



## Tectonic Events Changed the Course of Ganga

**For Prelims:** [Ganges Delta](#), [Paleochannel](#), [Indo-Burma Mountain Ranges](#), [Tectonic Plates](#), [Ganges-Meghna-Brahmaputra Delta](#), [Seismic Waves](#), [Sand Dikes](#), [Liquefaction](#), [Optically Stimulated Luminescence \(OSL\) Dating](#), [Flood](#), [Subsidence](#)

**For Mains:** Role of Important Geophysical Phenomena in shaping the of Earth.

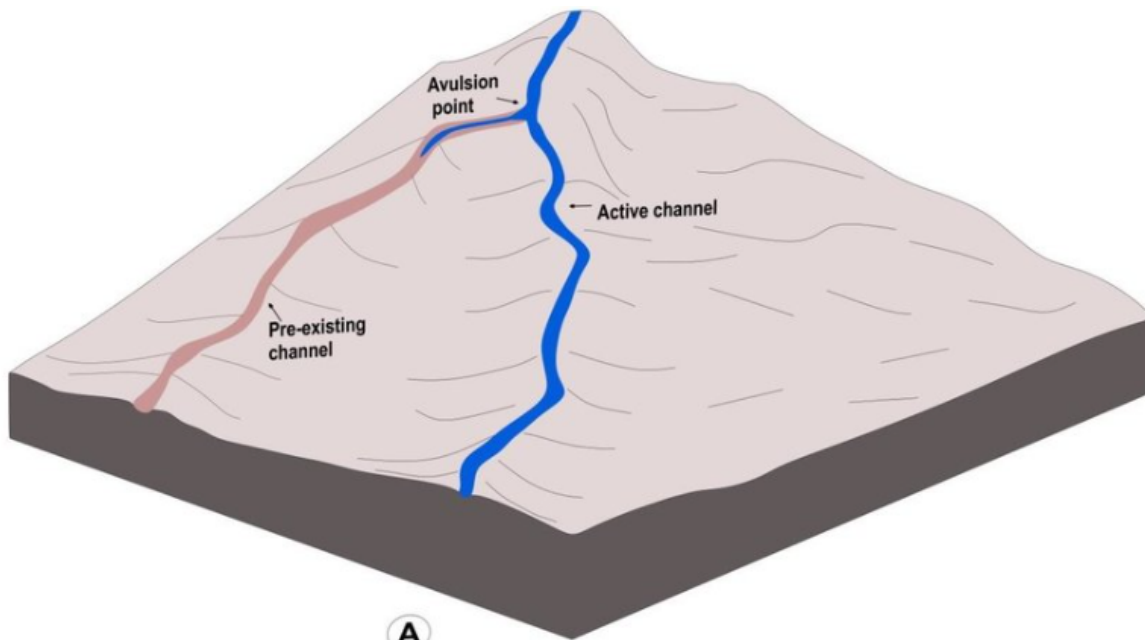
[Source: TH](#)

Recently, Researchers studied river channels in the [Ganges delta](#) in Bangladesh.

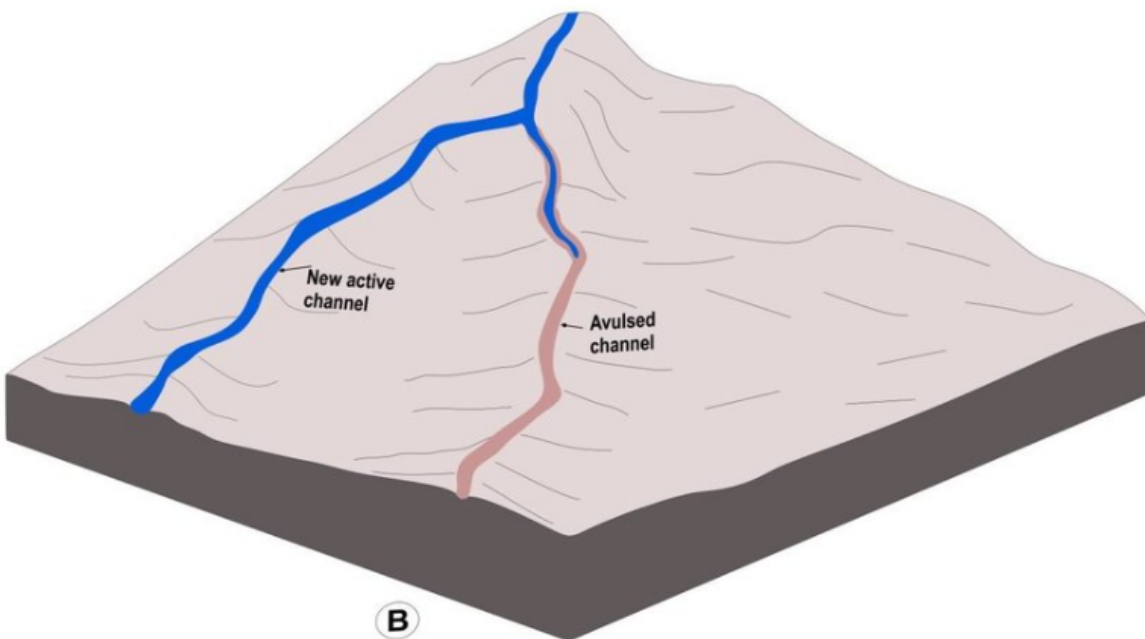
- They discovered a [paleochannel](#) (**ancient river channel**) indicating the Ganga had changed its course abruptly about 2,500 years ago due to an earthquake.

### How Earthquakes Impact the Course of a River Ganga?

- **Earthquake Origin:** The researchers speculated the earthquake could have originated from the [Indo-Burma mountain ranges](#) or the [Shillong hills](#), where the Indian and Eurasian **tectonic plates** meet.
- **Impact:** The discovery highlights that large earthquakes can trigger major river [avulsions](#) (changes in the course of river flow), which could lead to **devastating floods**, especially in densely populated regions like the [Ganges-Meghna- Brahmaputra delta](#).
- **Earthquake Evidence:**
  - **Seismite Formation: Seismites** (sedimentary beds deformed by seismic movements) are formed when [seismic waves](#) pressurise a layer of watery sand, causing it to burst through mud layers.
  - **Sand Dikes:** Researchers found two large [sand dikes](#) a kilometre to the east of the palaeochannel. Sand Dikes are formed when earthquakes disturb the river bed and cause sediments to flow ([liquefaction](#)).
  - **Dating Techniques:** Researchers used [optically stimulated luminescence \(OSL\) dating](#) to estimate the timing of the avulsion and the formation of the sand dikes. They determined that both events occurred around 2,500 years ago, suggesting the earthquake caused the river avulsion.
- **Future Hazards and Recommendations:**
  - **Potential Impact:** A similar earthquake today could [flood](#) areas affecting up to 170 million people in India and Bangladesh.
  - **Increased Risk:** Factors such as rapid [subsidence](#) and climate change-induced sea level rise increase the risk of river avulsions.
  - **Future Research:** Emphasis should be placed on understanding the frequency of quake-driven avulsions and improving earthquake forecasting.
  - **Preparedness:** There is a need for **collaboration between India, Bangladesh, and Myanmar for research, monitoring**, and preparedness to mitigate the risks **associated with such natural disasters**.



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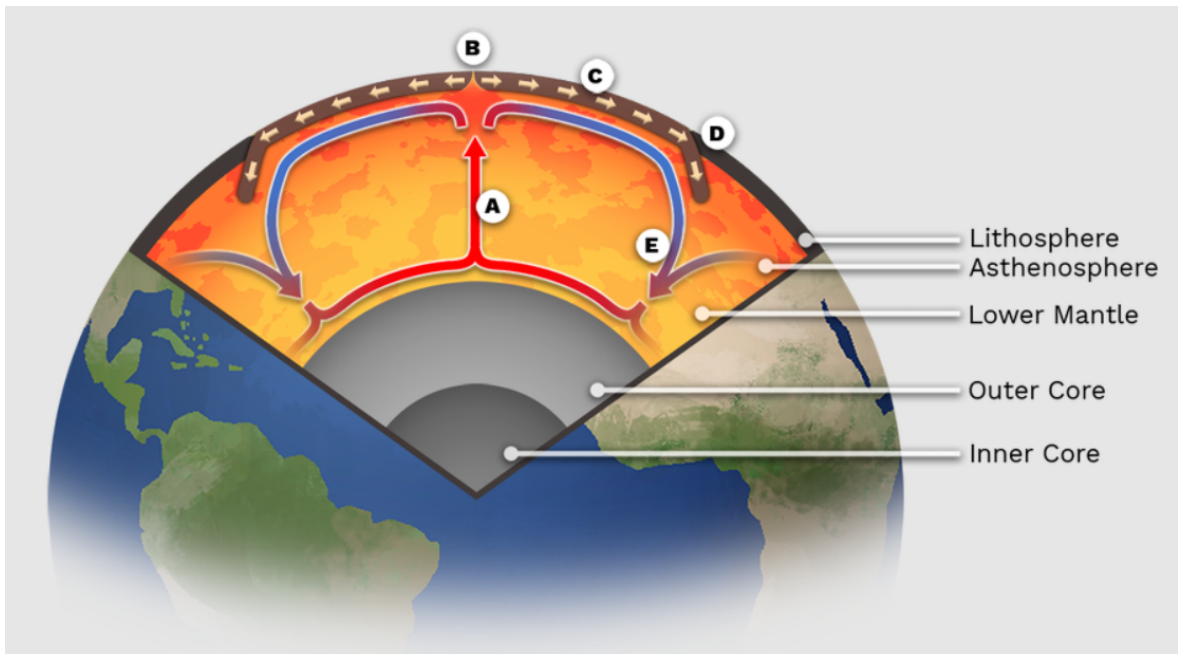


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## What are Tectonic Activities?

### ▪ Tectonic Activities:

- The Earth's outermost layer, the **lithosphere** (comprising the crust and upper mantle), is broken into large rocky plates.
  - These plates **rest** on a partially **molten layer** called the **asthenosphere**.
  - Due to **convection current** in the asthenosphere, the plates move at **different rates**, from 2-15 centimetres per year.
  - This movement creates various **geological formations**, including the **Himalayas**, the **East African Rift** and the **San Andreas Fault** in California.
- It explains how **major landforms** including the formation of **mountains**, **volcanic activity**, and **earthquakes** are created by the movements beneath the Earth's surface.
- The **seven major plates** listed from largest to smallest are the Pacific, **North American**, **Eurasian**, **African**, **Antarctic**, **Indo-Australian** and the **South American Plate**.

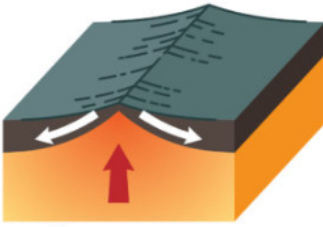


▪ **Earthquakes due to Tectonic Activities:**

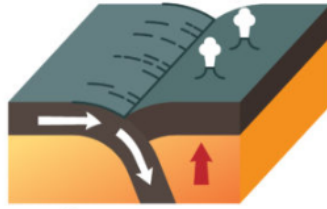
- Tectonic activities lead to **earthquakes** primarily through the movement of the Earth's tectonic plates.
- Earthquakes typically occur at the **boundaries** of tectonic plates, which can be **categorised into three main types:**
  - **Convergent Boundaries:** Plates move toward each other, causing one plate to be forced **beneath another (subduction)**. This process can create intense pressure and lead to **powerful earthquakes**.
  - **Divergent Boundaries:** Plates move apart from each other, allowing magma to rise and create new crust. Earthquakes here are usually **less powerful but frequent**.
  - **Transform Boundaries:** Plates slide past each other horizontally. The friction between the plates can cause stress to build up, which, when released, results in an **earthquake**.

# PLATE BOUNDARIES

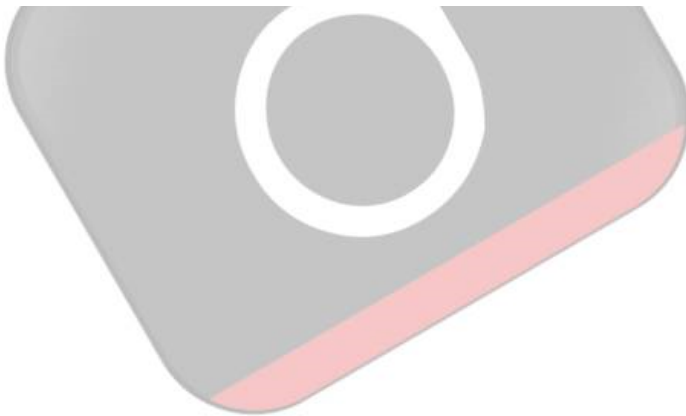
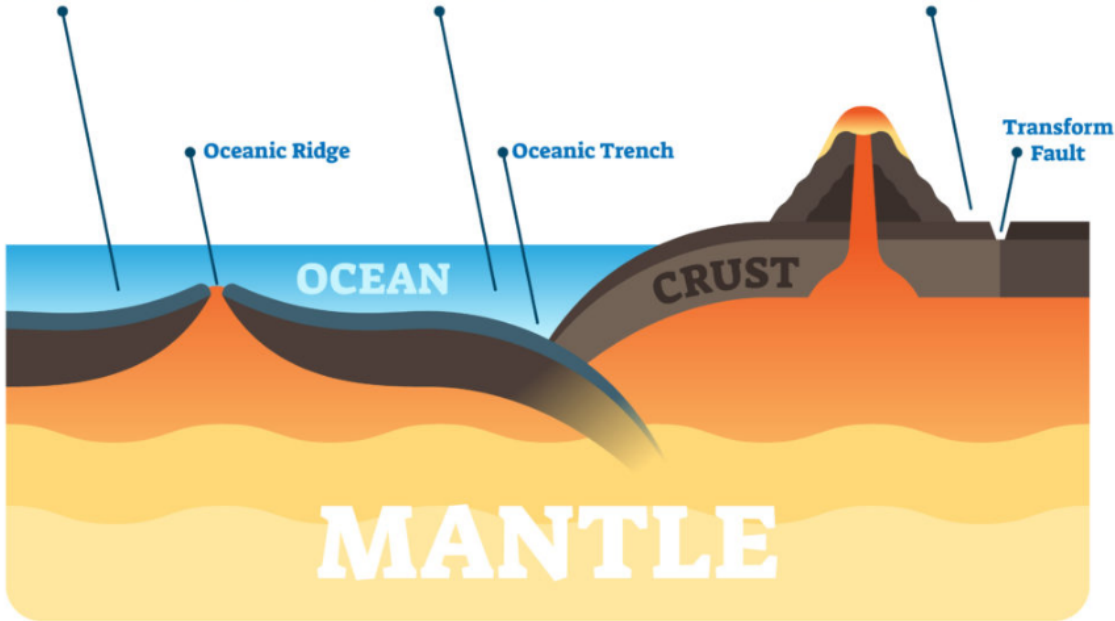
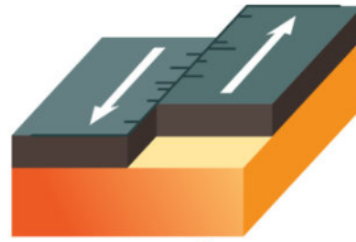
**DIVERGENT  
PLATE BOUNDARY**



**CONVERGENT  
PLATE BOUNDARY**



**TRANSFORM  
PLATE BOUNDARY**





# EARTHQUAKE



## ABOUT

- Shaking of the earth; caused due to release of energy, generating **seismic waves in all directions**

## EARTHQUAKE WAVES

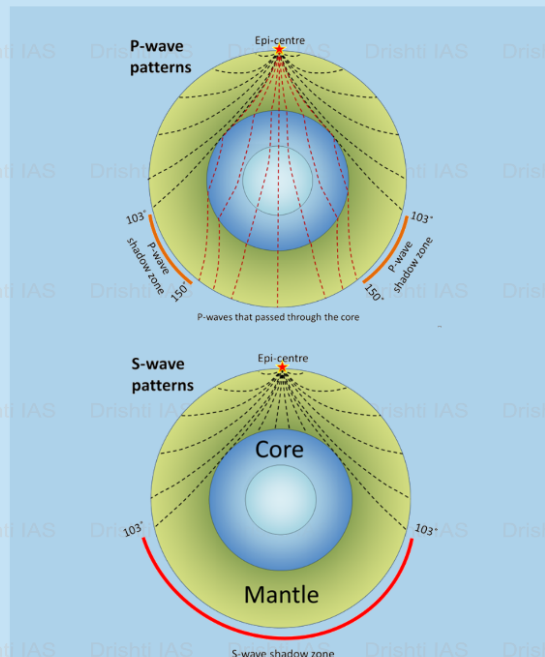
- Body Waves:** Move in all directions travelling through the body of the earth
  - P Waves:** Move faster, First to arrive at surface, Similar to sound waves, Travel through gaseous, liquid and solid materials
  - S Waves:** Arrive at surface with some time lag, Travel only through solid materials
- Surface Waves:** Last to report on seismographs, More destructive, Cause displacement of rocks
  - Love Waves:** Same motion as S-waves (horizontal) without vertical displacement, Sideways motion perpendicular to the direction of propagation, Faster than Rayleigh waves
  - Rayleigh Waves:** Cause the ground to shake in an elliptical pattern, Spread out the most of all seismic waves, Move vertically and horizontally in a vertical plane

## HYPOCENTER

- Location where the earthquake starts (below earth's surface)

## EPICENTER

- Location right above the Hypocenter (on the earth's surface)



## CAUSES OF EARTHQUAKES

- Release of energy along a Fault/Fault Zones** (break in the crustal rocks)
- Movement of **tectonic plates (most common)**
- Volcanic eruption** (stress changes in rock-injection/withdrawal of magma)
- Human activities** (mining, explosion of chemical/nuclear devices etc.)

## MEASURING EARTHQUAKE

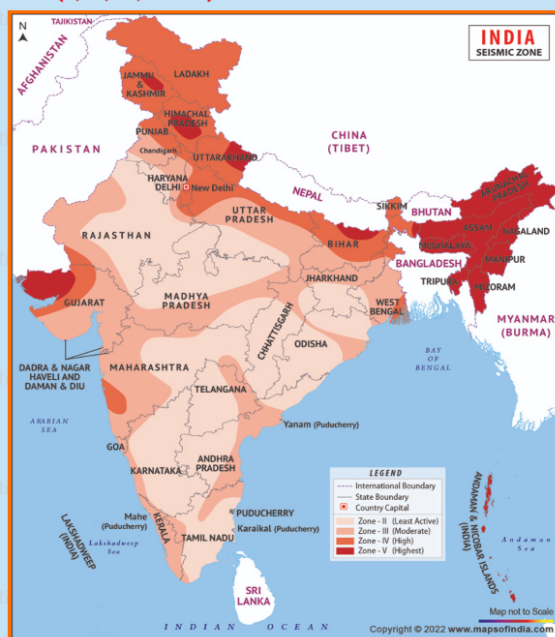
- Seismometers** - Measures seismic waves
- Richter Scale** - Measures magnitude (energy released; range: 0-10)
- Mercalli** - Measures intensity (visible damage; range: 1-12)

## DISTRIBUTION

- Circum-Pacific Belt** - 81% of earthquakes
- Alpide Earthquake Belt** - 17% of the largest earthquakes
- Mid-Atlantic Ridge** - Mostly submerged underwater

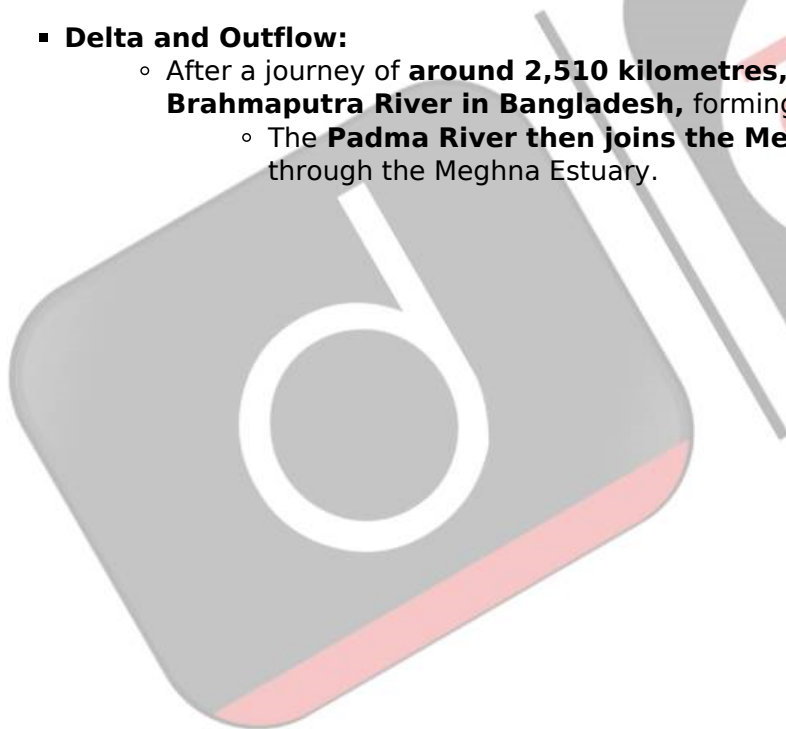
## EARTHQUAKE IN INDIA

- India is **one of the highly earthquake affected countries** due to the presence of technically active mountains - the Himalayas.
- India has been divided into **4 seismic zones (II, III, IV, and V)**



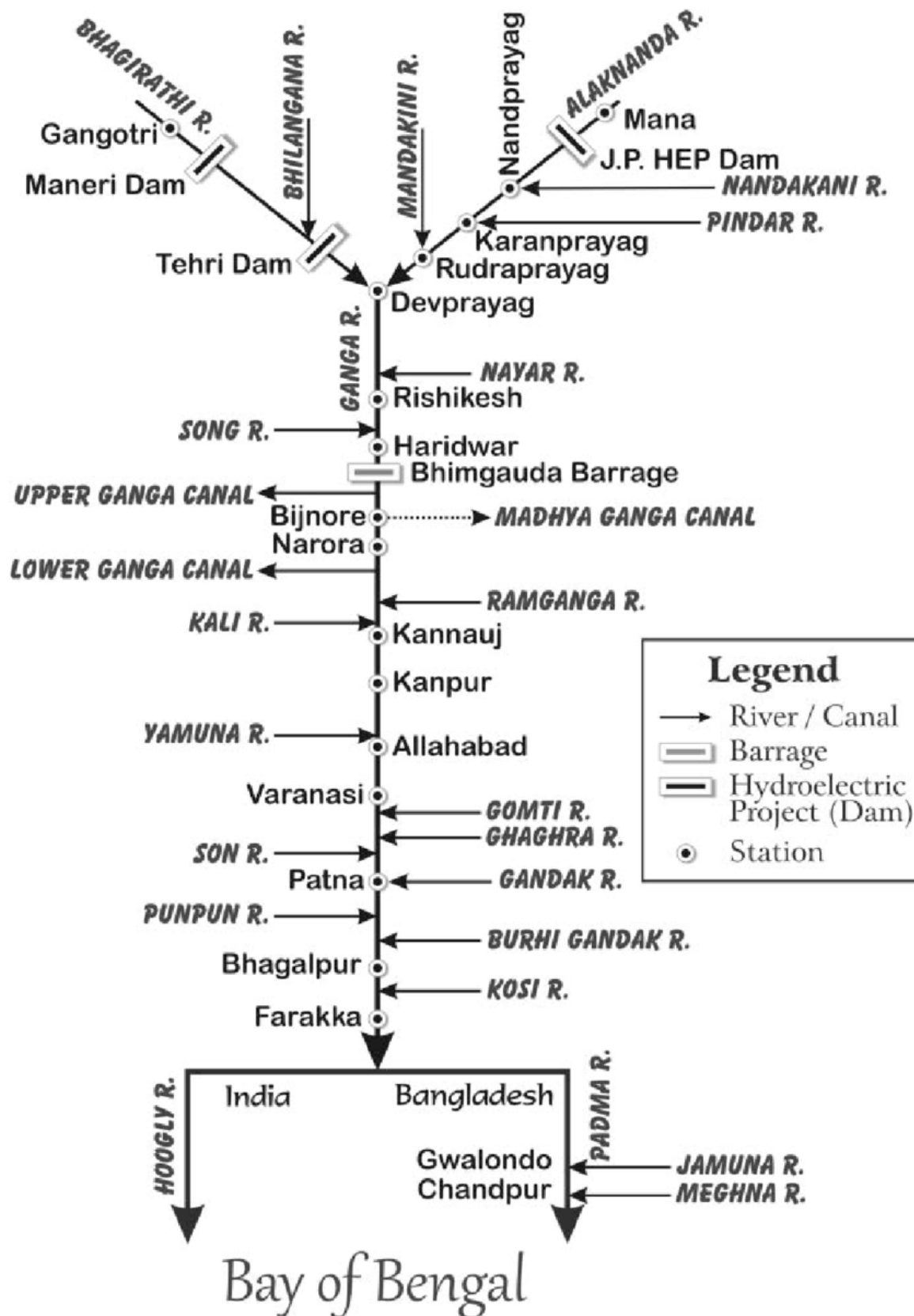
## What are Key Facts About the Ganga River System?

- The **Ganga** originates as Bhagirathi from **Gangotri Glacier, Uttarakhand** at an elevation of 3,892 m.
- Many small streams comprise the **headwaters** of the Ganga. The important among these are **Alaknanda, Dhauliganga, Pindar, Mandakini** and **Bhilangana**.
  - At Devprayag, where Alaknanda joins Bhagirathi, the river acquires the name Ganga. It traverses 2525 km before flowing into the Bay of Bengal.
- The Ganga is **formed from the 6 headstreams and their five confluences**.
  - **Devprayag**: Confluence of Bhagirathi river and Alaknanda river.
  - **Rudraprayag**: Confluence of **Mandakini river and Alaknanda** river.
  - **Nandaprayag**: Confluence of **Nandakini river and Alaknanda** river.
  - **Karnaprayag**: Confluence of **Pindar river and Alaknanda** river.
  - **Vishnuprayag**: Confluence of **Dhauliganga river and Alaknanda** river.
- The **Bhagirathi, considered to be the source stream**, rises at the foot of Gangotri Glacier, at Gaumukh. It finally empties into the Bay of Bengal.
- **Major Tributaries of the Ganga River:**
  - **Left Bank Tributaries:** Ramganga, Gomti, Ghaghara, Gandak, Burhi Gandak, Koshi, Mahananda.
  - **Right Bank Tributaries:** Yamuna, Tons, Karamnasa, Sone, Punpun, Falgu, Kiul, Chandan, Ajoy, Damodar, Rupnarayan.
- The **Ganga** flows out of the hills and into the plains at a point where it **meets the Yamuna in Allahabad**.
- **Delta and Outflow:**
  - After a journey of **around 2,510 kilometres, the Ganga River merges with the Brahmaputra River in Bangladesh**, forming the Padma River.
    - The **Padma River then joins the Meghna River** and flows into the Bay of Bengal through the Meghna Estuary.



# Flow Chart of the Ganga River Basin

(Not To Scale)



**Legend**

- River / Canal
- ▬ Barrage
- ▬ Hydroelectric Project (Dam)
- Station

## Tectonic Movement and Decline of Harappan Civilization

- Multiple layers of silt at Mohenjodaro show that repeated Indus river floods contributed to the decline of the Harappan civilization.

- **Researchers** argued that the floods at Mohenjodaro were the result of tectonic **movements**.
- The theory states that the Indus area is a **disturbed seismic zone** and tectonic movements led to the creation of a **gigantic natural dam** that **prevented** the **Indus** from flowing towards the sea, turning the area around Mohenjo Daro into a huge lake.
  - It caused **prolonged submergence** of the cities located on the bank of the river Indus.
- They argued that such flooding which could **drown buildings 30 feet** above the ground level of the settlement could **not** be the result of **normal flooding** in the river Indus.
- However, few researchers pointed out that the idea that a river would be dammed in such a manner even by tectonic uplifts is **not convincing**.

#### **Drishti Mains Question:**

Q. What is Plate Tectonics? How does it affect the various geophysical phenomena on Earth?

## **UPSC Civil Services Examination Previous Years' Questions (PYQs)**

### Mains

**Q.** Mention the global occurrence of volcanic eruptions in 2021 and their impact on the regional environment. **(2021)**

**Q.** Briefly mention the alignment of major mountain ranges of the world and explain their impact on local weather conditions, with examples. **(2021)**

**Q.** Explain the formation of thousands of islands in Indonesian and Philippines archipelagos. **(2014)**

PDF Reference URL: <https://www.drishtias.com/printpdf/tectonic-events-changed-the-course-of-ganga>