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GEOGRAPHY

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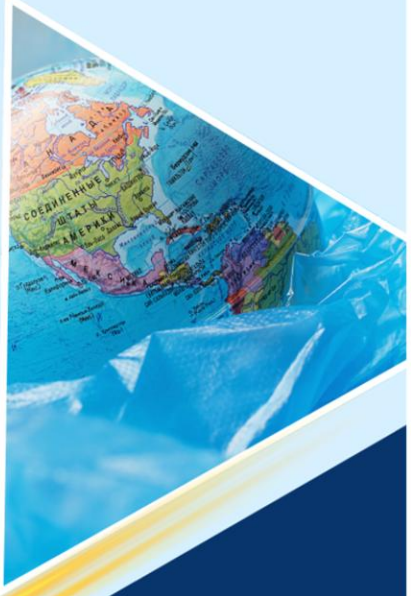

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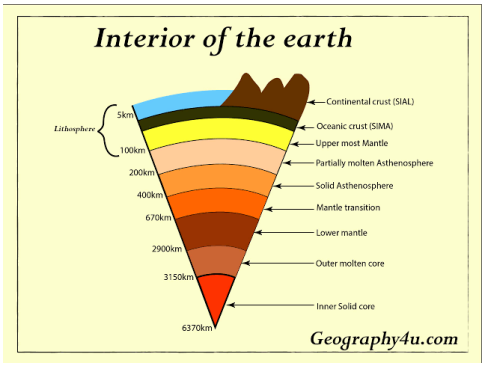
Table of Contents

a) General Concepts 1
b) Geographical Information about India 3
c) Physical Division of India 6
d) Geological Composition of India 31
e) Indian Drainage System 35

1. General Concepts

What is Geography



Geography is defined as the study of Earth and the forces that shape it, both physical and human. More specifically, it is the study of Earth's landscapes, people, places, and environments.

Hecataeus (Greek scholar) is called the father of geography because he first arranged the geographical descriptions through the book "Ges Periodus".

Interior of the Earth

Crust vs Lithosphere

Continental Drift Theory

Continental drift was a revolutionary theory explaining that continents shift position on Earth's surface. The theory was proposed by geophysicist and meteorologist Alfred Wegener in 1912, but was rejected by mainstream science at the time. Scientists confirmed some of Wegener's ideas decades later, which are now part of the widely accepted theory of plate tectonics.

According to the Continental Drift Theory, part of the crust are capable of horizontal movement round the globe causing the continents to slowly change their positions in relation to one another.

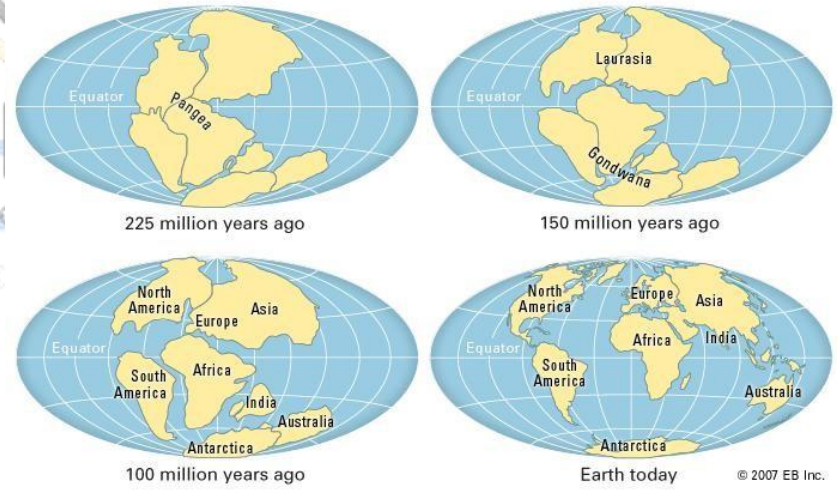
The fact that South America is a mirror image of Africa is presented as a proof of the continental drift theory (see video below for an animation showing the migration of both of these continents).

For hundreds of millions of years, all the land of Earth was joined together in one large mass or super continent. Scientists call it Pangaea (meaning “all lands” in Greek). Then about 200 million years ago the land began to drift apart. It broke into two pieces, and scientists have called the continent in the north Laurasia and the continent in the south Gondwanaland (named by Eduard Suess, an Austrian geologist).The two large continents continued to break apart into the smaller continents that exist today. Scientists call this movement ‘continental drift’.

Plate Tectonic Theory

The term plate tectonics was first used by Tuzo Wilson, of the University of Toronto but the Plate Tectonics theory was first published by W.J Morgan of the Princeton University in 1962.

Plate tectonics is a scientific theory describing the large-scale motion of 7 large plates and the movements of a larger number of smaller plates of the Earth‘s lithosphere, over the last hundreds of millions of years.



The theoretical model builds on the concept of continental drift developed during the first few decades of the 20th century. The geo scientific community accepted plate-tectonic theory after seafloor spreading was validated in the late 1950s and early 1960s.

According to Plate tectonics theory

the lithosphere is believed to have been broken into fragments that are floating on a ductile layer called asthenosphere (upper part of the mantle).

The movement of these plates is attributed to the convention currents being generated in the upper mantle.

Plates move horizontally over the asthenosphere as rigid units.

The lithosphere includes the crust and top mantle with its thickness range varying between 5-100 km in oceanic parts and about 200 km in the continental areas.

The oceanic plates contain mainly the Simatic crust and are relatively thinner, while the continental plates contain Sialic material and are relatively thicker.

Lithospheric plates (tectonic plates) vary from minor plates to major plates, continental plates (Arabian plate) to oceanic plates (Pacific plate), sometimes a combination of both continental and oceanic plates (Indo-Australian plate).

The movement of these crustal plates (due to convection currents in the mantle) causes the formation of various landforms and is the principal cause of all earth movements.

The margins of the plates are the sites of considerable geologic activity such as seafloor spreading, volcanic eruptions, crustal deformation, mountain building, and continental drift.

Major tectonic plates

Antarctica and the surrounding oceanic plate – (Surrounded by divergent boundaries.)

North American plate – (shifting westwards, velocity 4-5 cm/year. It is half oceanic—half continental)

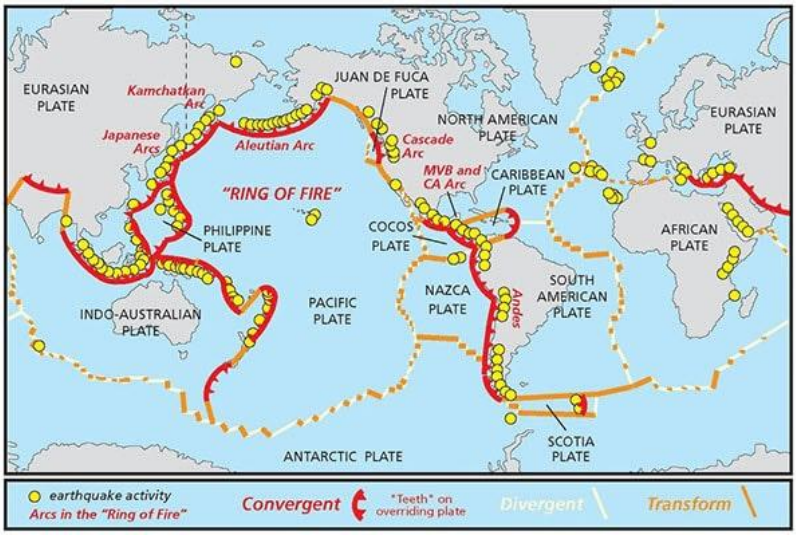
South American plate – *(*shifting westwards, Half continental — half oceanic. 3-4 cm/year)

Pacific plate – (Truly oceanic plate. Shifting NW 2- 3cm/year)

India-Australia-New Zealand plate

Africa with the eastern Atlantic floor plate

Eurasia and the adjacent oceanic plate – (mostly continental, shifting eastwards. Velocity -2-3cm/year



What are Continents

A continent is a large expanse of land that may or may not be separated from other continents by one or more oceans.

A continent is any of several large geographical regions. Continents are generally identified by convention rather than any strict criteria. A continent could be a single landmass or a part of a very large landmass, as in the case of Asia or Europe.

What are Oceans and How they are different from Sea

An ocean is a continuous body of salt water that is contained in an enormous basin on Earth's surface. The major oceans and their marginal seas cover nearly 71 percent of Earth's surface, with an average depth of 3,688 metres (12,100 feet).

In terms of geography, seas are smaller than oceans and are usually located where the land and ocean meet. Typically, seas are partially enclosed by land.

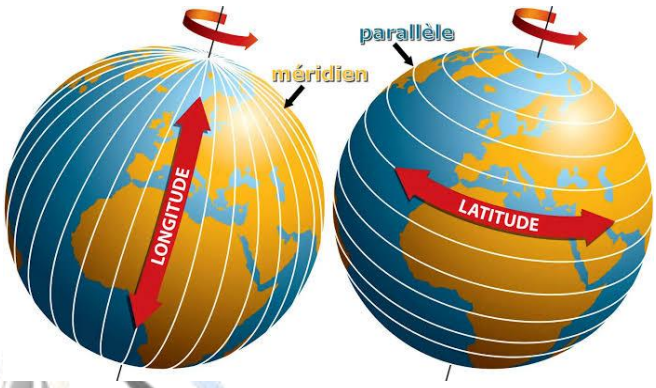
- Define the terms Isthmus, Strait, Channel and Pass
- Define the terms Mountain, Plateau and Plains
- What are Latitudes and Longitudes

Latitude

A geographic coordinate that indicates the north-south position of a point on the Earth's surface is known as latitude. The term "latitude" refers to an angle that extends from 0° at the Equator to 90° (North or South) at the poles. As circles parallel to the equator, parallels or lines of constant latitude run east-west. The terminology latitude and longitude are used to describe the exact location of features on the surface of the Earth. The term latitude should be used to refer to the geodetic latitude, which is explained below. In a nutshell, geodetic latitude is the angle formed between a point and the equatorial plane by a vector perpendicular to the ellipsoidal surface.

Longitude

The east-west position of a point on the Earth's surface, or the surface of a celestial body, is specified by longitude. The Greek letter lambda represents an angular measurement. It is commonly given in degrees.



Meridians (lines that run from pole to pole) link sites of the same longitude together. By agreement, the prime meridian passes near the Royal Observatory in Greenwich, England, and is designated as 0° longitude. Longitudes that are positive are east of the prime meridian, whereas those that are negative are west

India has a unique culture and is one of the oldest and greatest civilizations of the world. India has achieved all-round socio-economic progress since its Independence. India covers an area of 32,87,263 sq. km, extending from the snow-covered Himalayan heights to the tropical rain forests of the south. As the 7th largest country in the world, India stands apart from the rest of Asia, marked off as it is by mountains and the sea, which give the country a distinct geographical entity. Bounded by the Great Himalayas in the north, it stretches southwards and at the Tropic of Cancer, tapers off into the Indian Ocean between the Bay of Bengal on the east and the Arabian Sea on the west.

Lying entirely in the northern hemisphere, the mainland extends between latitudes 8° 4' and 37° 6' north, longitudes 68° 7' and 97° 25' east and measures about 3,214 km from north to south between the extreme latitudes and about 2,933 km from east to west between the extreme longitudes. It has a land frontier of about 15,200 km. The total length of the coastline of the mainland, Lakshadweep Islands and Andaman & Nicobar Islands is 7,516.6 km.

2. Geographical information about India

Location	**The Indian peninsula is separated from mainland Asia by the Himalayas. The Country is surrounded by the Bay of Bengal in the east, the Arabian Sea in the west, and the Indian Ocean to the south.**
Geographic Coordinates	Lying entirely in the Northern Hemisphere, the Country extends between 8° 4' and 37° 6' latitudes north of the Equator, and 68° 7' and 97° 25' longitudes east of it.
Indian Standard Time	GMT + 05:30
Area	3.3 Million sq. km
Telephone Country Code	+91

Border Countries	Afghanistan and Pakistan to the north-west; China, Bhutan and Nepal to the north; Myanmar to the far east; and Bangladesh to the east of West Bengal. Sri Lanka is separated from India by a narrow channel of sea, formed by Palk Strait and the Gulf of Mannar.
Coastline	7,516.6 km encompassing the mainland, Lakshadweep Islands, and the Andaman & Nicobar Islands.
Climate	The climate of India can broadly be classified as a tropical monsoon one. The Indian Meteorological Department (IMD) designates four official seasons: i. Winter, from December to early April ii. Summer or pre-monsoon, from April to June (April to July in north-western India) iii. Monsoon or rainy, from June to September iv. Post-monsoon, from October to December
Terrain	The mainland comprises of four regions, namely the great mountain zone, plains of the Ganga and the Indus, the desert region, and the southern peninsula.
Natural Resources	Coal, iron ore, manganese ore, mica, bauxite, petroleum, titanium ore, chromite, natural gas, magnesite, limestone, arable land, dolomite, barytes, kaolin, gypsum, apatite, phosphorite, steatite, fluorite, etc.
Natural Hazards	Monsoon floods, flash floods, earthquakes, droughts, and landslides.
Environment - Current Issues	Air pollution control, energy conservation, solid waste management, oil and gas conservation, forest conservation, etc.
Environment - International Agreements	Rio Declaration on environment and development, Cartagena Protocol on biosafety, Kyoto Protocol to the United Nations Framework Convention on climatic change, World Trade Agreement, Helsinki Protocol to LRTAP on the reduction of sulphur emissions of nitrogen oxides or their transboundary fluxes (Nox Protocol), and Geneva Protocol to LRTAP concerning the control of emissions of volatile organic compounds or their transboundary fluxes (VOCs Protocol).
Geography - Note	India occupies a major portion of the south Asian subcontinent.

People	**Information about Indian Citizens**
Population	India's population, as on 1 March 2011 stood at 1,210.9 million (623.2 million males and 587.6 million females)
Population Growth Rate	The average annual exponential growth rate stands at 1.64 per cent during 2001-2011
Birth Rate	The Crude Birth rate was 20.1 during 2011-15
Death Rate	The Crude Death rate was 7.2 during 2011-15
Life Expectancy Rate	65.8 years (Males); 68.1 years (Females) in the period 2006-2011
Sex Ratio	940 according to the 2011 census
Nationality	Indian
Ethnic Groups	All the five major racial types - Australoid, Mongoloid, Europoid, Caucasian, and Negroid find representation among the people of India.

Religions	According to the 2001 census, out of the total population of 1,028 million in the Country, Hindus constituted the majority with 80.5%, Muslims came second at 13.4%, followed by Christians, Sikhs, Buddhists, Jains, and others.
Languages	There are 22 different languages that have been recognised by the Constitution of India, of which Hindi is an Official Language. Article 343(3) empowered Parliament to provide by law for continued use of English for official purposes.
Literacy	According to the provisional results of the 2011 census, the literacy rate in the Country stands at 74.04 per cent, 82.14% for males and 65.46% for females.

Government

Information about Indian Government

Particulars	Description
Country Name	Republic of India; Bharat Ganrajya
Government Type	Sovereign Socialist Democratic Republic with a Parliamentary system of Government.
Capital	New Delhi
Administrative Divisions	28 States and 8 Union Territories.
Independence	15th August 1947 (From the British Colonial Rule)
Constitution	The Constitution of India came into force on 26th January 1950.
Legal System	The Constitution of India is the fountain source of the legal system in the Country.
Executive Branch	The President of India is the Head of the State, while the Prime Minister is the Head of the Government, and runs office with the support of the Council of Ministers who form the Cabinet Ministry.
Legislative Branch	The Indian Legislature comprises of the Lok Sabha (House of the People) and the Rajya Sabha (Council of States) forming both the Houses of the Parliament.
Judicial Branch	The Supreme Court of India is the apex body of the Indian legal system, followed by other High Courts and subordinate Courts.
Flag Description	The National Flag is a horizontal tricolour of deep saffron (kesaria) at the top, white in the middle, and dark green at the bottom in equal proportion. At the centre of the white band is a navy blue wheel, which is a representation of the Ashoka Chakra at Sarnath.
National Days	26th January (Republic Day) 15th August (Independence Day) 2nd October (Gandhi Jayanti; Mahatma Gandhi's Birthday)

3. Physical Division of India

What is Physiographic Division ?

Physical division refers to a distinct area of land within a larger region, which possesses its own distinctive landforms and geological features. In simple terms, they effectively categorize large areas based on a common set of physical features.

The concept of physiographic divisions allows us to classify, study, and manage different areas of a vast region according to their physical characteristics and natural environments.

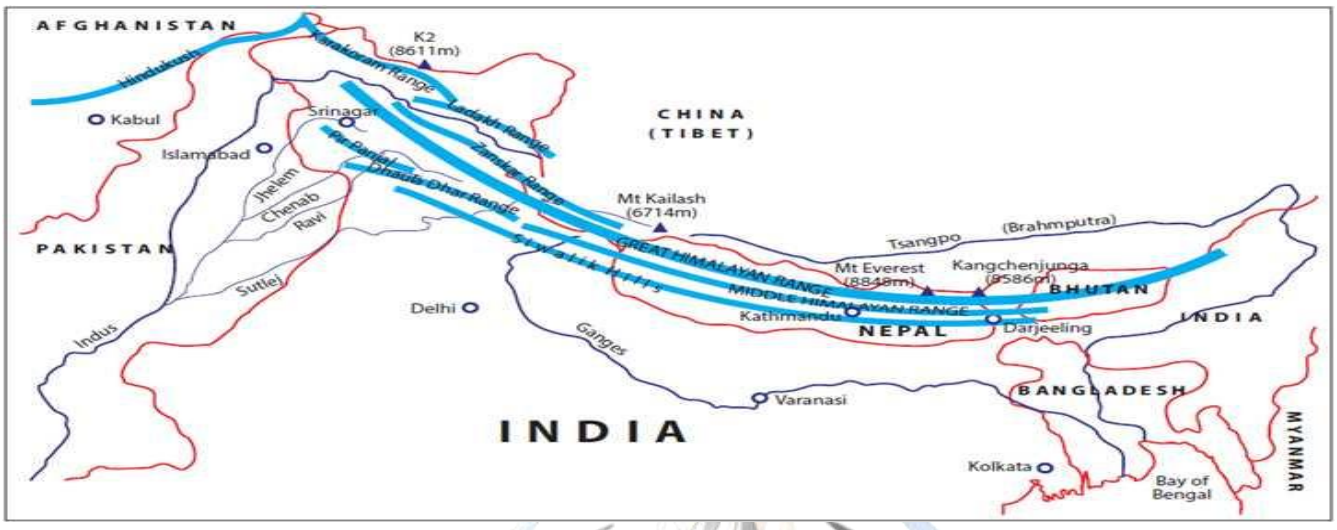
- **Physiographic Divisions of India**

The vast expanse of India encompasses a great diversity of relief features. Based on these features, India has been divided into the following 5 physiographic divisions:

1) The Himalayas
2) The Indo-Gangetic Plains
3) The Peninsular Plateau of India
4) The Coastal Plains of India
5) The Indian Islands

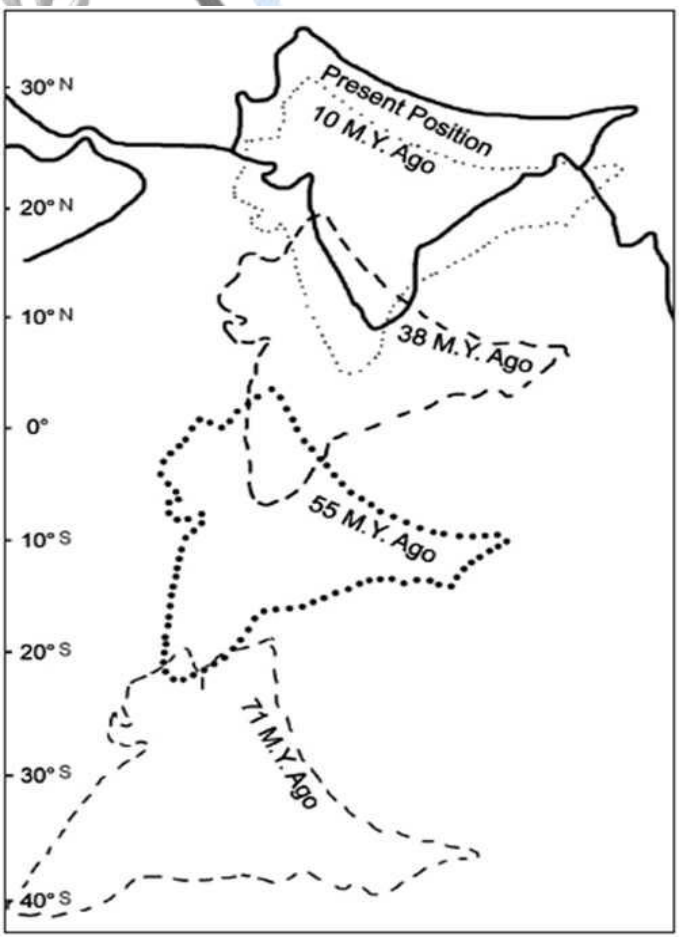
1. The Himalayas

The Himalayas are young fold mountains formed by the convergence of two tectonic plates. They constitute one of the 5 physiographic divisions of India. Along with acting as a grand barrier guarding India's frontiers, they also act as a dividing range between the Tibetan Plateau in the north and India in the south.



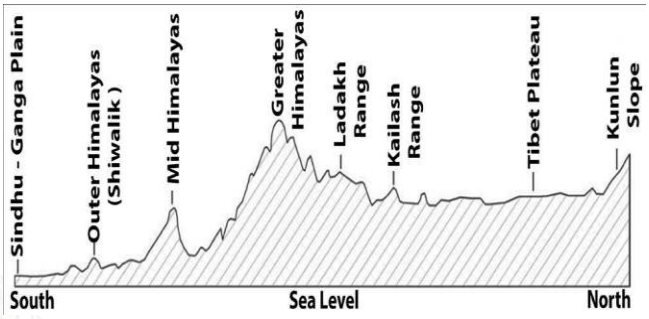
Formation of Himalayas

- The Himalayas were formed several million years ago as a result of the convergence of the Indo-Australian Tectonic Plate with the Eurasian (Asian) Tectonic Plate. The series of events that led to their genesis and evolution are listed chronologically below:
- Existence of Pangea and Panthalassa: Around 250 million years ago, there existed a supercontinent called Pangea (a giant formation of land under which all the continents of the world were attached together as a monolithic structure). This Pangea was surrounded by a massive water body called Panthalassa.



- **Breaking of Pangea :** Around 150 million years ago, the supercontinent Pangea began to break into different parts. First of all, it broke into two parts:
- **Laurasia or Angara land :** The northern part of the Pangea was called Angara land or Laurasia.
- It consisted of landmasses that contained present-day North America, Europe, and Asia.
- **Gondwanaland :** The southern part of the Pangea was called Gondwanaland.
- It consisted of present-day South America, Africa, South India, Australia, and Antarctica.
- **Formation of Tethys Sea :** Due to the breaking down of Pangea, a long narrow sea was created between Angara land and Gondwanaland, occupying the area where the Himalayas stand today. This sea was known as the Tethys Sea.

- **Deposition of Sediments :** During the course of time, huge amounts of sediments were deposited in the bed of the Tethys Sea by the rivers flowing from Angara land as well as Gondwanaland.
- **Breaking Down of Gondwanaland and Angara land**: The Gondwanaland and Angara land were further broken down into different smaller landmasses. The Indo-Australian Plate (comprising present-day Australia and the Indian Sub-continent) emanated from the Gondwanaland and the Eurasian Plate (containing present-day Europe and Northern Asia) emanated from the Angara land.
- **Convergence of Indo-Australian and Eurasian Plates** : The convectional currents generated in the Mantle of the Earth made the Indo-Australian Plate drift northwards towards the Eurasian Plate. This drift continued for millions of years, leading to the convergence of the two plates across the Tethys Sea.



- **Formation of Folds** : As the two plates continued to approach each other, the area of the Tethys Sea began to shrink and the sediments in its seabed were slowly pushed upwards, leading to the formation of folds.
- **Genesis of the Himalayas**: Eventually, the Tethys Sea vanished completely and sediments rising from its seabed formed a mountain range, which is now known as the Himalayas.
- It is to be noted that the convergence of the two tectonic plates continues to date, leading to the rising of the Himalayas by about 5 mm per year even now

Longitudinal Division of Himalayas :

On the basis of the latitudinal extent, the Himalayas can be divided into three divisions:

1) Trans-Himalayas.
2) The Himalayan Mountain Ranges.
3) The Eastern Hills or Purvanchal.

The Trans-Himalayas

- It is the name denoted to the Himalayan Ranges which are north of the Great Himalayan Range.
- They stretch in an east-west direction for a distance of about 1,000 km.
- Their average elevation is approximately 3000 meters above mean sea level.
- The prominent ranges that comprise the Trans-Himalayas include – The Karakoram Range, the Ladakh Range, and the Zaskar Range.

Karakoram Range

- The Karakoram Range is the northernmost range of the Trans-Himalayan in India.
- It forms India's boundary with Afghanistan and China.
- The average width of this range is 110-130 km.
- It is home to some of the highest peaks and the largest glaciers in the world.
- K2, also known as Mount Godwin-Austen, lies in this range.
- It is approximately 8611m high and is the second-highest peak in the world.
- Siachen Glacier and Remo Glacier are some of the prominent glaciers lying in this range.

Ladakh Range

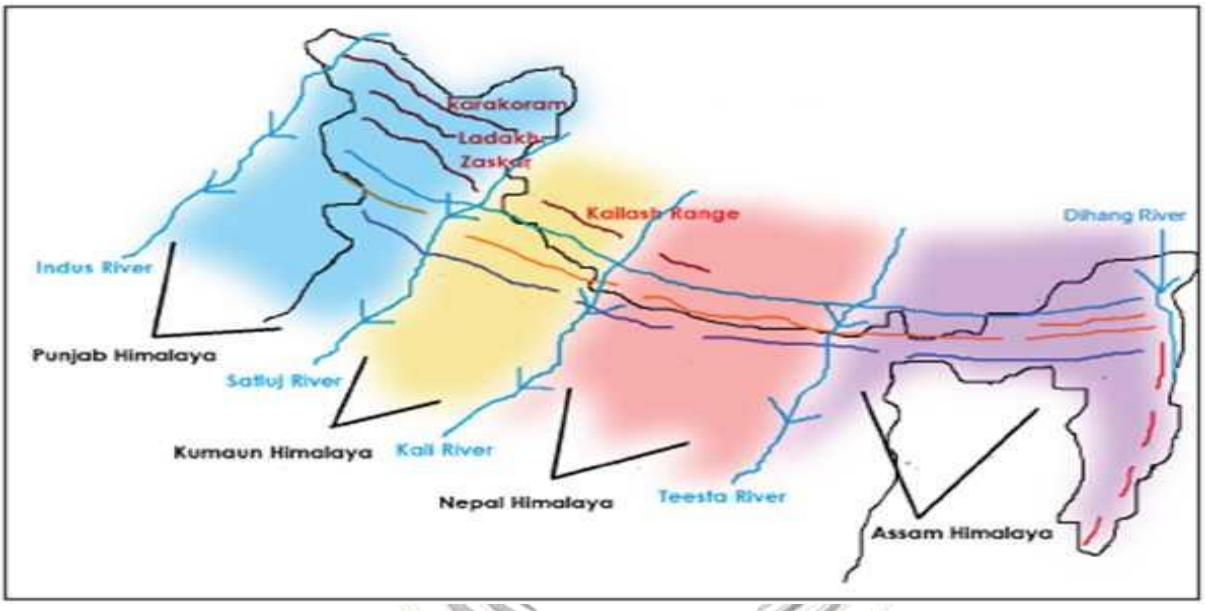
- It is considered the southeastern extension of the Karakoram Range.
- From the mouth of the Shayok River in north Kashmir, it extends in the southeast direction towards the Indo-Tibetan borders.
- The Deosai Mountains, situated towards the southwest of the Indus River in Pakistan-Occupied Kashmir (POK), are occasionally considered part of the Ladakh range.
- The Kailash Range in western Tibet is also considered a westward extension of the Ladakh Range.

Zaskar Range

- It runs more or less parallel to the Great Himalayan Range.
- This range extends in the southeast direction from the Suru River to the upper Karnali River.
- Kamet Peak (25,446 feet) is the highest peak in this range.

The Himalayan Ranges

- Alternative Names: The Himalayan Ranges are known by various other names such as Himadri, Himavan, etc.



Composition: The Himalayan Range is the youngest mountain range in the world and consists mostly of uplifted sedimentary and metamorphic rocks.

Boundaries: They are bordered on the northwest by the Karakoram and Hindu Kush ranges, on the north by the Tibetan Plateau, and on the south by Indo-Gangetic Plains.

The southern boundary of the Himalayas is well-defined by the foothills but the northern boundary is rather obscure and merges with the edge of the Tibet Plateau.

Extent: The range of the main Himalayas stretches for a distance of over 2,400 km from the Indus Gorge in the west to the Brahmaputra Gorge in the east.

Width: The Himalayan Mountain Ranges are wider on the western side compared to the eastern side.

Elevation: The average elevation of the Himalayan Range is approximately 6,100 m.

While the elevation of the Western Himalayas witnesses a gradual change, there is a comparatively rapid change in elevation in the Eastern Himalayas.

Sub-Divisions: The Himalayan Ranges are further subdivided into Greater Himalayas, Inner or Middle Himalayas, and Shivalik.

The Greater Himalayas

- They are also known as the Himadri, the Inner Himalayas, or the Central Himalayas.
- These mountains are composed of Archaean rocks like granite, gneisses, and the ancient schist.

- The orientation of the Greater Himalayas changes in different regions as explained below:
- They extend towards the southeast across the regions of northern Pakistan, northern India, and Nepal
- Thereafter, they curve eastwards across the regions of Sikkim and Bhutan.
- Finally, they turn towards the northeast across the region of northern Arunachal Pradesh.
- They comprise several of the world's highest peaks.
- Some of the prominent peaks in the Greater Himalayas (from west to east) include – Nanga Parbat, Mount Everest, Kanchenjunga, and Namcha Barwa.
- The orientation of slopes in this range is steep towards the north and gentle towards the south.

The Middle Himalayas

- They are also called Lesser Himalayas or Lower Himalayas.
- Their mean elevation is about 3,500 to 5,000 meters and their average width is about 60 to 80 km.
- Prominent ranges comprising this sub-division of the Himalayas include – Nag Tibba, Mahabharat Range, Dhauladhar, the Pir Panjal, and the Mussoorie Range.
- Various important rivers such as Jhelum and Chenab pass through this range.
- The famous Valley of Kashmir lies between Pir Panjal and Zanskar range.
- The Jhelum River cuts through the Kashmir valley.
- They are also home to some famous hill resorts like Shimla, Chail, Ranikhet, Chakrata, Nainital, Almora, etc.
- The Middle Himalayas are also famous for the formation of Karewas, which refer to fluvioglacial deposits between the Greater Himalayas and the Middle Himalayas (Pir Panjal).

The Shiwalik or Outer Himalayas

- The Shiwalik Hills are the southernmost range of the Himalayas which lie between the Middle Himalayas in the north and the Indo-Gangetic Plains in the south.
- They rise abruptly from the plain of the Indus and Ganges rivers in the south and parallel the main range of the Himalayas in the north.
- They are separated from the main Himalayan Range by valleys.
- The portion of the Shiwalik lying in the region of Nepal is called the Churia Range.
- The Shiwaliks are wider on the western side compared to the eastern side.
- Formation of Doons and Duars is the peculiar feature of the Shiwaliks.
- The upliftments of the Shiwaliks stopped the flow of many rivers, resulting in the formation of temporary lakes. The sediments being carried by these rivers were deposited at the bottom of these lakes. Over a period of time, the rivers could cut through the Shiwalik. As a result, water drained away from these lakes, and the sediments in the form of fertile alluvial soils were left behind.
- It is these fertile alluvial soils, which are known as Doons in the west and Duars in the eastern part of India.
- They are important for the cultivation of tea.

The Eastern Hills or the Purvanchal

- Towards the region of Dihang Gorge, the Himalayas take a rapid southward turn because of Syntaxial Bend and form a series of relatively low hills. Collectively, these hills are also called Purvanchal as they are located in the eastern part of India.
- They extend from Arunachal Pradesh in the north to Mizoram in the south.
- These hills constitute India's border with Myanmar.
- Prominent ranges comprising the Purvanchal include the following:

Patkai Bum :

They are the northernmost range of Purvanchal, lying along the boundary between Arunachal Pradesh and Myanmar.

Naga Hills :

They lie to the south of Patkai Bum. They, along with Patkai Bum, form the watershed between India and Myanmar.

Manipur Hills :

They are situated to the south of Naga Hills. The Barail Range splits the Naga Hills from the Manipur Hills.

Mizo Hills or Lushai Hills :

They lie to the south of Manipur Hills

Regional Division of Himalayas

Based on the longitudinal extent, the Himalayas have been divided into 4 regional divisions – Punjab Himalayas, Kumaon Himalayas, Nepal Himalayas, and Assam Himalayas.

Punjab Himalayas

It lies between the Indus River in the west and the Sutlej River in the east.

The majority of this region lies in the state of Jammu and Kashmir and Himachal Pradesh. Hence, they are also known as Kashmir and Himachal Himalayas.

Nearly, all the ranges such as Karakoram, Pir Panjal, Ladakh, Zanskar and Dhaula Dhar are prominent in this section.

It is dominated by high snow-covered mountains, deep gorges, and high mountain passes.

Kumaon Himalayas

- It lies between the Sutlej River in the west and the Kali River in the east.
- It is also known as Garhwal Himalayas in the west.
- As compared to the Kashmir Himalayas, this region is more loftier.
- Prominent peaks lying in this region include – Nanda Devi, Trisul, Kedarnath, Dunagiri, Kamet, Badrinath.
- This region is home to some of the major hill stations such as Nainital, Ranikhet, and Almora.

Nepal Himalayas

- It stretches from the Kali River in the west to the Tista River in the east.
- A majority of this section lies in Nepal, therefore it is called Nepal Himalayas.
- This section is dominated by some of the tallest peaks in the world, including Mount Everest, Kanchenjunga, Dhaulagiri, etc.
- The famous Valley of Kathmandu is located in this region.

Assam Himalayas

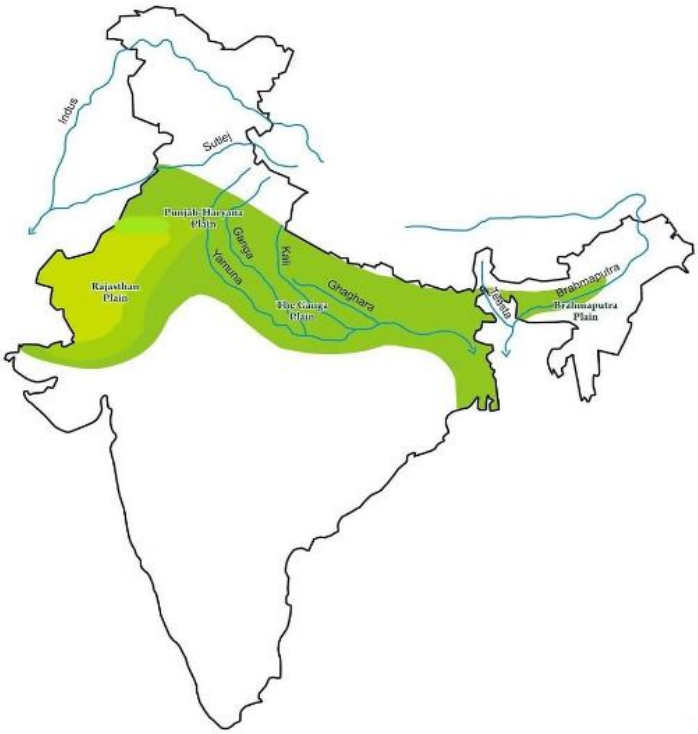
- It is a sector of the Himalayas that lies between the Tista River in the west and the Brahmaputra River in the east In India, it covers the states such as Assam and Arunachal Pradesh.
- This sector is much lower in elevation when compared to the Nepal Himalayas.
- The Himalayas make a sudden turn towards the south in the region of Arunachal Pradesh. Hence, ranges in the Assam Himalayas region are arranged in the north-south direction.
- Prominent peaks in this region include – Namcha Barwa, Gyala Peri, Kengto, and Nyegyi Kangsang.
- Namcha Barwa is the highest peak in this region.

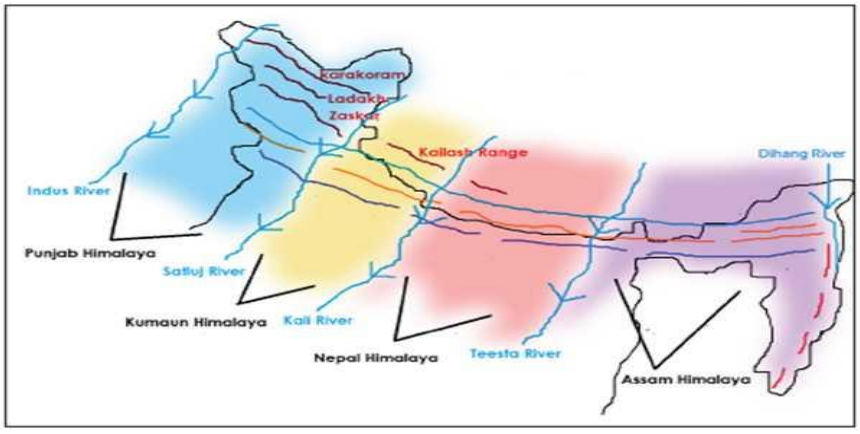
2. The Indo-Gangetic Plains: Formation, Features & Regional Divisions

Stretching from the foothills of the Himalayas to the Bay of Bengal, the Indo-Gangetic Plains, also known as the Great Plains of North India, is a vast and fertile landscape. These plains, formed by millennia of sediment deposits from the mighty Indus, Ganges, and Brahmaputra River systems, hold immense significance for the subcontinent's cultural, economic, and ecological well-being. This article of explain the formation of the Indo-Gangetic Plains, its major features, regional divisions, geomorphology, and significance.

About the Indo-Gangetic Plains

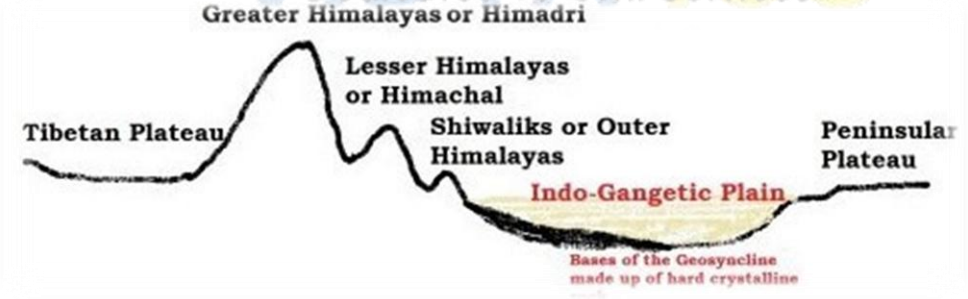
- The Indo-Gangetic Plains, also known as the Indo-Gangetic-Brahmaputra Plains or the Great Plains of North India, refer to an aggradational plain formed by the alluvial deposits carried by the three rivers – Indus, Ganga, Brahmaputra, and their tributaries. It constitutes one of the 5 physiographic divisions of India. Along with being the youngest physiographic feature of India, it also holds the distinction of being the largest alluvial plain in the world.
- **Fatures of the Indo-Gangetic Plainse**





North-South Extension	They extend from the **south of the Himalayas upto the edge of the Peninsular Plateau.**
East-West Extension	They extend from the **mouth of the Indus in the west** to the mouth of the Ganga in the east.
Boundaries	They are bounded by the **Shiwalik range to the north, the Desert to the west,** the **Peninsular Plateau to the south,** and the **Puruvachal Hills to the east.**
Length	The total length of this tract is **3200 km**, of which around **2400 km** lies **in India** and the rest lies in Bangladesh.
Width	The average width of the Great Northern Plains is 150-300 km. They are widest in the west where their width goes up to 500 km, and narrow down towards the east where their width shrinks down to 60-100 km.
Area	They occupy an area of around **7.8 lakh sq. km**, making it **the largest alluvial plain in the world.**
States Covered	The Great Northern Plains of India spread over the states – Punjab, Haryana, Delhi, Uttar Pradesh, Bihar, parts of Jharkhand and West Bengal, and Assam.
Extreme Horizontality	Extreme horizontality is an important feature of this plain. With an average elevation of around 200 m and the highest elevation of about 291 m above the mean sea level, its average gradient range is just 15-20 cm.
Soil Cover	The rivers coming from the northern mountain carry a huge load of sediments which get deposited over these plains. Thus, these plains have a rich and fertile soil cover.

Formation of the Indo-Gangetic Plains



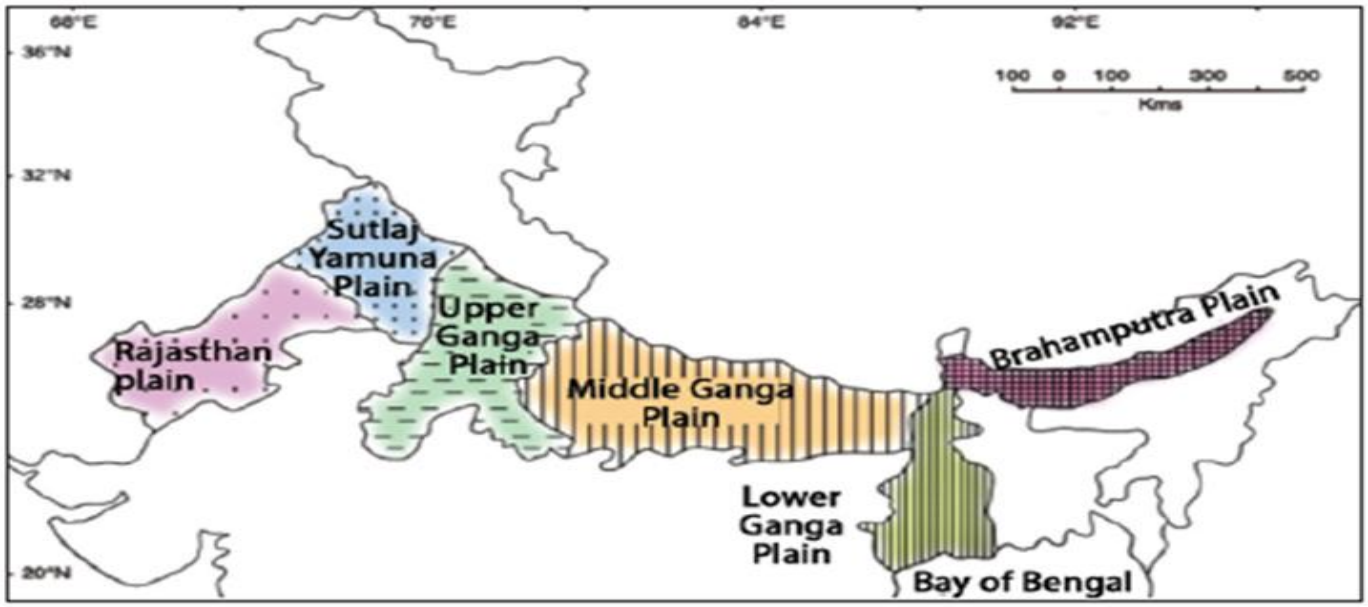
These plains have been formed by the **depositional works of the three major river systems – Indus, Ganga, and Brahmaputra.** The sediments of these rivers filled the wide depression that existed between the Peninsular and Himalayan regions.

In the Tertiary Period, the movement of the Indo-Australian Plate towards the Eurasian Plate led to the formation of the Himalayas. The continued convergence of these two tectonic plates led to upheaval in the Himalayas and created a deep depression between the Peninsula and the Himalayas in the form of a large syncline. Rivers flowing down from the Himalayas brought along a lot of sediments, depositing them in the deep depression. This resulted in the formation of the Indo-Gangetic Plains or the Great Plains of India.

❖ **Regional Divisions of the Indo-Gangetic Plains**

Regionally, the Indo-Gangetic Plains are classified into 4 major divisions:

1. The Rajasthan Plain
2. The Punjab-Haryana Plain
3. The Ganga Plain
4. The Brahmaputra Plain



i) The Rajasthan Plain

- This region forms the **western extremities** of **the Indo-Gangetic Plains**.
- It consists of the Thar or Great Indian Desert covering western Rajasthan and adjoining areas in Pakistan.
- The Rajasthan Plain can be divided into two parts:

Marusthali

- The eastern part of the Rajasthan Plain, which is a proper desert, is known as Marusthali.
- It covers a great part of the Marwar plain.

  Although it looks like an aggradational plain on the surface, geologically it is a part of the Peninsular Plateau. The same is proved by the fact that it has a vast stretch of sand with few outcrops of bedrock of **gneisses, schists, and granites.**
- Its **eastern part is rocky**, while the **western part** is covered by shifting sand dunes locally known as **Dhrian**.

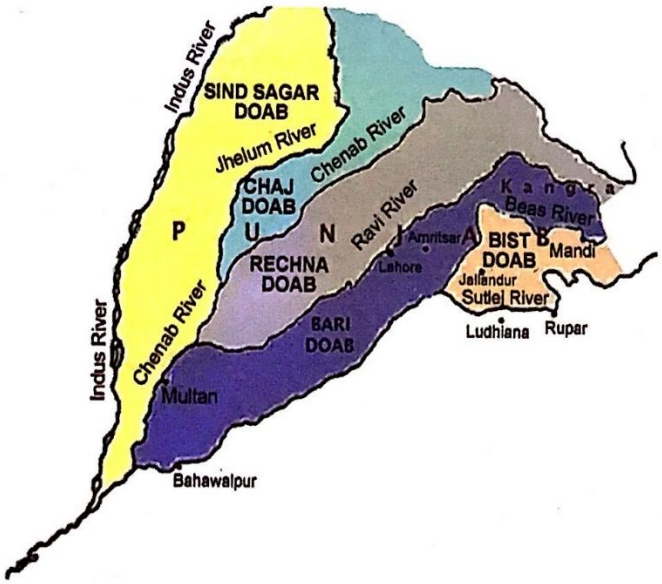
Rajasthan Bagar

- The eastern part of the Thar desert upto the Aravalli Range is a semi-arid plain which is known as Rajasthan Bagar.
- Numerous short seasonal streams originating from the Aravali drain this area and form patches of fertile tracts, called Rohi.
- The river **Luni** is an example of such a stream that flows southwest of Aravalli and drains into the Rann of Kutch. The tract north of the **Luni** is called **Thali** or sandy plain.
- The Thar desert also has several saline lakes like Sambhar, Didwana, Khatu, etc.

ii) The Punjab-Haryana Plain

- It lies towards the east and north-east of the Rajasthan Plain.

- The entire plain extends for a **length of 640 km** in the **northwest to southeast** direction in the states of **Punjab** and **Haryana**.
- Its average width is 300 km.
- The plain slopes gently down towards the south-west. Hence the rivers in this region flow in the same direction.
- The plain is mostly made of silts and hence the soil is porous.
  - The part of the plain near the river banks, formed by the deposition of new alluvium, is called **Bet**.
  - The foot-hill regions of the plain, made up of large boulders, gravel, sand, and clay, are known as the **'Bhabar' Plain**. (This soil cannot hold water).
- In Haryana, it is bounded in the east by the Yamuna River.
- The Punjab part of this plain is formed as a **result of alluvial deposits of five rivers** – Satluj, the Beas, the Ravi, the Chenab, and the Jhelum.
  - That's why the Punjab Plain is also called the **'Land of Five Rivers'**.



- The **Punjab part** of this plain is primarily made up of the **5 'Doabs'** (tract of land lying between two confluent rivers), which from east to west are as follows:
  - **Bist-Jalandhar Doab** lying between the **Beas** and the **Satluj**.
  - **Bari Doab** lying between the **Beas** and the **Ravi**.
  - **Rachna Doab** lying between the **Ravi** and the **Chenab**.
  - **Chaj Doab** lying between the **Chenab** and the **Jhelum**.
  - **Sind Sagar Doab** lying between the **Jhelum**-Chenab and the **Indus**.

- Some **important features** of the Punjab-Haryana Plain can be seen as follows:
  - **Bet Lands:** These are **Khadar-rich floodplains**, wherein fertile soils are deposited annually, making them very fertile.
  - **Dhayas:** These are **broad flood plains of Khadar** flanked by bluffs.
  - **Chos:** The northern part of this plain adjoining the Shiwalik hills has been heavily **eroded by numerous streams**, which are called Chhos.

iii) The Ganga Plain

- It is the **largest unit** of the Indo-Gangetic Plains with an **area of 3.75 lakh sq. km**.
- This plain is **formed by the alluvial deposition** of the Ganga along with its Himalayan as well as Peninsular tributaries.
- It extends from **Delhi to Kolkata** in the states of Uttar Pradesh, Bihar, and West Bengal.
- The **general slope** of the entire plain is **to the east and southeast**.
- Depending upon geographical variations, the Ganga Plain has been subdivided into **three divisions**:

The Upper Ganga Plain

- **Location:** Forms the westernmost and the upper part of the Ganga Plain.
- **Boundaries:** The Shiwaliks in the north, the Peninsular boundary in the south, and the Yamuna River in the west. Its eastern boundary remains obscure.
- **Average Gradient:** about 25 cm per km.
- **Important Features:** Because of the very low gradient, the rivers flow sluggishly in the plain. This leads to the formation of riverine features such as river bluffs, river meanders, oxbow lakes, levees, abandoned river courses, sandy stretches (Bhurs), etc.

- **Major Units (west to east):** Ganga-Yamuna Doab, Rohilkhand Plains, and Avadh Plains.

The Middle Ganga Plain

- **Location:** It lies to the east of the Upper Ganga Plain, spreading over the eastern part of Uttar Pradesh and Bihar.
- **Boundaries:** The Himalayan foothills in the north, and the Peninsular edge in the southern boundary. Its western as well as eastern boundaries remain obscure.
- **Important Features:** Because of the very low gradient in the region, rivers flow sluggishly in this flat land. As a result, the area is marked by riverine features such as levees, bluffs, oxbow lakes, marshes, tals, ravines, etc.
  - Almost all the **rivers** in this region keep on **shifting their courses**, making the area prone to **flood. Kosi** is particularly notorious for this, and is called the **'Sorrow of Bihar'**.
- **Major Units (west to east):** Ganga-Ghaghara Doab, Ghaghara-Gandak Doab, and Gandak-Kosi Doab (Mithila Plain).

The Lower Ganga Plain

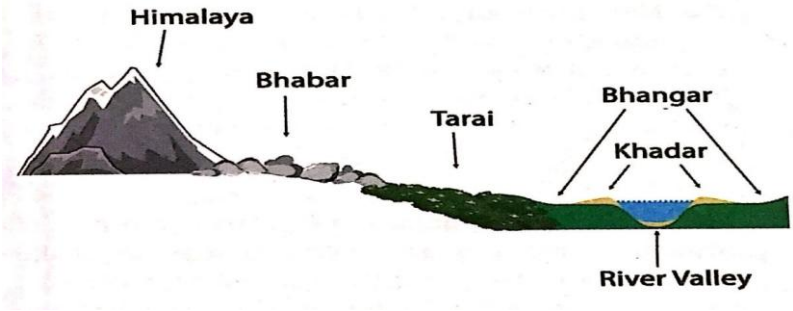
- **Location:** It lies to the east of the Middle Ganga Plain, spreading over the eastern part of Bihar, the whole of Bengal, and most parts of Bangladesh.
- **Boundaries:** The Darjeeling Himalaya in the north; the Bay of Bengal in the south; the Chotanagpur Highlands in the west; and the Bangladesh border in the east.
- **Important Features:** The most prominent feature of this region is delta formation, which accounts for around 2/3rd of this part of the plain.
  - The Ganga, along with the Brahmaputra, forms **the largest delta of the world** on the coastal side of this plain. The delta, called the **Ganga-Brahmaputra Delta**, is known for Mangroves and Royal Bengal Tiger.

iv) The Brahmaputra Plain

- It lies in the **northeastern part** of the country.
- It is also known as **Brahmaputra Valley or Assam Valley or Assam Plain**.
- Although it is often treated as the eastward continuation of the Ganga Plain, it is, actually, a well-demarcated separate physical unit.
- It is surrounded by the **Eastern Himalayas of Arunachal Pradesh** in the north, **Patkai Bum** and **Naga Hills** in the east, the **Garo-Khasi-Jaintia** and **Mikir Hills** in the south, and Indo-Bangladesh border and lower Ganga Plain boundary in the west.
- Similar to the Ganga Plain, this is also an **aggradational plain** built up by the depositional work of River Brahmaputra and its tributaries.
- The tributaries of Brahmaputra flowing down from the north debouch abruptly in this valley. This leads to the formation of several riverine **features** such as **alluvial fans, sandbars, river meanderers, oxbow lakes,** etc.
  - **Majuli Island**, formed by the Brahmaputra, is **the largest riverine island in the world**.
- The Brahmaputra Valley is famous for its **tea plantations**.

Geomorphology of the Indo-Gangetic Plains

Some of the distinctive geomorphological features of the Indo-Gangetic Plains can be seen as follows:



The Bhabar

- It is a **narrow belt of about 8-16 km** width stretching in an east-west direction as the northern boundary of the Great Northern Plains.
- It runs along the foothills of the Shiwaliks from the River Indus to the River Tista.
- This belt consists of **alluvial fans** which are formed by the deposition of **unassorted sediments** in the form of **gravel** and **pebble-studded rocks**.
- Because of the porous nature of the sediments in this region, **water streams sink and flow underground**. Hence, this area has **dry river courses** except in the rainy season.

The Tarai

- It lies to the **south of the Bhabhar** region and runs parallel to it.
- Its **width** ranges from **15-30 km**.
- The streams that flow underground in the Bhabhar region emerge in this region leading to the formation of **marshy and damp tracts of land**.
- It is composed of **comparatively finer alluvium** and is covered by forests.
- Most parts of the Tarai area have been converted into agricultural land, especially in the states of Punjab, Uttar Pradesh, Uttarakhand, etc.

The Khadar

- This belt forms the **flood plain along the river banks**.
- The **newer alluvium** brought by the rivers every year gets deposited along this belt. This makes this region **very fertile**.
- The **absence of calcareous deposits** in this region makes it very suitable for extensive cultivation.

The Bhangar (or Bangar)

- It refers to the **alluvial terrace** formed above the level of the flood plain.
- It is the **largest part of the Indo-Gangetic Plains**.
- Soil in this region is made up of **older alluvium** and is **not renewed frequently**. Thus, this region is **not very fertile**.
- It consists of **calcareous deposits**, locally known as **Kankar**.

Reh or Kalla

- They refer to **barren saline efflorescence's** of the dry regions in Uttar Pradesh and Haryana.

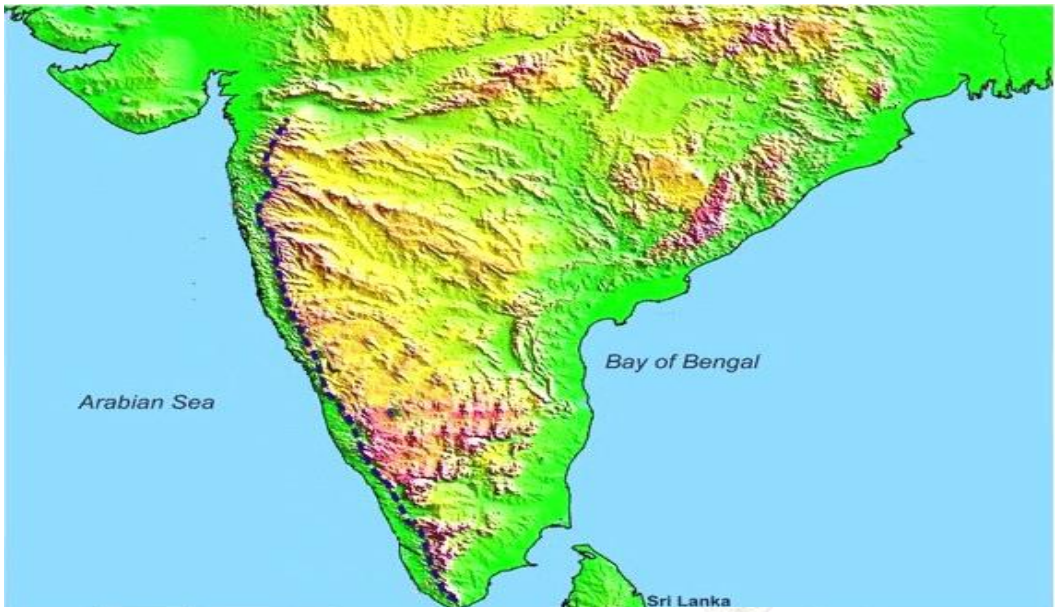
Bhur

- These are the **elevated pieces of land** that have been formed along the Ganga River banks due to **wind-blown sand accumulation** in the hot and dry months.

Significance of the Indo-Gangetic Plains

- **Home to a Large Population**: The plains constitute less than one-third of the total area of the country but support over 40 percent of the total population of the country.

- **Agriculture**: Fertile alluvial soils, flat surfaces, slow-moving perennial rivers, and favourable climate facilitate intense agricultural activity in this region. For the same reason, the northern plains are called the *granary of the nation.*
- **Roads and Railways**: The region has a wide network of roads and railways because of the easy typography. This has led to wide **urbanization and industrialization** in this region.
- **Religious Significance**: The region holds religious significance because of the presence of several **religious places along the banks** of sacred rivers like the Ganga and Yamuna.
  Much more than just a geographical feature, **the Indo-Gangetic Plains or the Great Plains of India** has been the cradle of Indian civilization. These fertile plains have been nurturing the Indian population for centuries. Of late, this region has been facing some threats such as declining fertility, water scarcity, population explosion, etc. Ensuring the sustainability of the Great Northern Plains of India is not just crucial for the subcontinent but for the ecological and cultural heritage of the entire planet. **Sustainable development** is the way forward.



3. Peninsular Plateau of India

About the Peninsular Plateau of India :

The Peninsular Plateau of India, also known as the Indian Peninsular Plateau, refers to the flat tableland that lies in the southern part of India and is surrounded by the oceans on three sides. It constitutes one of the 5 physiographic divisions of India. Along with being the oldest landmass of India, it also holds the distinction of being the largest physiographic division of India.

Features of the Peninsular Plateau of India

- **Shape**: It is roughly triangular.
  - Its broad base lies at the southern edge of the Indo-Gangetic Plains. From here, it tapers downwards up to Kanyakumari.
- **Extent**: Its northern boundary is an irregular line running from Kutch along the western flank of the Aravalis to areas near Delhi, which then moves roughly parallel to the Yamuna and the Ganga up to the Rajmahal Hills and the Ganga Delta.
- **Boundaries:** It is surrounded by hill ranges on all three sides:
  - In the north, it is bounded by the Aravali Range, the Vindhya, the Satpura, the Bharmer, and the Rajmahal Hills.
  - In the west, it is bounded by the Western Ghats.
  - In the east, it is bounded by the Eastern Ghats.

- **Area**: Peninsular India is the largest physiographic unit of India with an area of 16 lakh sq. km.
  - The area occupied by the Peninsular Plateau of India equals almost half of the area of the country.
- **Composition**: This old tabular block is made of schists and Archaean genesis.
- It is regarded as a stable shield that hasn't had many structural alterations since it first formed.
- **Slope**: The Peninsular block slopes mostly from west to east.
  - This is the reason major peninsular rivers (except Narmada and Tapi) flow from west to east and drain into the Bay of Bengal.
- **Elevation**: The average height of the Peninsular Plateau of India is 600–900 meters above the mean sea level.

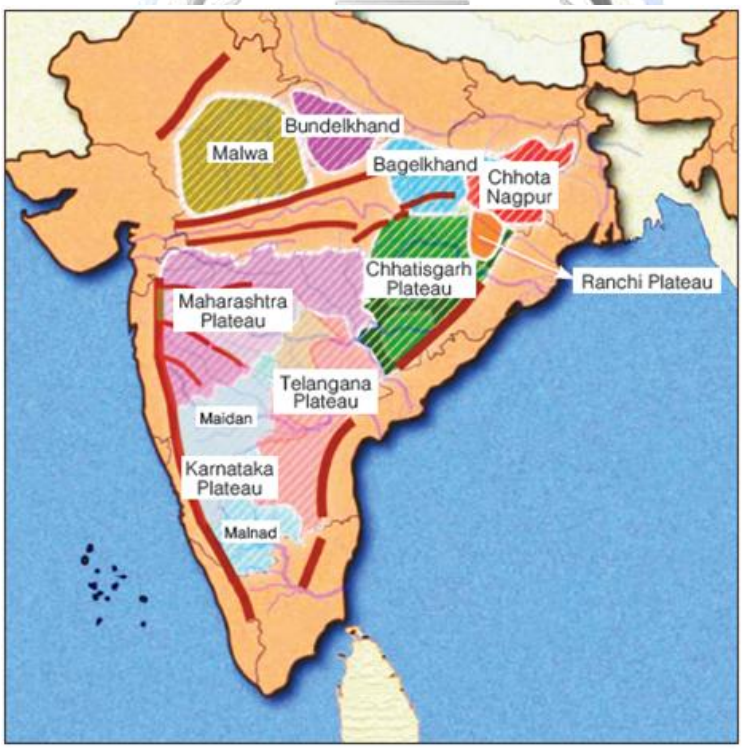
Geomorphology of Peninsular Plateau of India

The Peninsular Plateau of India is made up of many smaller plateaus and hill ranges, interspersed with river basins and valleys. Thus, studying the geomorphology of Peninsular India entails studying major plateaus and major hill ranges in the region.

The same are explained in detail in the sections that follow.

Major Plateaus of Peninsular India

The Peninsular Plateau of India or the Indian Peninsular Plateau, as a physiographic unit, consists of several smaller plateaus. The prominent smaller plateaus of Peninsular India are described as follows:



The Marwar Upland

- **Location**: It is located to the east of the Aravali Range.
  - It is for this reason it is also called the Upland of Eastern Rajasthan.
- **Elevation & Slope**: The average elevation of this part of the Indian Peninsular Plateau is 250-500 m, and it slopes eastwards.
- **Composition**: It is made up of Sandstone, Shales, and Limestones of the Vindhyan period.
- **Rivers**: River Banas, a tributary of River Chambal, originates from the Vindhyan Range and then flows through this region.

- **Topography**: It is a region of rolling plateau with rounded hills and forest.
  - The erosional works of River Banas and its tributaries have played an important role in shaping the topography of this region.

The Central India Plateau (Madhya Bharat Pathar)

- **Location**: It is located to the east of the Marwar Upland.
  - Most of it lies in the Chambal River Basin.
- **Composition**: This part of the Peninsular Plateau of India is made up of old rocks and some interspersed rounded hills composed of sandstone.
- **Rivers**: Chambal River flows in a rift valley through this region.
- **Topography:** It is an open rolling plateau.
  - Ravines or Badlands of River Chambal.

The Bundelkhand Plateau

- **Location**: It is bounded by the Yamuna River to the north, Madhya Bharat Pathar to the west, Vindhyan Scarp lands to the east and southeast, and Malwa Plateau to the south.
- **Spread**: It spreads over the Uttar Pradesh-Madhya Pradesh border and surrounding areas in the two states.
- **Elevation & Slope**: It has an average elevation of 300-600 m above the mean sea level with the plateau sloping down from the Vindhyan Scarp toward the Yamuna River.
- **Composition**: It is an old dissected upland made up of 'Bundelkhand Gneiss' comprising Granite and Gneiss.
- **Rivers**: The prominent rivers flowing in the area include the Betwa, Dhasan, and Ken.
- **Topography**: Senile topography is a characteristic of this region of the Indian Peninsular Plateau.
  - The erosional work of the rivers flowing in this region has made this area undulating (wave-like surface), and hence unfit for cultivation.
  - Also, the area is marked by a chain of hillocks (small hills) made of Granite and Sandstone.

The Malwa Plateau

- **Location**: It is a triangular-shaped plateau.
  - Its base lies on the Vindhyan Hills in the north and is bounded by the Aravali Range in the west and Bundelkhand in the east.
  - The plateau constitutes an extension of the Deccan Traps.
- **Elevation**: The general height of the plateau is 600 m in the south which steeps down to 500 m in the north.
- **Composition**: It has been formed by basaltic lava flow, and hence is covered with black soils.
- **Rivers**: It is drained by two drainage systems:
- The first one, flowing towards the Arabian Sea includes – The Narmada, the Tapi, and the Mahi.
- The other one, flowing towards the Bay of Bengal includes – Chambal, Sindh, Betwa, and Ken.
- **Topography**: The region of the Peninsular Plateau of India comprises rolling surfaces with flat-topped hills dissected by rivers.
  - The plateau is marked by the Chambal ravines in the north.

The Baghelkhand Plateau

- **Location**: It lies to the east of the Maikal Range.

➢ It is bounded by the Son River on the north and anticlinal highlands and synclinal valleys made up of sandstones and limestones in the south.

- **Elevation**: The region has a general elevation of 150 m to 1200 m.
- **Composition**: Its western part is made up of limestone and sandstones. Its eastern part, on the other hand, is composed of granite.
- **Rivers**: The central part of the plateau acts as a water divide between the drainage systems of the Son River in the north and the Mahanadi River in the south.
- **Topography**: The region of the Peninsular Plateau of India has uneven relief.
  - ➢ It comprises the scarps of the Vindhyan sandstones between the Ganga Plain and the Narmada-Son Trough.
  - ➢ The general horizontality is a characteristic of the region and shows that this area has not undergone any major disturbance.

The Chotanagpur Plateau

- **Location**: It lies to the east of the Baghelkhand Plateau and represents the north-eastern projection of the Peninsular Plateau of India.
- **Spread**: The plateau spreads over the border areas of Jharkhand, northern Chhattisgarh, and the western part of West Bengal.
- It lies entirely between the basins of the Ganga and Son Rivers to the north and the Mahanadi River to the south.
- **Elevation**: The average height of the plateau is 700 m above sea level.
- Its mid-western portion, having an elevation of about 1100 m, is known as the Pat Lands.
- From the Pat Lands, the plateau descends in all directions in a series of steps, particularly towards the east, until it merges gradually with the Lower Ganga Plain.
- **Composition**: The rocks of the plateau are mostly Gondwana, with sections of Deccan lava, gneisses, and Archaean granite.
- **Rivers**: The plateau witnesses a radial drainage pattern with numerous rivers and streams flowing in different directions.
  - ➢ The prominent rivers flowing in the region are – Son, Damodar, Subarnrekha, North Koel, South Koel, and Barakar.
- Major Geographical Features: Some of the major geographical features present in this region include:

The Hazaribagh Plateau

- It lies to the north of the Damodar River.
- This plateau comprises isolated hills, such as Parasnath hills.
- Though a plateau, it resembles a peneplain due to the large-scale erosion.

The Ranchi Plateau

- It lies to the south of the Damodar Valley.
- The surface of the plateau is rolling with some areas interrupted by monadnocks and conical hills.
- The western part of this plateau consists of Pats and Mesas, which refer to high areas capped with laterite.

The Rajmahal Hills

- It is situated at the northeastern edge of the Chhota Nagpur plateau.

- It is mainly composed of basaltic lava.

The Meghalaya Plateau (Shillong Plateau)

- **Location**: It lies in the northeastern part of the country.
  - ➢ It is bounded by the Brahmaputra Valley in the north, and Surma and Meghna Valleys in the south.
- **Formation**: It is a rectangular block formed by the extension of the Peninsular Plateau of India in the northeastern direction beyond the Rajmahal hills.
  - ➢ During the Himalayan orogeny, due to the force exerted by the north-eastwardly movement of the Indo-Australian Plate, a huge fault, known as Malda Gap or Garo-Rajmahal Gap, was created between the Meghalaya Plateau and the Rajmahal hills, detaching it from the Indian Peninsula.
  - ➢ The Gap was gradually filled up by the depositional activities of the nearby rivers.
- **Composition**: The plateau is largely composed of Archaean or Dharwarian quartzites, shales, and schists.
- **Topography**: It is an imposing plateau with rolling grassland, hills, and river valleys.
- **Major Geographical Features**: Major geographical features present in the region include:
  - ✓ **The Garo Hills :** The western part of the Meghalaya Plateau is known as the Garo Hills (900 m).
  - ✓ **The Khasi-Jaintia Hills :** The central part of the Meghalaya Plateau is known as the Khasi-Jainita Hills (1500 m).
  - ✓ **The Mikir Hill** : The eastern part of the Meghalaya Plateau is known as the Mikir Hills (700 m).

The Deccan Plateau

- **Location**: It is a triangular-shaped plateau bordered by the Satpura and Vindhya in the northwest, the Mahadev and Maikal in the north, the Western Ghats in the west, and the Eastern Ghats in the east.
- **Area**: With an area of about 5 lakh sq. km, this plateau constitutes the largest unit of the Indian Peninsular Plateau or the Peninsular Plateau of India.
- **Elevation & Slope**: It has an average elevation of 600 m.
- Its general slope is from west to east, which is indicated by the flow of major rivers of the region like the Mahanadi, the Godavari, the Krishna, and the Cauvery.
- **Sub Plateaus**: The Deccan Plateau consists of several smaller plateaus, which have been formed by the dissection of rivers. These are:

The Maharashtra Plateau

- It lies in Maharashtra and forms the northern part of the Deccan Plateau.
- The area resembles a rolling plain because of the weathering activity.
- The presence of horizontal lava sheets has led to the formation of Deccan Trap topography.
- The entire expanse of this part of the Peninsular Plateau of India is covered by black cotton soil also known as Regur.

The Karnataka Plateau (Mysore Plateau)

- It lies to the south of the Maharashtra Plateau and forms the southern part of the Deccan Plateau.
- The major streams draining this region include the Godavari, Krishna, Kaveri (Cauvery), Tungabhadra, Sharavati, and Bhima.
- The topography of the region resembles a rolling country type.
- Several rivers that rise from the Western Ghats divide this plateau into two parts:

Malnad

- Malnad is a word for hill country in Kannada.
- Malnad consists of deep valleys with dense forests.

Maidan

- Maidan consists of a rolling plain interspersed with low granite hills.

Telangana Plateau

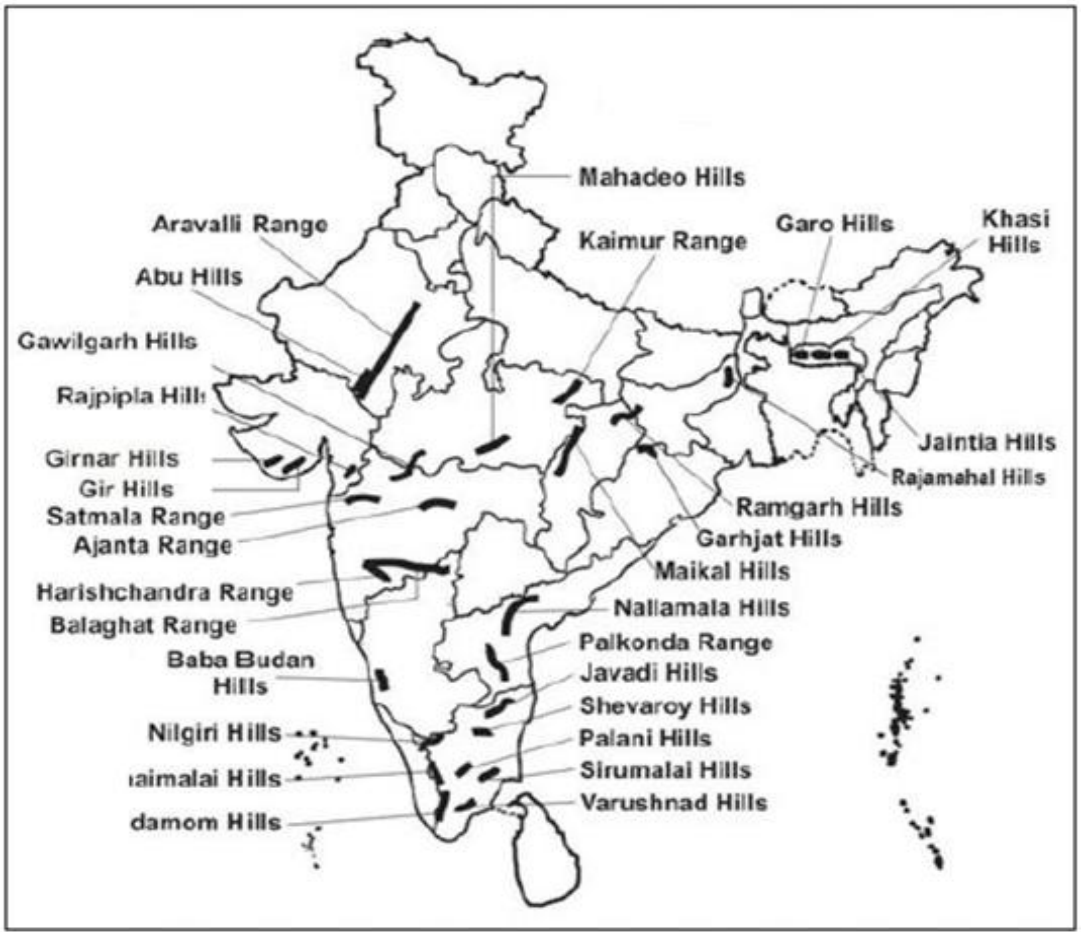
- It occupies the region of Telangana.
- The region is drained by three river systems – the Godavari, the Krishna, and the Penneru.
- This part of the Peninsular Plateau of India is composed of two major physiographic regions, namely, the Ghats and the Peneplains.

The Chhattisgarh Plain

- It is a saucer-shaped depression drained by the upper stretch of River Mahanadi.
- The entire basin is situated between the Hills of Odisha and The Maikala Range.
- The basin is laid with nearly horizontal beds of limestone and shales.

Major Hill Ranges of Peninsular India :

The smaller plateaus of the region of the Peninsular Plateau of India are divided from one another by river valleys and hill ranges. The prominent hill ranges of Peninsular India are discussed below:



The Aravali Range

- **Location**: It is a residual mountain running in a northeast-to-southwest direction for about 800 km between Delhi and Palanpur in Gujarat.
  - Its northeastern end is marked by the Delhi Ridge.
- **Formation**: The Aravalis are remnants of one of the oldest fold mountains in the world.
- **Elevation**: The general elevation of this mountain range is only 400 – 600 m.
- **Prominent Peaks**: Mount Abu (1158 m), Guru Shikhar (1722 m – the highest peak of the Aravalis), etc.

The Vindhyan Range

- **Location**: It lies to the south of the Malwa Plateau and runs parallel to the Narmada Valley in the east-west direction
  - It stretches for a distance of over 1200 km from Jobat in Gujarat to Sasaram in Bihar.
  - This range, lying in the region of the Peninsular Plateau of India, forms the northern border of the Deccan and serves as the watershed between the Ganga and South Indian River systems.
- **Formation**: They are considered a Block Mountain as they have been formed through cracks in the Earth's crust.
- **Elevation**: The general elevation of this range is 300-650 m.
- **Composition**: It comprises horizontally bedded ancient sedimentary rocks with its western part covered with lava.
- **Rivers:** The area is drained by several rivers, including the Betwa, Ken, and Chambal.
- **Ranges**: These mountains continue eastward into two branches:

The Kaimur Range

- It is the northern branch that runs north of the Son River upto western Bihar.

The Bharner Hills

- It is the southern branch, running between the upper reaches of the Son and Narmada rivers to meet the Satpura Range.

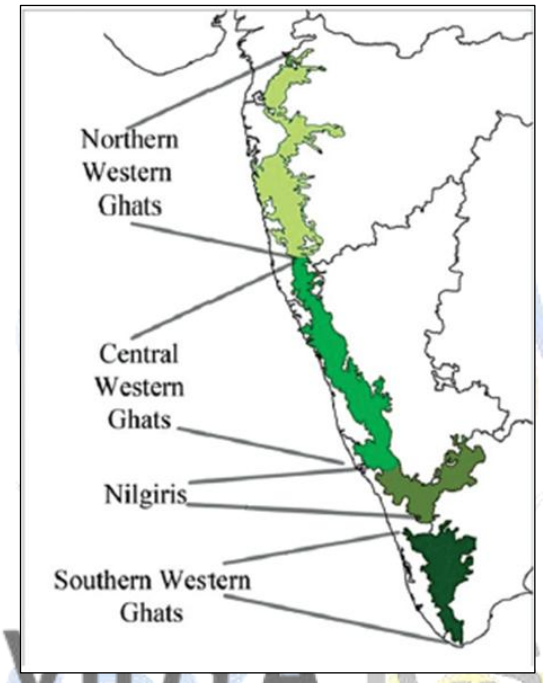
The Satpura Range

- **About**: It is a series of seven Block Mountains, thus justifying its name Satpura
  - In Sanskrit, 'Sat' means seven, and 'Pura' means mountains).
- **Location**: It lies in the region of the Peninsular Plateau of India and is located to the south of the Vindhyan Range and stretches in an east-west direction between the Narmada and the Tapi.
  - It starts from the Rajpipla Hills in the west and continues for a distance of around 900 km through the Mahadev Hills to the Maikala Range.
- **Rivers**: The Satpura Range is drained by many rivers, including the Narmada, Wainganga, Wardha and Tapi.
- Important Peaks: Dhupgarh (1350 m) near Pachmarhi on Mahadev hills is the highest peak.
  - The other peaks are Astamba Dongar (1325 m) and Amarkantak (1127 m).

The Western Ghats (or the Sahyadris)

- **About**: The Western Ghats, also known as the Sahyadris, refer to the mountain range that runs parallel to the western coast of the Peninsular Plateau of India.

- **Location**: To the east of this mountain range lies the Deccan plateau and to the west lies the Coastal Plains and the Arabian Sea.
- **North-South Extent**: It runs parallel to and near the coast of the Arabian Sea, from the Tapi Valley to a point north of Kanyakumari.
  - ➢ It spreads over the States of Gujarat, Maharashtra, Goa, Karnataka, Kerala, and Tamil Nadu as well as two UTs namely Dadra & Nagar Haveli and Puducherry (Mahe).
- **Topography**: They are characterized by steep-sided, terraced, flat-topped hills or cliffs, presenting a mesa-like stepped topography.
- **Slope**: On the western side, the Western Ghats rise abruptly from the Western Coastal Plain. However, on the eastern side, they slope gently.
- **Divisions**: The Western Ghats can be divided into three sections – the Northern Section, Middle Sahyadris, and Southern Section.



The Northern Western Ghats (The Northern Sahyadri)

- **Location:** This section of the Western Ghats is located between the Tapi Valley to a little north of Goa.
- **Composition**: It is composed of horizontal sheets of Deccan lavas forming an imposing wall along the western coastal plains.
- **Important Peaks**: Kalsubai (1646 m), Salher (1,567 m), Mahabaleshwar (1438 m) and Harishchandragarh (1424 m).
- **Important Passes**: Thalghat and Bhorghat.
  - ➢ They provide passage between the Western Coastal Plain and the Deccan Plateau

The Central Western Ghats (The Central Sahyadri)

- **Location**: This section of the Western Ghats runs from 16°N latitude up to the Nilgiri Hills.
- **Composition**: This part is made up of granites and gneisses.
- **Important Peaks**: Doddabetta (2637 m), Makurti (2554 m), Vavul Mala (2,339 m), the Kudremukh (1892 m) and Pushpagiri (1714 m).

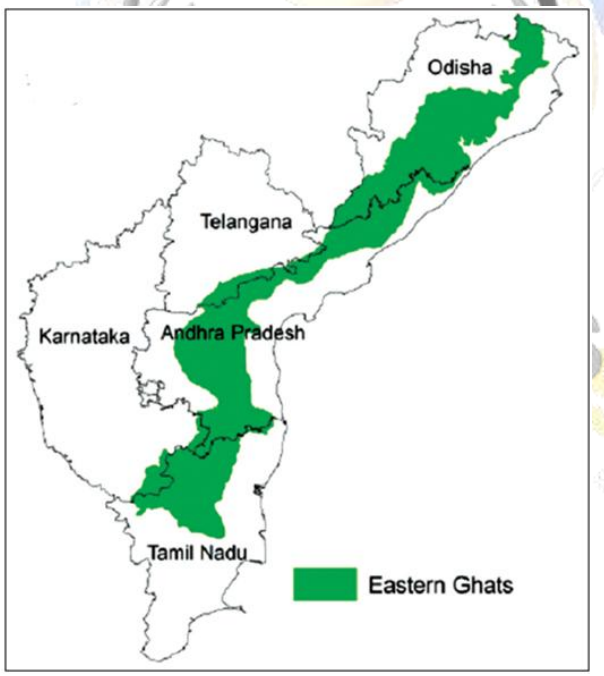
The Southern Western Ghats (The Southern Sahyadris)

- **Location**: This section forms the southernmost division of the Western Ghats.
  - The southern part of the Western Ghats is separated from the main Sahyadri Range by a mountain pass called the Palghat Gap.
- **Important Peaks**: Anai Mudi (2,695 m) is the highest peak in the peninsular plateau region as well as the whole of southern India.
- **Important Hills**: Prominent hills lying in this section are discussed as follows.
  - From the Anai Mudi Peak, three ranges radiate in different directions:

    - ✓ **The Anaimalai Hills** The Anaimalai Hills (1800-2000 m) run from the Anai Mudi Peak towards the north.
    - ✓ **The Palni Hills** The Palni Hills (900-1200 m) run from the Anai Mudi Peak towards the northeast.
    - ✓ **The Cardamom Hills** The Cardamon Hills (1000-1500 m), also known as the Ealaimalai Hills, run from the Anai Mudi Peak towards the south other hills located in this section are.
    - ✓ **Agasthyamalai Hills** Agasthyamali Hills (1,868 m), well known for its endemic components, is situated at the southern end of Western Ghats.

The Eastern Ghats

- **About**: The Eastern Ghats refers to a series of discontinuous ranges of mountains that border the eastern edge of the Indian Peninsular Plateau, and run almost parallel to the east coast of India.



- **Location**: To the west of this mountain range lies the Deccan Plateau and to the east lies the Coastal Plains and the Bay of Bengal.
- **North-South Extent**: They stretch from the Mahanadi in Odisha to the Vagai in Tamil Nadu.
- **Topography**: Unlike the Western Ghats, the Eastern Ghats are not a continuous range. They comprise a chain of highly broken and detached hills.
- **Divisions**: The Eastern Ghats can be divided into two sections:

The Northern Eastern Ghats

- **Location**: This section of the Eastern Ghats lies between the Mahanadi and the Godavari Valley.

- **Important Hills**: Some of the important hill ranges lying in this part are:

✓ **Maliya Range** Mahendra Giri (1501 m) is the tallest peak in this range.
✓ **Madugula Range** Some important peaks in this range are – Arma Konda (1680 m), Gali Konda (1643 m), Sinkram Gutta (1,620 m), etc.

The Southern Eastern Ghats

- **Location**: This section of the Eastern Ghats lies between the Godavari and the Krishna rivers.
- **Important Hills :** Some of the important hill ranges in this part include:

✓ **The Nallamalai Range** The southern part of the Nallamalai Range is called the Palkonda Range.
✓ **Javadi Hills** These hills are located in northern Tamil Nadu.
✓ **Shevroy-Kalrayan Hills** These hills are also located in Tamil Nadu.
✓ **Biligiri Rangan Hills** These hills are situated at the border of Karnataka and Tamil Nadu.

- At its southern extremities, the Eastern Ghats merge with the Western Ghats.

Significance of the Peninsular Plateau of India : As the oldest and the most stable landmass of the Indian subcontinent, the Peninsular Plateau of India carries many significances:

- **Mineral resources**: The plateau is blessed with large quantities of mineral resources like Iron, Copper, Manganese, Bauxite, Chromium, Mica, Gold, etc.
- **Coal deposits**: The region contains 98 percent of the Gondwana coal deposits in the country.
- **Agriculture**: The region is covered with black soil which is found suitable for the production of several crops such as cotton, tea, coffee, rubber, millet, etc.
- **Forest produce**: Being replete with forest these areas are an abundant source of forest produce like timber, etc.
- **Rivers**: The rivers in these areas offer great opportunities for the generation of hydroelectricity and provide irrigation facilities for crops.
- **Tourism**: The place has numerous places of scenic beauty such as Ooty, Pachmarhi, Kodaikanal, Mahabaleshwar, Mount Abu, etc.

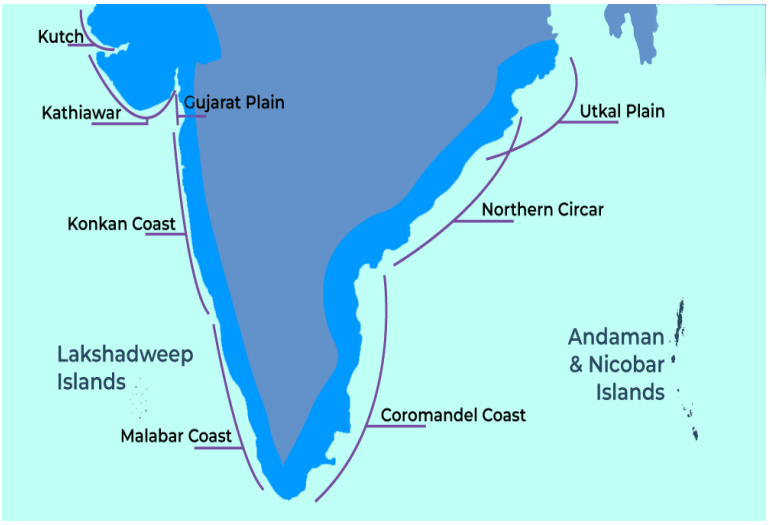
Much more than just a geographical feature, the Peninsular Plateau of India carries multiple significance. This largest physiographic division of India is a source of multiple resources. Of late, it faces several challenges, including deforestation, soil degradation, and loss of biodiversity. Understanding and preserving this unique landform is crucial for ensuring the ecological balance and sustainable development of the region.

5. The Coastal Plains of India

The Coastal Plains of India refers to the stretch of narrow coastal strip lying between the edges of the Peninsular Plateau and the coastline of India. They constitute one of the 5 physiographic divisions of India. These plains stretch for a distance of about 6000 km along the Arabian Sea in the west and the Bay of Bengal in the east.

Divisions of the Coastal Plains of India

- The **Coastal Plains of India** have been divided into two parts:
  - The Western Coastal Plains of India
  - The Eastern Coastal Plains of India
- The **two parts** of the coastal plains meet at the southernmost tip of **India – Kanyakumari.**
- These two parts have been further subdivided into various sub-parts as discussed in the sections that follow.

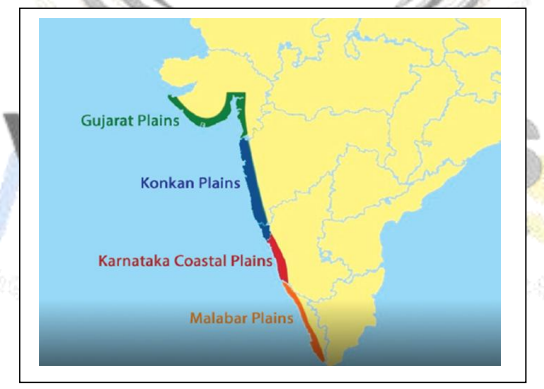


The Western Coastal Plains of India

- **Location**: They lie between the Western Ghats and the Arabian Sea coast.
- **Spread**: They stretch from the Rann of Kutch in the north to Kanyakumari in the south.
- **States Covered**: These plains begin in the state of Gujarat and stretch through Maharashtra, Goa, and Karnataka up to Kerala.
- **Width**: With an average width of about 65 km, they are quite narrow in the middle and a bit broader in the northern and southern parts.
- **Nature**: They are an example of a Submergent Coastline, thus providing natural conditions for the development of ports.

Sub-Divisions

Based on the relief and structure, these can be divided into the following subdivisions:

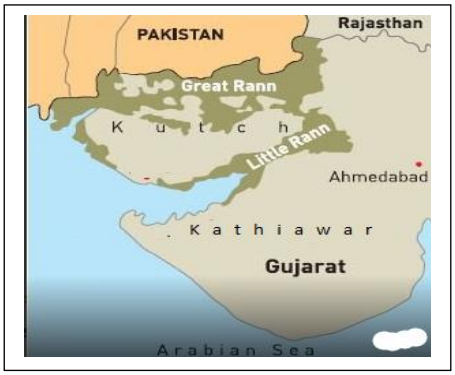


The Kutch Peninsula

- **Location**: It spreads over **northwestern Gujarat.**
- **Formation**: It was, **originally**, an island surrounded by seas and lagoons. The surrounding seas and lagoons, later on, got filled by deposition of sediment by the Indus River which used to flow through this area. In this way, the islands became a part of the mainland.
- **Topography**: The area has an **arid and semi-arid landscape** because of the scarcity of rain and the work of wind.
- **Chief physiographic features** of this region include **coastal sand dunes**, and **sandy plains**, which are interspaced with **bare rocky hills.**
- **Extensions**: In the north and south-east, it is bounded by two salt-soaked plains as described below

The Great Rann

- It is a **salt-soaked plain** lying all along the **north of Kutch**.
- It is almost completely flat and rises only a few meters above sea level.
- It is flooded by the Banas and the Luni rivers during the rainy season.



The Little Rann

- It is the southern continuation of the Great Rann.
- It lies on the coast and to the south-east of Kutch.

The Kathiawar Peninsula

- **Location**: It lies to the **south of the Kutch Peninsula**.
  - It is **surrounded** by the **Little Rann** on the **eastern side** and the **Nal Basin** on the **northeastern side**.
- **Prominent Hills**: This region consists of some prominent hills as mentioned below:
  - **Mandav Hills**: They lie in the central part of the Kathiawar Peninsula.

    Many small streams radiate in all directions from the Mandab Hills.
- **Girnar Hills**: With an average height of around 1,117 m, Girnar Hills form the **highest point** in the region.
- **Gir Range**: It lies in the **southern part** of the Kathiawar Peninsula.
  - This range is famous as the **abode of the Gir Lion**.

The Gujarat Plain

- **Location**: It lies to the **east of** the **Kutch** and **Kathiawar** Peninsulas and spreads over the **southern part of Gujarat and the coastal areas of the Gulf of Khambhat.**
- **Formation**: This plain has been formed by **depositions** of rivers like **Narmada, Tapi, Mahi,** and **Sabarmati**.
- **Slope**: Its average slope is **towards** the west and **southwest**.
- **Elevation**: It is of **low elevation** with none of its parts exceeding 150 m in height.
- **Topography**: The topography of this plain can be divided into two parts:
- **The Eastern Part:** This part is composed of sediments, and hence is **fertile** and suitable for agriculture.
- **The Coastal Part**: This part is covered by wind-blown **loess (heaps of sand),** which has given rise to a **semi-arid** landscape.

The Konkan Plain

- **Location**: This plain lies to the **south of the Gujarat plain.**
- **Spread**: It extends from **Daman to Goa** for a distance of about 500 km.
- **Width**: Its average width varies from **50-80 km**.
- **Topography**: It has some **characteristics of marine erosion** including cliffs, shoals, reefs, and islands in the Arabian Sea.
  - Mumbai, situated in this plain, was initially an island reclaimed to connect it with the mainland.
  - The Konkan coast has a series of small bays and beaches.

The Karnataka Coastal Plain

- **Location**: This plain lies to the **south of the Konkan plain.**
- **Spread**: It is about 225 km long, extending from **Goa to Mangalore.**
- **Width**: It is a narrow plain with an average width of **30-50 km**, the maximum being 70 km near Mangalore.
- **Topography**: The diverse topography of this plain can be seen as follows:
  - In the **central part**, numerous spurs (lateral ridges of land), descending from the Western Ghats, cross the plain. These spurs go very close to the coast, thus reducing the width of the plain in this part.

- In **some places**, the **streams** originating in the Western Ghats descend along steep slopes and make **waterfalls**.

  For example, the **River Sharavati** while descending over the slope forms the **Jog Falls** – one of the highest waterfalls in the world.
- In the **coastal parts,** marine topography forms the prominent features.

The Kerala Plain

- **Nomenclature**: It is also known as the **Malabar Plain**.
- **Location**: It is situated between Mangalore and Kanyakumari, stretching for a distance of around 500 km.
- **Width**: This plain is much **wider than** the **Karnataka Plain**.
- **Elevation**: It is a **low-lying** plain.
- **Topography**: The presence of lakes, lagoons, backwaters, spits, etc. is the chief characteristic of this plain.
- The **backwaters of Kerala** are known as **Kayals**, which are the shallow lagoons or inlets of the sea running parallel to the coastline.
- **Vembanad Lake**, one of the Ramsar Wetlands, is the largest backwater with a length of 75 km and a width of 5-10 km.

The Eastern Coastal Plains of India

- **Location**: It is situated **between** the Eastern Ghats and the Bay of Bengal.

  Its **discontinuous** is a **discontinuous line** of the Eastern Ghats.
- **Spread**: It extends from the **Subarnarekha River** along the West Bengal-Odisha border to Kanyakumari.
- **Width**: Their average width is around **120 km**, although they may be as wide as 200 km in the deltaic regions and as narrow as 35 km in between the deltas.

  Overall, they are **wider in comparison to the Western Coastal Plains.**
- **Formation**: It has been formed as a result of the **alluvial fillings** by the Rivers Mahanadi, Godavari Krishna, and Cauvery. Thus, it also contains some large deltas.
- **Nature**: They are an example of an **Emergent Coastline**, thus **NOT** providing natural conditions for the **development of ports.**

- ✓ **Nomenclature** : It is known by **different names in different regions:**
- ✓ **Northern Circars** : The section of the Eastern Coastal Plains lying between the Mahanadi and the Krishna rivers is known as the Northern Circars.
- ✓ **Carnatic** : The section of the Eastern Coastal Plains lying between the Krishna and the Cauvery rivers is known as the Carnatic.

Sub-Divisions

Based on the relief and structure, these can be **divided into the following subdivisions:**

The Utkal Plain

- The Utkal Plain comprises the **coastal region of Odisha,** including the **Mahanadi Delta.**
- The famous **Chilka Lake** is located in this region.

The Andhra Plain

- It is **located south of the Utkal Plain** and extends **up to Pulicat Lake.**
- The **chief characteristic** of this plain is the **delta formation** by the Rivers **Godavari** and **Krishna**.
- This part is, **largely**, **a straight coast** and **lacks** any significant **indentations**. This makes the **development of ports** in this part very difficult.
  - However, there are some **prominent ports** in this part, such as **Visakhapatnam, Machilipatnam** etc.

The Tamil Nadu Plain

- It **stretches** for a distance of around 675 km from **Pulicat Lake to Kanyakumari** along the coast of Tamil Nadu.
- The **most important feature** of this plain is the **Cauvery Delta** where the plain is 130 km wide.
  - The fertile soil and large-scale irrigation facilities have made the **Cauvery Delta** the **granary** of **South India**.

Difference between Eastern and Western Coastal Plains

Western Coastal Plains	Eastern Coastal Plains
Narrower	Wider
Intersected by various mountains of Western ghats.	Run continuously from north to south.
Rivers form estuaries.	Rivers form wide deltas.
Favors the formation of harbors.	Do not favor the formation of harbors as they have wide continental shelves.
Receives a high amount of rain from southwest monsoons.	Receives rains from both northeast and southwest monsoons.
Largely rocky. However, there are estuaries on the Konkan coast and back-waters on the Malabar coast.	Mostly sandy and have sand dunes and lagoons.

Significance of the Coastal Plains of India

- **Agriculture**: These coastal plains are covered by fertile soil, and hence are agriculturally very productive.
- **Port**: The entire length of the coast is dotted with big and small ports which help carry out trade.
  About **98% of India's international trade** is carried through these ports.
- **Economic Resource**: The coastal plains are sources of salt, monazites, mineral oils, and gas as well as centers of fisheries.
- **Human Settlements**: These coastal plains are home to dense human settlements and have some of the largest cities in India.

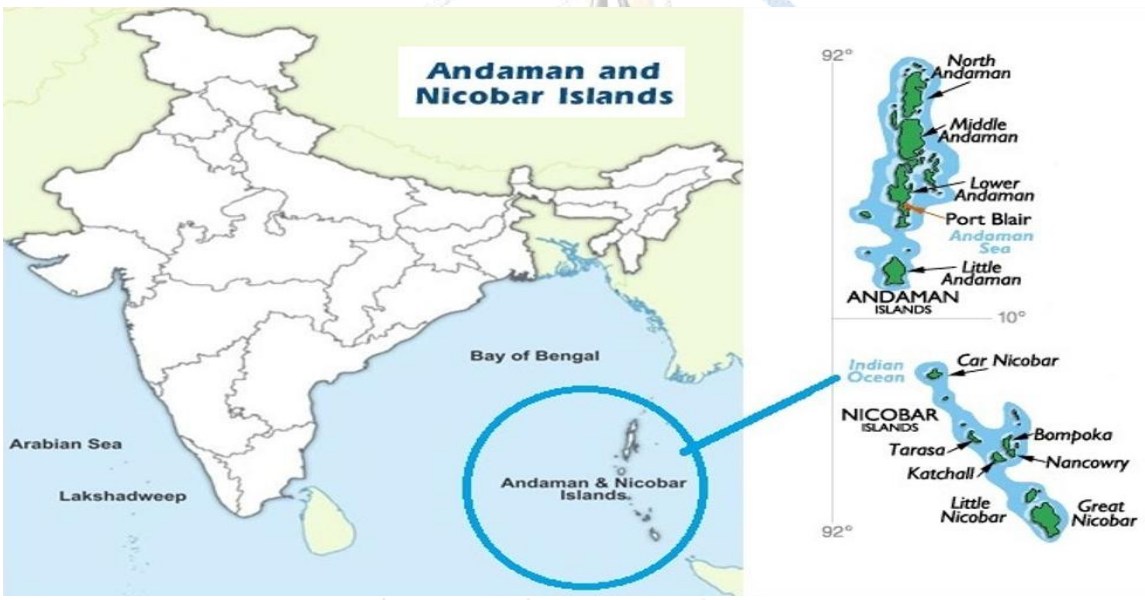
Much more than just a geographical feature, **the Coastal Plains of India** carry multiple significance. Apart from providing the ports, they are a source of many other resources. Of late, they are facing the risk of inundation due to global warming and the probable rise in sea level. Ensuring the sustainability of the coastal plains is not just crucial for India but for the marine ecology of the subcontinent. **Sustainable development** is the way forward.

6. The Indian Islands

The **Indian Islands** refer to the **group of islands,** scattered across the Indian Ocean, the Arabian Sea, and the Bay of Bengal, which form parts of the territory of India. Together, they constitute one of the 5 Physiographic Divisions of India

They are, broadly, categorized into two main groups of islands

- The Andaman and Nicobar Islands
- The Lakshadweep Islands



The Andaman and Nicobar Group of Islands

- **Location**: They are a group of islands of India, located in the **Bay of Bengal.**
- **Extent**: These islands form an **arcuate chain (convex to the west)** and extend from 6° 45′ N to 13° 41′ N and from 92° 12′ E to 93° 57′ E.
  - They stretch for a distance of about 590 km with a maximum width of about 58 km.
- **Major Islands in the Group**: This archipelago is composed of more than 500 big and small islands, which are divided into **two distinct groups of islands** – The Andaman Islands and the Nicobar Islands.

The Andaman Islands

- **Area**: The Andaman is a closely-knit group of islands in India with a length of around 260 km and a width of around 30 km.
- **Sub-groups**: These islands are divided into **three major sub-groups – North Andaman, Middle Andaman,** and **South Andaman.**

- The two major archipelagos of this group of islands – the **Little Andaman** and the **Great Andaman** – are **separated** from each other by the 50 km wide **Duncan Passage.**
- **The capital city** of the Andaman & Nicobar Islands **Port Blair** is located in **South Andaman**.

- **Habitation**: Only around 24 islands are inhabited in this group of islands.

The Nicobar Islands

- **Area**: This group of islands in India are scattered over a length of 262 km with a maximum width of 58 km covering an area of 1,653 sq km.
- **Sub-groups**: These islands are divided into **three major sub-groups –** Northern Group, Central Group, and Southern Group. The prominent islands in each subgroup are:
  - **Northern Group**: Car Nicobar and Battimalv.
  - **Central Group**: Chowra, Chaura or Sanenyo, Teressa or Luroo, Bompuka or Poahat, Katchal, Camorta, Nancowry or Nancowrie, Trinket, Laouk or "Isle of Man", Tillangchong, etc.
  - **Southern Group**: Great Nicobar (the largest island of the Nicobars), Little Nicobar, Kondul Island, Pulo Milo or Pillomilo (Milo Island), Meroe, Trak, Treis, Menchal, Kabra, Pigeon and Megapod.
- **The Great Nicobar** is the **largest and** the **southernmost island** in the group, which is only 147 km away from Sumatra island of Indonesia.
- **India's southernmost point 'Indira Point'** is located at the **southern tip of the Great Nicobar.**
- **Habitation**: Only around 12 islands are inhabited in this group of islands.
  - The **indigenous ethnic groups** are the **Nicobarese** and the **Shompen**.

- **Other Features**
  - The waterbody named **'Ten Degree Channel'** separates the **Andaman Islands in the north** from the **Nicobar Islands in the south.**
  - **Most** of these islands have a **volcanic base** and are made of tertiary sandstone, limestone, and shale.
- The **Barren** and **Narcondam** islands, north of Port Blair, are **volcanic islands**.
- Some of the islands are fringed with coral reefs.
  - Most of the islands are mountainous and reach considerable heights.

- **Saddle Peak** (737 m) in **North Andaman is the highest peak** in the Andaman and Nicobar Islands.
  - The **names** of the following three islands were **changed** in 2018:

1. **Ross Island** – renamed as **Netaji Subhash Chandra Bose Dweep**
2. **Neil Island** – renamed as **Shaheed Dweep**
3. **Havelock Island** – renamed as **Swaraj Dweep**

The Lakshadweep Islands

- **Location**: They are a group of islands of India, located in the **Arabian Sea**, close to the Malabar coast of Kerala.

- **Extent**: This group of islands in India are widely scattered over an area of 108.78 sq. km. extending from 8° N to 12°20′ N and 71°45′ E to 74 °E.

- **Major Islands in the group**: Though the term Lakshadweep literally means one lakh islands, the

Lakshadweep Islands, actually, consist of a group of only 25 small islands.

These islands are divided into **three groups** as follows:

Amindivi Islands

- The islands **north of 11° N** are known as Amindivi Islands.

Cannanore Islands

- The islands **south of 11° N** are called Cannanore Islands.

Minicoy Islands

- It is located in the **extreme south**.
- It is the **largest** and the **most advanced** island in the group of Lakshadweep Islands.
- **Composition: All the islands** in this group are of coral origin and are surrounded by fringing reefs.
- **Topography**: Their topography is **flat** and there is almost **complete absence of any major relief features** such as hills, streams, valleys, etc.
  - Shallow lagoons are seen on their western side, while on the eastern seaboard, the slopes are steeper.
- **Capital**: The capital city of the Lakshadweep Islands is **Kavaratti**.

Significance of the Indian Islands

- **Strategic Significance**: The locations of the islands of India are such that they are of great strategic importance for the country:
  - The **Andaman and Nicobar Islands**, located **close to the Strait of Malacca,** offer India significant **strategic leverage in the Indian Ocean Region.**
  - These islands in India serve as a **forward operating base** for the Indian Navy, enhancing India's maritime security and surveillance capabilities in the region.
- **Economic Significance**: The islands of India contribute to the nation's economy through **tourism, fisheries, and agriculture.**
- **Environmental Significance:** The Indian Islands experience an equatorial climate and have **thick forest cover**. Their forests are home to a **great diversity of flora and fauna.**

Much more than just a geographical feature, **the Islands of India** carry multiple significance. Apart from providing strategic leverage to India, they are a source of many other resources. Of late, the islands in India are facing the risk of inundation due to global warming and the probable rise in sea level. Ensuring the sustainability of these islands is not just crucial for India but for the marine ecology of the subcontinent. **Sustainable development** is the way forward.

4. Geological Composition of India

- The geological structure, encompassing the organization and deposition of rocks within the **Earth's crust,** significantly influences the land's relief and soil characteristics.
- Additionally, it provides insights into the extensive mineral resources concealed beneath the **Earth's surface.**
- While certain rocks display significant deformation and metamorphism, others represent recently deposited alluvium awaiting diagenesis.
- India's geological evolution traces back to the split of Pangea into two distinct continents: **Laurasia (Angara land)** and Gondwanaland. India was originally part of the **Gondwanaland** Rock System. Laurasia constituted the contemporary continents of North America (Greenland), Europe, and Asia. Meanwhile, Gondwanaland comprised the current landmasses of **Antarctica, Australia, Africa**, South America, and **Madagascar.**

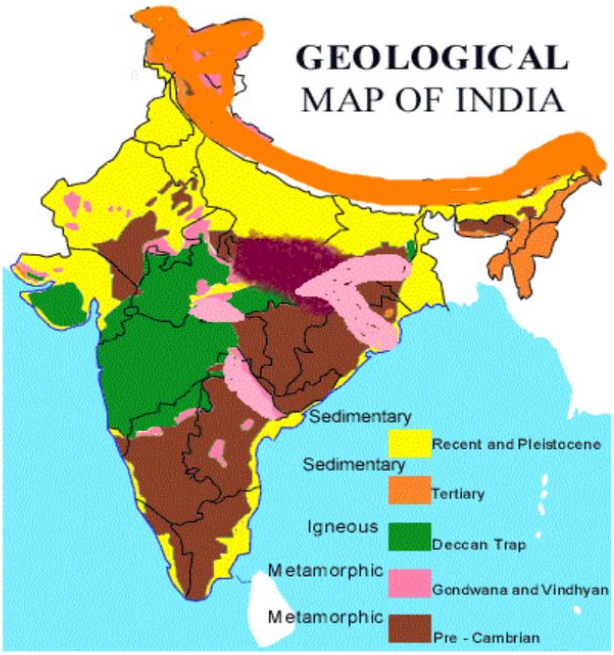
Time Scale of Indian Geological Structure

	Period	Epoch	Million Years Ago	Distinctive Life	Major Structural Episodes
Cenozoic	Quaternary	Recent / Holocene	0.01	Ice age ends	Humans are dominant
Cenozoic	Quaternary	Pleistocene	2.5	Age of man	
Cenozoic	Tertiary	Pliocene	12	Age of mammals (flowering plants and trees)	Main Alpine Episode
Cenozoic	Tertiary	Miocene	25		Laramide Phase
Cenozoic	Tertiary	Oligocene	35-40		
Cenozoic	Tertiary	Eocene	60		
Cenozoic	Tertiary	Palaeocene			
Mesozoic	Cretaceous	–		Age of reptiles (Dinosaurs) and birds	General Worldwide Elevation
Mesozoic	Jurassic	–			
Mesozoic	Triassic	–			
Palaeozoic	Permian	–		Age of Amphibians	Main Hercynian Episode
Palaeozoic	Carboniferous		350	Widespread forests	
Palaeozoic	Devonian		440-101	Age of fishes	
Palaeozoic	Silurian		440-10	Age of Marine Invertebrates	
Palaeozoic	Ordovician		500	Abundant fossils first appear	
Palaeozoic	Cambrian		600	Main Caledonian Episode	

Azonic	Pre-Cambrian		Oldest rocks	Several Mountain Building Episodes	

Classification of Indian Rocks

- Indian rocks can be divided into the following categories based on their formation in different periods of the Geological Time Scale (GTS).



Geological Map of India

Archaean Group

The rocks of the Archaean group are divided into two classes.

The Archaean Rock System

- These are the **oldest rocks** of the Earth crust. They have been found at the bottom of the stratified (sedimentary) deposits in all countries of the world. These are also called as **pre-Cambrian rocks.**
- They are often called as the **fundamental complex or the basement complex**. They form the foundation of all ancient plateaus and core of all folded mountain ranges of the world, including Great Himalayas.
- These rocks have lost their fundamental structure due to undergoing excessive transformation over the years. Now, these are Gneiss and **Schist t**ype of rocks.
- The majority of the Indian Peninsular comprises Archaean rocks, classified into three types: **Bengal**

Gneiss, Bundelkhand Gneiss, and Nilgiri Gneiss.

- These rocks, located in various regions such as Odisha, Madhya Pradesh, Chhattisgarh, Chota Nagpur plateau, Meghalaya plateau, Bundelkhand, and extending from North of Vadodra to the Aravallis of Rajasthan and the entire length of the Himalayas (except Sikkim), form a crucial repository of India's mineral wealth.

Dharwar Rock System

- Originating in the district of Dharwar in **Karnataka**, these ancient metamorphosed sedimentary rocks lack fossils.
- Found in various areas like **Karnataka, Visakhapatnam, Gujarat**, and the Aravalli ranges, they consist of hornblende, schist, quartzite, slates, and dolomite.

- Highly metalliferous, these rocks house minerals such as iron-ore, manganese, lead, zinc, gold, silver, mica, copper, precious stones, and building materials.
- Locations include Bellary, Mysore, Balaghat, Ladakh, Zaskar, Kumaon mountain ranges, Chota Nagpur plateau, Chhattisgarh, Odisha, Rajasthan, and Meghalaya plateau.

Purana Group

Cuddapah Rock System

- Formed through the erosion and deposition of Dharwar rocks 1400-600 million years ago.
- Predominantly found in **Cuddapah** district **(Andhra Pradesh),** Kurnool district, Chhattisgarh, Singhbhum (Jharkhand), Kalahandi, Keonjhar (Odisha), and Aravallis.
- Rich in iron, copper, manganese, cement, grade limestone, cobalt, nickel, asbestos, jasper, and quartzites.
- Known for low metallic contents in ores, some uneconomical for extraction.
- Rajasthan's Cuddapah rocks are also known as **Delhi Ridge**, hosting diamonds and gold.

Vindhyan Rock System

- Named after the Vindhyan mountain, formed by the deposition of river valleys and shallow oceans.
- Acts as a dividing line between the Gangetic plains and the Deccan plateau, extending from Sasaram to Chittorgarh.
- Found in **Bastar, Kaimur r**anges, **Chittorgarh**, Bhima valley (Karnataka), and Kurnool district (Andhra Pradesh).
- Rich in durable stones, flagstone, ornamental stones, diamondiferous areas (Panna and Golconda), limestone, pure glass-making sand, red sandstone, sandstone, building materials, and raw materials for cement and chemical industries.
- Notable structures like **Sanchi Stupa, Red Fort, Jama Masjid, Fatehpur Sikri, etc**., were built using red sandstone.

The Dravidian Group (Palaeozoic: 600-300 Million Years Age)

- The Dravidian Group (Palaeozoic: 600-300 Million Years Age) comprises various rock systems with distinct characteristics.
- **Cambrian Rocks:** Best developed in the North-West Himalayas, Spiti Valley, Kullu, Lahaul (Himachal Pradesh), Baramulla (Kashmir), and Kumaon Hills (Uttarakhand). Main rocks include sandstone, shales, and dolomite.
- **Ordovician Rocks:** Developed in Spiti valley, Lidder valley, Kumaon region. Main rocks: Quartzite, sandstone, grits, and limestones.
- **Devonian Rocks:** Developed in Spiti Valley and Kumaon. Main rock: Quartzite.
- **Carboniferous Rocks**: Developed in Spiti valley, Kashmir, Shimla, Pir-Panjal, Kumaon, Chota Nagpur plateau, and Chhattisgarh. Main rocks include sandstone, limestone, clay, shale, and coal.

The Aryan Group

The Aryan Group, from the upper Carboniferous period to the present times, is characterized by five rock systems.

Gondwana Rock System

- Formed during the upper Carboniferous and Jurassic periods.
- Discovered in the Gond region of Madhya Pradesh, with sandstones, shales, clay, and deposits of iron ore, copper, uranium, antimony, sandstone, slate, and conglomerates.
- Found in Damodar valley, Mahanadi valley, along the Godavari, and in the Himalayas (Kashmir, Darjeeling, Sikkim).

- Predominant coal deposits (bituminous and anthracite) in this area, constitute 98% of India's coal.

Jurassic Rock System

- Formed due to **marine transgression in the latter** part of the Jurassic period.
- Found in the Jaisalmer area of Rajasthan, Kutch, Guntur, and Rajamundry, with limestone, shales, and sandstones.

Deccan Trap (Cretaceous Period)

- Spreads over **Kachchh** (Kutch), Kathiawar, Gujarat, Madhya Pradesh, Maharashtra, and parts of Andhra Pradesh.
- Result of intense volcanic activity, with basaltic lava deposits used for building roads.
- Regur soi**l (black soil)** developed on it, suitable for cotton cultivation.

Tertiary Rock System

- Formed from Eocene to **Pliocene**, marked by the birth of the Himalayas and the age of mammals.
- Divided into Eocene, Oligocene, and Miocene systems.
- **Eocene System:** Mainly found in Jammu and Kashmir, Himachal Pradesh, Rajasthan, Gujarat, and North-Eastern India.
- **Oligocene System:** Poorly developed in India, found in the Barail series of Assam.
- **Miocene System:** Fully developed in India, found in tertiary areas of the extra peninsula.
- **Quaternary Rock System:** Divided into two subdivisions without a clear-cut boundary between them.
- The Pleistocene era, characterized by a cold climate and glaciations, witnessed the origin of the Himalayas. In contrast, the more **recent** division, beginning around 1200 years ago after the withdrawal of the last glaciations, is associated with the formation of the Northern plains and coastal regions.
- The formation of the Himalayan mountain resulted from the folding process driven by compressional forces arising from the collision between the Indian and Eurasian plates during the tertiary era of the **Cenozoic period**. This process, occurring between the middle of the Pliocene and Eocene periods, led to the contraction of the Tethys sea and the subsequent formation of the Indus Tsangpo Suture Zone (ITSZ).
- Key milestones in the Himalayan geological timeline include the Oligocene epoch, when the great Himalayas originated, and the development of the Main Central Thrust (MCT) structure towards the end of the Oligocene epoch.
- The lesser/middle Himalayas took shape in the Miocene period, accompanied by the formation of the Main Boundary Fault (MBF) at its conclusion. Subsequently, the Shivalik Himalayas emerged during the Pliocene epoch, coinciding with the development of the Himalayan Frontal Fault (HFF) structure at the end of the Pliocene.
- This intricate structural arrangement represents the subduction of the Indian plate beneath the Eurasian plate. Post the Pleistocene ice age, the Northern plains of India originated as a result of the deposition of sediments carried by rivers descending from the Himalayas.
- Notable quaternary formations include ice age deposits in Kashmir, the formation of Alluvial plains in North India, the creation of Rajasthan deserts, the Rann of Kutch, laterite formation in the peninsula, and the development of regur soils. Kashmir and the Himalayas witnessed the deposition of ice age deposits, contributing to the diverse geological history of the region.

5. Indian Drainage System

Indian Drainage System

The **Indian Drainage System** encompasses an extensive network of rivers and streams that traverse the country's diverse landscape. This intricate system plays a crucial role in shaping India's geography, supporting its ecosystems, and providing essential resources for agriculture, industry, and daily life. We will study in detail the Indian Drainage System, exploring its categorization, key features, various ways in which it is utilized and other related aspects.

About Indian Drainage System

- Most rivers discharge their waters into the Bay of Bengal, while some flow through the western part of the country and empty into the Arabian Sea.
- Also, the northern parts of the Aravalli range, some parts of Ladakh, and arid regions of the Thar Desert have inland drainage.
- All the major rivers of India originate from one of the three main watersheds:
  - The Himalayas and the Karakoram Range,
  - The Chotanagpur Plateau,
  - Vindhyas and Satpura Range and
  - The Western Ghats

Categorisation of Indian Drainage System

The Indian Drainage System can be categorised into three groups:

- Drainage Systems Based on **Origin**,
- Drainage Systems Based on **Type of Drainage,**
- Drainage Systems Based on **Orientation to the Sea**

All these categorisations of the Indian Drainage System have been discussed in detail in the section that follows.

Drainage Systems Based on Origin

The Indian drainage system can be classified based on its origin into two parts:

- **The Himalayan Rivers (Perennial Rivers)**: Indus, Ganga, Brahmaputra, and their tributaries.
- **The Peninsular Rivers (Non-Perennial Rivers)**: Mahanadi, Godavari, Krishna, Cauvery, Narmada, and Tapi and their tributaries.

Drainage Systems Based on Type of Drainage

The Indian Drainage System or the river systems of India can be classified into four groups:

- The Himalayan Rivers,
- The Deccan Rivers, and
- The Coastal Rivers that drain into the sea and
- The rivers of the Inland Drainage Basin

Note:

Streams like the **Sambhar Lake in western Rajasthan** are mainly seasonal in character, draining into the inland basins and salt lakes.

The only river that flows through the salt desert is **the Luni in** the **Rann of Kutch.**

Drainage Systems Based on Orientation to the Sea

The Indian Drainage System based on the orientation to the sea are:

Bay Of Bengal Drainage	Arabian Sea Drainage
Rivers that drain into the Bay of Bengal.	Rivers that drain into the Arabian Sea.
East flowing rivers.	West flowing rivers.
Nearly 77 per cent of the drainage area of the country is oriented towards the Bay of Bengal.	Nearly 23 per cent of the drainage area of the country is oriented towards the Arabian Sea.

Bay Of Bengal Drainage	Arabian Sea Drainage
The Ganga, the Brahmaputra, the Mahanadi, the Godavari, the Krishna, the Cauvery, the Penneru, the Penneiyar, the Vaigai, etc.	The Indus, the Narmada, the Tapi, the Sabarmati, the Mahi and a large number of swift-flowing western coast rivers descending from the Sahyadris.

River Regimes

- The pattern of flow of water in a river channel over a year is known as its regime.
  - Usually, fluctuations in the water flow of a river occur due to various factors such as melting, precipitation, formation of rocks or other relief changes etc. resulting in different river regimes.
    - For example, the regimes of Himalayan rivers are different from peninsular rivers.
- The **Himalayan rivers are perennial** as they are fed by both rainfall and glaciers and are said to be of **glacial regime whereas the Peninsular rivers are fed only by the rainfall** and thus subjected to fluctuations in the water flow depending on the amount of rainfall and said to be of the **monsoonal regime.**
  - The rivers with the monsoonal regime have minimum water flow from **January to May** and maximum water flow in the monsoon season from **June to September.**
  - For instance, the **Narmada River** has minimal discharge from January to July but **experiences a sharp increase in August,** reaching its peak flow. The decline in October is as dramatic as the August rise.

Utilization of River Water in India

The water from the river used for the following purposes:

- **Irrigation** – The river carries 45% of the total precipitation but because of uneven topography and flow characteristics all of it is not usable.
  - And above 45%, only 33% of the annual flow is available for irrigation.
- **Hydro-electricity** – Large rivers in mountainous regions has great hydro-electricity potential.
  - However, power generation from the peninsular river requires the impounding of water during monsoon months whereas the Himalayan river does not have such a problem as their flow is appreciable even during the critical winter months.
  - Furthermore, they have other difficulties in the construction of large storage due to narrow valleys, high siltation, high seismicity in the region and vast alluvial plains with no variation in relief.
- **Waterways** – The country has one of the longest navigable rivers.
  - The most important navigable rivers are **Ganga, Brahmaputra, Mahanadi etc.**
- **Water Supply**: The river water is used for agriculture, and water supply to cities, villages, and big industries.
  - Unfortunately, the quality and quantity of water in the river are being eroded due to the discharge of sewage and effluents in the river and diversion of water respectively.
- **Fishing**: About 50% of the country's total fish production comes from inland fisheries to which the river, its canals and its reservoir contribute the most.
  - There is tremendous scope for an increase in freshwater fish production, with improvement in water quality and quantity in rivers.

Conclusion

The Indian drainage system is a complex and dynamic network that has played a pivotal role in the country's development and sustenance. As the water demand continues to grow, it is crucial to manage this precious resource effectively, ensuring its equitable distribution and sustainable utilization. The

preservation and responsible management of India's drainage system will be instrumental in securing the country's water security and promoting sustainable development for generations to come.

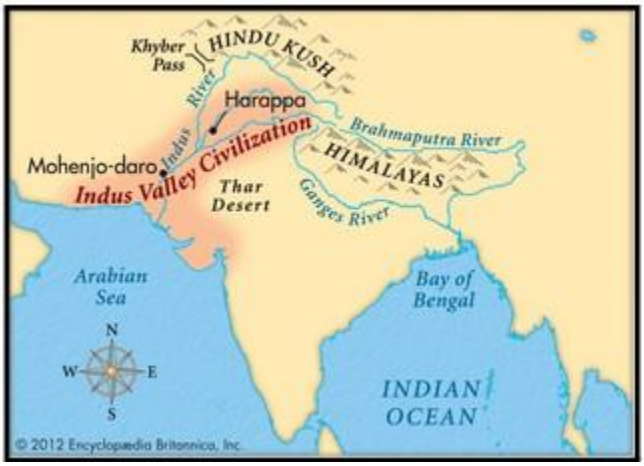
Difference between the Himalayan River System and the Peninsular River System

tures	Himalayan River System	Peninsular River System
Origin	The Himalayan rivers originate from the high Himalayan ranges and are known as the Himalayan rivers.	The Peninsular rivers originate in the hills of the Peninsular Plateau and are called Peninsular Rivers.
Catchme rea	Himalayan rivers have large basins and catchment areas.	Peninsular rivers have relatively smaller basins and catchment areas.
Valleys	Himalayan rivers flow through deep, V-shaped valleys known as gorges.	Peninsular rivers flow through comparatively shallow valleys.
Drainage e	Himalayan rivers exhibit antecedent drainage.	Peninsular rivers exhibit consequent drainage.
Water y	Himalayan rivers are perennial.	Peninsular rivers depend on rainfall, with flow occurring mainly during the rainy season.
Stage	Himalayan rivers are youthful, flowing through the Young Fold mountains.	Peninsular rivers, flowing through one of the world's oldest plateaus, have reached a mature stage.
Meander	Upon entering the plains, Himalayan rivers slow down, forming meanders and frequently shifting their beds.	Peninsular rivers, with their hard rock surfaces and non-alluvial nature, generally follow straighter courses with limited meandering.
Deltas & Estuaries	Himalayan rivers create large deltas at their mouths, with the Ganga-Brahmaputra delta being the largest in the world.	Some Peninsular rivers, like the Narmada and Tapti, form estuaries, while others, such as the Mahanadi, Godavari, Krishna, and Cauvery, form deltas.

Indus River System

The Lifeline of South Asia: Exploring the Importance and Magnificence of the Indus River System

Introduction

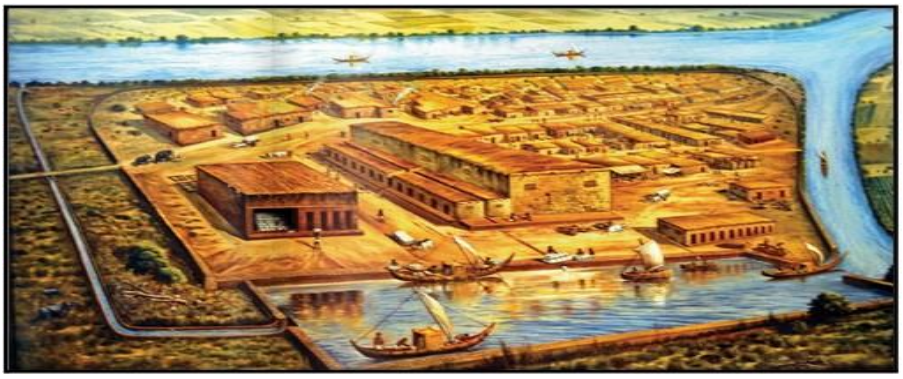


The Indus River system, an ancient and colossal river network, holds paramount importance for South Asia, known as Sindhu in Sanskrit and Mehran in Sindhi, is an extraordinary trans-Himalayan River situated in South Asia. It spans an impressive length of approximately 2,000 miles (3,200 km), making it one of the world's longest rivers. With a vast drainage area of about 450,000 square miles (1,165,000 square km), including the majestic Himalayas, Hindu Kush, and Karakoram Range, it holds immense significance. While 175,000 square miles (453,000 square km) lie within these mountain ranges, the remainder flows through the semi-arid plains of Pakistan. The Indus River showcases a remarkable annual flow of around 58 cubic miles (243 cubic km), which is twice that of the Nile River and three times that of the combined Tigris and Euphrates rivers.

Historical Significance of Indus Basin

The Indus River and its tributaries have played a significant role in shaping the history and civilization of the region it traverses. The renowned Indus Valley Civilization, with its major cities like Harappa and Mohenjo-Daro, flourished along the banks of this river. Archaeological excavations have revealed the vast extent of this civilization, spanning from northeastern Afghanistan to Pakistan and northwestern India, encompassing over 1,052 cities and settlements.

The Persian Empire was the first Western power to annex the Indus Valley, followed by the invading armies of Alexander the Great. Subsequently, the region witnessed the dominion of various empires, including the Mauryans, Kushans, and Muslim rulers such as Babur, Mahmud of Ghazni, and Mohammed Ghori.



The Indus River holds significant cultural and linguistic importance as well. It finds mention in the ancient Hindu scriptures, the Rigveda, referred to as "Sindhu." The name "India" is believed to have been derived from the river's name, as the Persian word "Hindu" and the Sanskrit word "Sindhu" share a common origin. The ancient Greeks referred to the Persians as "Indos" and the inhabitants of the region as "Indoi,"

signifying "The People of the Indus." This linguistic connection further underscores the historical and cultural significance of the Indus River in shaping the identity of the land it flows through.

Geographical Features

The Indus River begins its course in the southwestern Tibet Autonomous Region of China, near Lake Mapam. It starts at a high elevation of around 18,000 feet (5,500 meters) and initially flows northwest. Along its path, it crosses the southeastern boundary of the disputed Kashmir region and receives its first major tributary, the Zanskar River, near Leh in Ladakh, India.

Continuing into the Pakistani-administered areas of Kashmir, the Indus is joined by another significant tributary, the Shyok River. As it moves downstream, it is fed by powerful glaciers from the Karakoram Range, Nanga Parbat massif, and Kohistan highlands. The Shigar, Gilgit, and other streams also contribute their glacial meltwater to the Indus.

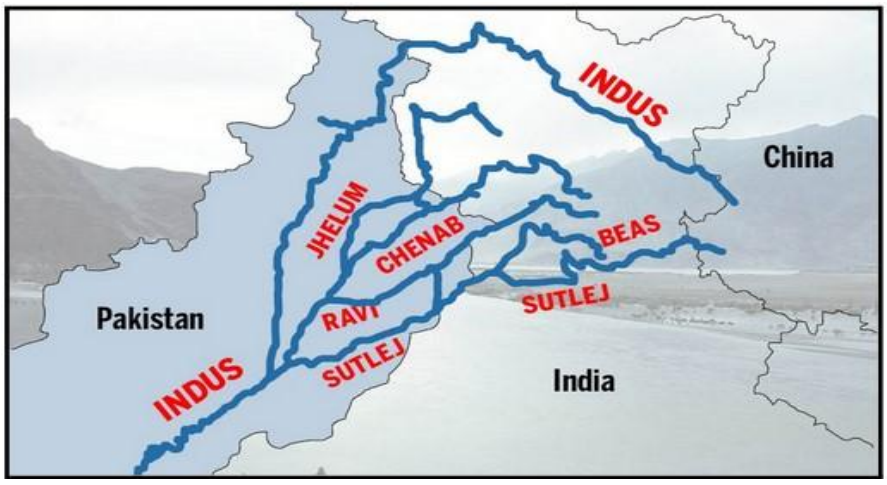
Leaving this mountainous region, the Indus transforms into a fast mountain stream, passing between the Swat River and Hazara areas in Khyber Pakhtunkhwa province. It continues its course until it reaches the Tarbela Dam reservoir. Just above Attock, the Kabul River joins the Indus, and this is where the river flows at an elevation of 2,000 feet (600 meters), crossed by the first bridge accommodating rail and road.

Afterwards, the Indus crosses the Salt Range near Kalabagh, entering the Punjab Plain. It receives the waters of the **Jhelum, Chenab, Ravi, Beas, and Sutlej rivers**, collectively known as the Punjab ("Five Rivers").

At this point, the Indus grows significantly larger, particularly during the flood season, stretching several miles wide. It flows slowly across the plain, depositing silt on its bed, gradually raising it above the sandy plain. In fact, much of the plain in Sindh province in Pakistan owes its formation to the alluvium carried by the Indus.

Major tributaries of Indus River in India

The Indus River in India is fed by several major tributaries. These tributaries play a crucial role in contributing to the flow and water supply of the Indus River. Here are the major tributaries of the Indus River in India



Chenab River

Originating from the BaraLacha Pass in the Zaskar Range, the Chenab River is formed by the confluence of the Chandra and Bhaga rivers in Himachal Pradesh. It flows through Jammu and Kashmir before entering Pakistan's Punjab plains.

Sutlej River

The Sutlej River starts from the southern slopes of Kailash Mountain, flows through Himachal Pradesh, and joins the Beas River in Punjab. It provides water for power generation and irrigation.

Beas River

Originating from the Rohtang Pass, the Beas River joins the Sutlej River in Punjab. It is known for its scenic beauty and is a popular tourist destination in Himachal Pradesh.

Ravi River

Starting from the Kullu Hills, the Ravi River flows through Himachal Pradesh and enters Pakistan through Amritsar. It joins the Chenab River in Pakistani Punjab.

Jhelum River

The Jhelum River originates from Verinag in the Kashmir Valley, flows through Baramulla, and forms a border between India and Pakistan. It joins the Chenab River at Trimmu.

These major tributaries contribute to the water supply, hydrology, and overall ecosystem of the Indus River system, making them vital components of the larger river network.

To prevent flooding, embankments have been constructed, but occasional breaches can result in devastating floods. The Indus has witnessed significant flood events in the past, such as those in 1947, 1958, and 2010. During periods of heavy flooding, the river can change its course. Near Tatta, the Indus branches into distributaries that form a delta, stretching over an area of 3,000 square miles (7,800 square kilometers). This delta extends along the coast for approximately 130 miles (210 kilometers), with an uneven surface containing a network of existing and abandoned channels. The coastal strip, around 5 to 20 miles (8 to 32 kilometers) inland, is prone to flooding during high tides. The Indus delta boasts elongated protruding distributaries and low sandy beaches.

Indus Water Treaty

The Indus Water Treaty, signed in 1960, is an important agreement between India and Pakistan that governs the sharing of water resources from the Indus River and its tributaries. It was brokered by the World Bank and is considered one of the most successful water-sharing treaties in the world.

The treaty was necessary because the Indus River flows through both India and Pakistan, and tensions over water sharing had been rising between the two countries. The agreement aimed to provide a framework for managing water distribution fairly and peacefully.

Under the treaty, the Indus River and its three western tributaries, namely the Jhelum, Chenab, and Indus itself, were assigned to Pakistan. India was given control over the three eastern tributaries, namely the Ravi, Beas, and Sutlej. This division was based on the principle of equitable sharing, ensuring that both countries had access to water resources.

The treaty established a Permanent Indus Commission composed of representatives from both India and Pakistan to resolve any disputes or issues related to the implementation of the treaty. The commission meets regularly to exchange data, discuss water projects, and address concerns.

One of the key provisions of the treaty is the permission for each country to construct storage facilities, such as dams and barrages, on their allocated rivers. However, certain restrictions were placed to prevent significant harm to the other country. For instance, India agreed to limit the storage capacity of its projects on the western rivers to avoid reducing the water flow to Pakistan.

The treaty also promotes cooperation between the two countries in sharing data and information about river flows, hydrological data, and planned water projects. This transparency helps build trust and allows both sides to make informed decisions about water management.

The Indus Water Treaty has played a crucial role in preventing major conflicts over water resources between India and Pakistan. It has endured through periods of political tensions and conflicts between the two nations. The treaty has provided a mechanism for resolving disputes and has facilitated the development of water infrastructure and irrigation systems in both countries.

However, challenges and disputes still arise, particularly regarding the construction of new dams or water projects by either country. The treaty requires constant dialogue and cooperation to address emerging issues and ensure the equitable sharing of water resources.The Indus Waters Treaty has been marred by issues and accusations of violations from both India and Pakistan. Pakistan raised concerns about India's hydroelectric projects, while India objected to Pakistan's projects in the Rann of Kutch. Bilateral relations have deteriorated, leading India to take steps to divert water from Pakistan. These include reviewing the Tulbul project suspension, objecting to the LBOD project, and initiating projects to utilize its share of water. There are also debates about the treaty's signing by Prime Minister Nehru instead of the head of state.

Overall, the Indus Water Treaty is a significant milestone in international water diplomacy. It has contributed to regional stability and cooperation by managing water resources in a fair and mutually beneficial manner. The treaty serves as a model for other countries facing similar challenges, highlighting the importance of dialogue, cooperation, and equitable sharing for sustainable water management.

Ganga River System

Origin of Ganga River

- The Ganga River is a major river of the Indian subcontinent rising in the Himalayan mountains and flowing about 2,525 km generally eastward through a vast plain to the Bay of Bengal.
- Flowing through a vast length, it crosses five states of India namely:
  - Uttarakhand,
  - Uttar Pradesh,
  - Bihar,
  - Jharkhand and
  - West Bengal
- It has a catchment area of **8,61,404 sq. km (26.4%)** of India.
- Finally, it drains into the Bay of Bengal. The Ganga River basin is among the most densely populated in the world, housing about half of India’s population.
- It supplies over one-third of India’s surface water and accounts for more than half of the country’s water use.
- Beyond its vital role in daily life, the Ganga is also revered as one of India’s holiest rivers, with cultural and spiritual significance extending far beyond the basin.

Course of Ganga River

- The Bhagirathi, considered to be the source stream of the Ganga, emanates from Gangotri Glacier at Gaumukh at an elevation of 3, 892 m (12,770 feet).
- Many small streams comprise the headwaters of the Ganga. The important among these are:
  - Alaknanda,
  - Dhauliganga,
  - Pindar,
  - Mandakini and
  - Bhilangana.
- At Devprayag, where the Alaknanda meets the Bhagirathi, the river is named Ganga.
- As it flows into the Gangetic Plains at Haridwar, a barrage channels a substantial portion of its water into the Upper Ganga Canal for irrigation purposes.
- Another barrage at Bijnore directs water into the Madhya Ganga Canal, but this occurs only during the monsoon season.
- At Narora, water is further diverted into the Lower Ganga Canal.
- Additionally, the Ramganga River joins the Ganga near Kannauj, contributing extra water to the river.
- Yamuna confluences Ganga at the Sangam in Prayagraj (Allahabad), making a major contribution to the river flow.
- Beyond Prayagraj, Ganga is joined by several tributaries, most of which are from the north and a few from the south.
- The Farakka barrage in West Bengal regulates the flow of the Ganga River, diverting a portion of its water into a feeder canal that connects to the Hooghly River, helping to keep it relatively free of silt.
- Below the Farakka barrage, the Ganga River divides into two branches:
  - Bhagirathi (Hooghly) is on the right and
  - Padma is on the left.
- The Bhagirathi (Hooghly) River meets the Bay of Bengal approximately 150 km downstream from Kolkata.
- Padma enters Bangladesh and meets rivers Brahmaputra and Meghna before finally joining the Bay of Bengal.

Tributaries of Ganga River

The major tributaries of the Ganga River are:

- Yamuna,
- Ramganga,
- Gomti,
- Ghaghara,
- Gandak,
- Damodar, and
- Kosi etc.

Some important tributaries of the Ganga River System have been discussed in detail in the section that follows.

Alaknanda River

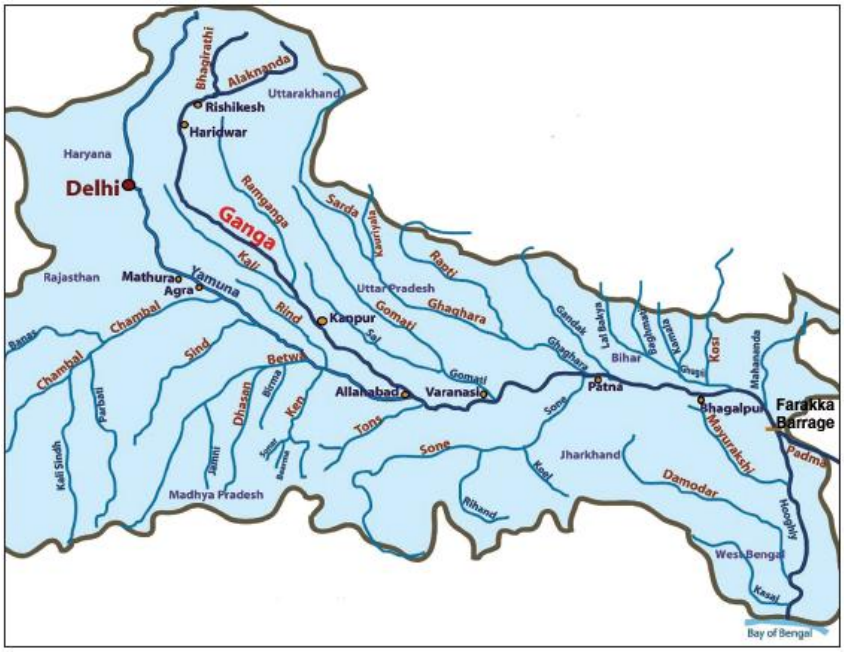
- The Alaknanda River is one of the primary headstreams of the Ganga River.
  - It originates at the confluence of the Satopanth and Bhagirath glaciers in Uttarakhand.
  - It meets the Bhagirathi River at Devprayag after which it is called as the Ganga River.
- Its main tributaries are the:

- **Mandakini**,
- **Nandakini, and**
- **Pindar rivers.**

- The Hindu pilgrimage centre of Badrinath and the natural spring Tapt Kund lie along the banks of the Alaknanda River.
- At its origin, ***Lake Satopanth*** is a triangular lake named after the Hindu trinity Lord Brahma, Lord Vishnu, and Lord Shiva.

Bhagirathi River

- The Bhagirathi River is one of the two major headstreams of the Ganga.
  - It converges with the Alaknanda at Devprayag to form the Ganga River.
- It rises at the foot of Gangotri Glacier, at Gaumukh, at the base of Chaukhamba peak in the Uttarkashi district of Uttarakhand.
- The upper catchment of the river is glaciated. It cuts spectacular gorges in its middle course where it cuts through granites and crystalline rocks of the central Himalayas.



Dhauliganga River

- The **Dhauliganga River** originates from **Vasundhara Tal,** perhaps the **largest glacial lake** in Uttarakhand.
- The Dhauliganga is a significant tributary of the Alaknanda, alongside the **Nandakini, Pindar, Mandakini, and Bhagirathi.**
  - It is joined by the **Rishi Ganga River at Raini.**
- It merges with the **Alaknanda at Vishnu Prayag.** There it loses its identity and the Alaknanda flows southwest through **Nanda Prayag, Karnaprayag** until it **meets the Mandakini River,** which comes from the north at Rudra Prayag.
- After subsuming the Mandakini, the Alaknanda continues past Srinagar before merging with the **Ganga at Dev Prayag .**
- The **Alaknanda** then fades into the Ganga, which proceeds first southward and then westward through notable pilgrimage sites like **Rishikesh** before entering the **Indo-Gangetic plains at Haridwar.**
  - Additionally, the **Tapovan Vishnugad Hydropower Project** is under construction on the **Dhauliganga**.

Rishi Ganga River

- Rishiganga River originates from the **Uttari Nanda Devi Glacier on Nanda Devi Mountain** and is also nourished by the **Dakshini Nanda Devi Glacier.**

- It flows through the **Nanda Devi National Park** and merges into the **Dhauliganga River** near the village of **Raini**.

Ramganga River

- The Ramganga River originates on the southern slopes of **Dudhatoli Hill** in the **Chamoli district of Uttarakhand.**
- It is **fed by springs** that rise from **underground water reservoirs.**
- The river's course through the lower Himalayan hills features distinct geomorphic characteristics such as incised meanders, paired and unpaired terraces, interlocking spurs, waterfalls, rock benches, cliffs, and towering ridges.
- It flows through the **Dun Valley of Corbett National Park** and is dammed at **Kalagarh**.
- The Ramganga ultimately joins the **Ganga near Kannauj**, with **Bareilly City** situated along its banks.

Gomti River

- The Gomti River originates from **Gomat Taal** which formally is known as **Fulhaar Jheel, near Madho Tanda, Pilibhit** in Uttar Pradesh.
- It meets the **Ganges River in Ghazipur.** At the confluence of the Gomti and Ganga rivers, the renowned **Markandey Mahadeo Temple** is located.
- The **Sai River,** a significant tributary, merges with the **Gomti near Jaunpur.**
- The cities of **Lucknow, Lakhimpur Kheri, Sultanpur, and Jaunpur** are situated along the banks of the Gomti River.

Ghaghara River

- The Ghaghara originates in the **glaciers of Mapchachungo.**
- It is also known as **Karnali or Kaurial.**
- It is a **transboundary perennial river** originating from the **Tibetan plateau near Lake Mansarovar.**
- It flows through the **Himalayas in Nepal** and is joined by the **Sharda River at Brahmaghat in India.**
- It is a major **left-bank tributary** of the Ganga and merges with it at **Chhapra in Bihar.**
- **Rapti, Chhoti Gandak, Sharda, and Saryu** are the major tributaries of this river.

Sharda River

- The Sharda River originates from the **Milam Glacier** in the **Nepal Himalayas,** where it is known as the **Goriganga**.
- In **Uttarakhand's Pithoragarh District,** it is also referred to as the **Kali River** and rises from Kalapaani, a significant site on the route of the **Kailash Manasarovar Yatra.**
- The river flows in a gorge section in the upper region of Himalayas.
- The Mahakali after it descends into the plains of India is known as **Sarda, which meets the Ghaghara.**

Sarayu River

- **The Sarayu** is a river that flows through **Uttar Pradesh and Uttrakhand.**
- **Sarayu** is a river that originates from a ridge south of **Nanda Kot Mountain in Bageshwar district, Uttarakhand.**
- This river holds ancient significance and is mentioned in the **Vedas and the Ramayana.**
- It is a **left-bank tributary of River Sharda.**

Rapti River

- The Rapti River originates south of the western **Dhaulagiri Himalayas** and the **Mahabharat Range in Nepal.**
- Its main channel emerges from springs on the **southern slopes of the lower Himalayas.**
- The river is essentially fed by underground water. It has the tendency of recurrent floods that led to its nickname **Gorakhpur's Sorrow.**

Gandak River

- The **Gandak River** is formed by the union of the **Kali and Trisuli rivers,** which rise in the **Great Himalayan Range in Nepal.**
- From this junction to the Indian border, the river is known as the **Narayani**.
- It enters the **Ganga River opposite Patna** in a place called **Sonepur**.
- The middle and the lower courses of the river flow through the V-shaped valleys, incised meanders, and have paired and unpaired terraces on either side.

Kosi River

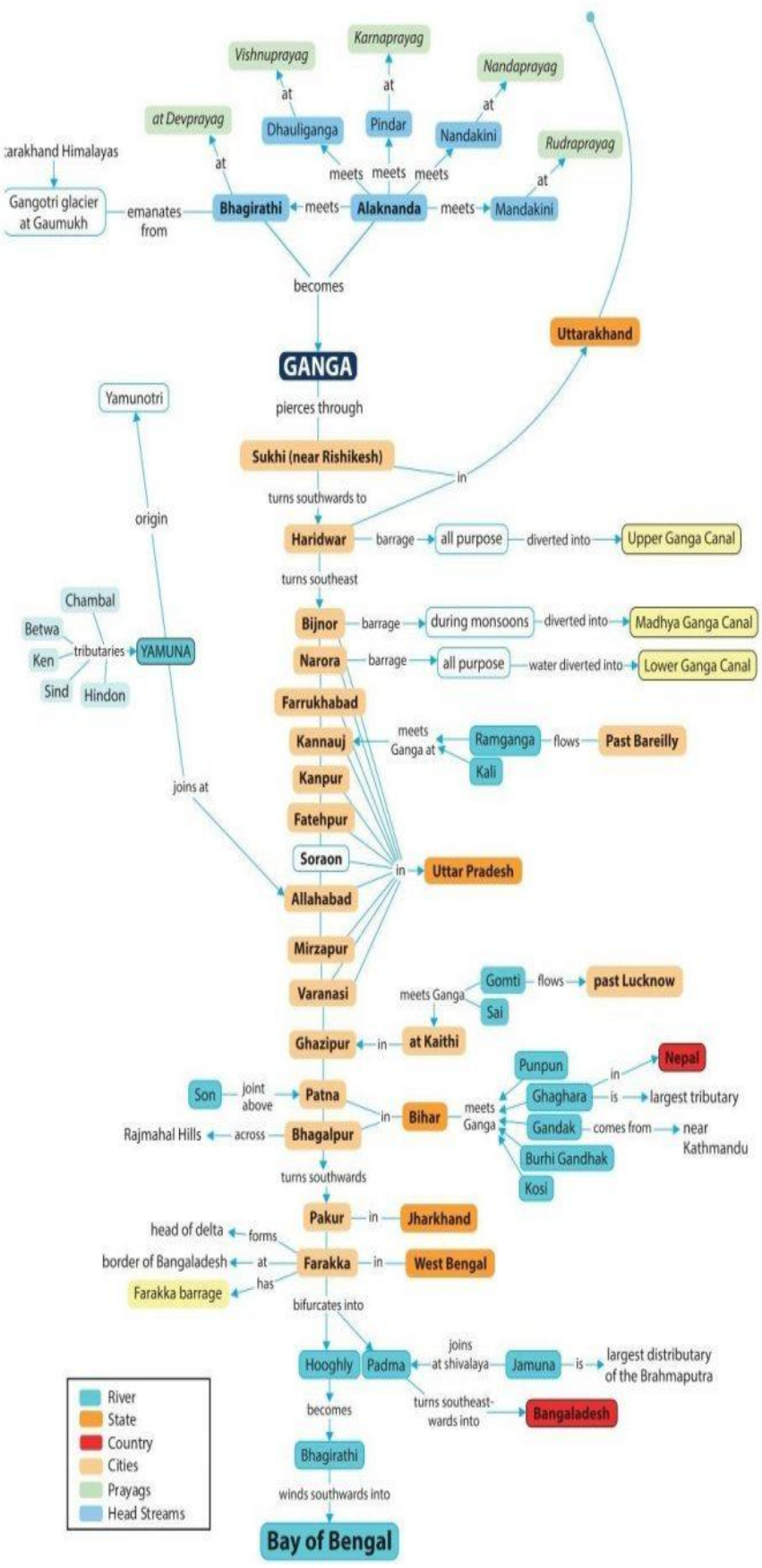
- **The Kosi River** is also known as Saptakoshi for its 7 Himalayan tributaries.
- It is an antecedent transboundary river that flows through both **Nepal and India.**
- This river is one of the largest tributaries of the Ganga and joins it at Kursela in the Kathiar district.
- The Kosi River's catchment includes the highest peak in the world, **Mount Everest, and Kanchenjunga.**
- Its unstable nature, attributed to the heavy silt it carries during the monsoon season, has earned it the nickname **Sorrow of Bihar.**

Son River

- The **Son River** originates near **Amarkantak in Madhya Pradesh,** just east of the Narmada River's headwaters, and flows north-northwest through **Madhya Pradesh.**
- The Son parallels the Kaimur hills, flowing east-northeast through **Uttar Pradesh, Jharkhand, and Bihar** states to join the **Ganga just above Patna.**

Note:
The Right-bank tributaries are:
Gopat River,
Rihand River,
Kanhar River, and
North Koel River.

The Left-bank tributaries are:
Ghaggar River,
Johila River, and
Chhoti Mahanadi River



Rihand River

- The Rihand rises from **Matiranga Hills** in the region southwest of the **Mainpat plateau, in Chhattisgarh.**

- The **Rihand Dam** was constructed across the Rihand River, the reservoir impounded behind the dam is called **Govind Ballabh Pant Sagar.**

North Koel River

- The North Koel River rises on the **Ranchi plateau** and enters the **Palamau division near Rud.**
- The North Koel, together with its tributaries, meanders through the northern region of **Betla National Park.**

Cities on the banks of Ganga River

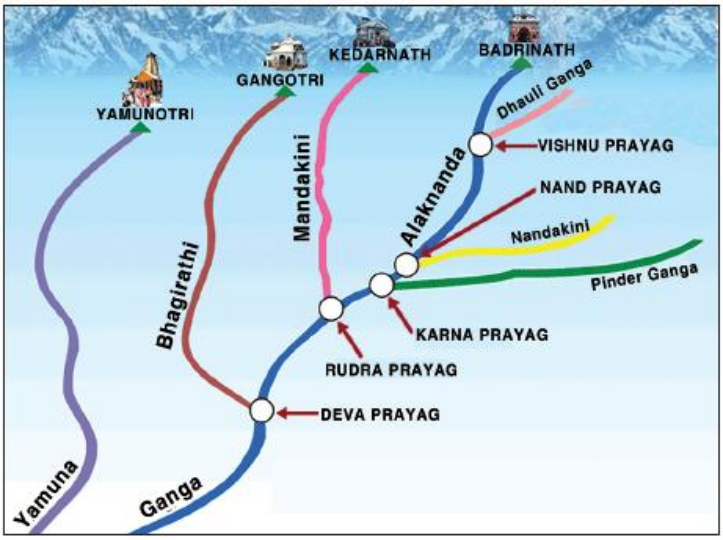
The Ganga River flows through major cities/towns like:

- Srinagar,
- Rishikesh,
- Haridwar,
- Roorkee (in Uttarakhand),
- Bijnor,
- Narora,
- Kannauj,
- Kanpur,
- Allahabad,

- Varanasi,
- Mirzapur (in Uttar Pradesh),
- Patna,
- Bhagalpur (in Bihar)
- Beharampore,
- Serampore,
- Howrah and
- Kolkata (in West Bengal).

P anga

	Rive
Devprayag	Bhagirathi and Alaknanda
Rudraprayag	Mandakini and Alaknanda
Nandaprayag	Nandakini and Alaknanda
Karnaprayag	Pindar and Alaknanda
Vishnuprayag	Dhauliganga and Alaknanda

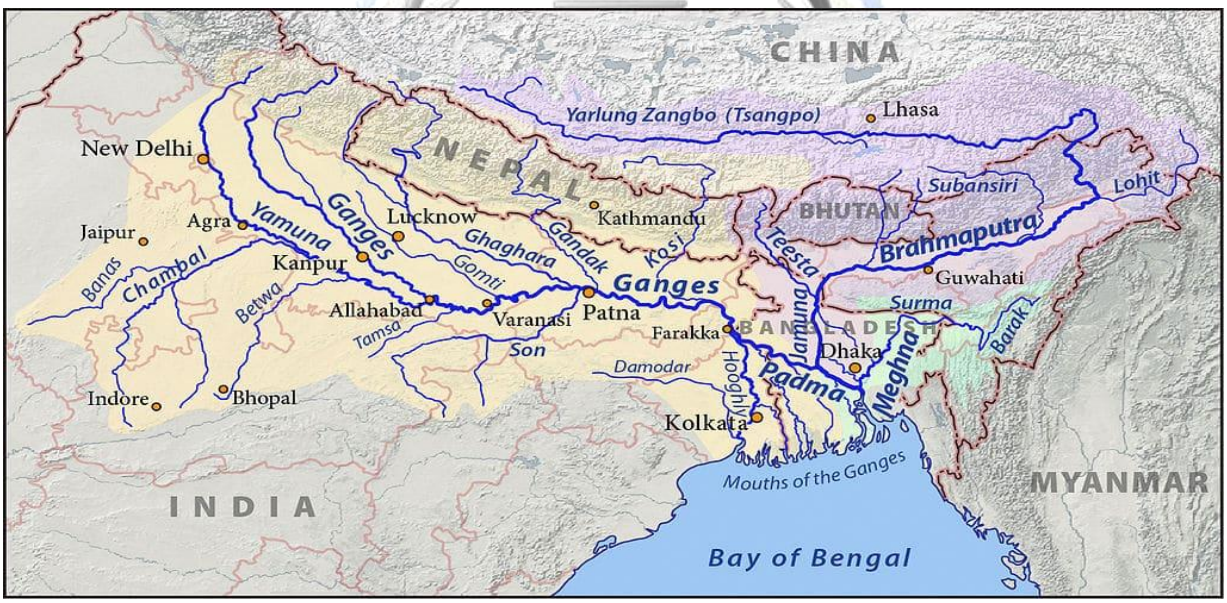


Ganga-Brahmaputra Delta

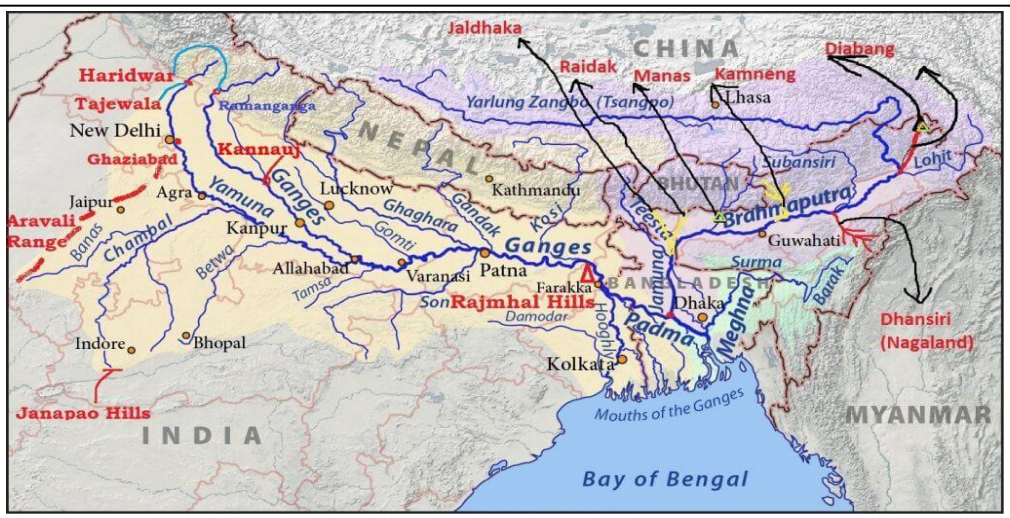
- Before entering the Bay of Bengal, the Ganga, along with the **Brahmaputra**, forms the largest delta of the world between the **Bhagirathi, Hugli and the Padma or Meghna.**
- The coastline of the delta is characterized by a highly **indented and complex** terrain.
- The delta is made of a web of distributaries and islands and is covered by dense forests called mangroves.
- A significant portion of the delta consists of **low-lying swamps** that become inundated with marine water **during high tides.**

Brahmaputra River System

- The **Brahmaputra (meaning the son of Brahma).**
- The Brahmaputra's source is the **Chemayungdung glacier** in southwestern **Tibet.** It's source is very close to the sources of Indus and Satluj.
- **Mariam La** separates the source of the **Brahmaputra from the Manasarovar Lake.**
- In Tibet, it passes through the **depression formed by the Indus-Tsangpo Structure Zone** between the Great Himalayas in the south and the Kailas Range in the north.
- Inspite of the exceptionally high altitude, the Tsangpo has a **gentle slope.** The river is sluggish and has a wide navigable channel for about 640 km.
- It receives a large number of tributaries in Tibet. The first major tributary is the Raga Tsangpo meeting the Tsangpo near **Lhatse Dzong**.
- It flows as the **Yarlung Tsangpo River** across southern **Tibet** to break through the Himalayas in great gorges and into **Arunachal Pradesh where it is known as Dihang.**
- Just west of the town of **Sadiya**, the **Dihang turns to the southwest** and is joined by **two mountain streams, the Lohit and the Dibang.**
- Below the confluence, the river is known as the **Brahmaputra.**
- **It flows through Bangladesh as the Jamuna** where it **merges with the Ganga** to form a vast delta, the Sunderbans.
- The **biggest and the smallest river islands in the world, Majuli, and Umananda respectively**, are in the river in the state of Assam.
- **Dibrugarh, Pasighat, Neamati, Tezpur, and Guwahati are the important urban centers on the river.**



Region	Name
Tibet	**Tsangpo** (meaning 'The Purifier')
China	**Yarlung Zangbo Jiangin**
Assam Valley	**Dihang** or Siong, South of Sadiya: Brahmaputra
Bangladesh	**Jamuna River**
Bangladesh	**Padma River**: Combined Waters of Ganga and Brahmaputra
Bangladesh	**Meghana**: From the confluence of Padma and Meghna



Major Tributaries of the Brahmaputra River

Left bank – **Dhansiri, Lohit, Dibang**

Right Bank – **Subansiri, Kameng, Ma**

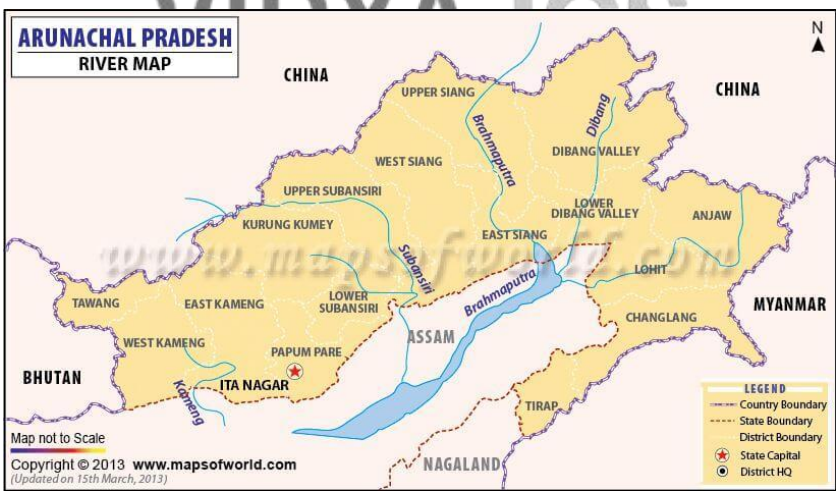
Tributaries

- left — Lhasa River, Nyang River, Parlung Zangbo, Lohit River, Dhansiri River, Kolong River
- right — Kameng River, Manas River, Beki River, Raidak River, Jaldhaka River, Teesta River, Subansiri River

nas, Sankosh

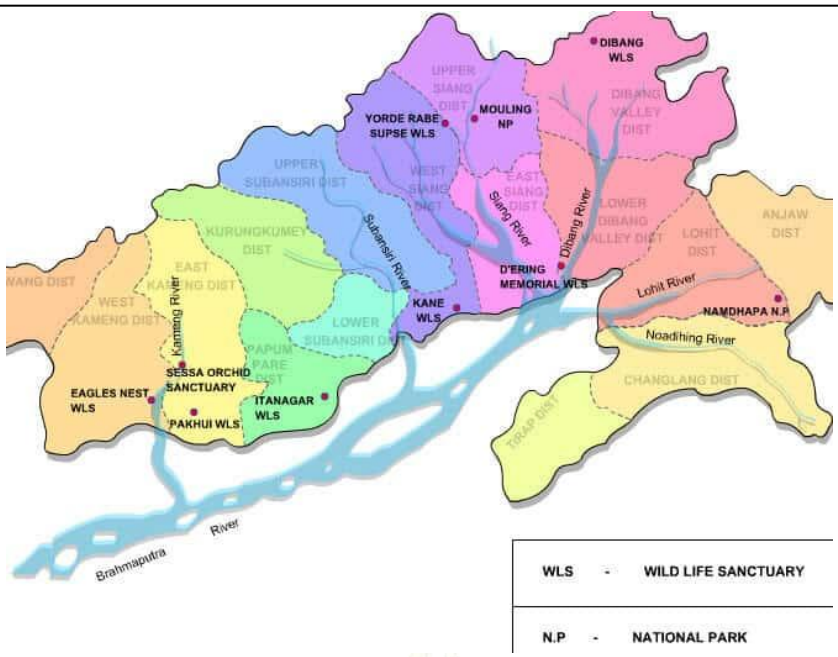
Subansiri River

- Subansiri River is also called as Gold River as it is famous for its gold dust.
- It flows through the Lower Subansiri District in Arunachal Pradesh.
- Subansari, a swift river offers excellent kayaking opportunities.



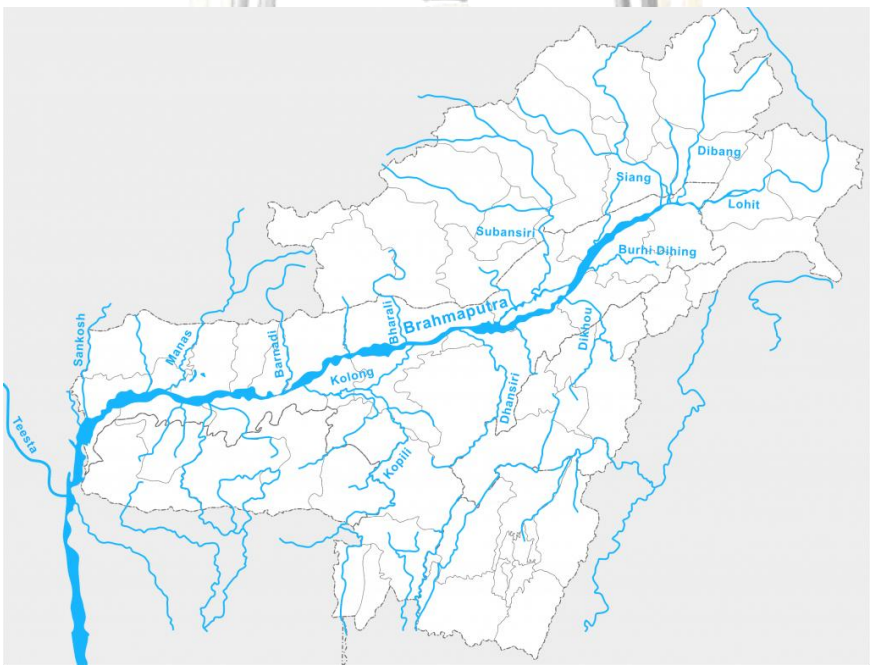
Kameng River

- Kameng River in the eastern Himalayan mountains originates in the Tawang district
- Flows through **West Kameng District, Arunachal Pradesh**, and Sonitpur District of Assam.
- The Kameng forms the boundary between East Kameng District and West Kameng Districts.
- The **Pakhui Wildlife Sanctuary and the Kaziranga National Park are located near the Kameng River.**



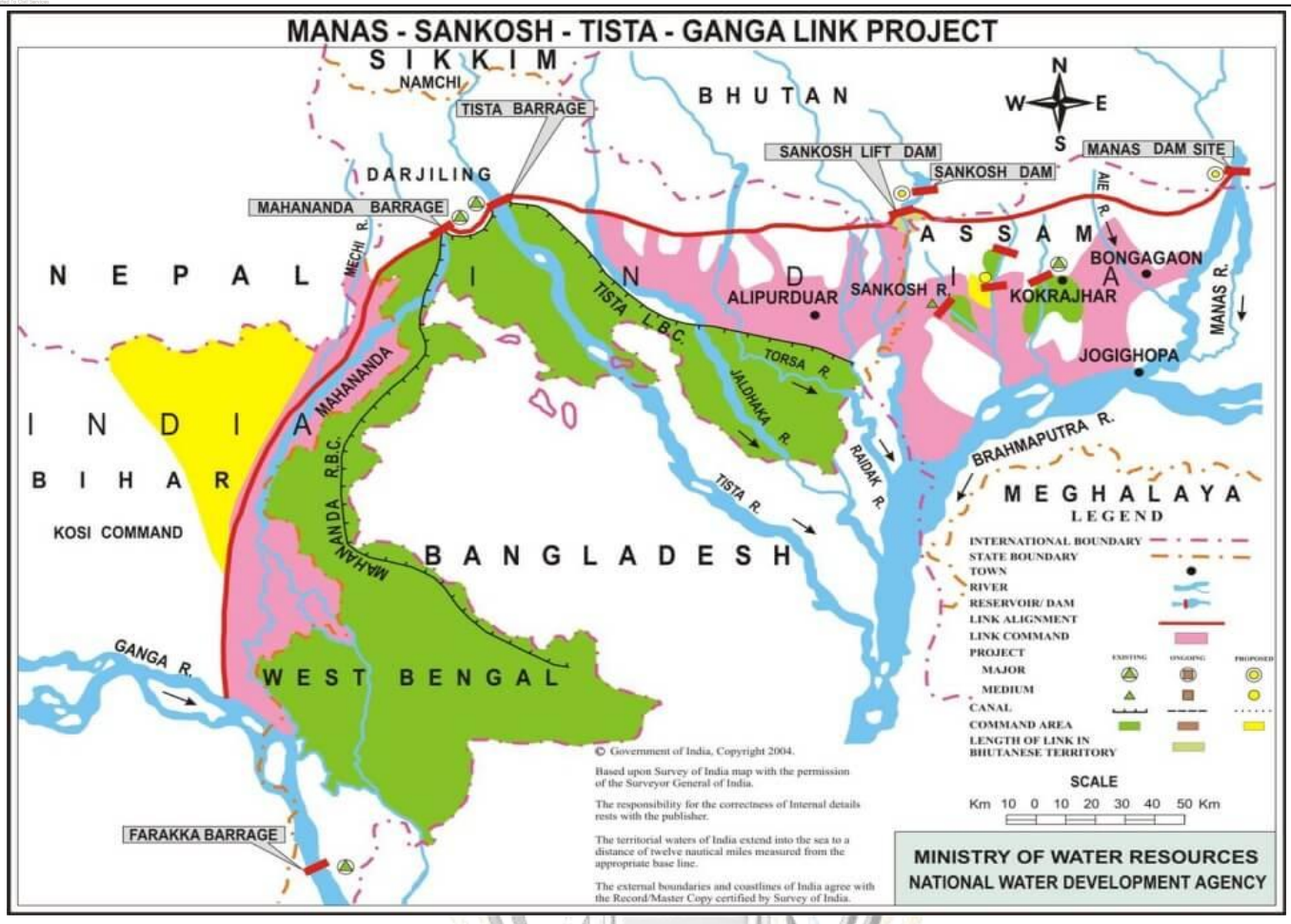
Manas River

- Manas River is a transboundary river in the Himalayan foothills between southern Bhutan and India.
- The total length of the river is 376 km, flows through Bhutan for 272 km and then through Assam for 104 km before it joins the mighty Brahmaputra River at Jogighopa
- **The river valley has two major reserve forest areas, namely the Royal Manas National Park in Bhutan and the contiguous Manas Wildlife Sanctuary.**



Sankosh River

- It rises in northern Bhutan and empties into the Brahmaputra in the state of Assam
- The upper catchment of the river is glaciated. The middle and the lower courses flow along **V-shaped valleys** that have been carved by running water
- The entire catchment of the river is covered with forests.



Teesta River

- The river originates from **Tso Lhamo lake** in **North Sikkim** at an elevation of 5330 m in the Himalayas.
- **Rangeet River is the major tributary of the Teesta River.** Rangeet river is the largest river in Sikkim. **Rangeet river joins Teesta river at a place known as Tribeni.**
- The river then flows past the town of Rangpo where it forms the border between Sikkim and West Bengal up to Teesta Bazaar.
- The river flows through Jalpaiguri and then to Rangpur District of Bangladesh, before finally merging with the mighty Brahmaputra.

Dibang River

- The river Dibang is one of the principal tributaries of the Brahmaputra river
- Originating from the snow-covered southern flank of the Himalayas close to the Tibet border at an altitude of more than 5000 m.
- It emerges from the hills to enter the plain area near Nizamghat in the Lower Dibang Valley district of Arunachal Pradesh
- The **Mishmi hills are found along the upper course of the Dibang River.**

Lohit River

- The River Lohit originates in eastern Tibet.
- The **river flows through the Mishmi hills to meet the Siang at the head of Brahmaputra valley**
- The valley of Lohit is **thickly forested, covered with alpine and sub-tropical vegetation**
- **A large variety of medicinal plants are also found here.**

Dhansiri River

- It is the main river of Golaghat District of Assam and Dimapur District of Nagaland
- It originates from Nagaland
- There are **numerous perennially waterlogged swampy regions associated with this river.**

Kopili River

- **Kopili River** is an interstate river in Northeast India that flows through the states of **Meghalaya and Assam** and is the **largest south bank tributary of the Brahmaputra in Assam.**
- **Carissa Kopilii (Plant Species)** is distributed sparsely along the Kopili riverbed. The **plant is threatened by a hydroelectric project** on the river and **water turned acidic because of coal mining in Meghalaya upstream.**

Siyom River

- The Siyom River is a **right tributary** of the Brahmaputra.
- Siyom **rises on the south of the main ridge of the Assam Himalaya** not far from the border with Tibet.
- The **Mouling National Park is located on the east bank** of the river.

- The Siyom initially flows in a southerly direction, later in an easterly and southerly direction through the West Siang District. The Saje River is the most prominent of its several tributaries.

Siyom Bridge

- The Siyom Bridge is a state-of-the-art 100-meter long, Class 70 Steel Arch Superstructure over Siyom River in Arunachal Pradesh.
- Siyom Bridge has a great Strategic Significance to tackle China as it is a gateway to sensitive areas of LAC in Arunachal Pradesh.

Major River Valley Projects/Dams/Barrages associated with the Brahmaputra river system-

In the state of Arunachal Pradesh-

- Tawang Hydel Power Project
- Subansiri Lower Hydel Power Project
- Ranganadi Hydel Power Project
- Paki Hydel Power Project
- Papumpap Hydel Power Project
- Dhinkrong Hydel Power Project
- Upper Lohit Hydel Power Project
- Damway Hydel Power Project
- Kameng Hydel Power Project

In the state of Sikkim-

- Rangit Hydel Power Project
- Teesta Hydel Power Project

In the state of Assam-

- Kopli Hydel Power Project

In the state of Meghalaya-

- New Umtru Hydel Power Project

In the state of Nagaland-

- Doyang Hydel Power Project

In the state of Manipur-

- Loktak Hydel Power Project
- Tipaimukh Hydel Power Project

In the state of Mizoram-

- Tuibai Hydel Power Project
- Tuirial Hydel Power Project
- Dhaleshwari Hydel Power Project

Mahanadi River system

- 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.
- It is bounded by the **Central India hills** on the north, by the **Eastern Ghats** on the south and east, and by the **Maikala range** on the west.
- The **Mahanadi ("Great River")** follows a total course of 560 miles (900 km).
- It has its **source in the northern foothills of Dandakaranya in Raipur District of Chhattisgarh** at an elevation of 442 m.
- 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 between the Mahanadi and the Rushikulya draining directly into the **Chilka Lake** also forms the part of the basin.
- The major part of the basin is covered with agricultural land accounting to 54.27% of the total area.
- It is one of the **most-active silt-depositing** streams in the Indian subcontinent.
- After receiving the **Seonath River**, it turns east and enters Odisha state.
- **At Sambalpur,** the ***Hirakud Dam*** (**one of the largest dams in India**) on the river has formed a man-made 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.**

Tributaries of Mahanadi River

- Its upper course lies in the saucer-shaped basin called the **'Chhattisgarh Plain'.**
- This basin is surrounded by hills on the north, west, and south as a result of which a large number of tributaries join the main river from these sides.
- ***Left bank*** Tributaries: The **Seonath**, the **Hasdeo**, the **Mand,** and the **Ib.**
- ***Right bank*** Tributaries: The **Ong**, the **Tel,** and the **Jonk.**

SEONATH

- It originates from **Panabaras Hill** (625 m) and flows towards the north-east.
- The river feeds the inhabitants and industries of **Durg District.**
- The total length of the **Sheonath River** is 345km.

HASDEO

- The River **originates from Chhattisgarh**
- The total length of the river is 333km and the drainage areais9856sqkm
- The **river flows towards the south of Chhattisgarh, through Bilaspur and Korba Districts**
- Along the river lie rocks and hilly areas, thin forest areas.

MAND

- It is a **left-bank tributary of Mahanadi**
- **Joins Mahanadi in Chandrapur before the river reaches Hirakud dam**, the total length of the river is 241sqkm
- It drains an area in the range of 5200sqkm
- **Mand River dam** has been constructed in the **Raigarh district** of Chhattisgarh.

IB

- It is a **left-bank tributary of Mahanadi River,**
- **Originates in hills in Raigarh district of Chhattisgarh**
- The river runs for a distance of about 252km and drains an area of 12,447sqkm
- **Ib river valley is famous for its rich coal belt.**

ONG

- It is a right-bank tributary of the Mahanadi river.
- **Flows across Orissa and joins Mahanadi at Sambalpur** 11km up-stream of Sonepur where Tel merges.
- It drains an area of about 5128sqkm.

TEL

- **Originating in the Nabarangpur district.**
- Flows through the Kalahandi, balangir, and Sonpur districts of Orissa
- It is the **second-largest river of Orissa.**

Kathajodi River

- **Kathajodi River is an arm of the Mahanadi River in Odisha**.
- **It branches off at Naraj,** then immediately is bifurcated. The southern branch, known as **Kuakhai,** which means Crow's pool, and flows into the Puri district. Its mouth is closed by a bar, so that little water flows into it except at flood times.
- **A little lower down from Cuttack the Kathajodi is bifurcated.** The right branch is **Sidhua** and the left branch is **Khatajodi.**
- Cuttack City is situated between Mahanadi and Kathajodi.
- **Other distributaries of Mahanadi include the Paika, Birupa, Chitroptala river, Genguti and Lun.**

Sukapaika River

- **Sukapaika** is one of the **several distributaries of the mighty Mahanadi river** in Odisha.
- It branches away from the Mahanadi at Ayatpur village in Cuttack district and flows for about 40 kilometers (km) before rejoining its parent river at Tarapur in the same district.

- In the process, it drains a large landmass comprising over 425 villages.
- However, the **river is undergoing sudden barrenness.**

- It covers three blocks such as **Cuttack Sadar, Raghunathpur and Nichintakoili of Cuttack.**
- Sukapaika river is an important system of the Mahanadi to control floodwater and maintain the flow in the river as well as the Bay of Bengal.

Chitroptala River

- The Chitrotpala river is a river in Orissa state, India. **It is a distributary of the Mahanadi, situated in both Kendrapara and Cuttack districts.**

Important cities

Projects on Mahanadi River

- Two important projects completed during pre-plan period in the basin are the **Mahanadi main canal** and **Tandula reservoir in Chhattisgarh**.
- During the plan period, the **Hirakud dam, Mahanadi delta project, Hasdeo Bango, Mahanadi Reservoir Project were completed.**

The Hirakud Dam– It is one of the first major multipurpose river valley projects started after India's independence. The dam aims at controlling floods in the Mahanadi basin, providing water for irrigation and municipal water supply. The dam is located near Sambalpur in the state of Odisha.

The Gangrel Dam– It is also known by the name of R.S. Sagar Dam. The dam is built across the Mahanadi river in Dhamtari district in the state of Chhattisgarh.

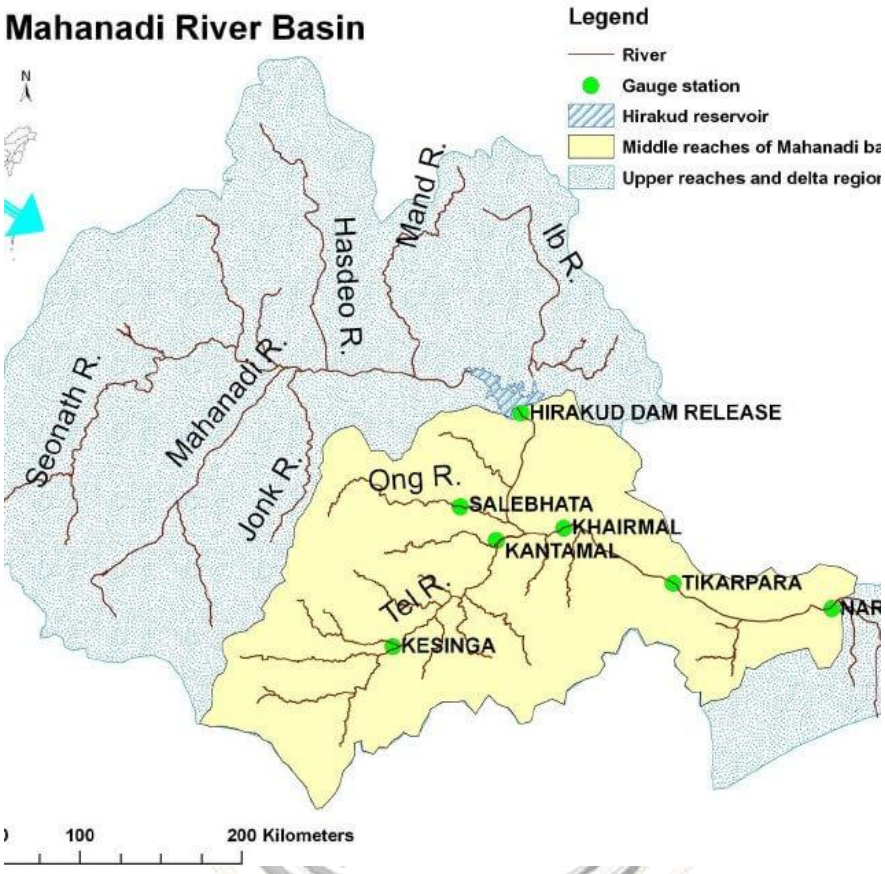
The Dhudhwa Dam– The dam is constructed across the Mahanadi river in Dhamtari district in the state of Chhattisgarh.

Industry in Mahanadi River Basin

- Three important urban centes in the basin are **Raipur, Durg and Cuttack**.
- Mahanadi basin, because of its **rich mineral resource** and **adequate power resource**, has a favorable industrial climate.
- The Important industries presently existing in the basin are the **Iron and Steel plant at Bhilai**, **aluminium factories at Hirakud and Korba**, **paper mill near Cuttack** and **cement factory at Sundargarh**.
- Other industries based primarily on agricultural produce are sugar and textile mills.
- Mining of coal, iron and manganese are other industrial activities.

Floods in Mahanadi River Basin

- The basin is subject to **severe flooding** occasionally in the delta area due to the inadequate carrying capacity of the channels.
- The multi-purpose **Hirakud dam** provides some amount of flood relief by storing part of floodwater.
- However, the **problem still persists and a lasting solution needs to be evolved.**



Godavari river System

Godavari River System

- The Godavari river is the largest river in Peninsular India. **It is known as the Dakshin Ganga or Vridha Ganga (old Ganga)** because of its age, size, and length. **It is navigable in the delta region.**
- **Source of origin of the Godavari river:** It rises from a place called Trimbak located in the Western Ghats in Nashik district in the state of Maharashtra.
- **Confluence or mouth of the Godavari river:** It drains into the Bay of Bengal before forming a large delta below Rajahmundry.
- The Godavari basin extends over states of Maharashtra, Andhra Pradesh, Chhattisgarh, and Odisha in addition to smaller parts in Madhya Pradesh, Karnataka, and the Union Territory of Puducherry (Yanam) having a total area of ~ 3 lakh Sq.km.
- The basin is bounded by **Satmala hills**, the **Ajanta range,** and the **Mahadeo hills** on the north, by the Eastern Ghats on the south and the east, and by the Western Ghats on the west.
- The total length of Godavari from its origin to outfall into the Bay of Bengal is 1,465 km.
- Rajahmundry is the largest city on the banks of Godavari.
- The **Sri Ram Sagar project** which was constructed on this river (1964-69) serves the irrigation needs of Adilabad, Nizamabad. Karimnagar and Warangal districts.

- The **Pravara, Indravati, Wainganga, Wardha, Pench, Kanhan, Penganga, Manjira, Bindusara and sabari rivers** are its important tributaries.
- **Nashik, Trimbakeshwar, Nanded, Aurangabad, Nagpur, Bhadrachalam, Nizamabad, Rajamundry, Balaghat, Yanam, and Kovvur** are the important **urban centers** on its bank.

Tributaries of Godavari River

- The left bank tributaries are more in number and **larger** in size than the right bank tributaries.
- The **Manjra** (724 km) is the only important right-bank tributary. It joins the Godavari after passing through the **Nizam Sagar.**

- *Left Bank Tributaries:* **Dharna, Penganga, Wainganga, Wardha, Pranahita** [conveying the combined waters of **Penganga, the Wardha and Wainganga], Pench, Kanhan, Sabari, Indravati etc.**
- *Right Bank Tributaries:* **Pravara, Mula, Manjra, Peddavagu, Maner** etc.
- Below Rajahmundry, the river divides itself into two main streams, the **Gautami Godavari** on the east and the **Vashishta Godavari** on the west, and forms a large delta before it pours into the Bay of Bengal.
- The delta of the Godavari is of **lobate type** with a round bulge and many distributaries.

Tributaries	
• left	Banganga, Kadva, Shivana, Purna, Kadam, Pranahita, Indravati, Taliperu, Sabari, Dharna
• right	Nasardi, Pravara, Sindphana, Manjira, Manair, Kinnerasani

MANJRA

- It is a **right-bank tributary** of the river Godavari.
- It originates in the **Balaghat range**, **near Ahmednagar**, at an altitude of 823 m.
- Manjra River flows through the **Latur District** of Maharashtra and the **Bidar District** of Karnataka before entering **Medak District** in Andhra Pradesh.
- It flows for about 96km in Medak District through Narayankhed, Jahirabad. Sangareddy and Narsapur Talukas.
- Ultimately, **it drains into the Godavari River at Basara near Nizamabad**.
- Valdi river is a tributary of Marijira, Nizam Sagar was constructed across the Manjra River between Achampeta and Banjapalle villages of the Niamabad district in Andhra Pradesh.
- The most outstanding feature of the project is the gigantic masonry dam sprawling across the river for 3km with a motorable road of 14feet width.

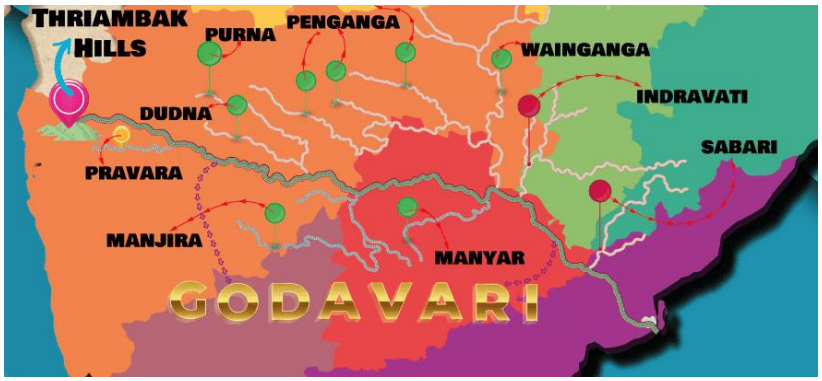
PAINGANGA

- (Penganga or Panuganga) It originates in the **Ajantha ranges in the Aurangabad district in Maharashtra**.
- It then flows through **Buldhana and Washim districts**.
- Then it **acts as a boundary between Yavatma and Nanded districts**.
- It then flows along the state **border between Maharashtra and AP**.
- **It joins the Wardha River** near a small village called Wadha in Wani Tehsil of Yavatmal district
- It is **deeply entrenched** and **not able to be navigated**.
- The river provides irrigation to the Washim and Yavatmal districts in Maharashtra.
- There are **two dams** being constructed on the river, namely **Upper Painganga and Lower Painganga.**
- Also, this dam is known as the **"Isapur Dam".**
- **Adan river is the major tributary.**
- It passes through the **Painganga Wildlife Sanctuary.**
- **Sahastrakund waterfalls** are situated on it.

WARDHA

- It is one of the **biggest rivers in the Vidarbha region of Maharashtra**.
- It **originates** at an altitude of 777 meters in **Satpura Range near Multai in Betul District of Madhya Pradesh**, about 70 miles north-west of Nagpur
- From the origin, it flows 32 km in Madhya Pradesh and then enters into Maharastra
- After traversing 528km, **it joins Wainganga and together they are called Pranhita**, which ultimately flows into the Godavari River

- Kar, Wena, Jam, Erai are the left tributaries
- Madu, Bembla. Penganga are the right tributaries
- A huge dam **(Upper Wardha Dam) is built on Wardha River near Morshi** and considered a lifeline for Amravati city.

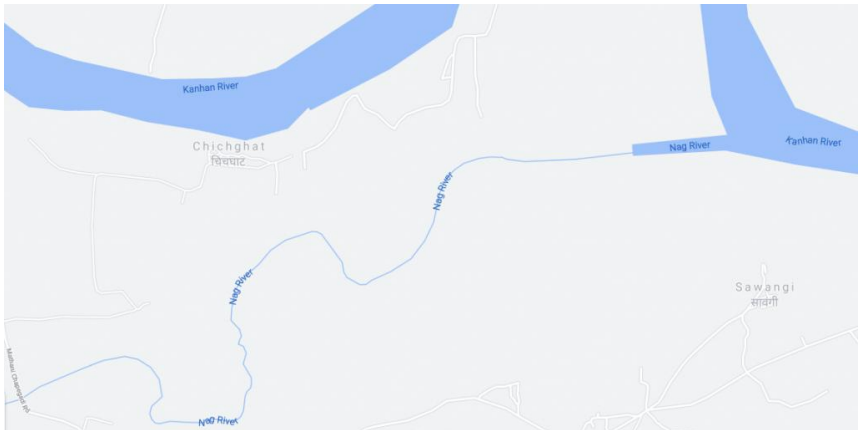


WAINGANGA

- It literally means **"the arrow of water"**.
- It originates about 12 km, from Mundara village of Sconi district in the southern slopes of the **Mahadeo Hills of the Satpura Range of Madhya Pradesh** and flows south through Madhya Pradesh and Maharashtra in a very winding course of approximately 4 360 miles
- **After joining the Wardha, the united stream, known as the Pranahitha**, ultimately falls into the river Godavari.
- It drains the Chandrapur. Gadchiroli, Bhandara, Gondia, and Nagpur districts of Maharashtra.
- The **main tributaries of the Wainganga River** are the **Thel, Thanwar, Bagh**, **Chulband**, **Garhavi**, **Khobragadi**, and **Kathani**, which meet on the left bank; and the Hirri, Chandan, **Bawanthari**, **Kanhan**, and **Mul** joining on the right bank.
- **Kamptee, Bhandara, Tumsar, Balaghat, and Pauna are the major urban and industrial centers along the river**.

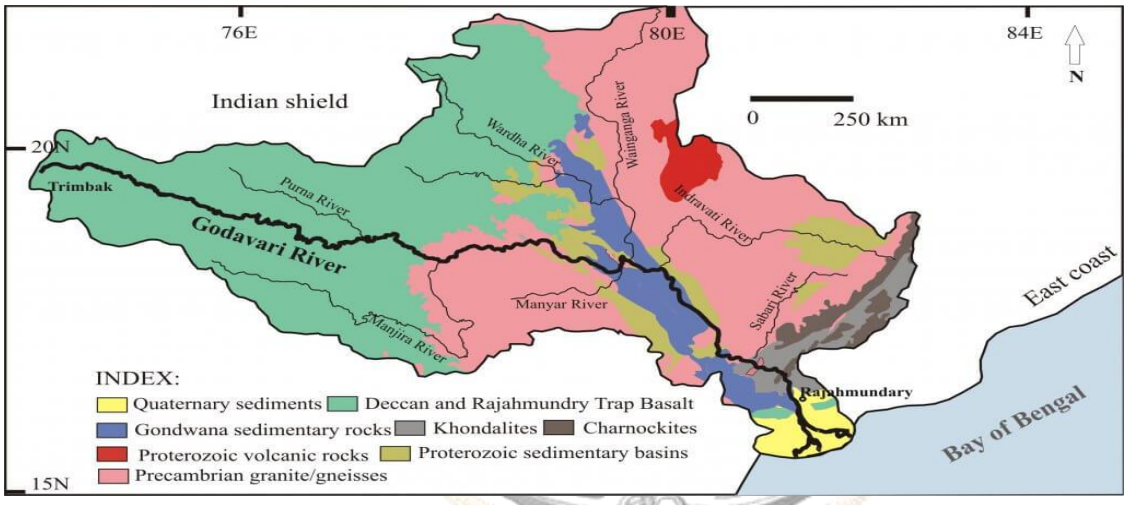
Nag River

- The **Nagpur city derives its name from the Nag river** which passes through the city.
- The Nag river **originates** from the **Ambazari Lake** in west Nagpur.
- Major Tributaries – **Pili river.**
- Endpoint – **confluence with Kanhan River**, and further Kanhan River confluence with Pench river and Forming a Kanhan-Pench river system.
  - The **Kanhan River** is an important **right-bank tributary of the Wainganga River** draining a large area lying south of the Satpura range in central India.



INDRAVATI

- **Indravati River originates from Thuamul Rampur rises in the Eastern Ghats in Kalahandi in Orissa**.
- Then it flows through **Bastar District** in Chhattisgarh for about 380km
- While in Bastar, Indravati is the largest and the most significant.
- It also forms the **boundary between Maharashtra and Chhattisgarh** states at places.
- Later this river **merges with the Godavari River at Bhadrakali in Dantewada District**.
- The **Indravati is sometimes known as the lifeline of the Bastar district.**
- The rocky bedded river is not good for navigation except near its confluence with the Godavari.
- The **largest tributary of the river is Pamer Chinta**.
- Indravati and her tributaries never dry up in summer.
- The **Chitrakoot Falls is located on the Indravati River**, some 40lm from Jagdalpur.
- Indravati National Park and Tiger Reserves are located in the adjoining region of Chattisgarh.



Projects on Godavari River

- Important projects completed duing the plan period are **Srirama Sagar, Godavari barrage, Upper Penganga, Jaikwadi, Upper Wainganga, Upper Indravati, Upper Wardha.**
- Among the on-going projects, the prominent ones are **Prnahita-Chevala** and **Polavaram.**

Industry in Godavari Basin

- The major urban Centers in the basin are **Nagpur, Aurangabad, Nashik, Rajhmundry.**
- **Nashik and Aurangabad** have a large number of industries especially **automobiles.**
- Other than this, the industries in the basin are mostly based on agricultural produce such as rice milling, cotton spinning and weaving, sugar, and oil extraction.
- **Cement and some small engineering industries also exist in the basin.**

Floods and Droughts in Godavari Basin

- Godavari basin faces **flooding problems in its lower reaches.**
- The coastal areas are **cyclone-prone.**
- The **delta areas face drainage congestion** due to flat topography.
- A large portion of Maharashtra falling **(Marathwada)** in the basin is **drought-prone.**

Godavari and Cauvery River Interlinking Project

- The project envisages the diversion of 247 thousand million cubic feet (tmcft) of unutilized water in the Indravati sub-basin of the Godavari basin to meet the requirements between the Godavari and the Cauvery rivers.
- **Water will be diverted from the Godavari River to Nagarjuna Sagar dam (through lifting) and further south to meet the demands of Krishna, Pennar, and Cauvery basins.**
- The **Godavari – Cauvery link comprises three components** namely,
  - **the Godavari (Inchampalli/Janampet) – Krishna (Nagarjunasagar),**
  - **the Krishna (Nagarjunasagar) – Pennar (Somasila) and**
  - **the Pennar (Somasila)–Cauvery.**
- The project will provide irrigation facilities to 3.45 to 5.04 lakh hectares in the Prakasam, Nellore, Krishna, Guntur, and Chittoor districts of Andhra Pradesh.


INDIA
MAJOR RIVERS
N
TAJIKISTAN
AFGHANISTAN
PAKISTAN
LADAKH
JAMMU & KASHMIR
HIMACHAL PRADESH
CHANDIGARH
PUNJAB
HARYANA
DELHI
UTTARAKHAND
RAJASTHAN
GUJARAT
UTTAR PRADESH
BIHAR
NEPAL
SIKKIM
BHUTAN
ARUNACHAL PRADESH
ASSAM
NAGALAND
MEGHALAYA
MANIPUR
BANGLADESH
TRIPURA
MIZORAM
MYANMAR (Burma)
CHINA (Tibet)
JHARKHAND
WEST BENGAL
MADHYA PRADESH
CHHATTISGARH
ODISHA
MAHARASHTRA
DADRA & NAGAR HAVELI AND DAMAN & DIU
TELANGANA
ANDHRA PRADESH
GOA
KARNATAKA
KERALA
TAMIL NADU
PUDUCHERRY
Yanam (Puducherry)
Mahe (Puducherry)
Karaikal (Puducherry)
LAKSHADWEEP (INDIA)
ANDAMAN & NICOBAR ISLANDS (INDIA)
SRI LANKA
MALDIVES
Arabian Sea
Bay of Bengal
INDIAN OCEAN
Indus
Jhelum
Chenab
Ravi
Beas
Sutlej
Yamuna
Ganga
Gomti
Ghaghara
Gandak
Kosi
Yarlung Tsangpo (Brahmaputra)
Brahmaputra
Lohit
Manas
Tista
Barak
Padma
Hugli
Luni
Banas
Chambal
Betwa
Parbati
Son
Sabarmati
Mahi
Narmada
Tapi
Wainganga
Mahanadi
Subarnarekha
Brahmani
Tel
Godavari
Indravati
Bhima
Krishna
Tungabhadra
Penner
Palar
Cauvery
Ponnaiyar
Kollidam
Ayeyarwady (Irrawaddy)
International Boundary
State/UT Boundary
River
Map not to Scale
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Krishna River System

- The **Krishna is the second-largest east-flowing river of the Peninsula.**
- Krishna river rises at Mahabaleshwar at an altitude of I336 m near the **Jor village** in the extreme north of **district Satara, Maharashtra** in the west, and meets the Bay of Bengal in Andhra Pradesh, on the east coast.
- **Ecologically, this is one of the disastrous rivers in the world**, in that it causes **heavy soil erosion** during the monsoon season.
- It is bounded by the **Balaghat range** on the north, by the Eastern Ghats on the south and the east, and by the Western Ghats on the west.
- The total length of the river from origin to its outfall into the Bay of Bengal is 1,400 km.
- The major part of the basin is covered with agricultural land accounting to 75.86% of the total area.
- The Krishna **forms a large delta** with a shoreline of about 120 km.
- **Almatti Dam, Srisailam Dam, Nagarjuna Sagar Dam, and Prakasham Barrage** are some of the major dams constructed on the river.
- Because it is fed by seasonal monsoon rains, the river's flow undergoes great fluctuation during the year, limiting its usefulness for irrigation.
- **Satara, Karad, Sangli, Bagalkot. Srisailant, Amaravati, and Vijayawada** are some of the **important urban and tourist centers** on the bank of the river.

Tributaries of Krishna River

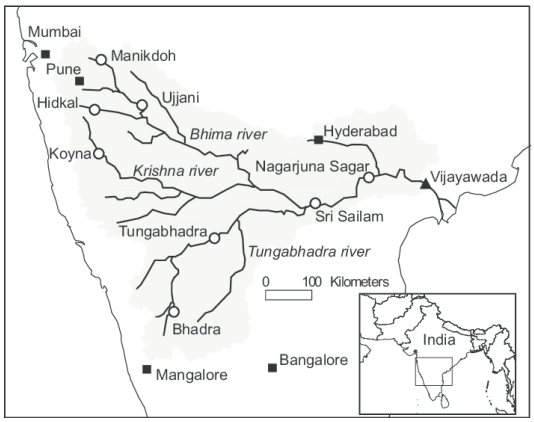
- **Right bank**: **Venna, Koyna, Panchganga, Dudhganga, Ghataprabha, Malaprabha and Tungabhadra** are the major right-bank tributaries
- **Left Bank**: **Bhima, Dindi, Peddavagu, Halia, Musi, Paleru, and Munneru** are the major left-bank tributaries
- The **Koyna** is a small tributary but is known for **Koyna Dam**. This dam was perhaps the main cause of the devastating **earthquake** (6.4 on Richter scale) in 1967 that killed 150 people.
- The Bhima originates from the **Matheron Hills** and joins the Krishna near Raichur after for a distance of 861 km.
- The Tungabhadra is formed by the unification of the **Tunga** and the **Bhadra** originating from **Gangamula** in the **Central Sahyadri**. Its total length is 531 km.
- At Wazirabad, it receives its last important tributary, the **Musi**, on whose banks the city of Hyderabad is located.

BHIMA

- It originates in **Bhimashankar hills** near Karjat on the western side of **Western Ghats (known as Sahyadri)**, in Maharashtra.
- **Bhima flows southeast** for 725 km through Maharashtra, Karnataka, Andhra Pradesh states.
- **Bhimashankar (one of the twelve esteemed Jyotirlinga shrines)**; Siddhatek, Siddhivinayak Temple of Ashtavinayak Ganesh: Pandharpur Vithoba Temple: Sri Dattatreya Temple: and Sri Kshetra Rasangi Balibheemasena Temple are some of the important temples located on the banks of the river.

MUSI

- **Also known as the Muchukunda river** in the olden days, the Musi River, a tributary of Krishna River, originates in Anantagiri Hills near Vikarabad, Rangareddi district, 90km west of Hyderabad
- In 1920, the **Osmansagar reservoir** was constructed across the river at Gandipet village
- Another important dam is **Himayat Sagar**, Hussain Sagar Lake was built on a tributary of the River Musi, **Together they act as a source of water for Hyderabad**.
- Musi River is also the bowl for water festivals such as boating races, decorated boating contest, and river swimming tournament.



KOYNA

- **It rises in Mahabaleshwar in Satara district of Maharashtra** and is a tributary of the Krishna River
- Unlike most of the other rivers in Maharashtra which flow East-West direction, the Koyna River flows in a **North-South direction**
- The **Koyna River is famous for the Koyna Dam** which is the largest hydroelectric project in Maharashtra
- The reservoir – **Shivasagar Lake,** is a huge lake of 50 km in length
- The dam is situated in Koyna Nagar in the Western Ghats
- The river meets the Krishna River at Karad
- The river is just about 100 in width and is slow-flowing.

PANCHGANGA

- The **Panchganga River flows through the borders of Kolhapur**.
- The Panchganga is formed by **four streams**: **the Kasari, the Kumbhi, the Tulsi, and the Bhogawati**.
- The Prayag Sangam confluence marks the beginning of the Panchganga River proper which after receiving the waters of the four tributaries continues in a larger pattern with the flow of waters received from the rivers, From North of Kolhapur, it has a **wide alluvial plain.**
- After developing this plain the river resumes its course eastwards. **It falls into the Krishna at Kurundvad.**

DUDHGANGA

- It is a **right-bank tributary of the-river Krishna**
- It is an important river of the Kolhapur district
- The **Kallammawadi Dam has been built on the Dudhganga River** in collaboration with the Karnataka State.

GHATAPRABHA

- **Ghataprahha River originates in the Western Ghats** at an altitude of 884 m and flows eastward for a distance of 283 km across Karnataka and Maharashtra states before **its confluence with the Krishna River at Almatti**.
- The Gokak waterfall on the river in Belgaum District is a noted tourist attraction
- The Ghataprabha Project is a hydroelectric and irrigational dam across the river.

MALAPRABHA

- **Malaprabha originates in Kanakumbi of Belgaum District in Karnataka**, at an altitude of 792 m in the Sahyadris
- It flows for a distance of 304 km and joins the Krishna River at an altitude of 488 m at Kudalasangama in Bagalkot district in Karnataka
- The Navilatirtha Dam is constructed near Munavalli in Belgaum District. **Its reservoir is called Renukasagara**
- **Famous temples of Aihole Pattadakal and Badami** are located on the Banks of this river. **These are listed as World Heritage sites by UNESCO.**

TUNGABHADRA

- The **ancient name of the river was Pampa**
- The **Tungabhadra river is formed by the confluence of two rivers, the Tunga River and the Bhadra River**, which flow down the eastern slope of the Western Ghats in the state of Karnataka
- From there, Thungabhadra meanders through the plains to a distance of 531 km and mingles with the Krishna at Gondimalla, near the famous **Alampur Jn** in **Mahaboobnagar District of Andhra Pradesh**.
- **Varada, Hagari, and Handri are the main tributaries of the Tungabhadra**

- The wedge of land that lies north of the Tungabhadra River, between the Tungabhadra and the Krishna, is known as the **Raichur Doab**.
- **Harihar, Hospet. Hampi, Mantralayam, and Kurnool are the major urban centers on the river.**

Projects on Krishna River

- Important ones are the **Tungabhadra, Ghataprabha, Nagarjunasagar, Malaprabha, Bhima, Bhadra** and **Telugu Ganga.**
- The major Hydro Power stations in the basin are **Koyna, Tungabhadara, Sri Sailam, Nagarjuna Sagar, Almatti, Naryanpur, Bhadra.**
- Tunagabhadra is a major inter-States project in the basin. In order to operate the project and to regulate the flows among the beneficiary States of Karnataka and Andhara Pradesh.
  - **The Tungabhadra Project**– The project aims at producing hydro-electricity, providing irrigation water and municipal water supply, and controlling floods in the region. Under this project, a dam has been constructed across the Tungabhadra river near Hospet in the state of Karnataka.
  - **The Srisailam Project**– Under the project, a large dam has been constructed across the Krishna river in Kurnool district in the state of Andhra Pradesh. It has created a reservoir named as Srisailam Sagar or Neelam Sanjjeva Reddy Sagar.
  - **The Nagarjuna Sagar Dam**– The construction of the dam started in 1950, being one of the earliest large infrastructure projects of India, aimed at bringing the Green Revolution. The dam has been constructed across the Krishna river straddling the borders of the Nalgonda and Guntur districts.
  - **The Prakasam Barrage**– The Prakasam Barrage was conceptualized by Major Cotton of the East India Company. It is constructed across the Krishna river near Vijayawada in the state of Andhra Pradesh.
  - **The Ghatprabha Project**– The project has been executed across the Ghatprabha river near Chandgad in Kolhapur district in the state of Maharashtra in the Krishna river basin.
  - **The Bhima Project**– The project has been executed across the Bhima river in the Solapur district in the state of Maharashtra in the Krishna river basin.

Resources in Krishna Basin

- The basin has **rich mineral deposits** and there is good potential for industrial development.
- Iron and steel, cement, sugar cane vegetable oil extraction, and rice milling are important industrial activities at present in the basin.
- Recently **oil has been struck in this basin** which is bound to have an effect on the future industrial scenario of this basin.

Industry in Krishna Basin

- The major Urban Centers in the Basin are **Pune, Hyderabad.**
- Hyderabad is the state capital of Telangana and is now a major IT hub.
- Pune in Maharashtra has number of **automobile and IT industry** and is major education centre.

Drought and Floods in Krishna Basin

- Some parts of the basin, especially the Rayalaseema area of Andhra Pradesh, Bellary, Raichur, Dharwar, Chitradurga, Belgaum, and Bijapur districts of Karnataka and Pune, Sholapur, Osmanabad, and Ahmedanagar districts of Maharashtra are **drought-prone.**
- The **delta area of the basin is subject to flooding**. It has been observed that the river bed in the delta area is continuously raised due to silt deposition resulting in a reduction in the carrying capacity of the channel.
- The **coastal cyclonic rainfall of high intensity and short duration makes the flood problem worse.**

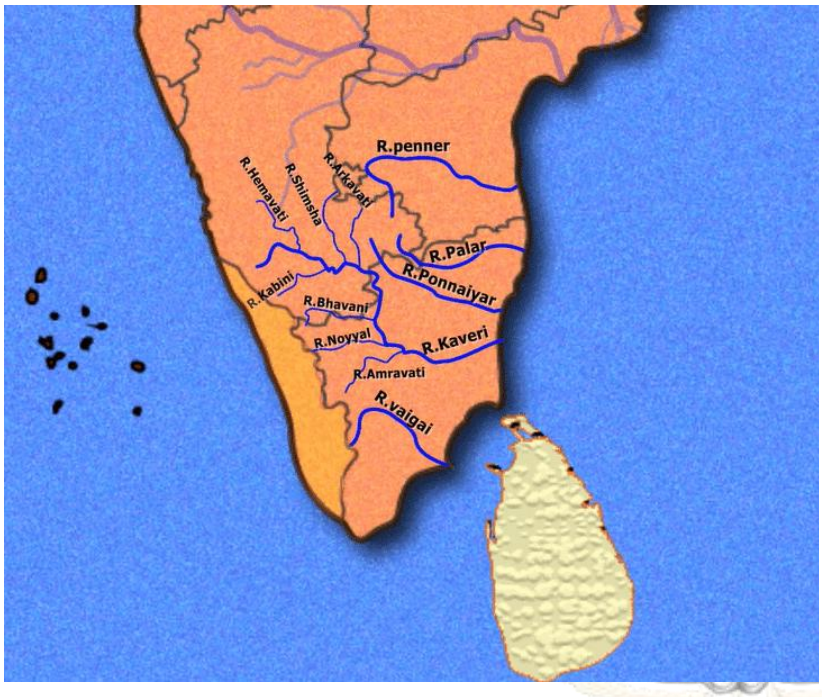
Cauvery River

- The Cauvery River (Kaveri) is designated as the '***Dakshi Bharat ki Ganga***' **or '*the Ganga of the South'.***
- The Cauvery River rises at an elevation of 1,341 m at **Talakaveri** on the **Brahmagiri range near Cherangala village of Kodagu (Coorg) district of Karnataka.**
- The total length of the river from origin to an outfall is 800 km.
- It flows in a southeasterly direction for 705 km through the states of Karnataka and Tamil Nadu and descends the Eastern Ghats in a series of **great falls**.
- Before **emptying into the Bay of Bengal south of Cuddalore, Tamil Nadu** the river breaks into a large number of distributaries forming a wide delta called the "**garden of southern India"**
- The Cauvery basin extends over states of Tamil Nadu, Karnataka, Kerala, and Union Territory of Puducherry draining an area of 81 thousand Sq.km.
- It is bounded by the Western Ghats on the west, by the Eastern Ghats on the east and the south, and by the ridges separating it from the Krishna basin and Pennar basin on the north.
- The Nilgiris, an offshore of Western ghats, extend Eastwards to the Eastern ghats and divide the basin into two natural and political regions i.e., Karnataka plateau in the North and the Tamil Nadu plateau in the South.
- Physiographically, the **basin can be divided into three parts – the Westen Ghats, the Plateau of Mysore, and the Delta**.
- The delta area is the most fertile tract in the basin. The principal soil types found in the basin are black soils, red soils, laterites, alluvial soils, forest soils, and mixed soils. **Red soils occupy large areas in the basin. Alluvial soils are found in the delta areas.**
- The basin in Karnataka receives rainfall mainly from the S-W Monsoon and partially from N-E Monsoon. The basin in Tamil Nadu receives good flows from the North-East Monsoon.
- Its upper catchment area receives rainfall during summer by the south-west monsoon and the lower catchment area during the winter season by the retreating north-east monsoon.
- It is, therefore **almost a perennial river** with comparatively fewer fluctuations in flow and is very useful for irrigation and hydroelectric power generation.
- Around Sivasamudram are the scenic **Sivasamudram Falls**, plunging a total of 100 m and reaching a width of 300 m in the rainy season
- The **falls supply hydroelectric power to Mysore, Bengaluru, and the Kolar Gold Fields**.
- Thus the Cauvery is one of the best-regulated rivers and 90 to 95 percent of its irrigation and power production potential already stands harnessed.
- The river drains into the Bay of Bengal. The major part of the basin is covered with agricultural land accounting to 66.21% of the total area.

Tributaries of the Cauvery River

- Left Bank: the **Harangi**, the **Hemavati**, the **Shimsha,** and the **Arkavati**.
- Right Bank: **Lakshmantirtha**, the **Kabbani**, the **Suvarnavati**, the **Bhavani**, the **Noyil,** and the **Amaravati** joins from the right.
- The river descends from the **South Karnataka Plateau** to the Tamil Nadu Plains through the ***Sivasamudram waterfalls (101 m high).***
- At Shivanasamudram, the river branches off into two parts and falls through a height of 91 m. in a series of falls and rapids.
- The falls at this point is utilized for power generation by the power station at Shivanasamudram.
- The two branches of the river join after the fall and flow through a wide gorge which is known as **'Mekedatu' (Goats leap)** and continues its journey to form the boundary between Karnataka and the Tamil Nadu States for a distance of 64 km.
- At **Hogennekkal Falls**, it takes a Southerly direction and enters the **Mettur Reservoir.**
- A **tributary called Bhavani joins Cauvery on the Right bank** about 45 Kms below **Mettur Reservoir.** Thereafter it enters the plains of Tamil Nadu.

- Two more tributaries **Noyil and Amaravathi join on the right bank** and here the river widens with a sandy bed and flows as **'Akhanda Cauvery'.**
- Immediately after crossing Tiruchirapalli district, the river divides into two parts, the Northern branch being called **'The Coleron'** and Southern branch remains as Cauvery and from here the Cauvery Delta begins.
- After flowing for about 16 Kms, the two branches join again to form '**Srirangam Island**'.
- On the Cauvery branch lies the **"Grand Anicut"** said to have been constructed by a **Chola King** in 1st Century A.D.
- Below the Grand Anicut, the Cauvery branch splits into two, Cauvery and **Vennar**.
- These branches divide and **sub-divide into small branches and form a network all over the delta.**



HEMAVATI

- It is an **important tributary of the Kaveri River**
- It rises from the Western Ghats at an elevation of about 1219m near Ballalarayana Durga in the Chikmagalur District of Karnataka and flows through Chikkamagalooru, Hassan District, and Mysore district before joining the Kaveri near Krishnarajasagara
- It is approximately 245 km long. A **large reservoir has been built on the river at Gorur** in the Hassan district.


KARNATAKA
RIVER MAP
N
Tirna
Manjra
Koyna Reservoir
Bhima
Mullamari
Bohithora
MAHARASHTRA
Kagna
TELANGANA
Panch Ganga
Doni
Bhima
Dudh Ganga
Ghatprabha
Krishna
Malprabha
Benji Hall
Tungabhadra
GOA
Tungabhadra Reservoir
Kalinadi
Kundel
ANDHRA PRADESH
Varada
Chiki Hagori
Hagari
Jog Falls
Linganamakki Reservoir
Charavari
Papagni
Tunga
Bhadra Reservoir
Bhadra
Hemavati
Shimsha
Arkavati
ARABIAN SEA
Netravati
Kaveri
Krishnarajasogora Reservoir
Kaveri Falls
TAMIL NADU
KERALA
Kabani
State Boundary
District Boundary
Rivers
Map not to Scale
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(Updated on 2nd June 2014)

SHIMSHA

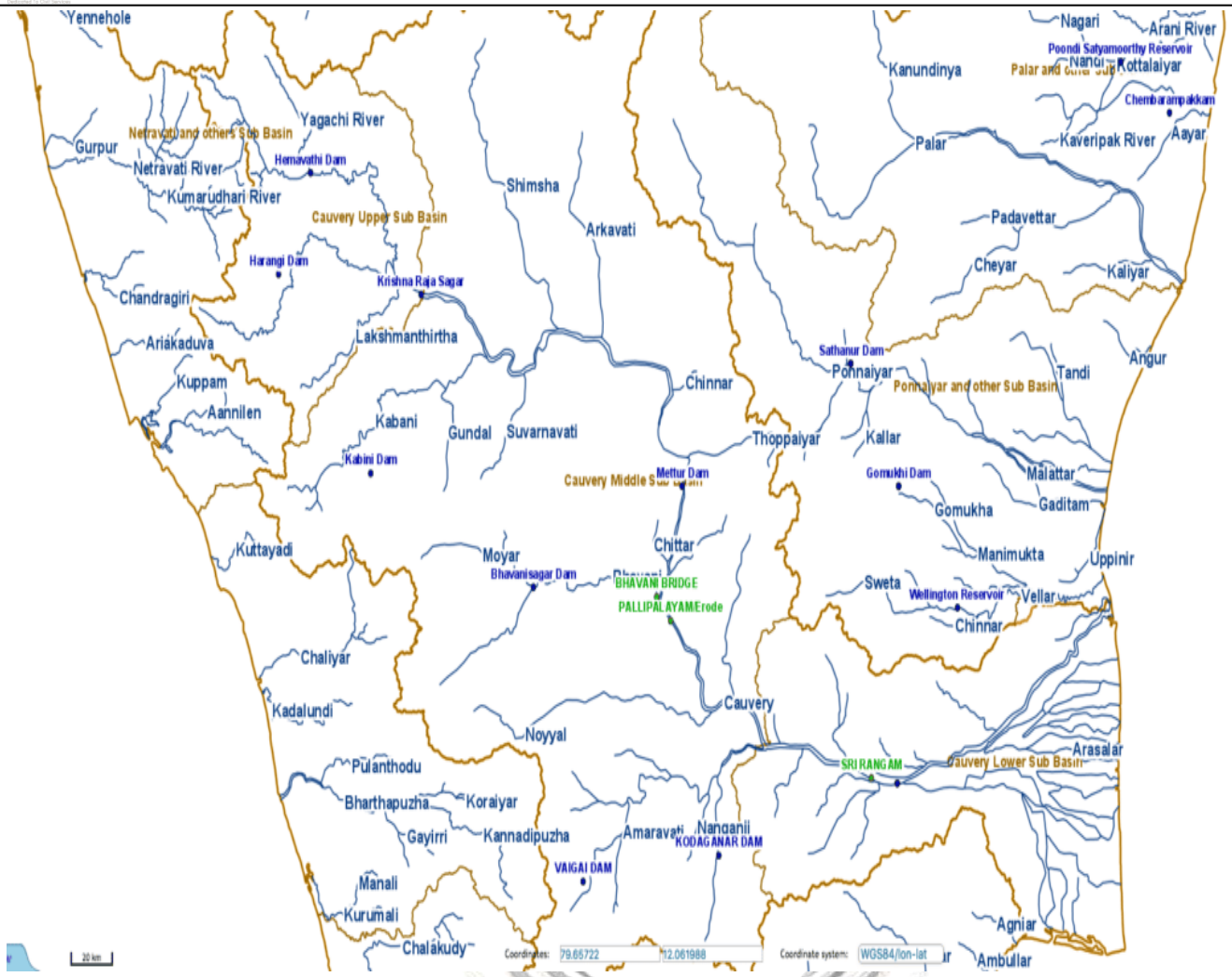
- It originates at an altitude of 914 m from the **Devarayanadurga hills** in the Tumkur District of Karnataka
- It is one of the tributaries of the river Kaveri
- Maddur is a major town that lies on this river
- Markonahalli Dam is a dam built across the river Shimsha in the Kunigal Taluk of Tumkur district
- Shimsha has a **waterfall at Shimshapura** in Malavalli Taluk
- This is also the location of the **Shimsha Hydro Electric Project.**

ARKAVATHY RIVER

- This 161 km long **river originates at Nandi Hills of Chikkaballapur district of Karnataka**
- It is a tributary of the Kaveri River, which it joins at Kanakapura, called **Sangama** in Kannada, after flowing through Kolar District and Bangalore Rural district
- The river drains into the Chikkarayappanahalli Lake near Kanivenarayanapura
- The picturesque Chunchi waterfall on the Arkavathi River at Sangama near Kanakapura attracts numerous tourists
- The water is taken from two reservoirs built on the river, the **Hesaraghatta** (or Hesseraggatta), and the **Tippagondanahalli Reservoir** (or T G Halli).

LAKSHMANA TIRRTHA

- It rises from the **Irupu Falls (also Iruppu Falls)**, located in the Brahmagiri Range in the Kodagu district of Karnataka, bordering the Wayanad district of Kerala.
- It then flows eastward and joins the Kaveri River in the **Krishna Raja Sagara Lake**.
- **Ramathirtha is its major tributary.**



KABINI

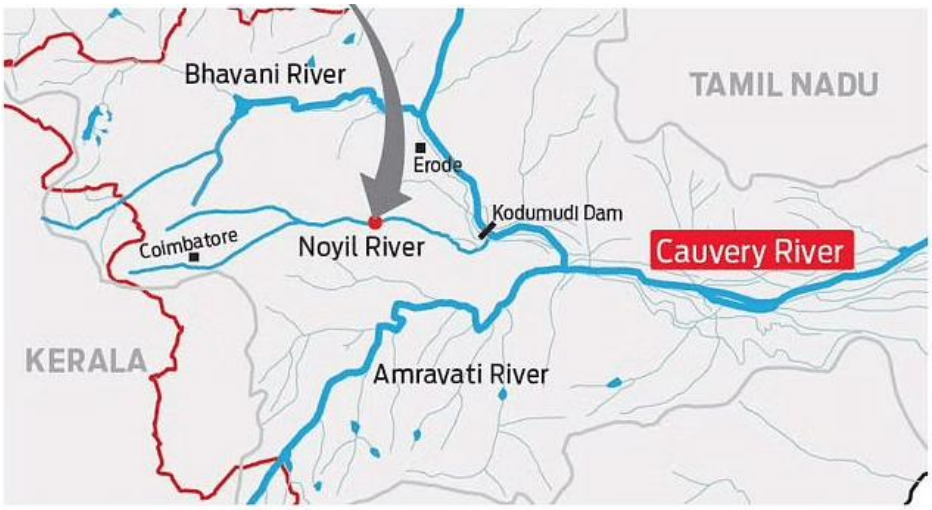
- **Kabini (also called Kabani and Kapila)** originates from Pakramthalam hills in Wayanad District of Kerala from the confluence of the Panamaram River and Mananthavady River
- The backwaters of the Kabini reservoir are very rich in wildlife especially in summer when the water level recedes to form rich grassy meadows
- After traversing two kilometers from the confluence of the Panamaram river, **Kabini forms an island called Kuruva Island**, spreading over 520 acres with diverse flora and fauna.

SUVARNAVATHY

- This 88km long river rises from the **Nasrur ghat Range** of Karnataka
- It is a tributary of the Kaveri River
- This river has a catchment area of about 1787 sq km
- The **Suvarnavathy dam** is located across Suvarnavathy River near Attigulipura in the village, Chamarajanagar Taluk at a distance of about 3 km away from the **Chikkahole reservoir Project**.

NOYYAL RIVER

- **Its original name was Kanchinadi** but changed later to the name of the place where it drains into the Kaveri River
- It rises from the **Vellingiri hills** in the Western Ghats in Tamil Nadu and drains into the Kaveri River
- Noyyal joins with river Cauvery at Kodumudi in **Erode District. The place is also called Noyyal.**
- The 173 km long tributary of the Kaveri River filled 32 tanks
- These interconnecting tanks held the water flowing from the Noyyal.



AMARAVATHI

- **Also known as Pournami,** this 175km long river begins at the Kerala/Tamil Nadu border at the bottom of Manjampatti Valley between the Annamalai Hills and the Palni hills in **Indira Gandhi Wildlife Sanctuary and National Park**.
- It descends in a northerly direction through **Amaravathi Reservoir and Amaravathi Dam** at Amaravathinagar
- This river nourishes the agriculture of Erode District
- The Amaravathi River and its basin, especially in the vicinity of Karur, are heavily used for industrial processing water and waste disposal and as a result, are severely polluted due to a large amount of textile dyeing and bleaching units.

Distributaries of the Cauvery River

Kollidam River (also called **Coleroon River**)

- The **Kollidam is a river in southeastern India**. The Kollidam is the northern **distributary of the Kaveri River** as it **flows through the delta of Thanjavur.**
- It splits from the main branch of the Kaveri River at the **island of** Srirangam and flows eastward into the Bay of Bengal. The **distribution system in Kollidam lies at** Lower Anaicut which is an island of river Kollidam.
- The **town of Chidambaram lies on its banks.**


TAMIL NADU
RIVER MAP
ANDHRA PRADESH
KARNATAKA
KERALA
Bay of Bengal
Palk Strait
Gulf of Mannar
INDIAN OCEAN
SRI LANKA
N
TIRUVALLUR
CHENNAI
VELLORE
KANCHIPURAM
KRISHNAGIRI
TIRUVANNAMALAI
DHARMAPURI
VILUPPURAM
SALEM
CUDDALORE
NILGIRIS
ERODE
NAMAKKAL
PERAMBALUR
ARIYALUR
NAGAPPATTINAM
COIMBATORE
KARUR
TIRUCHCHIRAPPALLI
THANJAVUR
TIRUVARUR
DINDIGUL
PUDUKKOTTAI
NAGAPATTINAM
SIVAGANGA
MADURAI
THENI
VIRUDHUNAGAR
RAMANATHAPURAM
THOOTHUKUDI
TIRUNELVELI
KANYAKUMARI
Palar
Shimsha
Kaveri
Kaveri Falls
Kabani
Cheyyar
Ponnaiyar
Stanley Reservoir
Bhavanisagar Reservoir
Vellar
Nohil
Kollidam
Amaravati
Vaigai
Gunaar
Vaippur
Chittar
Map not to Scale
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(Updated on 17th August 2012)
LEGEND
State Boundary
District Boundary
State Capital
River

Vennar or Vennaaru River

- The Vennar River or Vennaaru is a river and **distributary of the Kaveri River in the Kaveri delta.**
- It flows through the Thanjavur, Tiruvarur, and Nagapattinam districts of Tamil Nadu.
- The **river begins at the Grand Anaicut at the eastern end of Srirangam Island,** where it branches off from the Kaveri. After diverging from the Kaveri, the Vennar flows east.
- Northwest of Thennankudi, **at the Thenperambur dam**, the Vennar splits into a northern and southern branch. The **northern branch becomes the Vettar River**, while the **southern branch continues east as the Vennar.**
- Northwest of Needamangalam, there is another dam across the river, and the river splits again, into three branches. **The Pamaniyar and Koraiyar Rivers begin as the two southern branches** created by this divergence, while the **Vennar continues through the northern branch**.

Arasalar River

- The **river Arasalar is a river that flows through Tamil Nadu and Pudducherry**, and a distributary of Kaveri river which splits into 5 different rivers when it enters into Thanjavur district from Trichy.
- The river takes is course from Thiruvaiyaru of Thanjavur where it branches from Kaveri and **emptying itself into the sea of Bay of Bengal at Karaikal**, east of Akalanganni.
  - **Karaikal once served as a river port till the 19th century** where the yachts and Marakkalam ships of Karaikal Marakkayar harbored in and, loaded and unloaded the goods towards exports and imports.
- The **river is polluted by high concentrations of nitrate and chromium** due to the mixing of sewage water into the river stream and industrial activities (in 2013).

Floods in Cauvery Basin

- The Cauvery basin is fan shaped in Karnataka and leaf shaped in Tamil Nadu. The run-off **does not drain off quickly** because of its shape and therefore **no fast raising floods occur** in the basin.

Projects on Cauvery River

- During the pre-plan period many projects were completed in this basin which included **Krishnarajasagar** in Karnataka, **Mettur dam** and **Cauvery delta system** in Tamil Nadu.
- Lower **Bhavani, Hemavati, Harangi, Kabini** are important projects completed duing the plan period.

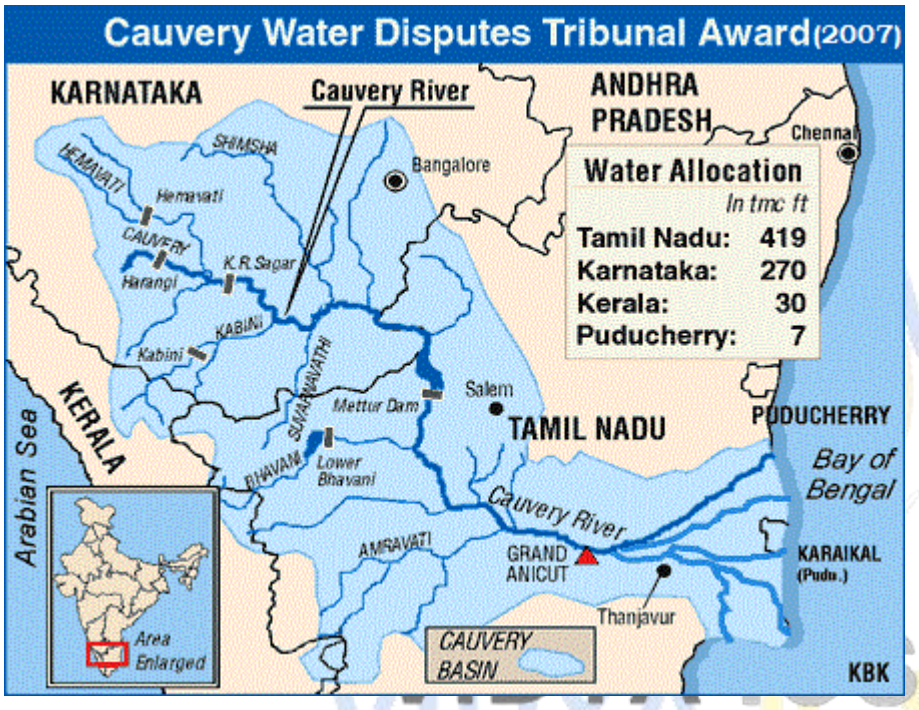
Industry in Cauvery Basin

- The city of Bangalore is situated just outside this basin.
- Important industries in the basin include the **cotton textile industry in Coimbatore** and Mysore, cement factories in Coimbatore and Trichinapally, and industries based on minerals and metals.
- The **Salem steel plant** and many engineering industries in Coimbatore and Trichinapally are also situated in this basin.

Cauvery River Disputes

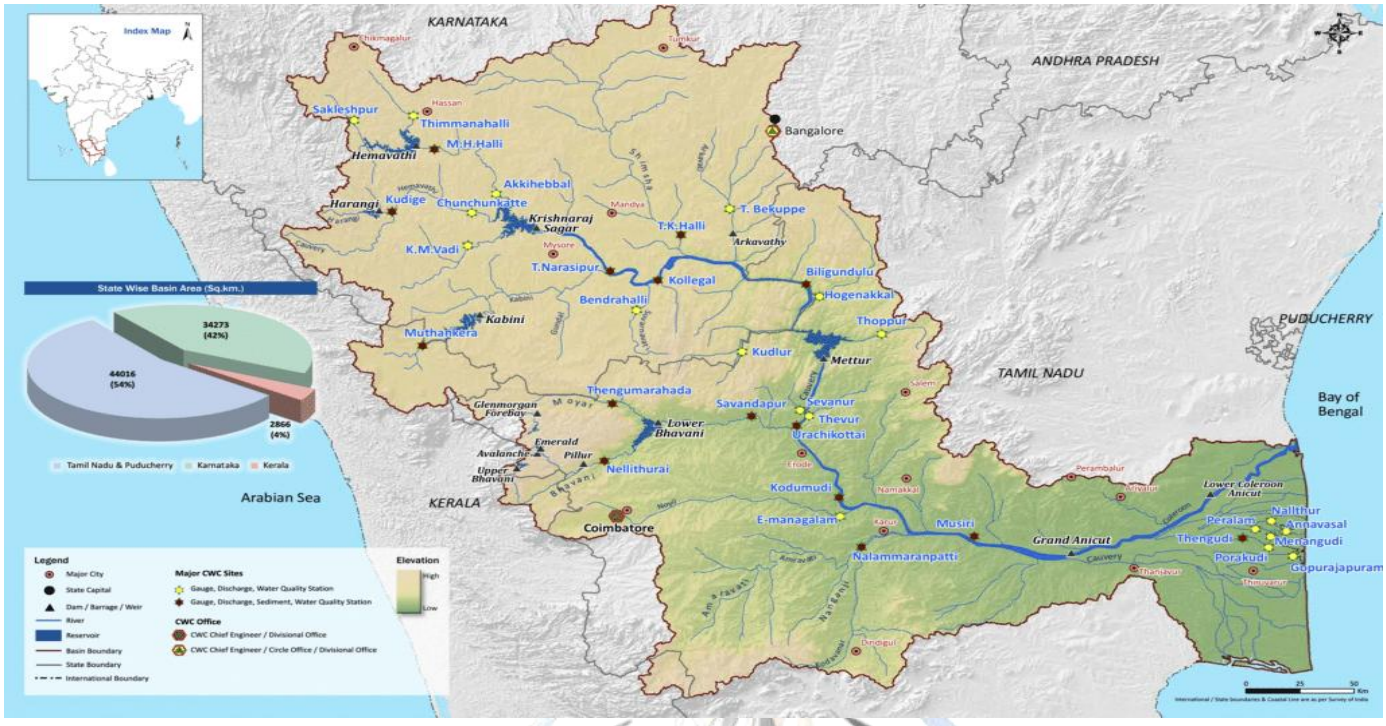
- **Historically**, Tamil Nadu used about 602 TMC of the total yield of the river i.e. the available water in a particular year.
- As a result, only about 138 TMC was available for Karnataka until the turn of the 20th century.
- In **1924**, Tamil Nadu built the Mettur dam across the Cauvery river.
- Subsequently, Karnataka and Tamil Nadu signed an agreement effective for 50 years.
- Accordingly, Tamil Nadu was allowed to expand its agricultural area by 11 lakh acres from the existing 16 lakh acres.
- Karnataka was authorized to increase its irrigation area from 3 lakh acres to 10 lakh acres.
- The Cauvery River thus primarily served the needs of farmers in Tamil Nadu.

- On completing 50 years, the **accord lapsed in 1974.**
- Subsequently, Karnataka claimed that the agreement restricted its ability to develop farming activities along the Cauvery basin.
- To make up the lost ground, **Karnataka** attempted to **expand farming activities** in the Cauvery basin.
- It started building reservoirs.
- With this, the Cauvery river water sharing issue emerged.
- **It is now a major water sharing dispute among Tamil Nadu, Karnataka, Puducherry, and Kerala.**
- **Tribunal** – By Tamil Nadu's demand, the **Union government formed the Cauvery Water Disputes Tribunal (CWDT) in 1990.**
- The **dispute was adjudicated by the Cauvery Water Disputes Tribunal**(**CWDT) in 2007.**
- Both Tamil Nadu and Karnataka **challenged the tribunal's order.**
- The **court reserved its order in September 2017.**



Major Inter-State River Disputes

River (s)	States
Ravi and Beas	Punjab, Haryana, Rajasthan
Narmada	Madhya Pradesh, Gujarat, Maharashtra, Rajasthan
Krishna	Maharashtra, Andhra Pradesh, Karnataka, Telangana
Vamsadhara	Andhra Pradesh & Odisha
Cauvery	**Kerala, Karnataka, Tamil Nadu, and Puducherry**
Godavari	Maharashtra, Andhra Pradesh, Karnataka, Madhya Pradesh, Odisha
Mahanadi	Chhattisgarh, Odisha
Mahadayi	Goa, Maharashtra, Karnataka
Periyar	Tamil Nadu, Kerala

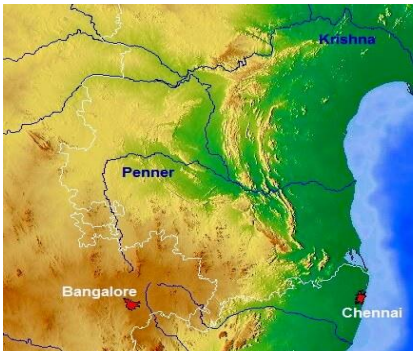


East Flowing Rivers in India

- Rivers have been of **fundamental importance throughout human history.** Water from rivers is a basic **natural resource**, essential for various human activities.
- Therefore, riverbanks have attracted settlers from ancient times. Using rivers for **irrigation, navigation, and hydropower generation is of special significance — particularly to a country like India, where agriculture is the major source of livelihood** of the majority of its population.
- The major **east-flowing rivers are the Godavari, Krishna, Cauvery, Mahanadi, Pennar, Subarnarekha, Brahamani, Ponnaiyar, Vaigai River, etc.**
- **East flowing rivers**:
  - flow into the **Bay of Bengal**
  - have **many tributaries**
  - **forms Deltas**
  - **carry larger sediments** than West flowing Rivers.

Pennar River

- The Pennar (also known as **Uttara Pinakini**) is one of the major rivers of the peninsula.
- The Pennar rises in the **Chennakasava hill** of the **Nandidurg range**, in **Chikkaballapura district** of **Karnataka,** and flows towards the east eventually draining into the Bay of Bengal.
- The total length of the river from origin to its outfall in the Bay of Bengal is 597 km.
- Located in peninsular India, the Pennar basin extends over states of **Andhra Pradesh and Karnataka** having an area of ~55 thousand Sq. km
- The fan-shaped basin is bounded by the **Erramala range** on the north, by the **Nallamala** and **Velikonda** ranges of the Eastern Ghats on the east, by the **Nandidurg hills** on the south, and by the narrow ridge separating it from the Vedavati valley of the Krishna Basin on the west.
- The other hill ranges in the basin to the south of the river are the **Seshachalam (famous for Red Sanders**) and



Paliconda ranges.

- The major part of the basin is **covered with agriculture** accounting to 58.64% of the total area.

Tributaries of Pennar River

- **Left** Bank: the **Jayamangali**, the **Kunderu** and the
- **Right** bank: the **Chiravati**, the **Papagni,** etc.

Projects on Pennar River

- Tungabhadra high-level canal in Krishna basin irrigated areas in Pennar basin also. The major project in the basin is the **Somasila project, Mylavaram Dam, Penna Ahobilam Balancing Reservoir (PABR Dam).**

Palar River

- Palar is a river of southern India. **It rises in the Nandi Hills in Chikkaballapura district of Karnataka** state and flows in **Karnataka, Andhra Pradesh, and Tamil Nadu** before reaching its confluence into the Bay of Bengal at Vayalur.
- The **Cheyyar and the Ponnai in Tamil Nadu are the major tributaries of this river Palar**.
- Palar river water from Palar anicut is diverted to the Poondi reservoir located in the Kosasthalaiyar River basin and to Chembarambakkam Lake located in the Adayar River basin.

Subarnarekha River

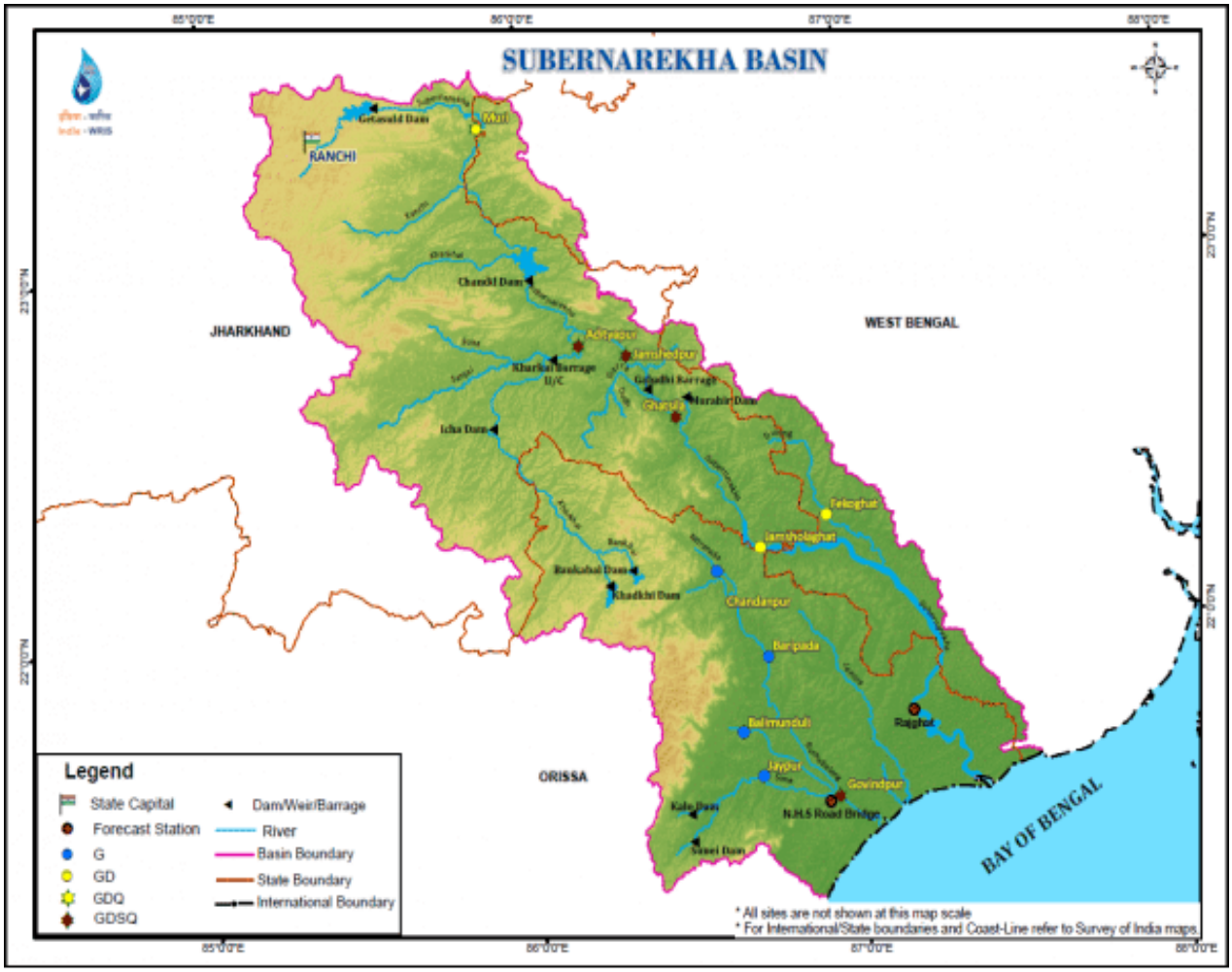
- The **Subarnarekha originates from the Ranchi Plateau in Jharkhand** forming the boundary between **West Bengal and Odisha** in its lower course.
- It joins the Bay of Bengal forming an **estuary between the Ganga and Mahanadi** deltas. Its total length is 395 km.

Tributaries of Subarnarekha River

- **Left bank**: **Dulang** River
- **Right bank**: Kanchi River, **Kharkai**, Karkari River, Raru River, Garru River.

Hundru Falls

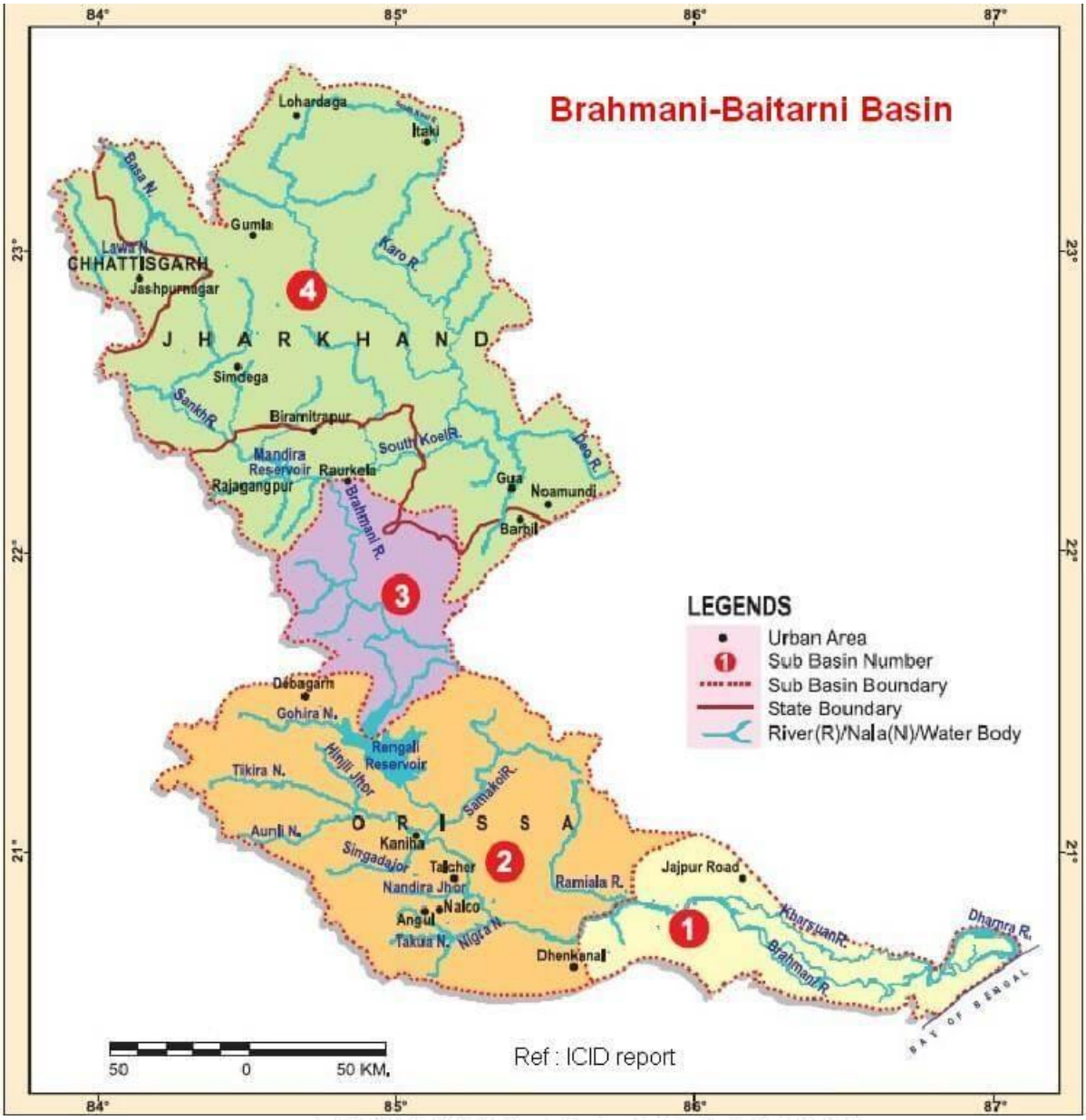
- **Hundru Falls is created on the course of the Subarnarekha, where it falls from a height of 98 metres** (322 ft).



Brahamani River

- The Brahmani river comes into existence by the confluence of the **Koel** and the **Sankh rivers** near **Rourkela**. It has a total length of 800 km.
- The basin is bounded in the North by the Chhotanagpur plateau, in the West and South by the Mahanadi basin, and in the East by the Bay of Bengal.
- The basin flows through **Jharkhand, Chhattisgarh, and the Orissa States** and drains into the Bay of Bengal.

- **Together with the river Baitarani, it forms a large delta** before emptying into the Bay of Bengal **at Dhamra.**



Rengali Dam

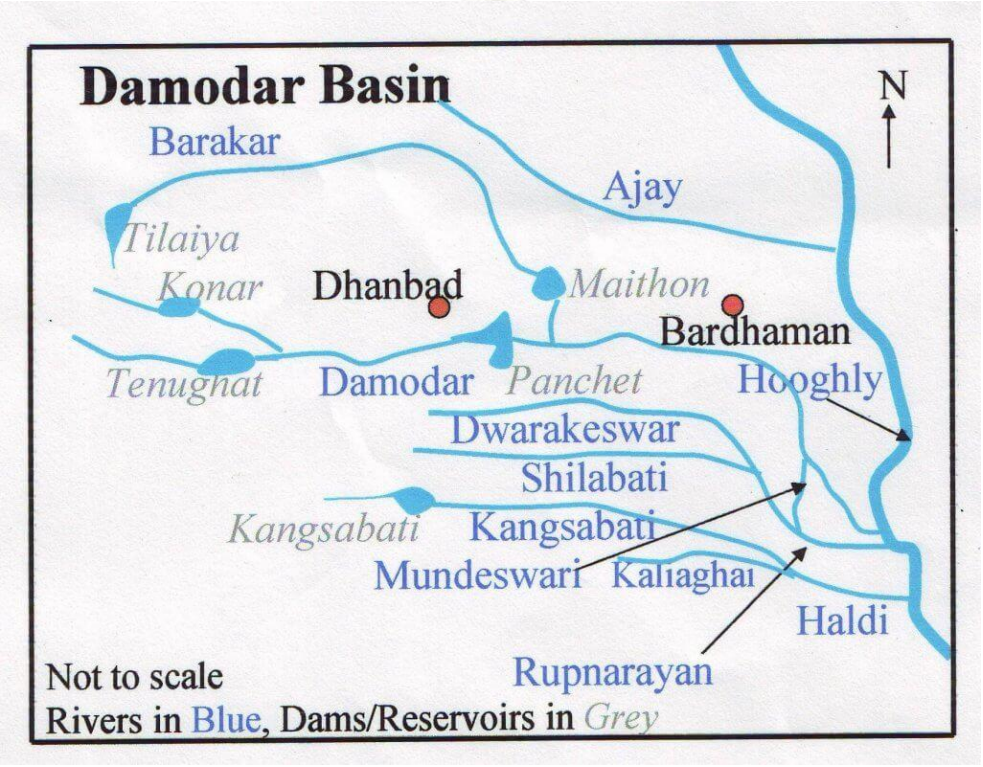
- **Rengali dam is a dam located in Odisha, India. It is constructed across the Brahmani River** in Rengali village, located 70 km from Angul in Angul district.

Baitarni River

- The Baitarani River is one of the **major rivers of Orissa**.
- The basin **lies mostly in the State of Orissa** excluding 736 km^2 in Singhbhum District of Jharkhand State.
- The **Baitarani River originates from Guptaganga hills in Keonjhar District of Orissa.**
- Initially the river flows in northern direction for about 80 km and then takes a sudden right turn. In this reach, the river serves as a boundary between Jharkhand and Orissa states up to the confluence of Kangira River.

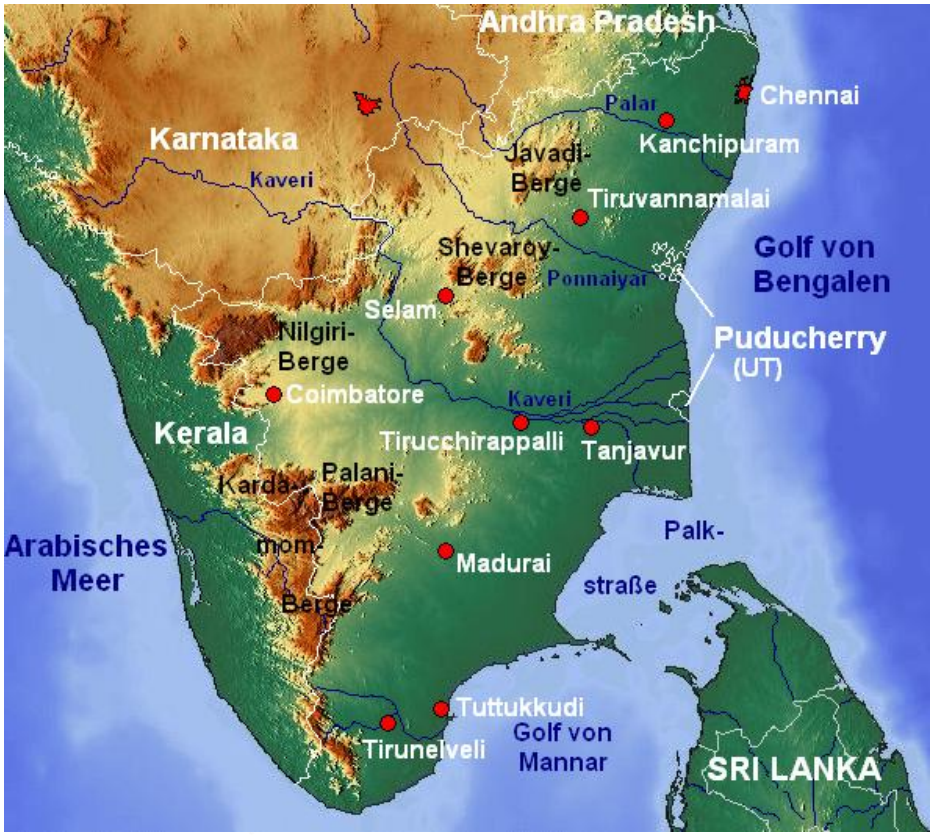
Damodar Rive

- The Damodar River rises in the **Palamau hills of Chota Nagpur** at an elevation of about 609.75 m and flows through a **rift valley**.
- It flows in a south-easterly direction entering the deltaic plains below Raniganj. Near Burdwan, the river abruptly changes its course to a southerly direction and **joins Hooghly** about 48.27 km below Calcutta.
- It has a number of tributaries and subtributaries, such as **Barakar, Konar, Bokaro, Haharo, Jamunia, Ghari, Guaia, Khadia and Bhera.**
- The **biggest tributary of the Damodar River is the Barakar.** The **source of Barakar is located in the vicinity of the Padma in the Hazaribagh district.**
- Earlier known as the **Sorrow of Bengal** because of its ravaging floods in the plains of West Bengal.
- At present, the Damodar is the most contaminated river in India, due to the **various industries** that have mushroomed on its riverbanks, which are good resources of minerals. There are a number of **coal-oriented industries** that are scattered over the Damodar basin.



Ponnaiyar River

- The **South Pennar River** is known as **Dakshina Pinakini** in Kannada and **Thenpennai** in Tamil. It is also referred as **Ponnaiyar.**
- The river **originates in the Nandi Hills in the Chikkaballapura district of Karnataka** and flows through Tamil Nadu before emptying into the Bay of Bengal.
- It covers a small area in the state of **Tamil Nadu, Karnataka, and Andhra Pradesh**.
- The Basin is bounded on the North -West, and South by **various ranges of the Eastern Ghats like the Velikonda Range, the Nagari hills, the Javadu hills, the Shevaroy hills, the Chitteri hills, and the Kalrayan hills**, and in **the East by the Bay of Bengal.**
- The **Krishnagiri dam and Sathanur Dam** are also built across this river. Moongilthuraipattu Sugar Factory is situated on the bank of the river.



Vaigai River

- The **Vaigai is a river in the Tamil Nadu state of southern India.**
- It **originates in Varusanadu Hills, the Periyar Plateau of the Western Ghats range**, and flows northeast through the Kambam Valley, which lies between the Palani Hills to the north and the Varushanad Hills to the south.
- The **Vattaparai Falls are located on this river.**
- The **river empties into the Palk Strait** near Uchipuli, close to the Pamban bridge in Ramanathapuram District.
- Its **main tributaries** are Suruliyaru, Mullaiyaru, Varahanadhi, Manjalaru, Kottagudi, Kridhumaal and Upparu.
  - The **Suruliyar and the Manjalar, the two important left-bank tributaries** together account for nearly 20 percent of the total catchment area of the Vaigai.
    - The **Suruliyar, the principal tributary of the Vaigai also rises in the Eastern slopes of the Varushanadu hills** and flows in the North and North-Easterly direction.
    - The **Manjalar another major tributary rises in the Palani hills** and flows generally in the Easterly direction before joining the Vaigai below the Vaigai dam.

- The Vaigai also receives another **minor tributary namely, the Varahanadhi (Varaha River) on its left bank** below the Vaigai dam.

- The Vaigai was the river that **flowed through the noted city of Madurai**, the **capital** (4th-11th century CE) **of the ancient and prosperous Pandya kingdom** located in southern Tamil Nadu.
- The river finds a mention in **Sangam literature** dated to 3**00 before the Common Era.**

West Flowing Rivers of Peninsular India

- The west-flowing rivers of Peninsular India are fewer and smaller as compared to their east-flowing counterparts.
- The two major west-flowing rivers are the **Narmada** and the **Tapi.**
- Other rivers: **Shetrunji River, Bhadra, Dhandhar, Sabarmati, Mahi, Vaitarana, Kalinadi, Bedti river, Sharvati, Mandovi, Juari, Bharatpuzha, Periyar, Pamba river**, etc.
- This exceptional behavior is because these rivers didn't form valleys and instead they flow through faults (linear rift, rift valley, trough) created due to the bending of the northern peninsula during the formation process of the Himalayas.
- These faults run parallel to the **Vindhyas** and the **Satpuras**.
- The **Sabarmati, Mahi,** and **Luni** are other rivers of Peninsular India which flow westwards.
- Hundreds of small streams originating in the **Western Ghats** flow swiftly westwards and join the Arabian Sea.
- It is interesting to note that the Peninsular rivers which fall into the Arabian Sea **do not form deltas, but only estuaries.**
- This is due to the fact that the west-flowing rivers, especially the Narmada and the Tapi flow through **hard rocks** and hence do not carry any good amount of silt.
- Moreover, the tributaries of these rivers are very small and hence they don't contribute any silt.
- Hence these rivers are not able to form distributaries or a delta before they enter the sea.
- A few rivers in Rajasthan do not drain into the sea. They drain into salt lakes and get lost in the sand with no outlet to the sea. Besides these, **there are the Desert Rivers which flow for some distance and are lost in the desert. These are Luni and others such as, Machhu, Rupen, Saraswati, Banas, and Ghaggar.**

Estuary

- An estuary is a partially enclosed body of water along the coast where freshwater from rivers and streams meets and mixes with saltwater from the ocean. (Primary productivity in estuaries is very high. Fishing is a dominant occupation around estuaries. Most of the estuaries are good **bird sanctuaries**).
- Estuaries and the lands surrounding them are places of transition from land to sea and freshwater to saltwater.
- Although influenced by the tides, they are protected from the full force of ocean waves, winds, and storms by such landforms as barrier islands or peninsulas.
- Estuarine environments are among the most productive on earth, creating more organic matter each year than comparably-sized areas of forest, grassland, or agricultural land.
- The tidal, sheltered waters of estuaries also support unique communities of plants and animals especially adapted for life at the margin of the sea.

- Estuaries have important commercial value and their resources provide economic benefits for tourism, fisheries, and recreational activities.
- The protected coastal waters of estuaries also support important public infrastructure, serving as **harbors and ports** vital for shipping and transportation.
- Estuaries also perform other valuable services. Water draining from uplands carries sediments, nutrients, and other pollutants to estuaries. As the water flows through wetlands such as swamps and salt marshes, much of the sediments and pollutants are filtered out.
- Saltmarsh grasses and other estuarine plants also help prevent erosion and stabilize shorelines **Mangroves**.

Narmada River

- **Narmada is the largest west flowing river of peninsular India.**
- Narmada flows westwards through a **rift valley** between the **Vindhyan Range** on the north and the **Satpura Range** on the south.
- It rises from **the Maikala range near Amarkantak** in **Madhya Pradesh**, at an elevation of about 1057 m.
- Narmada basin extends over states of **Madhya Pradesh, Gujarat, Maharashtra, and Chhattisgarh** having an area ~1 Lakh Sq.km.
- It is bounded by the **Vindhyas on the north, Maikala range on the east, Satpuras on the south, and by the Arabian Sea on the west.**
- Its total length from its source in **Amarkantak** to its estuary in the **Gulf of Khambhat** is 1,310 km.
- The hilly regions are in the upper part of the basin, and lower-middle reaches are broad and fertile areas well suited for cultivation.
- **Jabalpur** is the only important urban center in the basin.
- The river slopes down near Jabalpur where it cascades (a **small waterfall**, especially one in a series) 15 m into a gorge to form the ***Dhuan Dhar (Cloud of Mist) Falls.***
- Since the **gorge is composed of marble, it is popularly known as the Marble Rocks.**
- It makes two waterfalls of 12 m each at **Mandhar and Dardi.** Near Maheshwar, the river again descends from another small fall of 8 m, known as the **Sahasradhara Falls.**
- There are several islands in the **estuary** of the Narmada of which **Aliabet** is the largest.
- The **Narmada is navigable** up to **112 km** from its mouth.

Tributaries of Narmada River

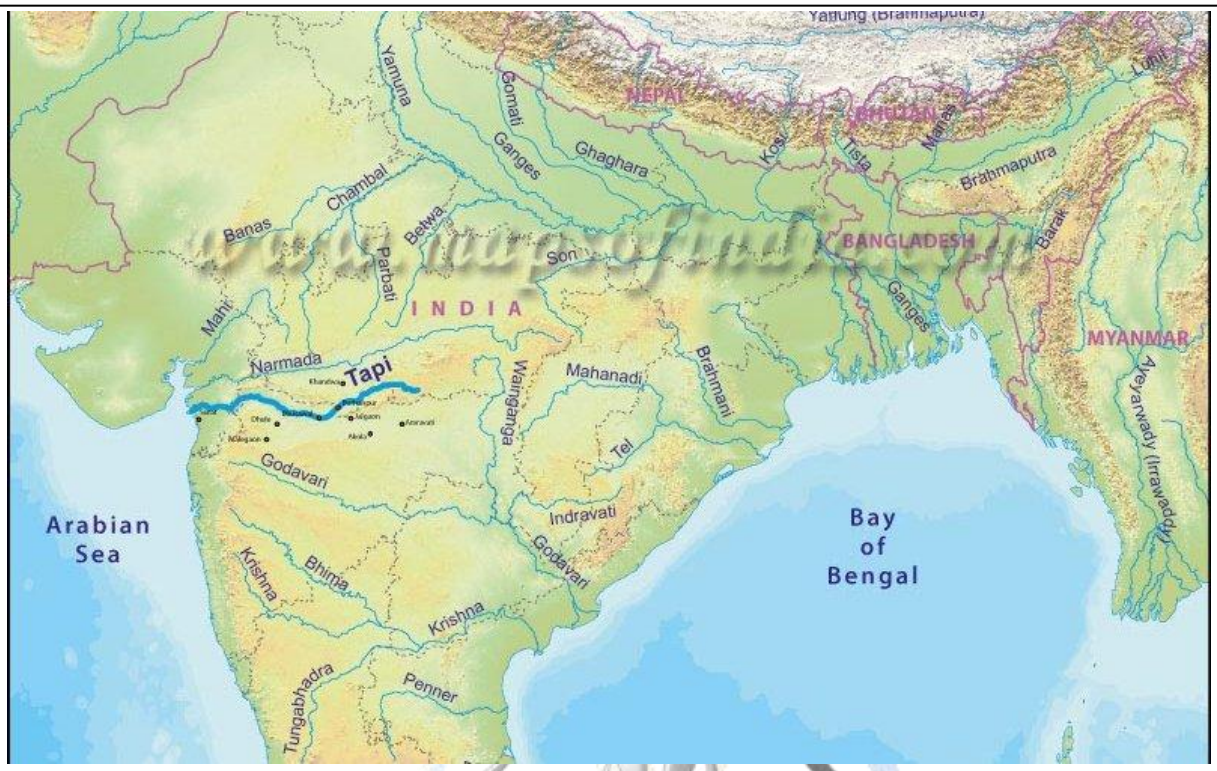
- **Right bank tributaries** are the **Barna, Hiran River**, **Tendoni River**, Choral River, **Kolar River**, Man River, Uri River, Hatni River, **Orsang River**
- **Left bank tributaries** – **Burhner** River, Banjar River, **Sher River**, **Shakkar River**, **Dudhi River**, **Tawa River**, **Ganjal River**, **Chhota Tawa River**, Kaveri River, Kundi River, Goi River, Karjan River
- The major Hydro Power projects in the basin are **Indira Sagar, Sardar Sarovar, Omkareshwar, Bargi & Maheshwar.**

Tawa River

- The river rises from the **Satpura Range of Betul in MP**.
- This river is the **longest tributary of River Narmada.**

Tapti River

- The **Tapti (also known as the Tapi)** is the **second-largest west flowing river of Peninsular India** and is known as 'the **twin' or 'the handmaid' of the Narmada.**
- **It originates near Multai reserve forest in Madhya Pradesh** at an elevation of 752 m.
- Flows for about 724 km before outfalling into the Arabian Sea through the **Gulf of Cambay [Gulf of Khambhat].**
- The Tapti River along with its tributaries flows over the plains of **Vidharbha, Khandesh,** and Gujarat and over large areas in the state of **Maharashtra** and a small area in **Madhya Pradesh and Gujarat.**
- The basin extends over states of Madhya Pradesh, Maharashtra, and Gujarat having an area of ~ 65,000 Sq.km
- **Situated in the Deccan plateau**, the basin is **bounded by the Satpura range on the north**, **Mahadev hills on the east, Ajanta Range and the Satmala hills on the south, and by the Arabian Sea on the west.**
- The hilly region of the basin is well forested while the plains are broad and fertile areas suitable for cultivation.
- There are two well-defined physical regions, in the basin, viz hilly region and plains; the hilly regions comprising **Satpura, Satmalas, Mahadeo, Ajanta,** and **Gawilgarh hills** are well forested.
- The plain covers the **Khandesh areas** (Khandesh is a region of central India, which forms the northwestern portion of Maharashtra state) which are broad and fertile suitable for cultivation primarily.



Tributaries of Tapti River

- ***Right Bank:*** the **Suki**, the **Gomai**, the **Arunavati** and the **Aner**.
- ***Left Bank:*** the **Vaghur**, the **Amravati**, the **Buray**, the **Panjhra**, the **Bori**, the **Girna**, the **Purna**, the **Mona** and the **Sipna**.

Projects on Tapti River

- Hathnur Dam of Upper Tapi Project (Maharashtra)
- Kakrapar weir and Ukai Dam of Ukai Project (Gujarat)
- Girna Dam and Dahigam Weir of Girna Project (Maharashtra)

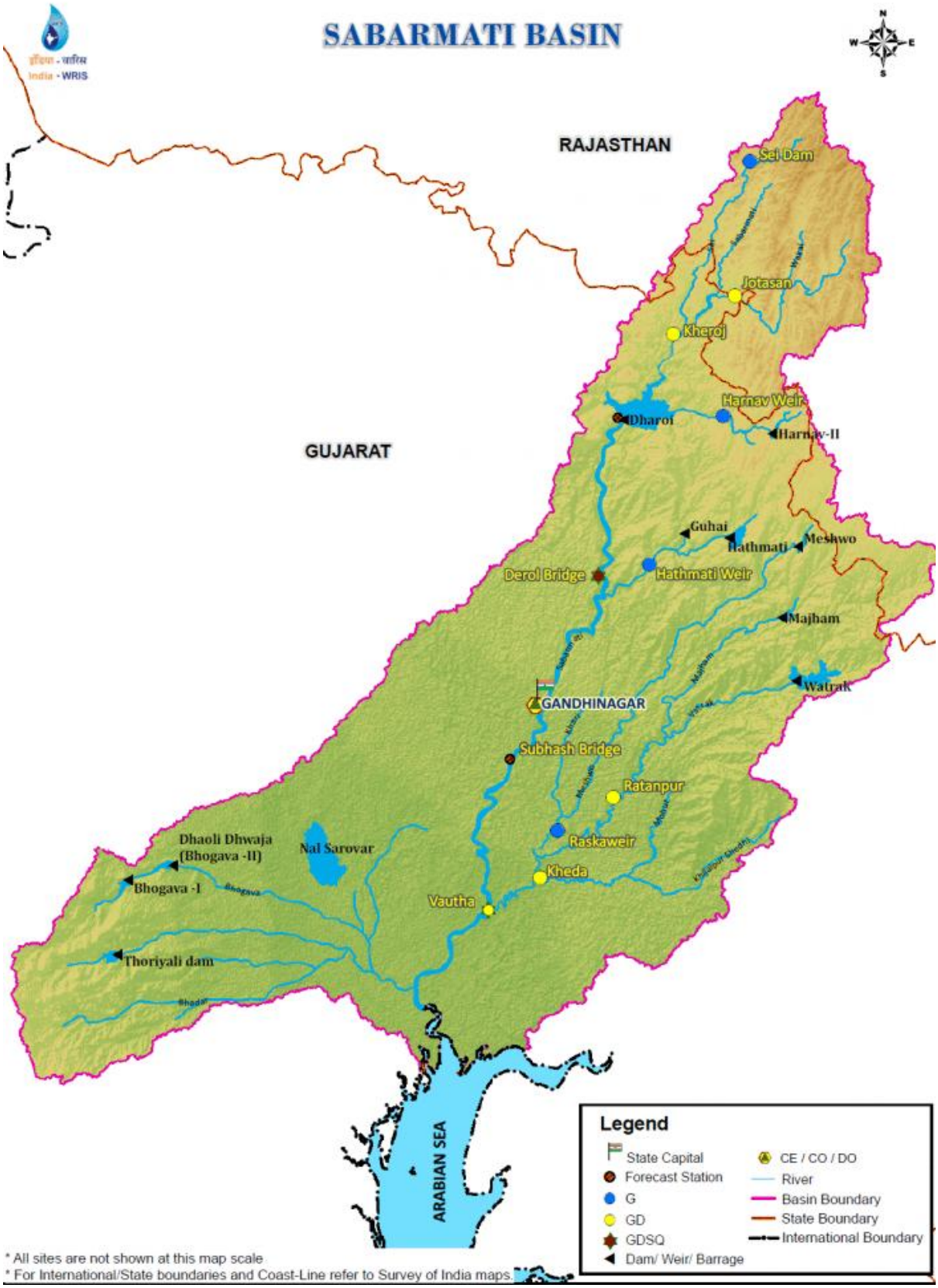
Industry in the Tapti Basin

- Important industries in the basin are **textile factories in Surat** and **paper and news print factory at Nepanagar.**

Sabarmati River

- The Sabarmati is the name given to the combined streams the **Sabar** and **Hathmati**.

- The Sabarmati basin extends over the states of **Rajasthan and Gujarat** having an area of 21,674 Sq km.
- The basin is bounded by **Aravalli hills** on the north and north-east, by Rann of Kutch on the west, and by the **Gulf of Khambhat** on the south.
- The basin is roughly triangular in shape with the Sabarmati River as the base and the source of the **Vatrak River** as the apex point.
- Sabarmati originates from **Aravalli hills** at an elevation of 762 m near village Tepur, in th**e Udaipur district of Rajasthan.**
- The total length of the river from origin to **outfall into the Arabian Sea** is 371 km.
- The major part of the basin is covered with agriculture accounting to 74.68% of the total area.
- Rainfall varies from a meager few mm in Saurashtra to over 1000 mm in the southern part.
- **Left bank tributaries**: the **Wakal, the Hathmati, and the Vatrak.**
- **Right bank tributaries**: the **Sei.**
- Projects: **Sabarmati reservoir (Dharoi), Hathmati reservoir, and Meshwo reservoir project** are major projects completed during the plan period.



Industry in Sabarmati Basin

- **Gandhinagar** and **Ahmedabad** are the important urban centers in the basin.
- Ahmedabad is an industrial city situated on the banks of Sabarmati.
- Important industries are textiles, leather and leather goods, plastic, rubber goods, paper, newsprint, automobile, machine tools, drugs and pharmaceuticals etc.
- The industrial city of Ahmedabad poses the danger of water pollution.

Mahi River

- The Mahi basin extends over states of **Madhya Pradesh, Rajasthan, and Gujarat** having a total area of 34,842 Sq km.
- It is bounded by **Aravalli hills** on the north and the north-west**, by Malwa Plateau** on the east, **by the Vindhyas** on the south, and by the **Gulf of Khambhat** on the west.
- Mahi is one of the major **interstate west flowing** rivers of India.
- It **originates from the northern slopes of Vindhyas** at an altitude of 500 m in t**he Dhar district of Madhya Pradesh.**
- The total length of Mahi is 583 km.
- It **drains into the Arabian Sea through the Gulf of Khambhat.**
- The **major part of the basin is covered with agricultural land** accounting to 63.63% of the total area
- Hydro Power stations are located – **Mahi Bajaj Sagar dam**, **Kadana Dam**, and **Wanakbori dam** (Weir).
- **Vadodara** is the only **important urban centre** in the basin. There are not many industries in the basin.
- Some of the industries are cotton textile, paper, newsprint, drugs, and pharmaceuticals. Most of these industries are located at **Ratlam.**

Tributaries of Mahi:

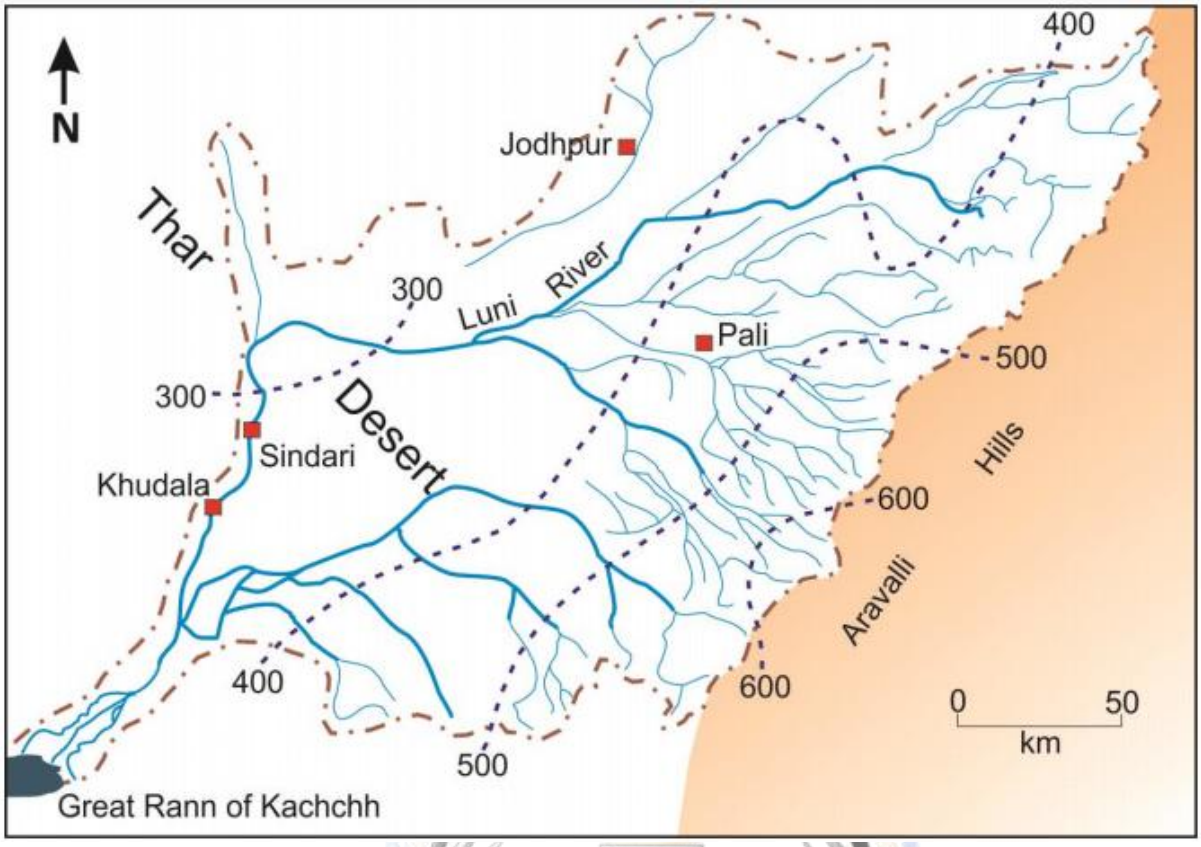
- **Som**
  - This is the **right bank tributary of Mahi**. **Som river rises near Som on the Eastern slopes of the Aravalli hills in the Udaipur district of Rajasthan** at an elevation of 600 m above m.s.l. and flows in the Eastern direction to join the main river Mahi on the right bank 6.3 km upstream of Paderdibadi site in Dungarpur

district of Rajasthan. Its total length is about 155 km. The total drainage area of Som is 8707 sq. km. **Gomti & Jakham** are the major right bank sub tributaries of Som.

- **Anas**
  - This is a **Left bank tributary of Mahi**. **Anas River rises near Kalmora on the Northern slopes of Vindhyas in Jhabua district in Madhya Pradesh** at an elevation of 450 m above m.s.l. and flows in the North – West direction and joins the main river Mahi on the left bank in the Dungarpur district in Rajasthan. It has a total length of about 156 km and a total drainage area of 5604 sq. km.
- **Panam**
  - This is a **Left bank tributary of Mahi.** Panam river **rises near Bhadra on the Northern slopes of the Vindhyas near the Jhabua district in Madhya Pradesh** at an elevation of about 300 m above m.s.l. and flows in the North – West direction and joins the main river on the left bank in the Panchmahal district of Gujarat. It has a total length of about 127 km and a drainage area of about 2470 sq. km.

Luni River

- The **Luni** or the **Salt River** (Lonari or Lavanavari in Sanskrit) is named so because its water is **brackish below Balotra.**
- Luni is the only river basin of any significance in **Western Rajasthan**, which forms the **bulk of the arid zone.**
- **Luni originates from the western slopes of the Aravalli ranges** at an elevation of 772 m near **Ajmer** flowing in the southwest direction and traversing a course of 511 km in Rajasthan, **it finally flows into the Rann of Kachchh** (it gets lost in the marsh).
- Most of its **tributaries drain the steep northwest of Aravalli hills and join it on the left side**. Its total catchment area falls in Rajasthan.
- The peculiarity of this river is that it **tends to increase its width** rather than deepening the bed because the banks are of soils, which are easily erodible whereas beds are of sand. The floods develop and disappear so rapidly that they have no time to scour the bed.



West flowing Rivers of the Sahyadris (Western Ghats)

- About **six hundred small streams originate from the Western Ghats and flow westwards to fall into the Arabian Sea.**
- The western slopes of the Western Ghats receive heavy rainfall from the south-west monsoons and are able to feed such a large number of streams.
- Although only about 3% of the areal extent flow swiftly down the steep slope and some of them make waterfalls.
- The **Jog or Gersoppa Falls**(289 m) made by the **Sharavati river** is the most famous waterfall of India.
    - **Sharavati is a river which originates and flows entirely within the state of Karnataka**.

Ghaggar River – Inland Drainage

- Some rivers of India are not able to reach the sea and constitute inland drainage.
- Large parts of the **Rajasthan desert** and parts of **Aksai Chin** in **Ladakh** have inland drainage.
- The ***Ghaggar*** is the **most important river of inland drainage.** It is a seasonal stream that rises on the lower slopes of the Himalayas and **forms the boundary between Haryana and Punjab.**
- **It gets lost in the dry sands of Rajasthan near Hanumangarh** after traversing a distance of 465 km.
- Earlier, this river was an affluent of the Indus, the dry bed of the old channel is still traceable.
- Its main tributaries are the Tangri, the Markanda, the Saraswati and the Chaitanya.
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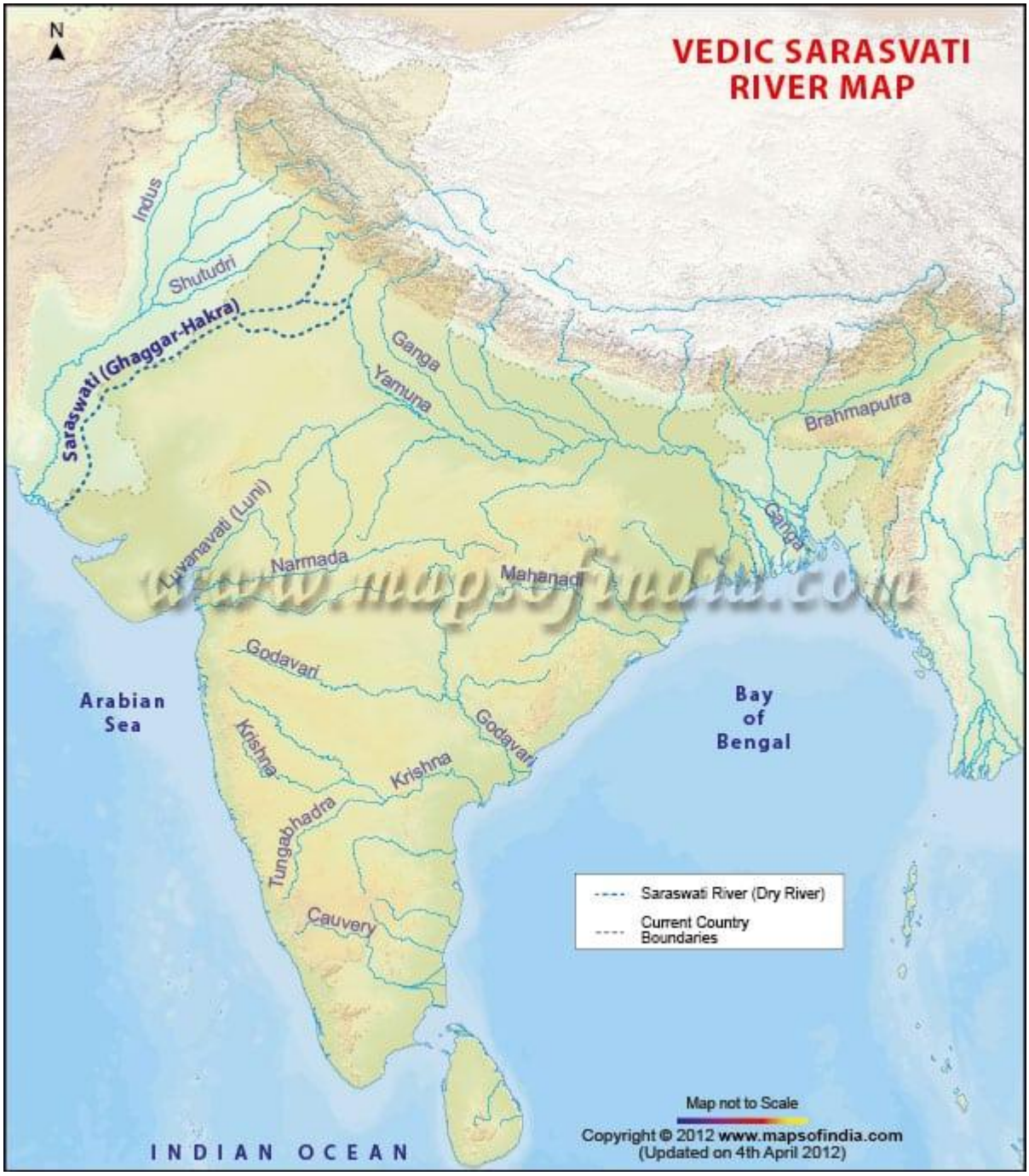

Mhadei river

- Mahadayi or Mhadei, the **west-flowing river, originates in Bhimgad Wildlife Sanctuary (Western Ghats)**, Belagavi district of **Karnataka**.
- It is essentially a **rain-fed river also called Mandovi in Goa.**
- It is joined by a number of streams to form the **Mandovi which is one of two major rivers** (the **other one is the Zuari river**) that flows through Goa.
- The river travels 35 km in Karnataka; 82 km in Goa before joining the Arabian Sea.
- **Kalasa-Banduri Nala project**
  - Undertaken by **the Government of Karnataka** to improve drinking water supply to **the Districts of Belagavi, Dharwad, and Gadag.** It involves building across **Kalasa and Banduri, two tributaries of the Mahadayi river** to divert 7.56 TMC of water to the **Malaprabha river.**
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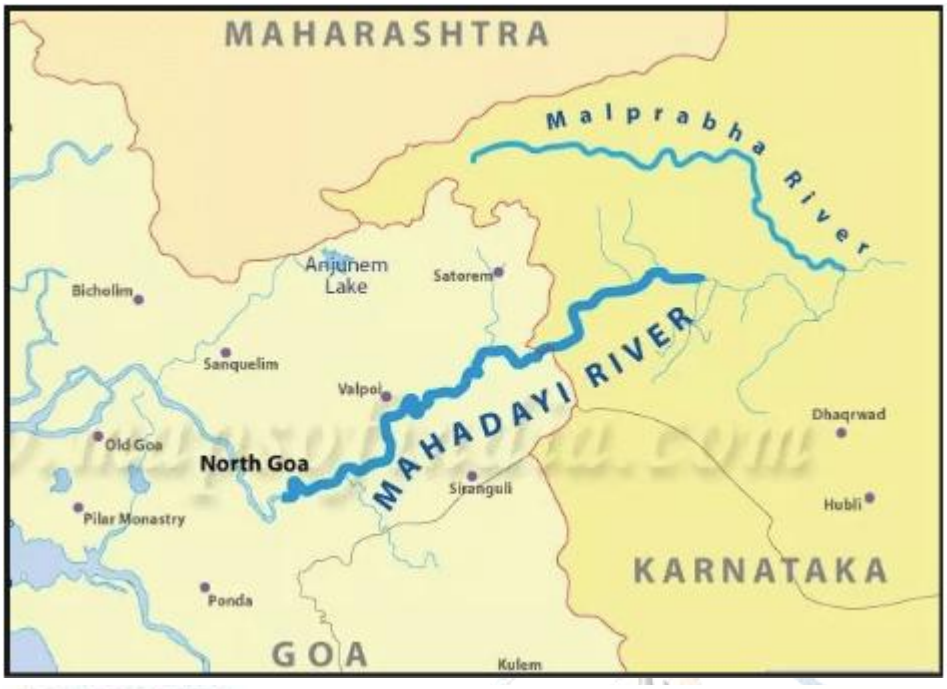
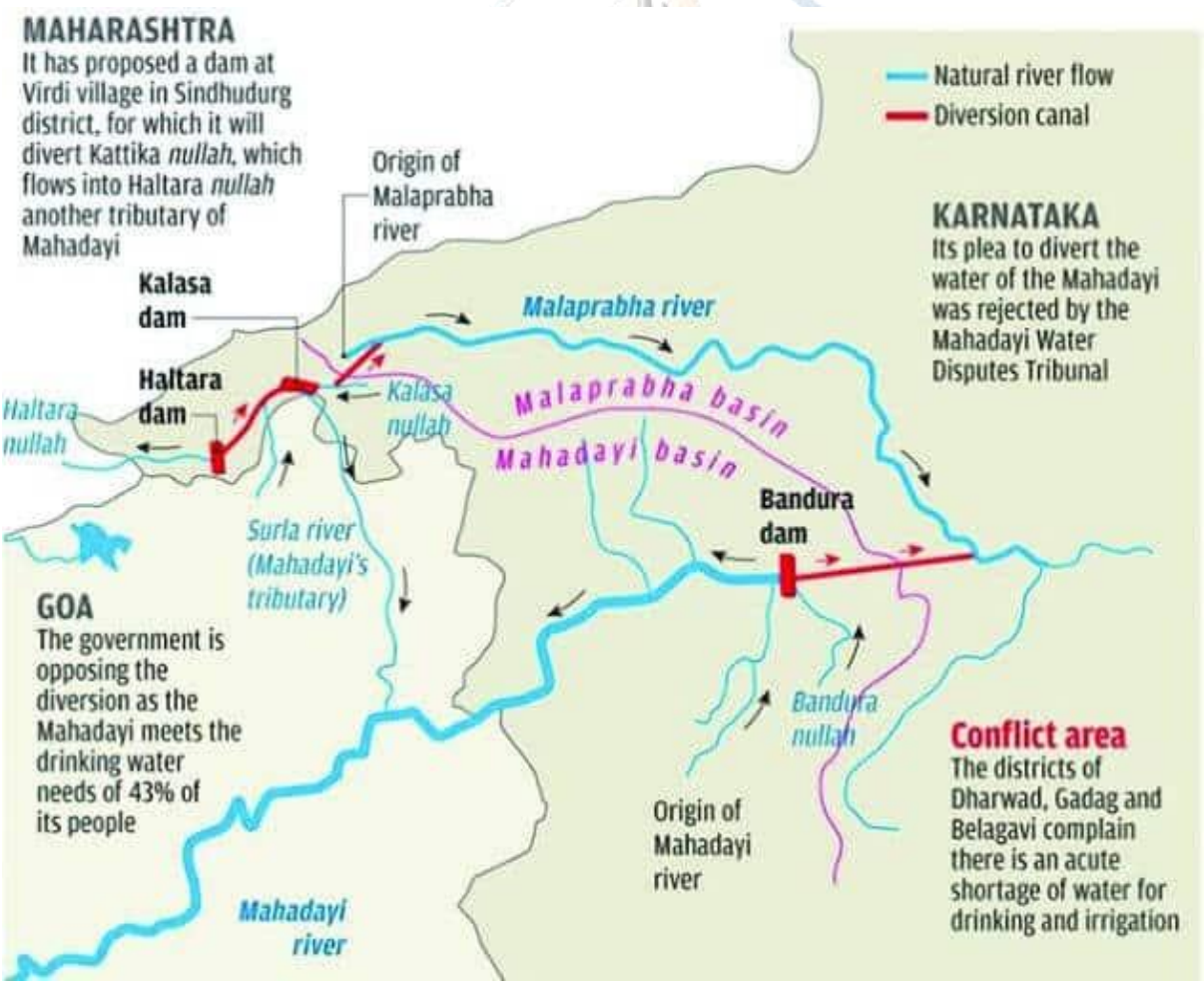




Usability of Rivers

- **Source of fresh water, irrigation, hydro-electric production, navigation, etc.**
- The Himalayas, Vindhyas, Satpuras, Aravalis, Maikala, Chhotanagpur plateau, Meghalaya plateau, Purvachal, Western and the Eastern Ghats offer possibilities of large scale water power development.

- Sixty percent of the total river flow is concentrated in the Himalayan rivers, 16 percent in the Central Indian rivers (the Narmada, the Tapi, the Mahanadi, etc.), and the rest in the rivers of the Deccan plateau.
- The Ganga and the Brahmaputra in the north and northeastern part of the country, the Mahanadi in Odisha, the Godavari and the Krishna in Andhra and Telangana the Narmada and the Tapi in Gujarat, and the lakes and tidal creeks in coastal states possess some of the important and useful waterways of the country.
- In the past, they were of great importance, which suffered a great deal with the advent of **rail and roads**.
- **Withdrawal of large quantities of water for irrigation resulted in the dwindling flow of many rivers.**
- The **most important navigable rivers are the Ganga, the Brahmaputra, and the Mahanadi.** The Godavari, the Krishna, the Narmada, and the Tapi are navigable near their mouths only.

West Flowing Rivers of Peninsular India

- The west-flowing rivers of Peninsular India are fewer and smaller as compared to their east-flowing counterparts.
- The two major west-flowing rivers are the **Narmada** and the **Tapi.**
- Other rivers: **Shetrunji River, Bhadra, Dhandhar, Sabarmati, Mahi, Vaitarana, Kalinadi, Bedti river, Sharvati, Mandovi, Juari, Bharatpuzha, Periyar, Pamba river**, etc.
- This exceptional behavior is because these rivers didn't form valleys and instead they flow through faults (linear rift, rift valley, trough) created due to the bending of the northern peninsula during the formation process of the Himalayas.
- These faults run parallel to the **Vindhyas** and the **Satpuras**.
- The **Sabarmati, Mahi,** and **Luni** are other rivers of Peninsular India which flow westwards.
- Hundreds of small streams originating in the **Western Ghats** flow swiftly westwards and join the Arabian Sea.
- It is interesting to note that the Peninsular rivers which fall into the Arabian Sea **do not form deltas, but only estuaries.**
- This is due to the fact that the west-flowing rivers, especially the Narmada and the Tapi flow through **hard rocks** and hence do not carry any good amount of silt.
- Moreover, the tributaries of these rivers are very small and hence they don't contribute any silt.
- Hence these rivers are not able to form distributaries or a delta before they enter the sea.
- A few rivers in Rajasthan do not drain into the sea. They drain into salt lakes and get lost in the sand with no outlet to the sea. Besides these, **there are the Desert Rivers which flow for some distance and are lost in the desert. These are Luni and others such as, Machhu, Rupen, Saraswati, Banas, and Ghaggar.**

Estuary

- An estuary is a partially enclosed body of water along the coast where freshwater from rivers and streams meets and mixes with saltwater from the ocean. (Primary productivity in estuaries is very high. Fishing is a dominant occupation around estuaries. Most of the estuaries are good **bird sanctuaries**).
- Estuaries and the lands surrounding them are places of transition from land to sea and freshwater to saltwater.
- Although influenced by the tides, they are protected from the full force of ocean waves, winds, and storms by such landforms as barrier islands or peninsulas.
- Estuarine environments are among the most productive on earth, creating more organic matter each year than comparably-sized areas of forest, grassland, or agricultural land.
- The tidal, sheltered waters of estuaries also support unique communities of plants and animals especially adapted for life at the margin of the sea.
- Estuaries have important commercial value and their resources provide economic benefits for tourism, fisheries, and recreational activities.
- The protected coastal waters of estuaries also support important public infrastructure, serving as **harbors and ports** vital for shipping and transportation.
- Estuaries also perform other valuable services. Water draining from uplands carries sediments, nutrients, and other pollutants to estuaries. As the water flows through wetlands such as swamps and salt marshes, much of the sediments and pollutants are filtered out.
- Saltmarsh grasses and other estuarine plants also help prevent erosion and stabilize shorelines **Mangroves**.

Narmada River

- **Narmada is the largest west flowing river of peninsular India.**
- Narmada flows westwards through a **rift valley** between the **Vindhyan Range** on the north and the **Satpura Range** on the south.
- It rises from **the Maikala range near Amarkantak** in **Madhya Pradesh**, at an elevation of about 1057 m.
- Narmada basin extends over states of **Madhya Pradesh, Gujarat, Maharashtra, and Chhattisgarh** having an area ~1 Lakh Sq.km.
- It is bounded by the **Vindhyas on the north, Maikala range on the east, Satpuras on the south, and by the Arabian Sea on the west.**
- Its total length from its source in **Amarkantak** to its estuary in the **Gulf of Khambhat** is 1,310 km.
- The hilly regions are in the upper part of the basin, and lower-middle reaches are broad and fertile areas well suited for cultivation.

- **Jabalpur** is the only important urban center in the basin.
- The river slopes down near Jabalpur where it cascades (a **small waterfall**, especially one in a series) 15 m into a gorge to form the ***Dhuan Dhar (Cloud of Mist) Falls.***
- Since the **gorge is composed of marble, it is popularly known as the Marble Rocks.**
- It makes two waterfalls of 12 m each at **Mandhar and Dardi.** Near Maheshwar, the river again descends from another small fall of 8 m, known as the **Sahasradhara Falls.**
- There are several islands in the **estuary** of the Narmada of which **Aliabet** is the largest.
- The **Narmada is navigable** up to **112 km** from its mouth.

Tributaries of Narmada River

- **Right bank tributaries** are the **Barna, Hiran River**, **Tendoni River**, Choral River, **Kolar River**, Man River, Uri River, Hatni River, **Orsang River**
- **Left bank tributaries** – **Burhner** River, Banjar River, **Sher River**, **Shakkar River**, **Dudhi River**, **Tawa River**, **Ganjal River**, **Chhota Tawa River**, Kaveri River, Kundi River, Goi River, Karjan River
- The major Hydro Power projects in the basin are **Indira Sagar, Sardar Sarovar, Omkareshwar, Bargi & Maheshwar.**

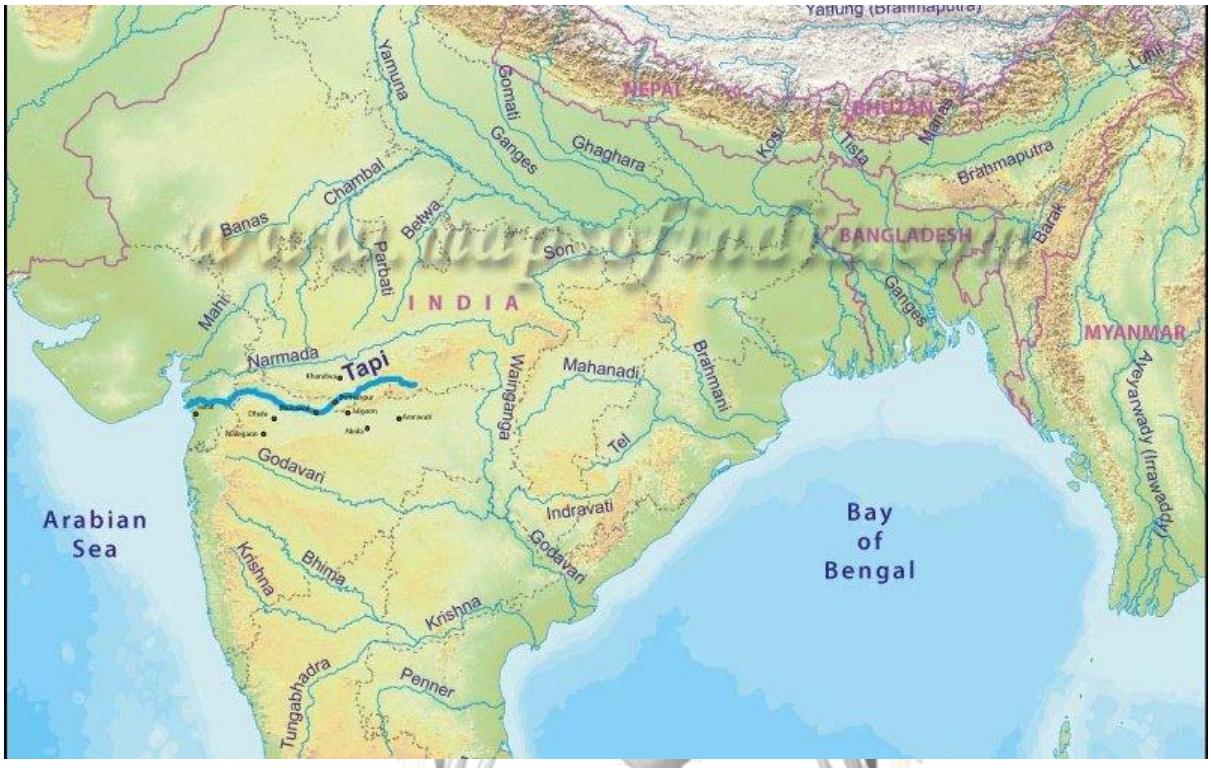
Tawa River

- The river rises from the **Satpura Range of Betul in MP**.
- This river is the **longest tributary of River Narmada.**

Tapti River

- The **Tapti (also known as the Tapi)** is the **second-largest west flowing river of Peninsular India** and is known as 'the **twin' or 'the handmaid' of the Narmada.**
- **It originates near Multai reserve forest in Madhya Pradesh** at an elevation of 752 m.
- Flows for about 724 km before outfalling into the Arabian Sea through the **Gulf of Cambay [Gulf of Khambhat].**
- The Tapti River along with its tributaries flows over the plains of **Vidharbha, Khandesh,** and Gujarat and over large areas in the state of **Maharashtra** and a small area in **Madhya Pradesh and Gujarat.**
- The basin extends over states of Madhya Pradesh, Maharashtra, and Gujarat having an area of ~ 65,000 Sq.km
- **Situated in the Deccan plateau**, the basin is **bounded by the Satpura range on the north**, **Mahadev hills on the east, Ajanta Range and the Satmala hills on the south, and by the Arabian Sea on the west.**
- The hilly region of the basin is well forested while the plains are broad and fertile areas suitable for cultivation.
- There are two well-defined physical regions, in the basin, viz hilly region and plains; the hilly regions comprising **Satpura, Satmalas, Mahadeo, Ajanta,** and **Gawilgarh hills** are well forested.

- The plain covers the **Khandesh areas** (Khandesh is a region of central India, which forms the northwestern portion of Maharashtra state) which are broad and fertile suitable for cultivation primarily.



Tributaries of Tapti River

- ***Right Bank:*** the **Suki**, the **Gomai**, the **Arunavati** and the **Aner**.
- ***Left Bank:*** the **Vaghur**, the **Amravati**, the **Buray**, the **Panjhra**, the **Bori**, the **Girna**, the **Purna**, the **Mona** and the **Sipna**.

Projects on Tapti River

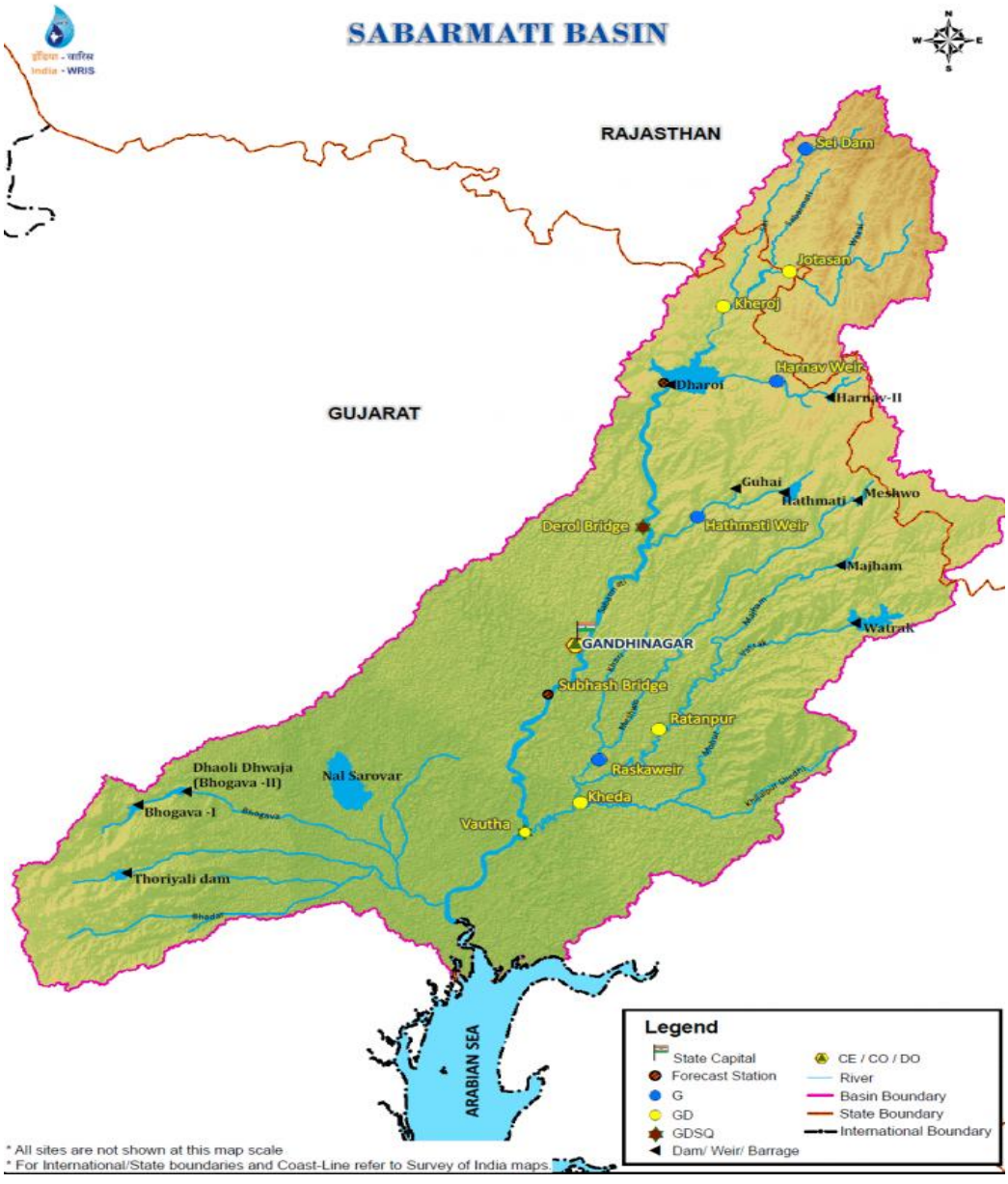
- Hathnur Dam of Upper Tapi Project (Maharashtra)
- Kakrapar weir and Ukai Dam of Ukai Project (Gujarat)
- Girna Dam and Dahigam Weir of Girna Project (Maharashtra)

Industry in the Tapti Basin

- Important industries in the basin are **textile factories in Surat** and **paper and news print factory at Nepanagar.**

Sabarmati River

- The Sabarmati is the name given to the combined streams the **Sabar** and **Hathmati**.
- The Sabarmati basin extends over the states of **Rajasthan and Gujarat** having an area of 21,674 Sq km.
- The basin is bounded by **Aravalli hills** on the north and north-east, by Rann of Kutch on the west, and by the **Gulf of Khambhat** on the south.
- The basin is roughly triangular in shape with the Sabarmati River as the base and the source of the **Vatrak River** as the apex point.
- Sabarmati originates from **Aravalli hills** at an elevation of 762 m near village Tepur, in th**e Udaipur district of Rajasthan.**
- The total length of the river from origin to **outfall into the Arabian Sea** is 371 km.
- The major part of the basin is covered with agriculture accounting to 74.68% of the total area.
- Rainfall varies from a meager few mm in Saurashtra to over 1000 mm in the southern part.
- **Left bank tributaries**: the **Wakal, the Hathmati, and the Vatrak.**
- **Right bank tributaries**: the **Sei.**
- Projects: **Sabarmati reservoir (Dharoi), Hathmati reservoir, and Meshwo reservoir project** are major projects completed during the plan period.



Industry in Sabarmati Basin

- **Gandhinagar** and **Ahmedabad** are the important urban centers in the basin.
- Ahmedabad is an industrial city situated on the banks of Sabarmati.
- Important industries are textiles, leather and leather goods, plastic, rubber goods, paper, newsprint, automobile, machine tools, drugs and pharmaceuticals etc.
- The industrial city of Ahmedabad poses the danger of water pollution.

Mahi River

- The Mahi basin extends over states of **Madhya Pradesh, Rajasthan, and Gujarat** having a total area of 34,842 Sq km.
- It is bounded by **Aravalli hills** on the north and the north-west**, by Malwa Plateau** on the east, **by the Vindhyas** on the south, and by the **Gulf of Khambhat** on the west.
- Mahi is one of the major **interstate west flowing** rivers of India.
- It **originates from the northern slopes of Vindhyas** at an altitude of 500 m in t**he Dhar district of Madhya Pradesh.**
- The total length of Mahi is 583 km.
- It **drains into the Arabian Sea through the Gulf of Khambhat.**
- The **major part of the basin is covered with agricultural land** accounting to 63.63% of the total area
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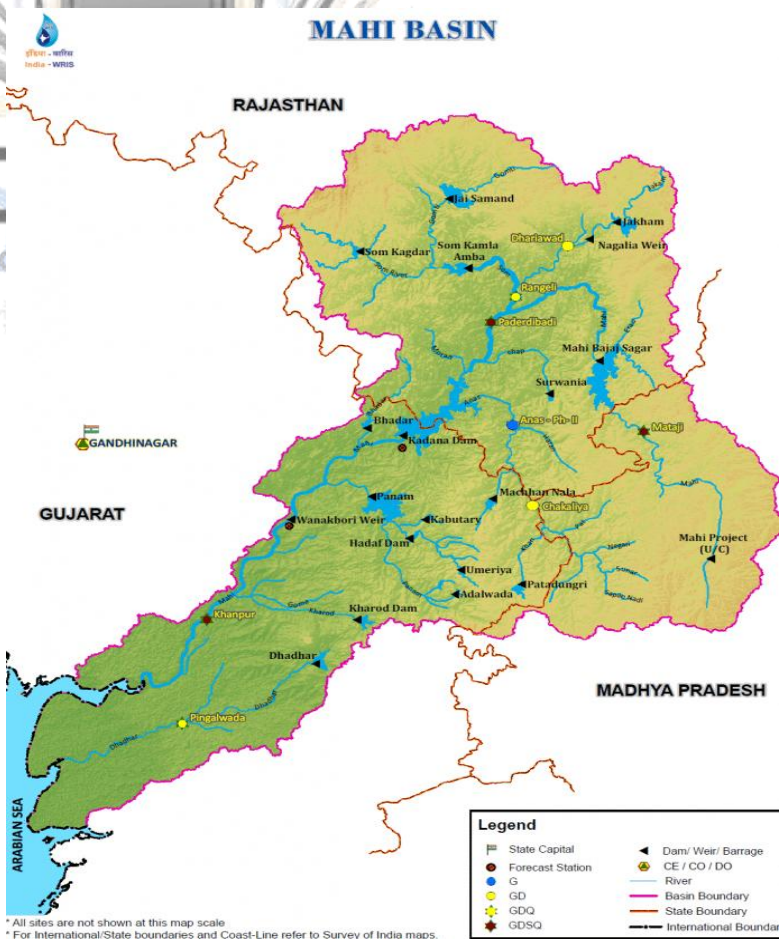

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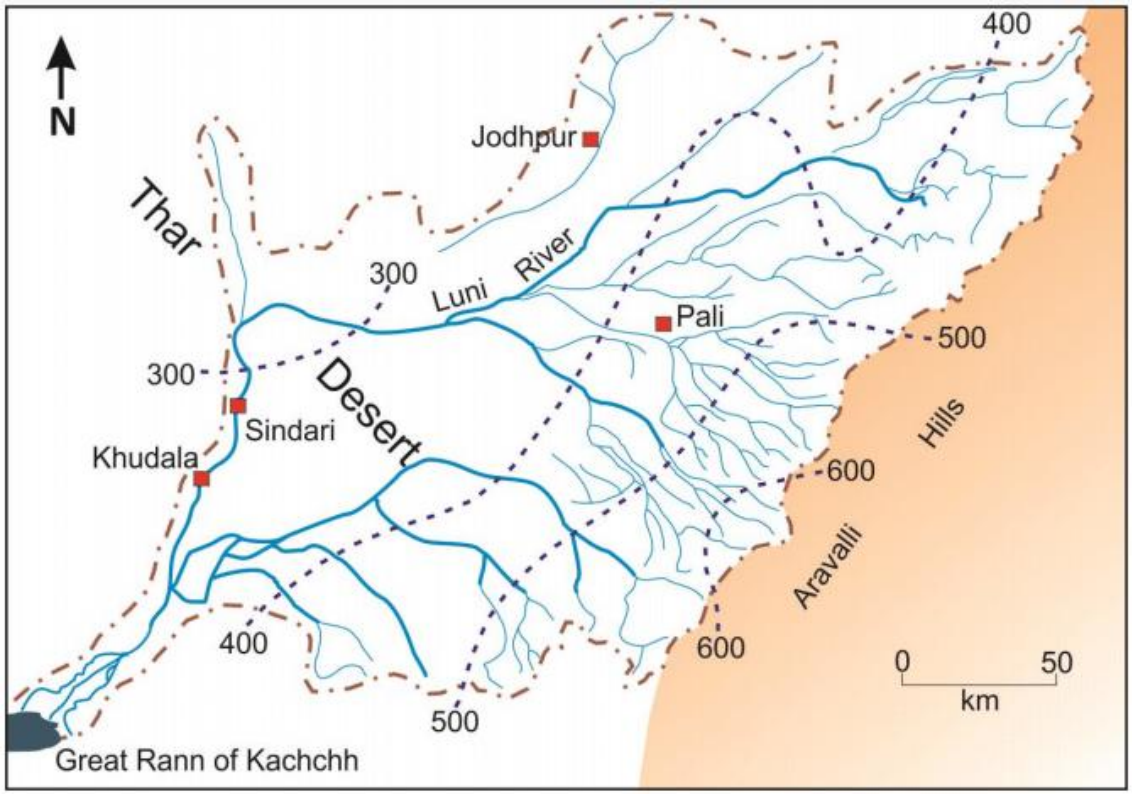

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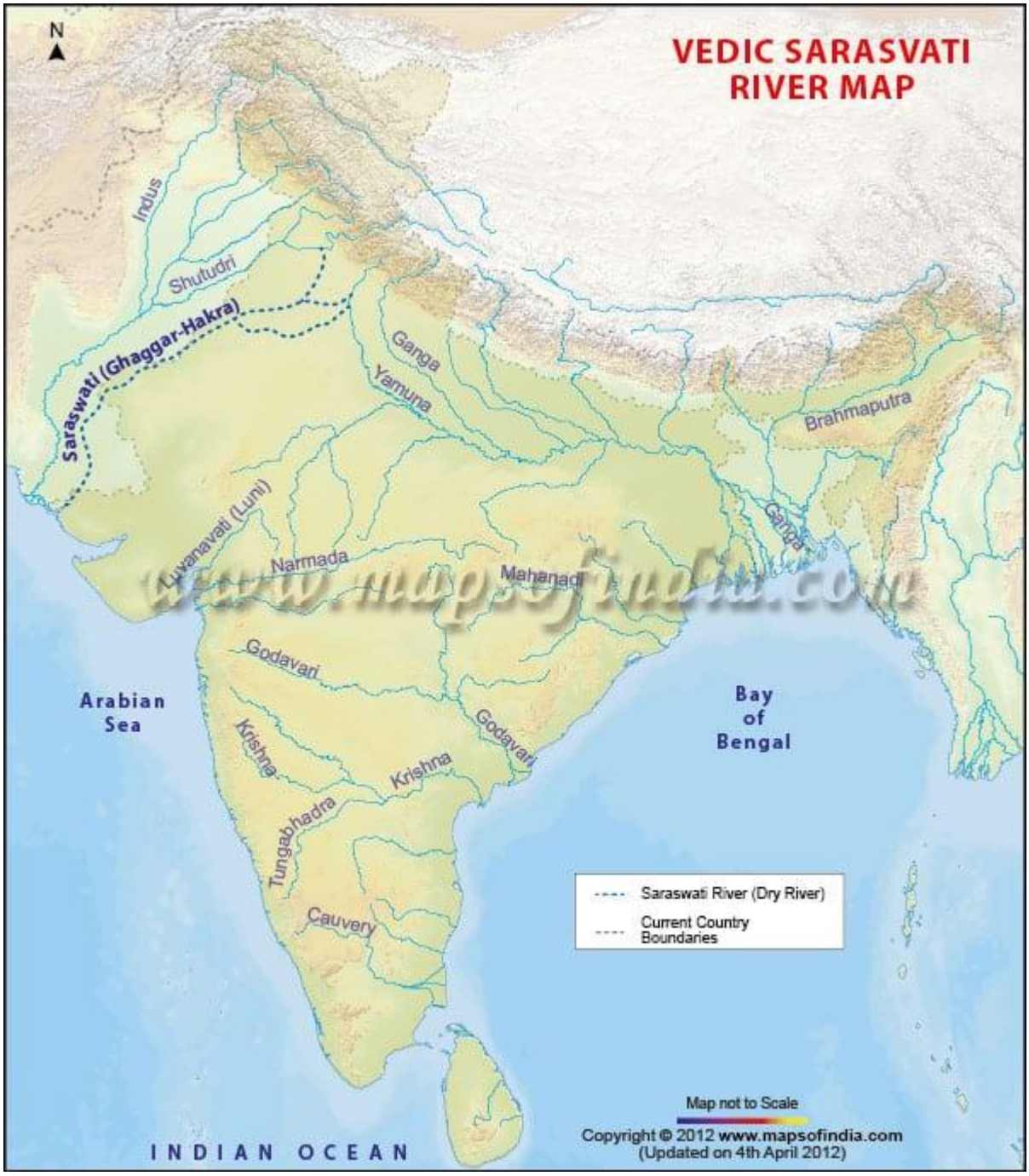

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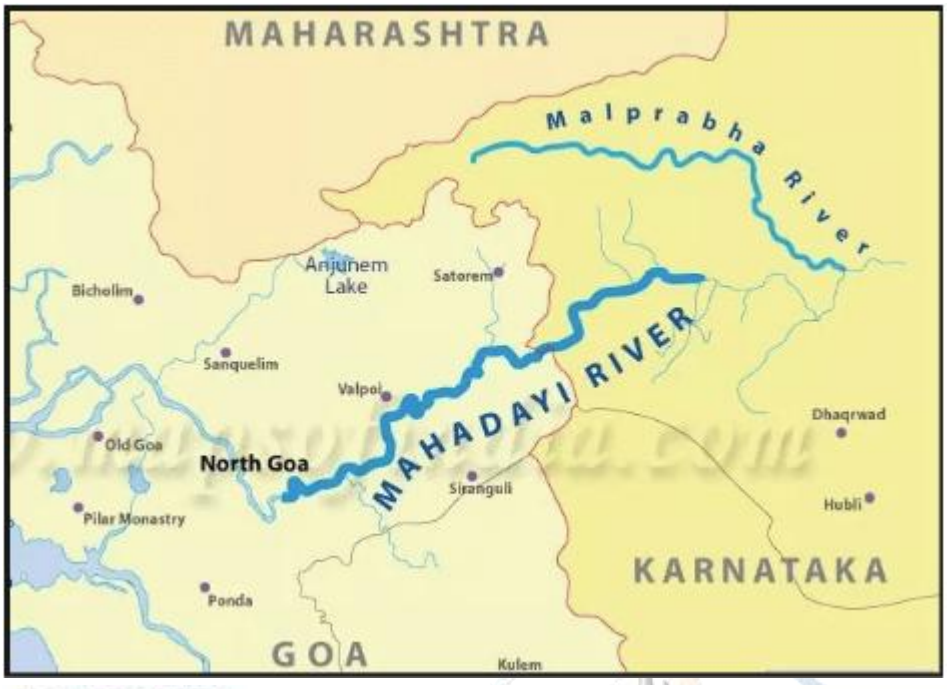

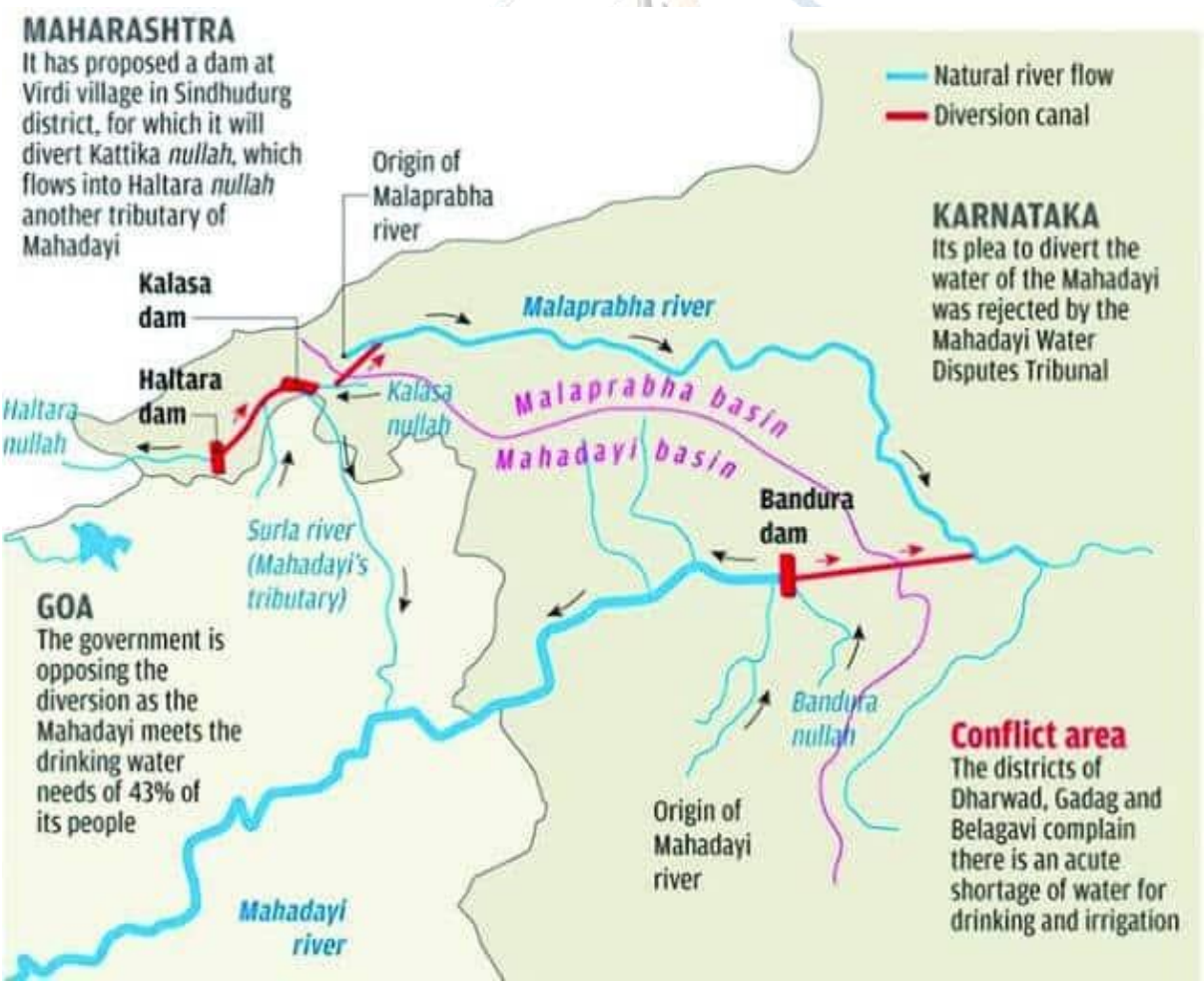

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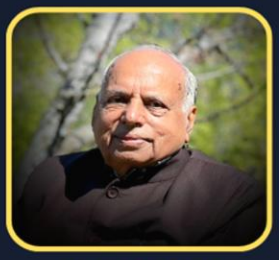

Suresh Jain
EX-I.A.S.

Shailendra Singh
Addl. Collector (A.D.M)

Robin Jain
Dy. S.P.

Vandana Jain
Joint Collector

Shubham Sharma
Joint Collector

Dipika Jain
C.T.I. (Commercial Tax)

In Collaboration With

Dir : Amit Jain
THE CORE IAS, DELHI

Dir : Sudarshan Lodha
TARGET UPSC, PUNE

THE CORE IAS

TARGET UPSC
The Lead You Need