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## Prelims Geography-9: Physiography of India-2

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### Model Questions

Please check Prelims Model Questions at the end of this module

### India's Drainage System

#### Open and Closed Basins

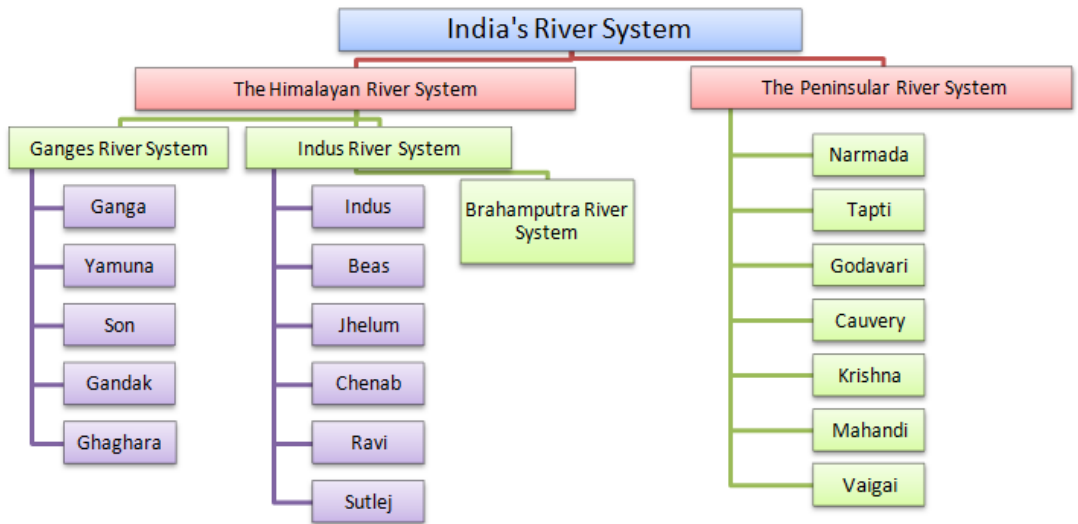
A drainage system is the pattern formed by the streams, rivers, and lakes in a particular **drainage basin**. A drainage basin is an extent or an area of land where surface water from rain and melting snow or ice converges to a single point or where the waters join another water body, such as a river, lake, reservoir, estuary, wetland, sea, or ocean.

The basin can be closed basin or open Basin. In open basin, the water body is hydro-logically toward the sea. The rivers which drain to oceans and seas have open basins.

In closed drainage basins the water converges to a single point inside the basin, known as a sink, which may be a permanent lake, dry lake, or a point where surface water is lost underground.

The drainage basin includes both the streams and rivers that convey the water as well as the land surfaces from which water drains into those channels, and is separated from adjacent basins by a drainage divide. The other words used for basin are catchment, catchment area, catchment basin, drainage area, river basin, water basin and watershed.

The river basins are controlled by the topography of the land such as rock types, gradient, soil type etc. The stream in a basin can be runoff, through flow or underground flow. The topographic barriers make watersheds. A watershed would represent all the stream tributaries that flow to some distance along the main stream. *Almost all of India's rivers are of open basin as more than 90% of total surface water runoff would go to Bay of Bengal.* Rest goes to Arabian Sea. There is just a small area in parts of Ladakh, northern parts of the Aravalli range and the arid parts of the Thar Desert, that have inland drainage.



### Indus River System

Indus River System is made of Indus River and its tributaries viz. Ravi, Beas, Satluj, Jhelum, Kishenganga (Neelum) and Chenab.

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The important facts about the rivers are as follows:

#### Indus River

- Indus River originates in Tibet in northern slopes of Mount Kailash near lake Mansarovar. Running via Ladakh, it enters into Pakistan through Gilgit-Baltistan and ends in Arabian Sea near Karachi.
- The total length of the river is 3,180 kilometers, making it Pakistan's longest river and world's

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21st largest river in terms of annual flow. The river basin is 11,165,000 square kilometers.

- Several tributaries of Indus River in Pakistan side are Nagar River, Astor River, Balram River, Dras River, Gar River, Ghizar River, Gilgit River, Gumal River, Kabul River, Kurram River, Panjnad River, Shigar River, Shyok River, Sohan River, Tanubal River, Zaskar River etc.
- On the eastern side, portion of it does run through Indian territory, as do parts of the courses of its five major tributaries viz. Beas, Chenab, Jhelum, Ravi and Sutlej. These tributaries are the source of the name of the Punjab region.

### Beas River

- Originates in the southern slopes of Pir Panjal ranges near Rohtang Pass in Himachal Pradesh.
- It flows south past Manali and through the Kullu Valley before entering the Punjab plains. It meets the Sutlej River near the **Harike Wetland** south of Amritsar. The Sutlej continues into Pakistani Punjab and joins the Chenab River at Uch near Bahawalpur to form the Panjnad River; the latter in turn joins the Indus River at Mithankot. So, originating in India and running for 470 kilometers, the river meets Sutlej in Punjab of India.
- The river is of Historic, known as *Arjikuja* and *Vipasa* in ancient times and **Hypphasis to ancient Greeks**.
- Some of the tributaries of the river Beas are as
  - **Parbati** which rises in the snowy wastes above Manikaran. It joins the river Beas near Shamshi in the Kulu valley;
  - **Haria** which joins the river Beas near Bhuntar;
  - **Sainj** which rises in the snows of an off-shoot of the Pir Panjal range that marks the watershed of the Beas and Satluj rivers. It joins the river Beas near Larji;
  - **Tirthan** which rises in the snows of an off-shoot of the Pir Panjal range. It joins the river Beas near Larji.

### Jhelum River

- Jhelum rises from **northern slopes of Pir Panjal ranges at Verinag spring** <sup>(which is main source)</sup> which girdles the valley of Kashmir. It flows through Srinagar and the Wular Lake before entering Pakistan through a deep narrow gorge.
- **The Kishenganga (Neelum) River, the largest tributary of the Jhelum**, joins it, at Domel Muzaffarabad. The Jhelum enters the Punjab in the Jhelum District. From there, it flows through the plains of Pakistan's Punjab, forming the boundary between the Chaj and Sindh Sagar Doabs.



- It ends in a confluence with the Chenab at Trimmu in District Jhang. The Chenab merges with the Sutlej to form the **Panjnad River** which joins the Indus River at Mithankot. Thus, In India it flows on in Jammu & Kashmir State.
- *Jhelam is the largest and most western of the five rivers of Punjab.* Chenab is its tributary. It was called **Vitasta in Rigveda** and **Hydaspes by the ancient Greeks**. Alexander the Great and his army crossed the Jhelum in BC 326 at the Battle of the Hydaspes River where it is believed that he defeated the Indian king, Porus.
- Verinag is situated at a distance of approximately 80 km from Srinagar. Considered to be the source of the River Jhelum, often termed as the lifeline of the province of Jammu and Kashmir, the beautiful region of Verinag a weekend getaway from Srinagar. The important dams and barrages on Jhelam river are **Mangla Dam, Rasul Barrage, Trimmu Barrage**.
- Its major tributaries are –
  - Liddar which originates in the snowy wastes at Chandanwari. It joins the river Jhelum in the central pan of the Kashmir valley;
  - Sind River which originates in the southern slopes of the great Himalayan range which hems the Kashmir valley;
  - Kishenganga which also originates on the southern slopes of the great Himalayan range.

### Chenab River

- Chenab River was called **Ashkini in Vedic times**. It originates at snow melt from the **Bara Lacha Pass in the Himachal Pradesh**. The waters flowing south from the pass are known as the **Chandra River** and those that flow north are called the **Bhaga River**. Eventually the Bhaga flows around to the south joining the Chandra at the village of Tandi, forming the **Chandrbhaga River at Tandi**.
- It becomes the Chenab when it joins the Marau River at Bhandera Kot, 12 km from Kishtwar Town in Jammu and Kashmir. It flows in the Indian state of Jammu & Kashmir, then Pakistan Province of Punjab and merges with Jhelum River at Trimmu, Ravi River Ahmedpur Sialand Sutlej River near Uch Sharif, Pakistan to form the Panjnad or the 'Five Rivers', the fifth being the Beas River which joins the Satluj near Ferozepur, India. The Chenab then joins the Indus at Mithankot, Pakistan.
- The total length of the Chenab is approximately 960 kilometres. The waters of the Chenab are allocated to Pakistan under the terms of the Indus Waters Treaty. **It was known as Acesines to the Ancient Greeks.**



### Ravi River

- The Ravi or **Iravati or Purushni of ancient India** is smallest of Five Punjab Rivers. It originates in Bara Bhangal, District Kangra in Himachal Pradesh and gets hemmed by Dhauladhar range in the south and the Pir Panjal in the north. It originates in Bara Bhangal as a joint stream formed by:
  - The Bhadal, which is fed by glaciers.
  - The Tant Gari, which is also fed by glaciers.
- The river Ravi flows in more or less westerly direction before it cuts across the Dhauladhar range to enter the plains of Punjab. Its main northern bank tributaries are the snow fed Siul and Baira streams. It follows a north-westerly course, flows through Barabhangal, Bara Bansu and Chamba districts. It flows in rapids in its initial reaches with boulders seen scattered in the bed of the river. The Budhil River, in Himachal Pradesh is a major tributary of the Ravi River. Another major tributary that joins the Ravi River, just below Bharmour, the old capital of Chamba, is the Seul River from the northern direction.
- The valley formed by the river was also exploited for its rich timber trees. However, the valley has large terraces, which are very fertile and known as “the garden of Chamba”. crops grown here supply grains to the capital region and to Dalhousie town and its surrounding areas. One more major tributary that joins the Ravi River near Bissoli is the Siawa. It enters the Punjab plain near Madhopur and Pathankot. It then flows along the Indo-Pak border for 80 kilometres (50 mi) before entering Pakistan and joining the Chenab River. The total length of the river is about 725 kilometres.
- Since this river flows at the boundary of India and Pakistan, studies have shown that the river is changing its course towards India due to heavy constructions in its way by Pakistan.

### Sutlej River

- Sutlej River was known as Śutudri in ancient India and is longest of the five rivers of Punjab. It originates near Lake Rakshastal in Tibet. It flows for a considerable distance before entering Indian Territory near Shipki La. Thereafter, it drains past the trans-Himalayan zone of Spiti. The major tributary which joins the river Satluj in this tract is the river Spiti. This tributary rises on the northern slopes of the great Himalayan range which hems the Lahaul and Spiti valleys. It drains the latter valley and flows in an eastern and south westerly direction before joining the river Satluj. The river Satluj has cut across the great Himalayan range through a deep gorge.
- Just upstream of this gorge, it is joined by the river Baspa which drains the north eastern part of Himachal Pradesh. After crossing the great Himalayan range, the river Satluj flows in a





more or less S W direction before emerging into the plains near Bhakra. In Pakistan, it waters the ancient and historical former Bahawalpur state. The region to its south and east is arid, and is known as Cholistan, is a part of Bahawalpur Division.

- The Sutlej is joined by the Beas River in Hari-Ke-Patan, Amritsar, Punjab, India, and continues southwest into Pakistan to unite with the Chenab River, forming the Panjnad River near Bahawalpur. The Panjnad joins the Indus River at Mithankot. Indus then flows through a gorge near Sukkur, flows through the fertile plains region of Sindh, and terminates in the Arabian Sea near the port city of Karachi in Pakistan. The waters of the Sutlej are allocated to India under the Indus Waters Treaty between India and Pakistan, and are mostly diverted to irrigation canals in India.

### Ganges River System

The major river Ganga and its tributaries like Yamuna, Son, and Gandak make the biggest cultivable plains of north and eastern India, known as the Indo-Gangetic plains. The main river, Ganga forms by the joining of the Alaknanda River and Bhagirathi River at Devprayag. The Bhagirathi, which is considered the Ganga's true source starts from Gomukh.

#### Course of Ganga

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Gangotri is called the origin of the River Ganga and seat of the goddess Ganga. However, it is actually the source of one of the Ganga's **6 headstreams** known as **Bhagirathi**. **Bhagirathi itself is joined by two headstreams called Bhilangna River and Jahnvi River**. Another mighty headstream is river **Alaknanda**. Bhagirathi and Alaknanda are the two major rivers of the Garhwal Himalaya, both originating from the mighty **Chaukhamba range of glaciers**. Chaukhamba is a mountain massif in the Gangotri Group of the Garhwal Himalaya. Its main summit, **Chaukhamba I**, is the highest peak in the group. It lies at the head of the Gangotri Glacier and forms the eastern anchor of the group. Other peaks are Chaukhamba II, Chaukhamba III and Chaukhamba IV.

Bhagirathi has its origin at Gangotri (which is called Gangotri Glacier) on the north-western face of Chaukhamba.

Alaknanda rises at the confluence and feet of the **Satopanth and Bhagirath Kharak glaciers**, on the south-eastern slopes of glacier fields of Chaukhamba.



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Gangotri is one of the four sites in the Char Dham pilgrimage circuit, other being Yamunotri, Kedarnath and Badrinath. The Gangotri Glacier is located in Uttarkashi District, Uttarakhand. The terminus of the Gangotri Glacier is said to resemble a cow's mouth, and the place is called Gomukh. Gaumukh is the source of Bhagirathi river. Gomukh is situated near the base of Shivaling; in between lies the Tapovan meadow. The river Bhagirathi flows from Gangotri and at Devprayag, it meets another headstream of Ganga called Alaknanda.

### Alaknanda

As written above, Alaknanda rises at the confluence and feet of the Satopanth and Bhagirath Kharak glaciers, on the south-eastern slopes of glacier fields of Chaukhamba. It meets the Bhagirathi river at Devprayag after flowing for approximately 190 km through the Alaknanda valley. After originating, it first meets the Saraswathi River and then flows in front of the Badrinath temple. After this, it meets its tributary and another headstream of Ganga called Dhauliganga. When Alaknanda meets Dhauliganga, it is called Vishnu Prayag. The two streams now become one and go ahead. Next headstream is Nandakini, which meets Alaknanda at Nandaprayag.

- From here, the Alaknanda river becomes mighty and now meets Pindar River at Karnaprayag.
- After Karnaprayag, the Mandakini river meets this stream and it is called Rudraprayag.
- Finally, the Alaknanda meets Bhagirathi at Devprayag and from here, it is called Ganga.



- These five Prayags or confluences are collectively called **Panchaprayag**. The Alaknanda contributes a significantly larger portion to the flow of the Ganga than the Bhagirathi.

Thus in all there are 6 headstreams that contribute in the making of Ganga. These are Alaknanda, Dhauliganga, Nandakini, Pindar, Mandakini, and Bhagirathi rivers.

### Further Course of Ganga Till Kanpur

After flowing 250 kilometers, Ganga emerges from the mountains at Rishikesh, and then debouches onto the Gangetic Plain at Haridwar.

Some of the Ganga water at Haridwar is diverted into the Ganga Canal, which irrigates the Doab region of Uttar Pradesh. Till Haridwar, the route of Ganga is little southwest, from here it begins to flow southeast through the plains of northern India. It flows 800 kilometers passing via Kannauj, Farukhabad, and reaches Kanpur. Before Ganga reaches Kanpur, two important rivers join it. One is **Kali River** and another is Ramganga. Kali River is also known with this name in Nepal but is known as **Sharda River in India**. It originates at Kalapaani in Pithoragarh district of Uttarakhand. Kali River makes India's eastern boundary with Nepal at some places and when it reaches the plains of Uttarakhand and Uttar Pradesh, it would be called as Sharda.

Next is Ramganga. Please note that there are two Ramganga rivers. One of them starts from Doodhatoli ranges in Pauri Garhwal and another from Namik Glacier of Pithoragarh. The Bareilly of Uttar Pradesh is located on the banks of the first. After Bareilly, it meets Kali River. The Kali river keeps flowing till Bahraich, by then it is known as **Saryu River**. Saryu River meets Ganga in the Bahraich of Uttar Pradesh.

### After Kanpur

After Kanpur, Ganga joins the Yamuna at the **Triveni Sangam** at Allahabad, a holy confluence in Hinduism. At their confluence the Yamuna is larger than the Ganga. After this, several stream such as Tamsa River, Ghaghara river, Gandaki River, Kosi River join it at various places which shall be discussed in this module. Ganga remains one stream flowing southeast till Bhagalpur. From Pakur in Jharkhand, Ganga starts dividing into various distributaries. In the Murshidabad District of West Bengal at the Farakka Barrage, Ganga's first distributor **Bhāgirathi-Hooghly** gets branched out. This Bhāgirathi-Hooghly river later becomes Hooghly river and then enters the twin cities of Kolkata and Howrah. At Nurpur it enters an old channel of the Ganga and turns south to empty into the Bay of Bengal.

The Farakka Barrage controls the flow of the Ganga, diverting some of the water into a feeder canal linked to the Hooghly for the purpose of keeping it relatively silt-free. Before the Hooghly river empties into Bay of Bengal, it meets Damodar River. But, the main branch of Ganga has to go a long way still. It enters Bangladesh from India near Chapai Nababganj and now its name is **Padma River**.



Here Padma meets one of the distributaries of Brahmaputra called **Jamuna or Jomuna**.

This combined stream meets Meghna river, that is another distributary of Brahmaputra at Chandpur in Bangladesh. The Meghna River finally flows into the Bay of Bengal.

The above discussion makes it clear that various distributaries of Ganga and Brahmaputra meet along the Bay of Bengal and these make one of the **largest delta in the world called Ganges Delta or Ganges-Brahmaputra delta**.

They also create underwater Bengal Fan, which is one of the largest submarine fans on Earth. The fan is about 3000 km long, 1000 km wide with a maximum thickness of 16.5 km. Most of the sediment is supplied by the confluent Ganga and Brahmaputra Rivers through the Ganga Delta in Bangladesh and West Bengal, India, with several other large rivers in Bangladesh and India providing smaller contributions.



### Tributaries of Ganga

The main tributaries of Ganga River are as follows:

#### Son River

Son River is largest of **southern tributaries of Ganga** that originates near Amarkantak in Madhya Pradesh near the source of Narmada River, and flows north-northwest through Madhya Pradesh before turning sharply eastward where it encounters the south-west-northeast-running Kaimur Range.

- The Son parallels the Kaimur hills, flowing east-northeast through Uttar Pradesh, Jharkhand

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and Bihar states to join the Ganga just above Patna. Geologically, the lower valley of the Son is an extension of the Narmada Valley, and the Kaimur Range an extension of the Vindhya Range.

- Chief tributaries of Son river are **Rihand and the North Koel**. The Son has a steep gradient (35–55 cm per km) with quick run-off and ephemeral regimes, becoming a roaring river with the rain-waters in the catchment area but turning quickly into a fordable stream.
- The Rihand River is a tributary of the Son River and flows through the Indian states of Chhattisgarh and Uttar Pradesh. It rises in Chhattisgarh at Matiranga hills and there is a Rihand Dam that was constructed at Pipri in Sonbhadra district of Mirzapur division in 1962 for hydropower generation. The reservoir of this dam is called Govind Ballabh Pant Sagar. Rihand meets Son at Sonbhadra of Uttar Pradesh.

### Ghaghara River

Karnali or Ghaghara originates in glaciers of Mapchachungo on the Tibetan Plateau near Lake Mansarovar, cuts through the Himalayas in Nepal and joins the Sarda River at Brahmaghat in India.

With a length of 507 kilometers it is the largest river in Nepal. The total length of Ghaghara River up to its confluence with the Ganga at Doriganj in Bihar is 1,080 kilometers.

It is the largest tributary of the Ganga by volume and the second longest tributary of the Ganga by length after Yamuna.

In Chinese it is called **K'ung-ch'iao Ho**, in Nepali it is called Kauriala and Karnali.

- Before Ghaghara joins the Ganga, river **West Rapti** joins it as an important tributary.
  - West Rapti is known as “Gorakhpur’s Sorrow”.
  - West Rapti is itself tributed by Rohni River in Gorakhpur.

### Gomti River

The Gomti originates from Gomat Taal which formally known as Fulhaar jheel, near Madho Tanda, Pilibhit, India.

It extends 900 km through Uttar Pradesh and meets the Ganga River near Saidpur, Kaithi in Ghazipur.

### Yamuna River

India’s Yamuna River is largest tributary of Ganga River, while Bangladesh’s Jamuna River is largest distributary channel of the Brahmaputra River. Origin of Yamuna is at Yamunotri Glacier on the south western slopes of **Banderpooch peak** in the Lower Himalayas in Uttarakhand. From there it travels a total length of 1,376 kilometers before merging with the Ganga at Triveni Sangam or Prayag at Allahabad.

### Yamuna River

Yamuna River is largest tributary of Ganga River, while Bangladesh’s Jamuna River is largest

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tributary channel of the Brahmaputra River. Yamuna is another sacred river of India that originates from Yamunotri Glacier at height 6,387 metres, on the south western slopes of **Banderpooch peak**, in the Lower Himalayas in Uttarakhand. From there it travels a total length of 1,376 kilometers and has a drainage system of 366,223 km<sup>2</sup>, 40.2% of the entire Ganga Basin, before merging with the Ganga at Triveni Sangam or Prayag at Allahabad.

- From Uttarakhand, Yamuna river flows for some 200 kilometers in Lower Himalayas and Shivalik Ranges.
- Its largest tributary **Tons River** flows through Garhwal region in Uttarakhand, and meets Yamuna near Dehradun.
- The other rivers such as Giri, Rishi Ganga, Kunta, Hanuman Ganga and Bata tributaries meet Yamuna, before it descends on to the plains of Doon Valley, at Dak Pathar near Dehradun.
- Further down, Yamuna is met by the Assan River, lies the Assan barrage, which hosts a Bird Sanctuary as well.
- After passing Paonta Sahib, it reaches Tajewala in Yamuna Nagar district, of Haryana, where a dam built in 1873, is the originating place of two important canals, the Western Yamuna Canal and Eastern Yamuna Canal, which irrigate the states of Haryana and Uttar Pradesh.
- The Western Yamuna Canal (WYC) crosses Yamuna Nagar, Karnal and Panipat before reaching the Haiderpur treatment plant, which supplies part of municipal water supply to Delhi, further it also receives waste water from Yamuna Nagar and Panipat cities.
- Yamuna is replenished again after this by seasonal streams and groundwater accrual, in fact during the dry season, it remains dry in many stretches from Tajewala till Delhi, where it enters near Palla village after traversing 224 km.

Along with Ganga to which run almost parallel after it touches the Indo-Gangetic plain and creates the Ganga-Yamuna Doab region. From Delhi onwards Yamuna gets polluted due to discharge of waste water through 15 drains between Wazirabad barrage and Okhla barrage renders the river severely polluted after Wazirabad in Delhi

### Tributaries of Yamuna

#### Betwa River

- Betwa or Vetravati originates in Vindhya Range just north of Hoshangabad in Madhya Pradesh and flows north-east through Madhya Pradesh and flow through Orchha to Uttar Pradesh. It meets Yamuna at Hamirpur town in Uttar Pradesh.

#### Sindh River

- Sindh River originates on the Malwa Plateau in Vidisha district, and flows north-northeast through the districts of Guna, Ashoknagar, Shivpuri, Datia, Gwalior and Bhind in Madhya Pradesh to join the Yamuna River in Etawah district, Uttar Pradesh.



- Manikhedha Dam has been constructed across the Sindh River in Shivpuri district, Madhya Pradesh.

### Hindon River

- Hindon River is a rainfed river that originates in the Saharanpur District. It flows between Ganges and Yamuna rivers and joins Yamuna river just outside Delhi.

### Chambal River

- Chambal River is one of the most pollution free rivers of India.
- It's a 960 Kilometer long river that originates at the Singar Chouri peak in the northern slopes of the Vindhyan mountains, 15 km West-South-West of Mhow in Indore District in Madhya Pradesh.
- From there, it flows in a northerly direction in Madhya Pradesh(M.P.) for a length of about 346 km and then in a generally north-easterly direction for a length of 225 km through Rajasthan.
- It enters U.P. and flows for about 32 km before joining the Yamuna River in Etawah District at an elevation of 122 m, to form a part of the greater Gangetic drainage system. Chambal is a rainfed river and its basin is bounded by the Vindhyan mountain ranges and on the north-west by the Aravallis.

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### Tributaries of Chambal:

- **Banas River:** Banas river is a rainfed river that flows in Rajasthan. Banas means hope of forests. It originates in Khamnor Hills of the Aravalli Range, about 5 km from Kumbhalgarh in Rajsamand and flows northeast through Mewar region of Rajasthan, meets the Chambal near the village of Rameshwar in Sawai Madhopur District. The cities of Nathdwara, Jahanpur, and Tonk lie on the river.
- **Kali Sindh River:** The Kali Sindh is a river in the Malwa region of Madhya Pradesh, that joins the Chambal River at downstream of Sawai Madhopur in Rajasthan
- **Parbati River:** Parbati River is a river in Madhya Pradesh, India that flows into the Chambal River. It is one of the Chambal River's three main tributaries, along with the Banas River and the Kali Sindh River.

## Brahmaputra River System

Brahmaputra originates on the Angsi Glacier located on the northern side of the Himalayas in Burang County of Tibet as the Yarlung Tsangpo River and flows southern Tibet to break through the Himalayas in great gorges. Tsangpo enters India after taking a U turn at Namcha Barwa and flows in Arunachal Pradesh and here we call it Dihang River or Siang River. This U turn marks the starting point of the Grand Canyon, known as Yarlung Zangbo Grand Canyon, which has



been confirmed as the largest in the world. It is 496.3 kilometers long, 56.3 kilometers longer than the Colorado Grand Canyon, previously considered the world's longest. It is 5,382 meters deep, much deeper than the 3,200 meters of Peru's Colca Canyon, previously known as the world's deepest canyon.

After taking this U -turn, Dihang meets Dibang River and the Lohit River at the head of the Assam Valley and then flows southwest through the Assam Valley, where it is known as Brahmaputra. In Assam it becomes a wide stream. Then it enters Bangladesh. In Bangladesh, the Brahmaputra is joined by the Teesta River, one of its largest tributaries. Below the Teesta, the Brahmaputra splits into two distributary branches. The western branch, which contains the majority of the river's flow, continues due south as the Jamuna to merge with the lower Ganges, called the Padma River. The eastern branch is called the lower or old Brahmaputra . It curves southeast to join the Meghna River near Dhaka. The Padma and Meghna converge near Chandpur and flow out into the Bay of Bengal. Brahmaputra is 3,848 km long, and its drainage area is 712,035 km<sup>2</sup>.

The waters of the River Brahmaputra are shared by China, India, and Bangladesh. In the 1990s and 2000s, there was repeated speculation about China building a dam at the Great Bend, with a view to divert the waters to the north of the country. This was denied by the Chinese government, later on.

### Important Tributaries of Brahmaputra

#### Teesta River

- Teesta River is lifeline of Sikkim and makes a border between Sikkim and West Bengal before joining the Brahmaputra as a tributary in Bangladesh. The total length of the river is 315 kilometres .
- It originates at Tso Lhamo Lake in North Sikkim and is formed by the melting of the Tista Khantse glacier.
- Just before the Teesta Bridge, which joins Kalimpong with Darjeeling, the river is met by its main tributary, the Rangeet River.
- At this point, it changes course southwards flowing into West Bengal. The river hits the plains at Sevoke, at a distance of 22 Km from Siliguri, where it is spanned by the Coronation Bridge which links the north-east states to the rest of India.
- The river then courses its way to Jalpaiguri and then to Rangpur District of Bangladesh, before finally merging with the mighty Brahmaputra at Fulchori.

#### Manas River

- Manas River follows in India and Bhutan and is the largest river system of Bhutan. Three other river systems of Bhutan are Amo Chu or Torsa, Wong Chu or Raidak, Mo Chu or Sankosh. It is met by three other major streams before it again debouches into India in western Assam.





- After flowing a total of 376 kilometers, it meets Brahmaputra River at Jogighopa. Its river valley is home to Royal Manas National Park in Bhutan and the contiguous Manas Wildlife Sanctuary of India which is a Project Tiger Reserve, an Elephant Reserve and a Biosphere Reserve as well as a UNESCO World Heritage Site.

### Rivers of Peninsular India

As a general observation, the Rivers of Peninsular India are rainfed and they shrink during the dry season. The line created by the Narmada River and Mahanadi River is the traditional boundary between northern and southern India. The Narmada flows westwards in the depression between the Vindhya and Satpura ranges. The plateau is watered by the east flowing Godavari and Krishna rivers. The other major rivers of the Deccan plateau are the Pennar and the Tungabhadra, a major tributary of the Krishna. There are numerous very small rivers on the Deccan plateau which flow mostly north to south and also south to north mixing with any of the west or east flowing major rivers.

#### Mahanadi River Basin

The 858 Kilometers long Mahanadi river flows through the states of Chhattisgarh and Odisha. It gets formed by numerous mountain streams and the farthest headstream is located in hills of the Dhamtari district of Chhattisgarh. These hills are extensions of the Eastern Ghats and are a source of many other streams which then go on to join the Mahanadi. The river first flows in north and drains Raipur. After Bilaspur, it is joined by its major tributary river Seonath.

After that the river flows eastward and joined by Jonk, Hasdeo rivers and reaches Odisha. Near Sambalpur of Odisha, the largest dam of the world Hirakud Dam blocks its water, spread between Lamdungri and Chandili Dunguri hills. After reaching Dholpur in Odisha, the rivers rolls towards the Eastern Ghats and passes the Satkosia Gorge. After crossing the Gorge, it meets the plains of Odisha and reaches Cuttak. Before entering Cuttack city, it gives off a large distributary called the Kathjori. Cuttack is located between these two channels. The Kathjori then throws off many streams like the Kuakhai, Devi and Surua and becomes Jotdar River, which fall into the Bay of Bengal after entering Puri district. The main stream of Mahandi gets divided into several distributaries such as Paika, Birupa, Chitartala, Genguti and Nun. These all distributaries form the Mahandi Delta which is one of the largest deltas in India. The Mahandi river empties into Bay of Bengal via several channels near Paradeep at False Point, Jagatsinghpur.

#### Importance of Mahanadi River

- Mahanadi valley is best known for its fertile soil and flourishing agriculture. Before the Hirakud dam was built, the river carried a huge amount of silt and its delta had one of the highest yield per acre in the whole of India. At present, agriculture primarily depends on a network of canals that arise from the river. Rice, oilseeds and sugarcane are the principal



crops here.

- The river was notorious for devastating floods, but the construction of Hirakud Dam has altered the situation.

### Tributaries of Mahanadi

The following flowchart shows the flow of Mahanadi from Source to Sea.

The major tributaries of Mahanadi are Seonath, Jonk, Hasdo, Mand, Ib, Ong, Tel etc.

- **Seonath River:** The Seonath River is the longest tributary of Mahanadi. It rises in an undulating region with numerous small groups of hills at Kotgal and flows 383 kilometers to join Mahanadi at its left bank at Khargand.
- **Tributaries of Seonath** are Kharahara, Tandula, Kharun, Surhi, Agar, Arpa rivers. The total drainage area of Seonath is 22% of the total drainage area of Mahanadi Basin.
  - **Jonk River:** Jonk River originates from the Khariar Hills of Kalahandi district of Odisha at an elevation of 762 meters. It flows 196 kilometers to join the Mahanadi on its right at Sheorinarayan.
- **Hasdo River:** It rises in the Sarguja district of Chhattisgarh and traverses 333 kilometers to meet Mahanadi at Mahudih. rs.surajsingh@gmail.com | www.gktoday.in/module/ias-general-studies
- Gej River is a principle tributary of Hasdo River
- **Mand River:** Mand River originates at an elevation of 686 meters in Sarguja district of Odisha and flows 241 kilometers to meet Mahanadi at Chandarpur.
- **Ib River :** Ib originates in Pandrapat of the Raigarh district of Chhattisgarh and flows 251 kilometers to fall into Hirakud Dam. It is a rainfed river.
- **Ong River:** It rises at an elevation of 457 meters on a hill in the northern outskirts of hills located on the course of Jonk River and flows 204 kilometers to meet Mahandi at Sonepur.
- **Tel River:** Tel river originates in plain in the Koraput of Odisha. It traverses 296 kilometers to meet Mahanadi at Sonepur.

### Hirakud Dam on Mahanadi River

- Built across Mahanadi River, about 15 km from Sambalpur in Odisha.
- Built in 1957, the dam is one of the world's longest earthen dam.
- Behind the dam extends a lake, Hirakud Reservoir, 55 km long.
- Initially proposed Sir M. Visveswararya in 1937, Central Waterways, Irrigation and Navigation Commission took up the work, and in 1946, Sir Howthorne Lewis, then the Governor of Orissa, laid the foundation stone of the Hirakud Dam.
- There are two observation towers on the dam one at each side. One is "Gandhi Minar" and the other one is "Nehru Minar". Both the observation towers present breathtaking views of



the lake.

- Helps control floods in the Mahanadi delta and irrigates 75,000 square kilometres of land. Hydroelectricity is also generated.
- Cattle Island is located in one of the extreme points of Hirakud Reservoir, a natural wonder. Completely inhabited by wild cattle, with out any trace of humans.
- Debrigarh wildlife sanctuary is located here.

### Brahmani River

Brahmani River is NOT a tributary of Mahanadi. It's a seasonal river that flows in Odisha. It is formed by the confluence of the Sankh and South Koel rivers near Raurkela, and flows through the districts of Sundargarh, Kendujhar, Dhenkanal, Cuttack and Jajapur. Together with the rivers Mahanadi and Baitarani, it forms a large delta before entering into the Bay of Bengal at Dhamra. Both headstreams of Brahmani river viz. Sankh and South Koel originate in Choota Nagpur Plateau.

- Sankh has its origins near the Jharkhand-Chhatisgarh border, near Netarhat Plateau.
- South Koel too arises in Jharkhand, near Lohardaga, on the other side of a watershed that also gives rise to the Damodar River.

Brahmani river is 480 kilometers long and is the second longest river in Orissa after the Mahanadi.

### Tributaries of Brahmani River

- **Baitarni River:** Baitarani River is another one of six major rivers of Odisha, which earn the name of coastal plains of Odisha as "Hexadeltaic region". The river originates in Guptaganga hills in Gonasika of Keonjhar district in Odisha and flows to make a natural boundary between Odisha and Jharkhand. It travels a distance of 360 km to drain into the Bay of Bengal after joining of the Brahmani at Dhamra mouth near Chandabali.

### Krishna River

The 1300 Kilometers long Krishna River or Krishnaveni is one of the longest rivers in Peninsular India. It is the fourth largest river in India after the Ganga, Godavari and the Narmada.

### Origin & Course

Krishna River rises at Mahabaleswar in district Satara, Maharashtra in the west and meets the Bay of Bengal at Hamasaladeevi in Andhra Pradesh, on the east coast. It flows through **Maharashtra, Andhra Pradesh and Karnataka**. The delta of this river is one of the most fertile regions in India and was the home to ancient Satavahana and Ikshvaku Dynasty kings. Vijayawada is the largest city on the River Krishna.



The river flows quickly, causing much erosion in June and August. During this time, Krishna takes fertile soil from Maharashtra, Karnataka and western Andhra Pradesh towards the delta region.

The river has a number of tributaries but Tungabhadra is the principal tributary. Other tributaries include the Mallaprabha, Koyna, Bhima, Ghataprabha, Yerla, Warna, Dindi, Musi and Dudhganga. Leaving Mahabaleswar behind, the Krishna takes the form of the Dhom lake in Panchgani, a popular hill station just 17 km from Mahabaleswar. Crisscrossing its way through Wai, Narsobachi and Wadi (near Kolhapur) in Maharashtra, the river enters Karnataka at Kurundwad, 60 km from Kolhapur. In Karnataka, the river passes through the Belgaum, Bijapur and Gulbarga districts, covering a total distance of 220 km. The Krishna enters Andhra Pradesh near Deosugur in Raichur district and meanders through Mehbubnagar, Kurnool, Guntur and Krishna districts. The river merges into the Bay of Bengal at Hamasaladeevi. Two dams, Srisailem and Nagarjuna Sagar are constructed across the Krishna River. Nagarjuna Sagar Dam is world's tallest masonry dam (124 meters).

### Krishna River Basin

Krishna Basin extends over an area of 258,948 square kilometers which is nearly 8% of total geographical area of the country. The basin lies in the states of Andhra Pradesh (113,271 km<sup>2</sup>), Karnataka (76,252 km<sup>2</sup>) and Maharashtra (69,425 km<sup>2</sup>). Most part of this basin comprises rolling and undulating country except the western border which is formed by an unbroken line of ranges of the Western Ghats. The important soil types found in the basin are black soils, red soils, Laterite and lateritic soils, alluvium, mixed soils, red and black soils and saline and alkaline soils. An average annual surface water potential of 78.1 km<sup>3</sup> has been assessed in this basin. Out of this, 58.0 km<sup>3</sup> is

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utilizable water. Culturable area in the basin is about 203,000 km<sup>2</sup>, which is 10.4% of the total culturable area of the country. In 2009 October heavy floods occurred, isolating 350 villages and leaving millions homeless, which is believed to be first occurrence in 1000 years. The flood resulted in heavy damage to Kurnool, Mahabubnagar, Guntur, Krishna and Nalgonda Districts.

### Tributaries of Krishna

Major Tributaries of Krishna River are as follows:

- **Left:** Bhima, Dindi, Peddavagu, Halia, Musi, Paleru, Munneru
- **Right:** Venna, Koyna, Panchganga, Dudhganga, Ghataprabha, Malaprabha, Tungabhadra

### Tungabhadra River

Most important tributary of Krishna River is the Tungabhadra River, which is formed by the Tunga River and Bhadra River that originate in the Western Ghats. Tungbhadra flows in Karnataka and Andhra Pradesh. It was known as Pampa during the epic period. The name of famous tourist spot Hampi is derived from Pampa, which is the old name of the Tungabhadra River on whose banks the city is built.

The Tunga and Bhadra Rivers rise at Gangamoola, in Varaha Parvatha in the Western Ghats forming parts of the Kuduremukh Iron Ore Project, at an elevation of 1198 metres. Bhadra flows through Bhadravati city and is joined by numerous streams. At Koodli, a small town near Shimoga City, Karnataka, the two rivers meet and called with the common name Tungabhadra. From here, Thungabhadra meanders through the plains to a distance of 531 km (330 mi) and mingles with the Krishna at Gondimalla, near Mahaboobnagar in Andhra Pradesh.

### Importance of Tungabhadra River

There are a number of ancient and holy sites on the banks of the Tungabhadra River.

- At Harihara there is a temple dedicated to Harihareshwara.
- The river surrounds the modern town of Hampi, where are the ruins of Vijayanagara, the site of the powerful Vijayanagara Empire's capital city and now a World Heritage Site. The site, including the Vijayanagara temple complex ruins, is being restored.
- Alampur, on the left – northern bank of the river, known as Dakshina Kashi in Mahabubnagar Dist. The Nava Brahma Temples complex is one of the earliest models of temple architecture in India.
- Bhadravathi, Hospet, Hampi, Mantralayam, Kurnool are located on its bank.

### Tributaries of Tungabhadra:

- Tunga River, Kumudvati River, Varada River, Bhadra River, Vedavathi River, Handri River

### Bhima River

Bhima River originates in Bhimashankar hills near Karjat in Maharashtra and flows southeast for 861 km through Maharashtra, Karnataka, Andhra Pradesh states. Bhima is a major tributary of the



Krishna River. Its banks are densely populated and form a fertile agricultural area. During its 861 kilometer journey, many smaller rivers flow into it. Kundali River, Kumandala River, Ghod river, Bhama, Indrayani River, Mula River, Mutha River and Pavna River are the major tributaries of this river around Pune. Of these Indrayani, Mula, Mutha and Pawana flow through Pune and Pimpri Chinchwad city limits. Chandani, Kamini, Moshi, Bori, Sina, Man, Bhogwati and Nira are the major tributaries of the river in Solapur. Of these Nira river meets with the Bhima in Narsingpur, in Malshiras taluka in Solapur district.

- The holy city of Pandharpur is on the bank of Bhima River.
- Bhimashankar is one of the twelve esteemed Jyotirlinga shrines. Other temples are Siddhatek, Siddhivinayak Temple of Ashtavinayak Ganesh Pandharpur Vithoba Temple in Solapur district., Sri Dattatreya Temple, Ganagapura, Gulbarga district, Karnataka, Sri Kshetra Rasangi Balabheemasena Temple in Rasanagi, Jevargi Taluq, Gulbarga district, Karnataka
- Tributaries of Bhima are:
  - Ghod, Sina, Kagini, Bhama, Indrayani, Mula-Mutha, Nira

### Malaprabha River

Malaprabha River is another important tributary of Krishna River, which flows in Karnataka. It rises at Kanakumbi in the Belgaum district and joins Krishna River at Kudalasangama in Bagalkot district. It also flows through Dharwar District. Hubli city gets its drinking water from this reservoir.

- Tributaries of Malprabha: Bennihalla, Hirehalla and Tuparihalla are the major tributaries to Malaprabha.

### Ghataprabha River

Ghataprabha is a tributary of Krishna that flows in Karnataka. The Ghataprabha Project at Hidkal is a hydroelectric and irrigational dam across the river.

Tributaries of Ghataprabha:

- Hiranyakeshi and Markandeya rivers are tributaries of Ghataprabha

### Other Tributaries of Krishna

Other tributaries include the Kudali river, Venna River, Koyna River, Yerla River, Warna River, Dindi River, Paleru River, Musi River, Urmodi River, Tarli River and Dudhganga River. The rivers Venna, Koyna, Vasna, Panchganga, Dudhganga, Ghataprabha, Malaprabha and Tungabhadra join Krishna from the right bank; while the Yerla River, Musi River, Maneru and Bhima rivers join the Krishna from the left bank.

### Important places on banks of River Krishna

#### Mahabaleshwar

- Mahabaleshwar besides being a popular hill station and a weekend getaway from Mumbai is also the source of the Krishna River



- Mahabaleshwar is located at an altitude of 1,372 meters in the Western Ghats.
- Mahabaleshwar can also be called the 'land of five rivers', since the holy streams Krishna, Koyna, Venna, Gayatri and Savitri emerge from here.
- There are many places of tourist interest in Mahabaleshwar. Lodwick Point is an important landmark in Mahabaleshwar. It is considered one of the finest locations in Mahabaleshwar from where one can enjoy the beauty of the surrounding area. This point was earlier known as Sydney Point. Arther Point is the queen of all points. It is fascinating to see the barren deep valley Savitri on the left and shallow green valley on the right.
- Other places of tourist interest in Mahabaleshwar include Elphinstone Point, Tiger's Spring, Kate's Point, Bombay Point, Wilson Point, Venna Lake and Kate's Point. Lingmala, Chinaman and Dhobi Waterfalls are also worth visiting in Mahabaleshwar. Kate's Point (also known as sunrise point) in particular offers fabulous view of the Krishna River.

### Srisaïlam

- Leaving Mahabaleshwar behind, the Krishna river takes the form of Dhoni in Panchgani, a beautiful hill station close (17 km) to Mahabaleshwar.
- It meanders through Narsobachi, Wadi in Maharashtra and crisscrosses its way through Karnataka before entering Andhra Pradesh.
- Srisaïlam (in Andhra Pradesh) is a holy town located on the banks of the Krishna. Srisaïlam is surrounded by lush greenery and has beautiful locations around.
- It is a wonderful weekend getaway from Hyderabad. Srisaïlam Sanctuary is the main attraction that covers an area of 3568 sq kms. The downstream Srisaïlam dam is home to a variety of crocodiles.

### Nagarjuna Sagar

- Popularly known for the Nagarjuna Sagar Dam, Nagarjuna Sagar is approximately 170 km from Hyderabad. The dam is an engineering marvel. Stretching across the mighty river Krishna, the barrage also has another distinction to its credit – it has created one of the world's largest man-made lake.
- The dam has played an important role in agricultural sector of the state.
- Nagarjunakonda was the largest and most important Buddhist centres in South India. The place derives its name from Acharya Nagarjuna, a renowned Buddhist scholar and philosopher, who had migrated here from Amaravati to propagate and spread the Buddha's message of universal peace and brotherhood.
- Not too far from Nagarjunakonda is Anupa, where a Buddhist University and Stadium were excavated.



### Amaravati

- Situated on the banks of the Krishna, Amaravati is a small town in Guntur district of Andhra Pradesh. Amaravati is an excavation site and was once the capital of Satavahanas. It is one of the important Buddhist sites in India. Amaravati is located about 60 km from Vijayawada.
- Amareswara Temple is the major tourist attraction in Amaravati. The temple is dedicated to Lord Shiva. It is believed that Lord Shiva is present here in the form of five lingams - Pranaveswara, Agasteswara, Kosaleswara, Someswara and Parthiveswara. The temple is built in the Dravidian style of architecture and has many legends associated with it.
- The remains of a 2000-year-old Buddhist settlement along with the great Buddhist stupa are among the main attractions in Amaravati. Mahachaitya or the Great Stupa was constructed approximately 2000 years ago. The stupa is made of brick with a circular vedika and depicts Lord Buddha in a human form, subduing an elephant.

### Vijayawada

- Vijayawada being a popular trade and commerce centre is also referred to as 'the business capital of Andhra Pradesh'. Vijayawada is the 3rd largest city in Andhra Pradesh and is the largest city on the banks of Krishna River.

### Kaveri River Basin

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Kaveri or Cauvery flows in Karnataka and Tamil Nadu. The river covers a distance of about 765 km and flows through the state of Karnataka and Tamil Nadu. On its journey to the Bay of Bengal, the river is joined by its tributaries, which include Shimsa, Hemavathi, Honnuhole, Arkavathi, Kapila, Lakshmana Theertha, Kabini, Lokapavani, Bhavani, Noyil and Amaravathy.



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Talacauvery (also Talakaveri) located about 5000 ft above sea level is considered the source of the Cauvery.

Talacauvery is located in Coorg district of Karnataka and is 47 km from Maidekri.

Talacauvery is considered a famous pilgrimage site in Karnataka. At the source of the Cauvery there is a temple where every year on Tula sankramana thousands of pilgrims gather to pay their respects to the Cauvery.

The river then flows through Mysore district where two islands Srirangapatnam and Shivanasamudram are formed. At Sivasamudram the river drops 98 meters forming famous falls known as Gagan Chukki and Bara Chukki. After meandering through Karnataka, the river then enters Tamil Nadu and forms the boundary between the Erode and Salem districts. The Cauvery is joined by the Bhavani River at Bhavani. Hogenakkal is a major landmark on the course of the Cauvery in Tamil Nadu. Trichy and Thanjavur are other important towns on the banks of the Cauvery.

The river after covering a distance of 765 km merges into the Bay of Bengal through two principal mouths. One of the important distributary is Kollidam, which 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.

### **Tributaries**

Amaravati, Arkavathy, Bhavani, Chinnar, Hemavati, Honnuhole, Kabini, Kannika, Kollidam, Lakshmana Tirtha, Lokapavani, Noyyal, Pambar, Shimsha, Sujyothi

### **Riparian States and UTs**

Karnataka, Kerala, Pondicherry, Tamil Nadu

### **Cauvery River Basin**

The Kaveri basin is estimated to 72,000 km<sup>2</sup> with many tributaries including the Shimsha, the Hemavati, the Arkavati, Honnuhole, Lakshmana Tirtha, Kabini, Bhavani River, the Lokapavani, the Noyyal and the Amaravati River.

### **Tributaries of Cauvery**

**Amaravathi River:** Amaravati River is a tributary of Kaveri River in Coimbatore. It is continuation of the Pambar and Chinnar rivers in Kerala. It begins at 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. It is joined by the Kallapuram River at the mouth of the Ajanda valley in Udumalaipettai. It joins with the Kaveri at Thirumukkudal, about 10km from Karur.

**Arkavati River:** It originates in Nandi Hills of Karnataka and joins Cauvery at Kanakapura, called Sangama in Kannada, after flowing through Kolar District and Bangalore Rural district. The river is



used by the Bangalore Water Supply and Sewerage Board to provide 135 million liters of drinking water per day to the city of Bangalore, or about 20% of all the city's water. The river drains into the Chikkarayappanahalli Lake near Kanivenarayanapura.

### **Tributaries of Akravati**

Kumudavathi and Vrishabhavathi rivers are tributaries to this river.

- **Bhavni River:** It is a major tributary of Cauvery River. It originates in Nilgiri Hills, where 12 major rivulets join Bhavani. The west and East Varagar tributaries coming from the Nilgiris are the largest and each have dams in Tamil Nadu. The Bhavani is a 217 km. long perennial river fed mostly by the southwest monsoon and supplemented by the northeast monsoon. Its watershed drains an area of 6,200 km<sup>2</sup> spread over Tamil Nadu (87%), Kerala (9%) and Karnataka (4%).
- **Hemavati River:** It starts in the Western Ghats at an elevation of about 1,219 meters near Ballalarayana durga in the Chikmagalur District of the state of Karnataka, in southern India, and flows through Chikmagalur, Hassan District and Mysore district before joining the Kaveri near Krishnarajasagara.

### **Godavari River Basin**

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With a length of 1465 Kilometers, Godavari is India's second largest river that runs within the country and also the longest river in South India. It originates near Trimbak in Nashik District of Maharashtra state and flows east across the Deccan Plateau into the Bay of Bengal near Narasapuram in West Godavari district of Andhra Pradesh.

The river is also known as Dakshin Ganga and Gautami. The Manjra and Indravati rivers are its major tributaries.

The Godavari is a sacred river and there are several places of pilgrimage on its banks. Trimbakeshwar and Nashik are major pilgrimage sites where one of the four Sinhastha Kumbh Mela takes place.

Every twelve years, Pushkaram, a major bathing festival, is held on the banks of the Godavari. The next Pushkaram festival is scheduled to be held in 2015.

### **Course of Godavari River**

The river originates from Trimbak and then flows in the east across the Deccan Plateau traversing through the Trimbakeshwar, Nashik, Kopergaon, Paithan, Nanded, Rajahmundry, Adilabad and Bhadrachalam.



Just after Rajahmundry, the river splits into two streams that widen into a large river delta, which provides an extensive navigable irrigation. In Nizamabad district of Andhra Pradesh, there is a multipurpose project on the Godavari, which is called the Sriramsagar Project. Godavari empties into the Bay of Bengal near Narasapuram in West Godavari district of Andhra Pradesh.

- A barrage was built on the river at Dowleswaram by Sir Arthur Cotton in 1852. As it was damaged in 1987 floods, it was rebuilt as a barrage and roadway during 1987 and named after him. The roadway connects Dowleswaram in East Godavari and Vijjeswaram in West Godavari.
- There is also a big dam built just after the source of the river at Trimbakeshwar. The dam is in the town of Gangapur, which literally means a town on a river. The dam provides drinking water to the residents of Nashik and also supplies water to the thermal power station situated downstream at Eklahara, which provides power to the town.
- There is another multipurpose project on the Godavari River named Sriram Sagar Project on the borders of Adilabad and Nizamabad District. It is in the town of Pochampad, 60 km away from Nizamabad. It irrigates 4 districts of Northern Telangana Region of Andhra Pradesh and supplies power.
- The Jayakwadi dam near Paithan is one of the largest earthen dam in India. This dam was built to address the problem of drought in Marathwada region and problem of flood along the bank of river. Two 'left' and 'right' canals provide the irrigation to fertile land up to Nanded district. This dam has major contribution in industrial development of Aurangabad Maharashtra.



- **Havelock bridge is on Godavari River.** It was constructed under the supervision of F.T. Granville Walton who had constructed the Dufferin Bridge over the Ganges, and Granville Mills, British engineers. Spanning over 3 km in length, it linked the East Godavari and West Godavari districts. The bridge has been a vital link enabling trains to run between Chennai and Howrah. Trains continued to ply over the bridge for a century until 1997, when train services over the bridge were suspended after the construction of 2 additional bridges.
- The **Coringa mangrove forests in the Godavari delta** are the second largest mangrove formation in the country. Part of this has been declared as the Coringa Wildlife Sanctuary, renowned for its reptiles. They also provide an important habitat to a wide variety of fish and crustaceans. These forests also act as barriers against cyclones, tropical storms and tidal waves thus protecting the nearby villages.
- The Krishna Godavari basin is one of the main nesting sites of the endangered Olive Ridley turtle.

### Important Places on the Bank of River Godavari

- **Trimbakeshwar:** The source of the Godavari – Trimbakeshwar is one of the holy places in the country. It is located about 40 km from Nashik. Trimbakeshwar is one of the twelve Jyotirlingas of Lord Shiva. It is believed that there is no sacred place like Trimbakeshwar, no river like Godavari and no mountain like Brahmagiri.
- **Nashik:** Nashik is the first major city on the banks of the Godavari after Trimbakeshwar. Nashik is located about 185 km from Mumbai. It is an important religious center and attracts thousands of pilgrims every year from different parts of the country.
- **Paithan:** Famous for its Paithani sarees, Paithan is located on the banks of the Godavari in Aurangabad district of Maharashtra. It is 56 km south of Aurangabad, the ancient capital city of the Satvahanas. Paithan is associated with great saint Eknath. His 'samadhi' is located here. The Eknath Shrine comes alive during 'Paithan Yatra', also known as Nath Shashti, when devotees from Maharashtra and neighbouring states come to pay their respects to the saint.
- **Nanded:** Nanded is famous for the Sikh gurudwara – Takhat Sachkhand Shri Hazur Abchalnagar Sahib. A town of great antiquity, Nanded was earlier known as 'Nandigram'. Gurudwara Shri Hazur Sahib is the main landmark in Nanded. It is one of the four high seats of authority of the Sikhs. This is the place where Shri Guru Gobind Singhji breathed his last. The gurudwara was built by Maharaja Ranjit Singh.
- **Bhadrachalam:** Bhadrachalam is situated on the banks of the Godavari and is 161 km from Rajahmundry and 200 km from Vijayawada. Bhadrachalam is regarded to be one of the holiest shrines in South India.



### Tributaries of Godavari

- **Indravati River:** Indravati River rises in the Eastern Ghats in Kalahandi Orissa, and flows west to join the Godavari, forming the boundary between Maharashtra and Chhattisgarh states at places. The river flows for a length of 535 km with a drainage area of 41,665 sq.km. The Indravati is sometimes known as the “lifeline” of the Bastar District, one of the most green districts in India.
- **Pranahita River:** Pranhita River flows on the border of Gadchiroli district in Maharashtra and Adilabad district in Andhra Pradesh. It forms with the confluence of two rivers called Wardha and Wainganga. The Painganga River joins Vainganga near Aheri. The river then flows up to Sironcha before it empties into the Godavari River, near Sironcha in Maharashtra. The River course is mainly through the dense forests which are rich in Sagwan (timber).

### Narmada River

Narmada or Rewa River is the third largest river that completely flows within India after Ganga & Godavari. It forms the traditional boundary between North India and South India. Narmada flows in a rift valley between the Satpura and Vindhya Ranges. It has been mentioned as Nammadus in the Periplus of Erythrean Sea.

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### Source and Course

Narmada originates in a small tank called Narmada Kund located on the Amarkantak hill in the Anuppur District of eastern Madhya Pradesh. The river descends from the Amarkantak hill range at the Kapildhara falls over a cliff and meanders in the hills flowing through a tortuous course crossing the rocks and islands up to the ruined palace of Ramnagar. Between Ramnagar and Mandla, (25 km (15.5 mi)), further southeast, the course is comparatively straight with deep water devoid of rocky obstacles. The Banger joins from the left. The river then runs north–east in a narrow loop towards Jabalpur. Close to this city, after the Dhuandhara falls, Narmada enters three narrow valleys between the Vindhya scarps in the north and the Satpura range in the South. The southern extension of the valley is wider at most places. These three valley sections are separated by the closely approaching line of the scarps and the Satpura hills. It forms the traditional boundary between North India and South India and flows westwards over a length of 1,312 km before draining through the Gulf of Cambay into the Arabian Sea, 30 km (18.6 mi) west of Bharuch of Gujarat.

### Basin

Between Vindya and Satpura ranges, Narmada extends over an area of 98,796 km<sup>2</sup>. The basin covers large areas in the states of Madhya Pradesh (86%), Gujarat (14%) and a comparatively smaller area (2%) in Maharashtra. In the river course of 1,312 km, there are 41 tributaries, out of which 22 are from the Satpura range and the rest on the right bank are from the Vindhya range.



### Importance

Narmada is one of the most sacred rivers of India. *Geologically, Narmada River is older than the river Ganges.* The river has been mentioned by Ptolemy in the Second century AD as Namade. In Puranas, it has been mentioned as Rewa. In Indian history, Kannada emperor from Chalukya dynasty Pulakeshin II is said to have defeated emperor Harshavardhana of Kannauj on the banks of Narmada. The valley is famous for the gorgeous Maheshwari saris, which are handwoven; comfortable in warm and cold weather, dressy and yet light; these saris have a dedicated, select following among Indian women. The Bhimbetka caves are located in a dyke of the Narmada valley at about 45 km northeast of Bhopal.

### Mahi River

Mahi rises in Minda Village, in Sardarpur district Madhya Pradesh and, after flowing through the Vagad region of Rajasthan, enters Gujarat and falls into the sea by a wide estuary near Khambhat. Mahi encircles entire Banswara District in Rajasthan and first dam known as Mahi dam is at right side in Rajasthan. Kadana Dam is on Mahi in Gujarat. It is one of only three major rivers in peninsular India that runs from east to west along with the Tapi River and the Narmada River.

### Tapti River

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Tapi River, with length of 724 km, is one of only three rivers in peninsular India that run from east to west – the others being the Narmada River and the Mahi River. The river rises in the eastern Satpura Range of southern Madhya Pradesh state, and flows westward, draining Madhya Pradesh's Nimar region, Maharashtra's Kandesh and east Vidarbha regions in the northwest corner of the Deccan Plateau and south Gujarat, before emptying into the Gulf of Cambay of the Arabian Sea, in the Surat District of Gujarat. The river, along with the northern parallel Narmada river, form the boundaries between North and South India. The Western Ghats or Sahyadri range starts south of the Tapi River near the border of Gujarat and Maharashtra. The Tapi (Tapi) River empties into the Gulf of Khambhat near the city of Surat in Gujarat. Tapi Basin lies in the states of Maharashtra (51,504 km<sup>2</sup>), Madhya Pradesh (9,804 km<sup>2</sup>) and Gujarat (3,837 km<sup>2</sup>).

### Ghaggar-Hakra River

Ghaggar-Hakra River flows in monsoon season only. It is known as Ghaggar before the Ottu barrage and as the Hakra downstream of the barrage. It originates in the Shivalik Hills of Himachal Pradesh and flows through Punjab and Haryana states into Rajasthan; just southwest of Sirsa, Haryana and by the side of talwara jheel in Rajasthan, this seasonal river feeds two irrigation canals that extend into Rajasthan. The downstream Hakra is a dried up stream that possibly end in Rann of Katch.



### Coastal Environment

#### Basics of Indian Coasts

The total coastline of India measures about 7,517 km, which is distributed among *nine coastal states* and *four Union Territories; and entire coast of India falls within tropics*. The **nine coastal states** are Gujarat, Maharashtra, Goa, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Odisha and West Bengal. The **Four coastal Union Territories** are Puducherry, Lakshadweep, Daman & Diu and Andaman & Nicobar Islands. The coasts of India include West coast, East coast and Coast of Lakshadweep and Andaman and Nicobar islands.

#### Largest states by Coastline

**Gujarat** is strategically located with **largest share in India's coastline**, followed by Andhra Pradesh and Tamil Nadu.

| State          | Coastline |
|----------------|-----------|
| Gujarat        | 1915.29   |
| Andhra Pradesh | 1037      |
| Tamil Nadu     | 864.73    |
| Kerala         | 560       |
| Maharashtra    | 510.31    |
| Orissa         | 457.2     |
| West Bengal    | 374       |
| Karnataka      | 258.15    |
| Goa            | 113.03    |
| Daman & Diu    | —         |
| Total          | 6089.71   |

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Over 22.6% of total coasts of India are of islands (Andaman and Nicobar, Lakshadweep and Diu islands). The Exclusive Economic Zones (EEZs) of India cover an area of about 2,305,143 km<sup>2</sup>, enclosed within 200 nautical miles <sup>(that is : 370.4 km)</sup> from the land. Out of this, 1,641,514 km<sup>2</sup> is shared by India's coasts of mainland while 663,629 km<sup>2</sup> is of Andaman and Nicobar Islands. This implies that all the areas on the continental shelves <sup>(Indian Continental Shelf- 468,000 km<sup>2</sup>)</sup> are under national sovereignty.



From various points of view, Indian coasts are very much important. India has *large coastal wetlands which cover an area of over 41,401 km<sup>2</sup>*. This is 27.13% of the Total area covered by wetlands in India. In contrast with the Inland wetlands, coastal wetlands are much less however. The inland wetlands of India cover 105649 Km<sup>2</sup>, which accounts Inland wetlands of India share around 69.22% of Total wetland area<sup>\*(a question was asked in Prelims 2012 on this)</sup>

Origin of the western and eastern coasts of India is generally attributed to the faulting and subsidence of the Arabian Sea and the Bay of Bengal towards the close of the Eocene Period. This implies that the alluvial deposits along these coasts are of very recent origin, ranging from Pliocene to recent times.

### West Coast of India

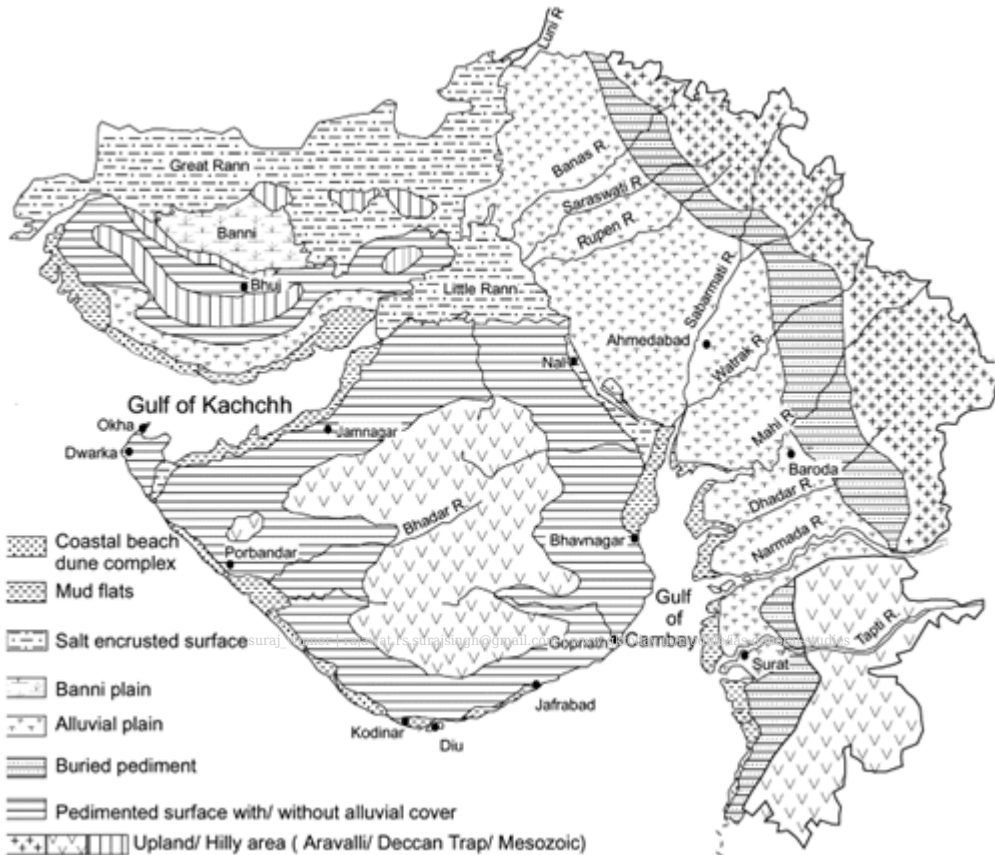
The Western Coastal plain lies between Kerala and Gujarat and stretches from the Arabian Sea to the Western Ghats. The total length of the western coasts is 1400 kilometers and its width varies from 10 kilometers to 80 kilometers. The elevation of the land ranges from 150m to 300m above sea level. The most important characteristics of the Western Coastal Plain are sandy beaches, coastal sand-dunes, mud-flats, lagoons, alluvial tracts, estuaries, lateritic-platforms and residual hills.

On the west coast, we have coastal plains of Gujarat and the coasts of the Peninsular India between Western Ghats and Arabian Sea. We divide the west coast into these three parts Coasts and Coastal Plains of Gujarat, Konkan Coast and Malabar Coast

### Coastal Plains of Gujarat

Physiographically, Gujarat is divided into three regions viz. Mainland Gujarat, Saurashtra Peninsula and Katch. Out of them, the **Mainland Gujarat** consists of eastern rocky highlands, the extensions of mountains of western India and the western Alluvial Plains including the coastal plains.





The **Saurashtra Peninsula** forms a rocky table land fringed by the coastal plains with the central part made up of the undulating plain broken by hills and dissected by various rivers flowing in all directions.

The eastern fringe is a low land which marks the site of the former sea connection between the Gulfs of Kach and Gulf of Cambay.

Then, the **Katch region** is made up of Ranns which is basically a salt encrusted wasteland just a few meters above sea level. It gets denudated in the monsoon. It is divided into Great Rann in the north and Little Rann in the east. Between Great Rann and Rocky mainland lies the **Banni Plains**.

The above discussion makes it clear that plains of Gujarat cover almost the entire state of Gujarat, except two districts viz. Banaskantha and Sabarkantha. These plains have become mainly due to the alluvial deposits of Sabarmati, Mahi, Luni and other rivers and also the depositional activity of winds.

Luni and Banas rivers discharge into Rann forming inland drainage during rainy season, both of



them are inland rivers.

### Konkan Coast

From South of Gujarat plain, Konkan coastal plain extends from Daman to Goa. Its last boundary down south is Gangavalli River.



The Konkan coast is generally narrow, not exceeding 65 km. It is widest near Mumbai. It is rocky and uneven, a few hills protrude up to the sea and that is why we find numerous light houses across the coasts to warn the ships remain away from the rocky area. The coast is rich in oil resources such as Bombay High. The northern part is sandy while the southern part is rugged.

### Malabar Coast

The Malabar Coast starts from south of Goa to Kanyakumari or Cape Comorin on India's southern tip extends. This is known for numerous **lagoons** aka. Kayals, which run parallel to the coast in southern part of Kerala. A chain of brackish lagoons and lakes lying parallel to the Malabar Coast in Kerala are called Backwaters. The network of Kerala Backwaters includes five large lakes linked by canals, both manmade and natural, fed by 38 rivers, and extending virtually half the length of Kerala state. The backwaters were formed by the action of waves and shore currents creating low barrier islands



across the mouths of the many rivers flowing down from the Western Ghats range.

Some important landmarks of this coast are the Vembanad lake, the longest lake of India and the **National Water Way-3**, that stretches Kottapuram to Kollam.

### Importance of Kerala Coasts

Kerala coastal zone is famous for its beautiful beaches, backwaters and lagoons. The coastal belt, a narrow strip of lowland, is the most picturesque region of Kerala, interspersed with extensive backwaters, lagoons and canals and flanked by luxuriant coconut groves and green rice fields. The lagoons and backwaters are never far from the sea and at several places they have established a permanent connection with it. The backwaters, rivers and the canal system form a navigable waterway of about 1,920 km.

This offers an unique ecological niche with great potential for brackish water fish farming in the state.

The sea off Kerala is one of the most productive zones for marine fish in India. Kochi is the major port located along the coast. The entire coastline is of natural beauty with vast beaches. *The tidal implications are felt deep into inland areas through the network of backwaters.* These tides have high utility for fishing, navigation and boating.

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### Eastern Coast of India

The eastern coasts cut through the **three states** viz. Tamil Nadu, Andhra Pradesh and Odisha. The **Cauvery delta** is most important sub region in Tamil Nadu, the **Krishna Godavari Delta** is most important landmark in Andhra Pradesh while the **Mahanadi Delta** is most important landmark in Odisha.

Eastern Coastal plain lies between the Eastern Ghats and the Bay of Bengal and is more extensive and wide than its western counterpart. They represent an **emergent coast** while its western counterpart is an example of **submerging coast**. The region receives both the Northeast and Southwest monsoon rains with its annual rainfall averaging between 1,000 mm and 3,000 mm. The width of the plains varies between 100 to 130 kilometers. The region is *wider, gets more rainfall, more hot and humid, more discontinuous and more fertile & irrigated in comparison to the western plains.* At places the plains are bordered with dunes. Mangrove forests also grow in this region. Lagoons are also found here.

This plain is broadly divided into

- **Coromandal Coast:** Ranges from Kanyakumari in Tamil Nadu to **False Divi Point** in Andhra Pradesh, which is just at the apex of the Krishna River delta.
- The region between the Krishna and Mahanadi for which an old term Northern Circars is sometimes used. Some classify it as Andhra Pradesh coastal plains.

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- Mahanadi Delta. Another broader term used is Utkal Coast, which also includes the **Chilika Lake**.

### Comparison of the East Coast and West Coast

| West Coast  | East Coast   |
|---|--|
| <p>Stretching from Rann of Kutch to Kanyakumari as a <u>narrow strip</u> between Arabian Sea and Western Ghats</p> <p>Divided into costal plains of Gujarat, Konkan Coast and Malabar Coast</p> <p>Highly influenced by <u>south west monsoon</u></p> <p><u>Lagoons and Estuaries are common</u></p> <p><u>Submerging Coast</u></p> <p><u>Less attacked by Cyclones</u></p> | <p>Stretching from Kanyakumari to Sunderbans as a relatively <u>broader (than western coast)</u> between Eastern Ghats and Bay of Bengal.</p> <p>Divided into Coromandal Coast and North Sircar coastal plains</p> <p>Influenced by <u>North East Monsoon. Also receives rains from South West Monsoon.</u></p> <p><u>Deltas are common</u></p> <p><u>Emergent Coast</u></p> <p><u>More attacked by Cyclones</u></p> |

### Important Observations about the Coastal Landmarks of India

#### Gulf of Kutch

Gulf of Kutch is the largest coastal habitat in the West coast of India. It is a shallow water body with depth extending from 60 m at the mouth to less than 20 m at the head of the Gulf. Average depth is 30 meters. Around the **Lushington Island**, the depth is just 5 meters.



- Bordered by Kutch in the north and Saurashtra in the south.
- Home to a **Marine National Park and Marine Sanctuary** at the southern shore, which includes 42 islands and a complex of fringing reefs backed by mudflats and sand flats, coastal salt marsh and mangrove forests, sand and rocky beaches which support a great diversity of fauna and flora.
- Many islands are **fringed with corals and mangroves** which provide disturbance free



habitats for many species of nesting birds.

- Apart from the islands, there are a large number of **wavecuts** (eroded shallow banks) such as Pirothan, Deda, Donna, Sankhodhar Beyt, Paga, Adatra and Boria, many of them have corals within.
- Gulf of Katch is the home for more than 800 species of organisms; 32 hard corals (Scleractinia) and 12 soft corals (Alcyonaria), 150-200 species of fishes, more than 100 species of algae, great diversity of sponges and worms, brittlestars, marine turtles and other reptiles, over 200 species of migratory and resident bird species.
- Gulf of Katch is home to the rare and endangered marine mammal, the **dugong (Sea Cow)**.
- Gulf of Kutch produces **95% of the salt requirements of the country**. Salt pans are located close to inter-tidal area and deep into the land.
- Gulf of Katch area is home for intermediate and major ports like **Kandla, Adani, Okha and Salaya**. Kandla is one of the major ports of India.
- The Asia's largest oil refinery is located at Jamnagar in the Gulf of Kutch.

### Gulf of Cambay

Gulf of Cambay or Gulf of Khambhat is a 80 miles long gulf that divides the Kathiawar peninsula to the west from the eastern part of Gujarat state on the east. Two major rivers of Gujarat viz. Narmada and Tapi empty here.



- The Gulf of Cambay is known for its extreme tides.
- The Gulf of Cambay is home to Alang shipyard, which is known for marine salvage industry,



half of all ships salvaged around the world are recycled here. The state government wants to make it largest International Maritime Organization-compliant ship recycling yard in the world and for that Gujarat has joined hands with Japan. The industry is benefited a lot by the tides here. Large ships are beached during the twice-monthly highest tides, and are dismantled when the tide recedes.

- The Gulf is encircled by a string of historical port towns such as Bharuch, Surat, Khambhat, Bhavnagar, and Daman.
- The Gulf is shallow and abounds in shoals and sandbanks. Mangroves are also found here, mainly in the Piram island.

### Gulf of Mannar

The Gulf of Mannar is a shallow bay, part of the Laccadive Sea in the Indian Ocean. A chain of low islands and reefs known as Adam's Bridge, also called Ramsethu, which includes Mannar Island, separates the Gulf of Mannar from Palk Strait, which lies to the north between India and Sri Lanka.



- The Thamirabarani River of south India and the Aruvi Aru of Sri Lanka drain into the Gulf of Mannar.
- The gulf of Mannar is home to thousands of species of flora and fauna and is known as one of the richest coastal regions in India. The corals, sharks, dugongs, dolphins and sea cucumber.
- The Gulf of Mannar Marine National Park was declared in 1986. The national park and its 10km buffer zone were declared Biosphere Reserve in 1989. The Gulf of Mannar is famous for its pearl banks of Pinctada radiata and Pinctada fucata for at least two thousand years.

### Palk Strait

Palk Strait connects the Bay of Bengal in the northeast with the Palk Bay and connects the Palk bay to Gulf of Mannar in the southwest. It is 53-80 kilometers wide, studded with a chain of low islands and reef shoals that are collectively called Adam's Bridge. This chain extends between Dhanushkodi on Pamban (Rameswaram) Island in Tamil Nadu and Mannar Island in Sri Lanka.





The shallow waters and reefs of the strait make it difficult for large ships to pass through, although fishing boats and small craft carrying coastal trade have navigated the strait for centuries. Large ships must travel around Sri Lanka. Construction of a shipping canal through the strait was first proposed to the British government of India in 1860, and a number of commissions have studied the proposal up to the present day. It is currently in news because of the Sethusamudram Shipping Canal Project.

### Islands of India

The islands of India constitute Andaman and Nicobar group of islands (Bay of Bengal), Lakshadweep Islands (Arabian Sea), riverine and off shore islands. The Lakshadweep and the Andaman & Nicobar Islands are India's two major island formations. Other significant islands in India include Diu Daman, a former Portuguese enclave; Majuli, a river island of the Brahmaputra; Elephanta in Bombay Harbour; and Sriharikota, a barrier island in Andhra Pradesh. Salsette Island is India's most populous island on which the city of Mumbai (Bombay) is located. 42 islands in the Gulf of Kutch constitute the Marine National Park. The number of islands of India in Bay of Bengal is approximately 5 times the islands in the Arabian Sea.

Andaman and Nicobar Islands which are largely tectonic and volcanic in origin, while the islands of the Arabian Sea are mainly coral formations.

### Andaman & Nicobar Islands (ANI)

The Andaman and Nicobar Archipelago consists of over 345 islands, islets and rocky outcrops, with land area extending up to 8,249 km<sup>2</sup> and a coastline stretch of 1,962 km; the Andaman Islands constitute 6408 km<sup>2</sup> and the Nicobars 1841 km<sup>2</sup>.



The Andaman Islands are the extension of the submerged **Arakan Yoma Tertiary Mountain range of Myanmar** and the Nicobars are the continuation of the **Mentawai Islands to the south and southeast of Sumatra**. The main rocks of these islands are sandstone, limestone and shale. These two island groups situated in the Bay of Bengal span  $6^{\circ}45' \text{ N}$  to  $13^{\circ}41' \text{ N}$  (740 km) and  $92^{\circ}12' \text{ E}$  to  $93^{\circ}57' \text{ E}$  (190 km).

The nearest land mass to Great Nicobar Island is Sumatra, 145 km southeast; and the Myanmar coast is roughly 280 km north of Landfall Island, the northern- most island in the Great Andaman group.

The topography of the Andaman and Nicobar Islands is hilly and undulating, the elevation in the Andamans is from 0 to 732 m, Saddle Peak being the highest in North Andaman Island. In the Nicobars the elevation rises from 0 to 568 m, Mt Thuillier being the highest peak on Great Nicobar Island.

The Andaman Islands support one of the world's most extensive mangrove ecosystems. Due to their long isolation, these islands have evolved significant diversity of flora and fauna with a **high level of endemism**.

The land area of 6408 km<sup>2</sup> in the Andamans constitutes **90% as reserves** and protected areas of which 36% is tribal reserves. The entire Nicobar group is a tribal reserve and has four wildlife sanctuaries, two





national parks and one biosphere reserve.

### Important Observations about the Ecological Profile of Andaman and Nicobar Islands

- The ANI consists of very fragile island ecosystems and some of the most pristine in the world, which supports very unique flora and fauna. The landscape for large islands emerges from **sea grass beds, coral reef or rocky outcrops, to beaches, littoral forest, Andaman slope forests, hilltops, into valleys and streams**. Some of the dominant tree species in these luxuriant forests reach heights of 40- 60 m.
- In some areas in the Andamans along the west and the east coast, the landscape starts from reefs or rocky outcrops to steep rock faces with wind blown vegetation.
- The topography of all large islands in the Andamans, Little Andaman, Little Nicobar and Great Nicobar Islands, is mostly interlaced with perennial and seasonal freshwater streams and in some areas a matrix of mangrove creeks extending into marshes.
- Little Andaman Island has ecosystems that do not occur anywhere else in the Andamans or the Nicobars, mainly extensive fresh and saline water marshes and peat
- 9% Dense Forests, 1.7% Open Forests, 12% Mangroves. Mangroves cover an area of 929 km<sup>2</sup> and in the Nicobar the extent is 37 km<sup>2</sup> (Balakrishnan, 1989; Andrews & Sankaran, 2002).
- ANI are fringed by one of the most spectacular **coral reefs** in the world.
- The **only primate**, the Nicobar crab eating macaque (*Macaca fascicularis umbrasa*) occurs in the southern group of the Nicobar Islands. The islands are a birdwatcher's paradise with as many as 250 species recorded.
- The complex geological history of these islands and the submergence of land bridges leading to isolation have left the islands with high levels of endemism. The widespread distribution of certain species indicates that there was an early evolution and dispersal throughout the archipelago. Endemism in reptiles and amphibians appears relative to species richness, islands with larger diversity have greater number of endemics.
- Protected areas in the islands are tribal reserves, national parks, wildlife sanctuaries, reserve, protected and preserved forest; and a biosphere reserve.
- An area of 513.70km<sup>2</sup> along the **west coast of South Andaman Island** is notified as a tribal reserve for the Jarawa people. This reserve extends north along the same coast into **Middle Andaman Island**, extending the reserve for another 338. 69 km<sup>2</sup>. A 5 km distance into the sea from the high tide line right along the entire stretch of the Jarawa Reserve is also notified as part of the reserve.
- **Strait Island**, 6.01 km<sup>2</sup> in area, on the east coast of Middle Andaman Island supports a population of 45-50 of the last remaining Great Andamanese people.



- To the south west of South Andaman Island is North Sentinel Island with an area of 59.67 km<sup>2</sup> and is inhabited by the Sentinalese people.
- The southern most island Little Andaman Island with a geographical area of 731.57 km<sup>2</sup> and of this, 706.49 km<sup>2</sup> with a distance of 3 km from the high tide line and into the sea along the coast has been notified as a tribal reserve for the Onge people.
- The entire group of 24 Nicobar Islands is notified as tribal areas; only 1,499.65 ha along the east coast from Campbell bay and up to 35 km is outside the Tribal Area and is inhabited by ex-servicemen, traders, government departments and the residents. Great Nicobar has a total area of 1044.54 km<sup>2</sup> and of which 853.19 km<sup>2</sup> is the tribal reserve, for both, the 380 Shompen people and the Nicobarese people.
- There are four national parks in the Andamans, Mahatma Gandhi Marine, Mount Harriet, Rani Jhansi Marine and Saddle Peak National Parks. The Nicobars have two areas notified as national parks and an area in Great Nicobar designated as the **Great Nicobar Biosphere Reserve**. Within the area of 960.40 km<sup>2</sup> in Great Nicobar Island, 110 km<sup>2</sup> is the **Galathea National Park**, situated on the south east of the island. On the east coast an area of 476.73 km<sup>2</sup> is notified as the **Campbell Bay National Park**. An area of 885 km<sup>2</sup> includes the Nicobar Biosphere Reserve and all these parks are within the tribal area.
- The Barren Island in the Andamans has an active volcano. In the Bay of Bengal, there are two volcanic islands (Barren and Narcondam) situated within 80 km east of the Andaman Islands.
- Rice is the main crop in Andaman and Nicobar Islands. Coconut and Arecanut are the main cash crops of Nicobar.

### Some other notes on Andaman and Nicobar Islands Kalapani

Andaman & Nicobar were known as 'Kalapani' because of their having been a penal settlement under the British Rule. First establishment of East India Company was in 1789 which was abandoned in 1796. Following the first war of Indian Independence in 1857, the British India Government founded the penal settlement in these islands in 1858, primarily known as Kalapani, for the deportation of freedom fighters from the mainland India, which continued till the Second World War. During the Second World War, the Japanese forces occupied the Andaman and Nicobar Islands in 1942. Further following the surrender of the Japanese forces in the Second World War, the British India Government reoccupied these islands in 1945 and continued their administration till the Independence of the country in 1947.

### 10 Degree Channel

It is a channel that separates the Andaman Islands from the Nicobar Islands in the Bay of Bengal. The channel is approximately 150 km wide, 400 fathoms deep running essentially along an east-west

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orientation. It is so named because it lies on the 10-degree line of latitude, north of the equator.



### Landfall Islands

The northern most point is Landfall Island which is 901kms away from the mouth of Hoogly River and about 190kms from Burma.

### Indira Point

The southern-most island is Great Nicobar, the southern-most tip of which Pygmalian Point now Indira Point is about 150kms away from Sumatra (Indonesia).

### Saddle Peak

Saddle Peak in North Andaman at a height of 732 meters above sea level is the highest point in these islands.

### Tribes

The original inhabitants of Andaman & Nicobar Islands lived in the forests on hunting and fishing. There are four Negrito tribes; viz., the Great Andamanese, Onge, Jarawa and Sentinalese in the Andaman group of islands and the Nicobarese and Shompens in the Nicobar group.

Around 50 percent of the population is made up of settlers from the mainland India, some people call Andamans as a Little India or a mini-India. The settlers or ancestors of these settlers came either prior to 1947 or after 1947.

### Chatam Island

The centre of activity of the Forest Department is Chatham Island. It has perhaps the biggest Saw Mill of its kind in Asia. Here logs are extracted with the help of elephants.



### Mount Harriet

It is the highest hill around South Andaman and is about 365m . Formerly it was the headquarters of the Chief Commissioner.

### Ross Islands

Seat of British Administration. The place came into decay with the shifting of the Chief Commissioner's Office in 1942 as areas close to the shore had developed serious cracks and it was felt that the building was not safe. Ross Island was occupied by Japanese in March 1942. In October 1945 the Islands were re-occupied by the British. Today the Island is deserted.

### Madhuban

A training ground for elephants.

### Ritchie's Archipelago

Ritchie's Archipelago is a cluster of smaller islands which lie some 25–30 km (16–19 mi) east of Great Andaman. The archipelago comprises some 4 larger islands, 7 smaller islands and several islets. The 4 large islands are Havelock Island, Henry Lawrence Island, John Lawrence Island and Sir William Peel Island.

### Havelock Island

Known for Coral Reefs

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### Neil Island

Known for timbering operations.

### Chiriyā Tapu

Also known as Bird Island

### The Viper Island

There was a jail prior to commissioning of Cellular jail.

### Car Nicobar

Most of the Nicobarese people are Christians.

### Cellular Jail

*Regarded by the freedom fighters all over the country as a place of pilgrimage and meant for "dangerous prisoners". The construction of the Cellular Jail was taken up in 1898 and completed by about 1906. Whole jail consists of cells and each cell was meant for one inmate only. Cellular Jail originally had seven, three storied wings with a total of 698 cells, radiating from a central tower which had an additional storey to facilitate watch and ward.*

*"Tyranny of our Freedom Fighters"*

*Convicts who were sentenced to transportation for life were sent to these islands and interned in the Cellular Jail. Many political prisoners and revolutionaries were incarcerated here during the freedom struggle. Against the tyranny of the Jail management political prisoners were not allowed to communicate with their friends and relatives on the mainland except once in a year. Even the letters coming from mainland and newspapers subscribed by the prisoners were censored before being given to them. While fighting against this tyranny some political leaders had to lay down their lives. Many prisoners had gone insane in the Jail and ended their lives by*



*committing suicide rather than subjecting themselves to the indignities heaped on them.*

### Damage to Building:

In 1941 earthquake caused considerable damage to the Jail building. During the Japanese occupation from March 1942 to October 1954 further damage was caused to the building. All this finally resulted in the demolition of four out of the seven wings of the Jail. At present there are only three wings and these stand as silent monument to the great patriot's and martyrs who were interned in this Jail, who had to sacrifice their lives at the altar of their country's freedom.

### Lakshadweep Islands

Lakshadweep is an archipelago consisting of 12 attols, 3 reefs and 6 newly formed/ submerged sand banks. It is comprised of – 11 inhabited islands, 16 uninhabited islands; six newly formed/ submerged sand banks and 3 reefs. The Inhabited islands are Kavaratti, Agatti, Bangaram, Amini, Kadmat, Kiltan, Chetlat, Bitra, Andrott, Kalpeni and Minicoy.

#### Aminidivi group (All Inhabited)

• Amini . Kadmat . Kiltan . Chetlat. Bitra

#### Laccadive group (First four Inhabited)

• Andrott. Kavaratti. Agatti. Kalpeni . Kalpitti . Bangaram. Tinnakkara . Parali. Tilakkam . Pitti . Cheriya . Suheli . Valiyakara . Pakshi Pitti . Kodithala

#### Minicoy group (Minicoy Inhabited)

• Minicoy. Veiningili

#### Submerged Reefs

• Beliapani. Cheriapani. Perumul Par

#### Submerged Banks

• Bassas de Pedro . Sesostris Bank . Cora Divh. Amini Pitti . Kalpeni Bank

- Bitra is the smallest of all having only a population of 267 (Census 2001).
- Though, the land area of this Coral paradise is only 32 Sq.kms. the inclusion of about 4200 Sq.kms. of its lagoon area, 20,000 Sq.km. of its territorial waters and almost 4, 00,000 Sq.kms of Exclusive Economic Zone makes it one of the largest territories of the country. Kavaratti is its capital (Headquarters). The total population of these islands is 60650 (as per 2001 census). Malayalam is traditional vernacular spoken in all the islands, *except Minicoy; where people speak*



Mahl, which is written in Divehi script and is the language of Maldives.

- The entire indigenous population because of their economic and social backwardness and geographical isolation is classified as Scheduled Tribes.

The tribes have, however not been named. The islanders are Muslims by religion. These islands lie about 220 to 440 kilometers away from the coastal city of Kochi in Kerala between 8° and 12° 13" North Latitude and 71° and 74° East Longitude.

### Important Observations about Lakshadweep

- Each island of Lakshadweep is fringed by coral sands. A common feature of these islands is that **a shallow lagoon exists invariably in their western side** separating the outer reef rim from low-lying coral islands composed essentially of calcareous sand and soil.
- Elevation of the Lakshadweep islands range from 0.5-7.0m above mean sea level. This implies that the danger from storm tides is tremendous over here.
- The origin of Lakshadweep Islands is attributed to theory of Sir Charles Darwin, according to whom the origin of these Islands can be traced to gradual submergence of some of the volcanic ridge into the Indian Ocean followed by accumulation of coralline deposits on the peaks and craters of these mountains. These deposits grew into coral islands resting on submerged mountaintops over a period of time.
- The islands are mostly coralline and their alignment appears to be in continuation of the Aravalli Strike of Rajasthan.
- Lakshadweep Islands are rich in marine wealth and an abode of plethora of coastal and marine bio-diversity with pristine Coral Reef Ecosystem which support variety of ornamental and food fishes belonging to various species besides the sedentary and slow moving creature such as Sea Cucumbers, shelled animals (Molluscs) and Hermit Crabs, Lobsters and Shrimps.
- The common farm species which are tend by the people are Cows, Goats, Ducks and Hens. Cats are common, but **dogs are almost wholly absent. There are no poisonous snakes on the islands**, and the islands are infested with rats and mosquitoes. The rats bring about a great deal of damage to coconut trees.
- The flora of Lakshadweep mainly consists of palm trees with coconut as the only commercial crop.
- Coastal bleaching and Coral erosion is one of the serious problems being faced by the Lakshadweep group of islands. During 1998 the strongest El Nino was recorded in Lakshadweep islands leading to rise in temperature in a range of 3-5° C above normal which resulted into severe coral bleaching, with mortality rates as high as 90% in some parts of these Islands. Rising sea levels may also lead to potentially acute erosion



### Other Islands

#### Diu Island

Diu is an off – shore island on the western coast, off the Gulf of Cambay, bordering Junagarh district. It is separated from the Gujarat Coast by a **tidal creek**. The coast has limestone cliffs, rocky coves and sandy beaches, the best of which are at Nagoa. A massive fort built by the Portuguese dominates the skyline. Nagoa beach is the most famous in Diu. Another beautiful beach is Ghoghla beach. The Diu fort was constructed between 1535 and 1541 AD after the defence alliance concluded between the Sultan of Gujarat and the Portuguese. The fort commands a magnificent view of sea.

#### Majuli Island

Majuli is a large river island in the Brahmaputra river, in Assam with an area of 1,250 Kms<sup>2</sup> once upon a time but but having lost significantly to erosion it has left with only a third of it. It was formed due to course changes by the river Brahmaputra and its tributaries, mainly the Lohit. It was originally a piece of land between Brahmaputra River (north) and Burhidihing river (south). Due to earthquakes back in medieval times, the change of Brahmaputra river course caused the formation of the Majuli Island. Majuli is also the abode of the Assamese neo-Vaisnavite culture. A wetland, Majuli is rich biodiversity spot and is home to many rare and endangered avifauna species including migratory birds that arrive in the winter season. Among the birds seen here are: the Greater Adjutant Stork, Pelican, Siberian Crane and the Whistling Teal. After dark wild geese and ducks fly in flocks to distant destinations. The island is almost pollution free owing to the lack of polluting industries and factories and also the chronic rainfall.

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#### Islands Off Mumbai

##### Butcher Island

Butcher Island (Jawahar Dweep) is an island off the coast of Mumbai. It has an oil terminal used by the port authorities to offload it from oil tankers. The crude oil is stored in oil containers on the island. From there they are piped to Wadala, in Mumbai where they are refined. This keeps the city relatively safe from a mishap. It is a restricted area and most of the island is covered with dense vegetation. A hillock rises from the centre of the island. It is located 8.25 kilometres (5.13 mi) from the Gateway of India.

##### Elephanta Island

Elephanta Island or Gharapuri Island is in Mumbai Harbour. It is home to the Elephanta Caves that have been carved out of rock.

##### Oyster Rock

Oyster Rock is an island in the Mumbai harbour, Mumbai, India. It is fortified, and owned by the Indian Navy.





### Pamban Island

Pamban Island or Rameswaram Island is in Tamil Nadu. The chain formed by Pamban Island, the shoals of Adam's Bridge, and Mannar Island of Sri Lanka separate Palk Bay and the Palk Strait in the northeast from the Gulf of Mannar in the southwest. Pamban Island extends for around 30 kilometres in width from the township of Pamban in the west to the remains of Dhanushkodi towards the south-east.

### Sri Harikota

Sriharikota is a barrier island off the coast of Andhra Pradesh. It houses India's only satellite launch centre in the Satish Dhawan Space Centre (also known as SHAR) and is used by the Indian Space Research Organisation to launch satellites using multi-stage rockets such as the Polar Satellite Launch Vehicle and the Geosynchronous Satellite Launch Vehicle. Sriharikota separates the Pulicat Lake from the Bay of Bengal, and is home to the town of Pulicat.

## Prelims Model Questions

### India's Physiography-2 Model Questions

1. Consider the following river of India:

1. Krishna River
2. Cauvery River
3. Godavari River

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Which among the above originate in Western Ghats?

- [A] Only 1 & 2  
[B] Only 2 & 3  
[C] Only 1 & 3  
[D] 1, 2 & 3

**Answer: [D] 1, 2 & 3**

<http://ces.iisc.ernet.in/biodiversity/documents/rivers.htm>

2. Which one of the following rivers originates from Amarkantak ?

1. Narmada
2. Son
3. Damodar
4. Tapti

Choose the correct option from the following codes:

- [A] Only 1 & 2  
[B] Only 1, 2 & 4  
[C] Only 2 & 4



[D] Only 1

**Answer: [A] Only 1 & 2**

River Narmada emerges from Amarkantak Hill of Maikal Range. Son river is largest of southern tributaries of Ganga that originates near Amarkantak in Madhya Pradesh near the source of Narmada River. Damodar originates in Chandwa on the Chota Nagpur Plateau. The Tapi River originates in the Betul district.

3. Indus river and Sutlej river have made magnificent gorges in Himalayas. Consider the following statements in this context:

1. Both Indus and Sutluj rivers originated before the Himalayan range was uplifted
2. Both Indus and Sutluj rivers emerge from the Tibetan side of Himalayas

Which among the above statements is / are correct?

[A] Only 1

[B] Only 2

[C] Both 1 & 2

[D] Neither 1 nor 2

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**Answer: [C] Both 1 & 2**

River Indus is an antecedent river as it is considered as older than the Himalayas. It has cut a magnificent gorge through the Himalayan mountain ranges that is more than 3 kilometres deep. Another major river of this system that is considered an antecedent river is the Sutlej. Satluj has also cut a gorge through the Central Himalayan Range. These rivers originated well before the Himalayan region was uplifted. The rivers Indus, Brahmaputra and Sutlej originated on Tibetan side and now traverse the existing mountain ranges, cutting deep gorges.

4. Most of the peninsular rivers in India are seasonal in nature. Which among the following is the least seasonal among all the rivers of the peninsula?

[A] Godavari

[B] Krishna

[C] Kaveri

[D] Tungbhadra

**Answer: [C] Kaveri**

Because of a long rainy season in its basin, the Cauvery is the least seasonal among all the rivers of the peninsular region

5. Consider the following statements:



1. Majority of the islands in Lakshadweep are uninhabited
2. There are almost no snakes in Lakshadweep

Which among the above statements is / are correct?

- [A] Only 1  
[B] Only 2  
[C] Both 1 & 2  
[D] Neither 1 nor 2

**Answer: [C] Both 1 & 2**

6. What is the approximate ratio of parts of Indian Coast belonging to Peninsular India to that belonging to Andaman, Nicobar, and Lakshadweep Islands?

- [A] 2:1  
[B] 2.5:1  
[C] 3:1  
[D] 3.5:1

**Answer: [B] 2.5:1**

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7. The origin of which among the following rivers is in Tibet?

1. Sutlej River
2. Indus River
3. Ghaghara River

Select the correct option from the codes given below:

- [A] 1 & 2  
[B] 2 & 3  
[C] 1 & 3  
[D] 1, 2 & 3

**Answer: [D] 1, 2 & 3**

8. Consider the following comparisons of the Himalayan Rivers and Peninsular rivers:

1. Most of the Himalayan rivers are perennial, while most of the peninsular rivers are rainfed
2. The gradient of the Himalayan rivers is steeper than peninsular rivers
3. The peninsular rivers cause more erosion on their way in comparison to the Himalayan rivers

Which among the above is / are correct?

- [A] Only 1 & 2  
[B] Only 2 & 3



[C] Only 1 & 3

[D] 1, 2 & 3

**Answer: [A] Only 1 & 2**

The rivers of the Himalayan region rise in the glaciers and they are perennial. In summer their volume tends to increase because snow melt in the upper reaches.

The peninsular rivers do not have their sources in glaciers and most of them are rainfed.

The Himalayan rivers not only carry a larger volume of water in comparison to their peninsular counterparts but also carry a larger amount of silt. On the other hand the peninsular region rivers carry a very limited amount of sediment.

The slopes of the Himalayan rivers is very steep on the upper reaches. That is one reason that they erode and transport huge amounts of sediments. Further, the landforms over these rivers flow is also young.

On the other hand, the peninsular rivers have not very steep gradient and they flow on already eroded old topography. Further, the hard rocks of the peninsular region are not as susceptible to erosion as those of the Himalayan region.

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9. The correct location of the Duncan pass is between\_\_\_:

[A] South and little Andaman

[B] North Andaman and south Andaman

[C] North and east Andaman

[D] North and Middle Andaman

**Answer: [A] South and little Andaman**

Duncan pass is located between South and little Andaman. Duncan Passage is a strait in the Indian Ocean. It is about 48 km (30 mi) wide; it separates Rutland Island (part of Great Andaman) to the north, and Little Andaman to the south. West of Duncan Passage is the Bay of Bengal; east is the Andaman Sea.

10. With reference to the rivers in India, the “Upper Yamuna” refers to the Yamuna river from its origin at Yamunotri to\_:

[A] Tajewala in Yamuna Nagar district

[B] Dak Pathar near Dehradun

[C] Okhla Barrage in Delhi

[D] Paonta Sahib in Himachal Pradesh

**Answer: [C] Okhla Barrage in Delhi**



“Upper Yamuna” refers to the reach of Yamuna from its origin at Yamunotri to Okhla Barrage in Delhi. A Memorandum of Understanding (MoU) was signed on 12th May, 1994 amongst the basin states of Himachal Pradesh, Uttar Pradesh, Haryana, Rajasthan and Delhi, for sharing the utilizable surface flows of river Yamuna up to Okhla. The MoU also provided for creation of “Upper Yamuna River Board” to implement the said agreement. Accordingly, the Central Government constituted the Upper Yamuna River Board in 1995 as a subordinate office under the Ministry of Water Resources. After the creation of Uttaranchal State in 2000, the resolution was modified to include Uttaranchal (now Uttarakhand) also in the Board. The resolution also provided for constitution of a Review Committee, to be known as the Upper Yamuna Review Committee (UYRC), comprising the Chief Ministers (Governor in case of President’s rule) of the co-basin states as members and Union Minister/Minister of State for Water Resources as Chairman, to supervise the working of the Upper Yamuna River Board (UYRB).

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