the famous Kashmir handicrafts, belong to this zone.
- Blue pine and spruce appear at altitudes of 2,225-3,048 m. At many places in this zone, temperate grasslands are also found. But in the higher reaches there is a transition to Alpine forests and pastures.
- Silver firs, junipers, pines, birch and rhododendrons, etc. occur between 3,000-4,000 m.
- The southern slopes of the Himalayas carry a thicker vegetation cover because of relatively higher precipitation than the drier north-facing slopes.
- At higher altitudes, mosses and lichens form part of the tundra vegetation.
- The southern mountain forests include the forests found in three distinct areas of Peninsular India viz; the Western Ghats, the Vindhyas and the Nilgiris