



# **RAS**

***Rajasthan Administrative Services***

***Rajasthan Public Service Commission***

***Volume - 4***

***Geography of India and World***



# RAS

## Geography of India & World

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# Indian Drainage System

## PREVIOUS YEAR QUESTIONS

Q1. Which is not a correct match?

(2023)

Lake		Location in State
(1) Bhim Tal	-	Uttarakhand
(2) Pulicat	-	Tamil Nadu
(3) Loktak	-	Manipur
(4) Roopkund	-	Himachal Pradesh
(5) Question not attempted		

Q2. Match list-I with list-II and choose the correct answer from the code given below- (2021)

List-I (River)	List-II (Tributary)
(A) Godavari	(i) Bhavani
(B) Mahanadi	(ii) Penganga
(C) Damodar	(iii) Seonath
(D) Kaveri	(iv) Barakar

Code -

- |                                    |                                    |
|------------------------------------|------------------------------------|
| (1) A-(iv), B-(ii), C-(i), D-(iii) | (2) A-(ii), B-(iii), C-(iv), D-(i) |
| (3) A-(i), B-(ii), C-(iv), D-(iii) | (4) A-(iii), B-(i), C-(ii), D-(iv) |

**Analysis-** Rivers and lakes are very important as every year there is one question. Nature of the questions are direct and simple if facts are known. Need to focus on tributaries of major rivers and location of major lakes.

The Flow of water through well-defined channels is called Drainage and network of such channels is called a Drainage system. The area drained by rivers and its tributaries is known as Drainage Basin.

The Great Water Divide separates India into three major drainage systems-Arabian sea drainage, Bay of Bengal drainage and Inland drainage system. (Water Divide is the elevated boundary that separates two water drainage systems.)

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Indian rivers mainly drains in 2 directions of main water divide line:

- 77% into Bay of Bengal.
- 23% into Arabian Sea.

## **I. Types of Drainage Patterns**

### **(i) Concordant drainage patterns**

- Concordant if drainage pattern correlates to topology and geology of area.
- Path of the river is highly dependent on the slope of the river and topography.

### **(ii) Discordant or Insequent drainage patterns**

- Discordant if it does not correlate to topology and geology of the area.
- River follows its initial path irrespective of the changes in topography.

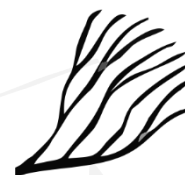
### **(iii) Dendritic Drainage Pattern**

- An irregular tree branch shaped pattern.
- Eg: The Indus, the Godavari, the Mahanadi, the Cauvery, the Krishna.



### **(iv) Parallel drainage pattern**

- Pattern of streams running parallel to each other is found in areas of moderate to steep slopes with some relief.
- Eg: The Godavari, the Kaveri, the Krishna and the Tungabhadra.



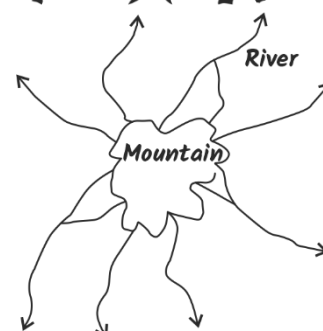
### **(v) Trellis Drainage Pattern**

- Formed when primary tributaries of main rivers flow parallel to each other and secondary tributaries join them at right angles.



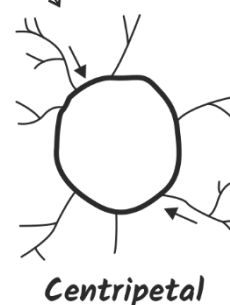
### **(vi) Radial Drainage Pattern**

- Develops around a central elevated point when rivers originate from a hill and flow in all directions.
- Eg: The Narmada, the Son and the Mahanadi originate from Amarkantak Hills and flow in different directions.

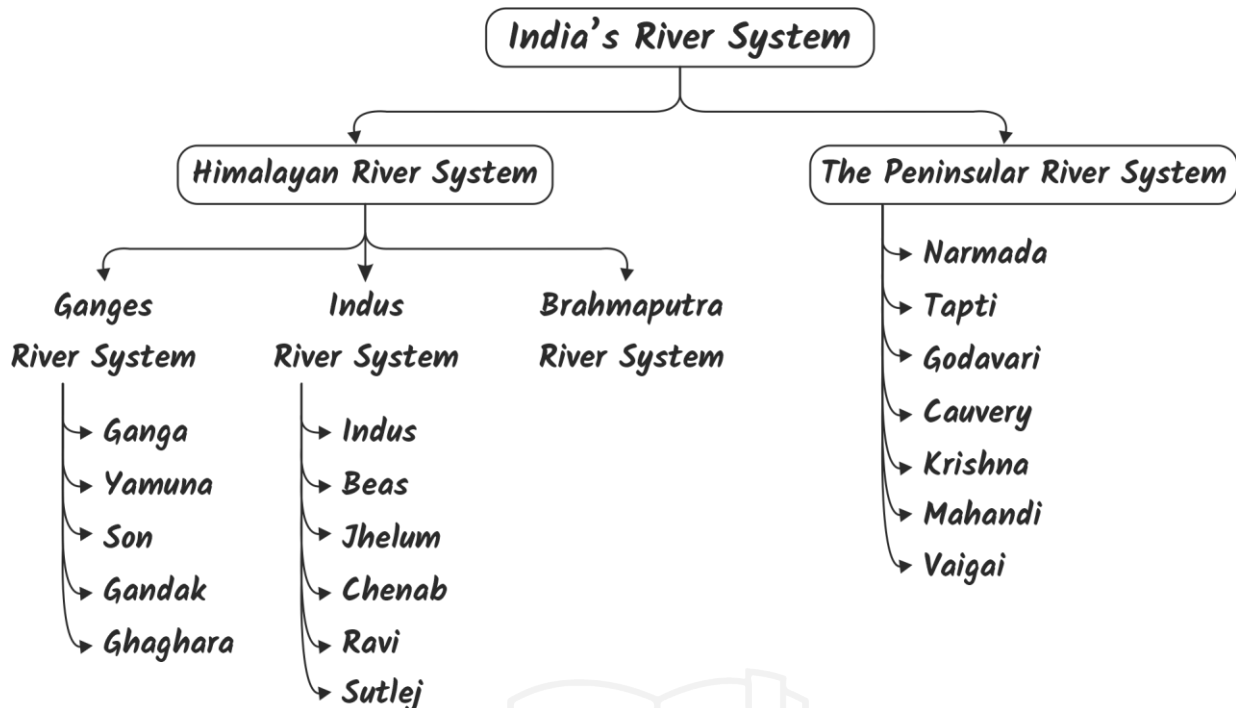


### **(vii) Centripetal Drainage Pattern**

- When the rivers discharge their waters from all directions in a lake or depression.
- Eg: streams of Ladakh, Tibet, and the Bagmati and its tributaries in Nepal.



## 2. Drainage System of India

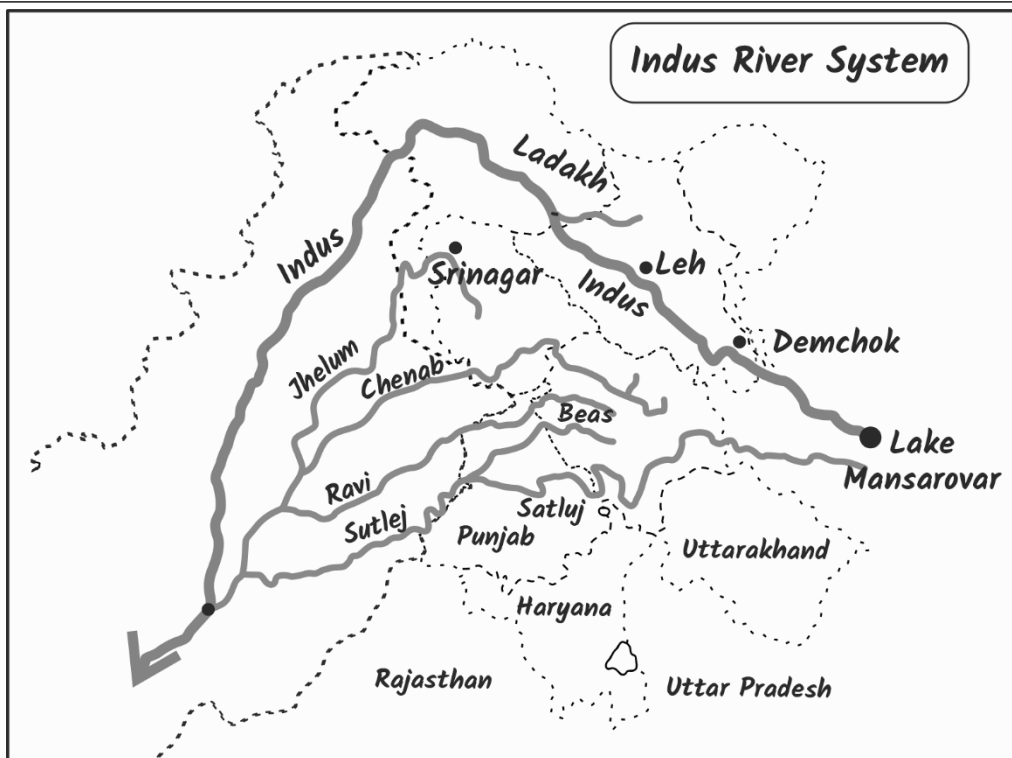


### 2.1 Himalayan Drainage System

➤ 3 main Himalayan rivers – the Indus, the Ganga and the Brahmaputra.

#### **(i) Indus River System**

- **Origin of Indus:** From a glacier near Bokhar Chu in Tibetan region in Kailash Mountain range near Mansarovar Lake. In Tibet it is known as Singi Khanban.
- **Course:**
  - Flows northwest and enters Ladakh at Demchok.
  - Takes a northwestern course and continues to flow towards the Leh region of Ladakh.
  - Total length-2880 Km(In India length is 1,114 Km).
  - Leh is situated on the banks of this river.
  - Flows between Ladakh and Zaskar range.
  - Right-bank tributaries: Shyok, Gilgit, Hunza, Nubra, Kabul, Khurram, Gomal, Swat.
  - Left-bank tributaries: Zaskar, Suru, Soan, Jhelum, Chenab, Ravi, Beas, Satluj rivers.



**Trick to remember the tributaries of Indus:**

*Indu Just Changed Rags to Bags.*

- Indus, Jhelum, Chenab, Rabi, Beas, Satluj

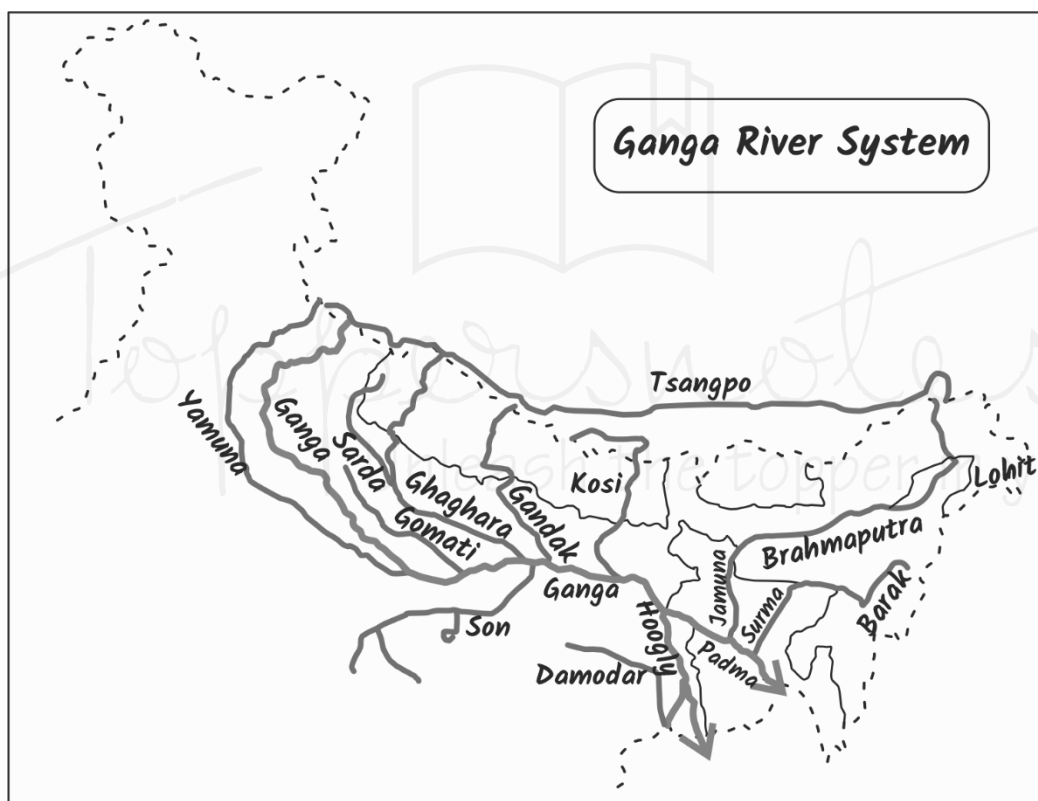


#### Major rivers related to Indus River System

Chenab River	<ul style="list-style-type: none"> <li>➤ Origin: near the Bara Lachla Pass in Lahaul-Spiti of Zaskar Range.</li> <li>➤ Formed by the confluence of Chandra and Bhaga rivers at Tandi (Lahaul and Spiti District of Himachal Pradesh).</li> <li>➤ Flows through Jammu region into Punjab plains in Pakistan.</li> <li>➤ Waters allocated to Pakistan under Indus Water Treaty</li> <li>➤ Baglihar Dam on this river.</li> </ul> <p><i>It is the largest tributary of the Indus river.</i></p>
Jhelum River	<ul style="list-style-type: none"> <li>➤ Origin: from a spring at Verinag at the foot of Pir Panjal in S-E part of the valley of Kashmir.</li> <li>➤ Largest tributary- Kishanganga (Neelum).</li> <li>➤ Ends in a confluence with Chenab in Jhang district Pakistan.</li> <li>➤ Forms Wular lake (largest fresh water lake in India)</li> <li>➤ Srinagar is situated on the banks of this river.</li> </ul>
Rabi River	<ul style="list-style-type: none"> <li>➤ Origin: Kullu hills near Rohtang Pass in Himachal Pradesh.</li> <li>➤ Follows a northwesterly course.</li> </ul>

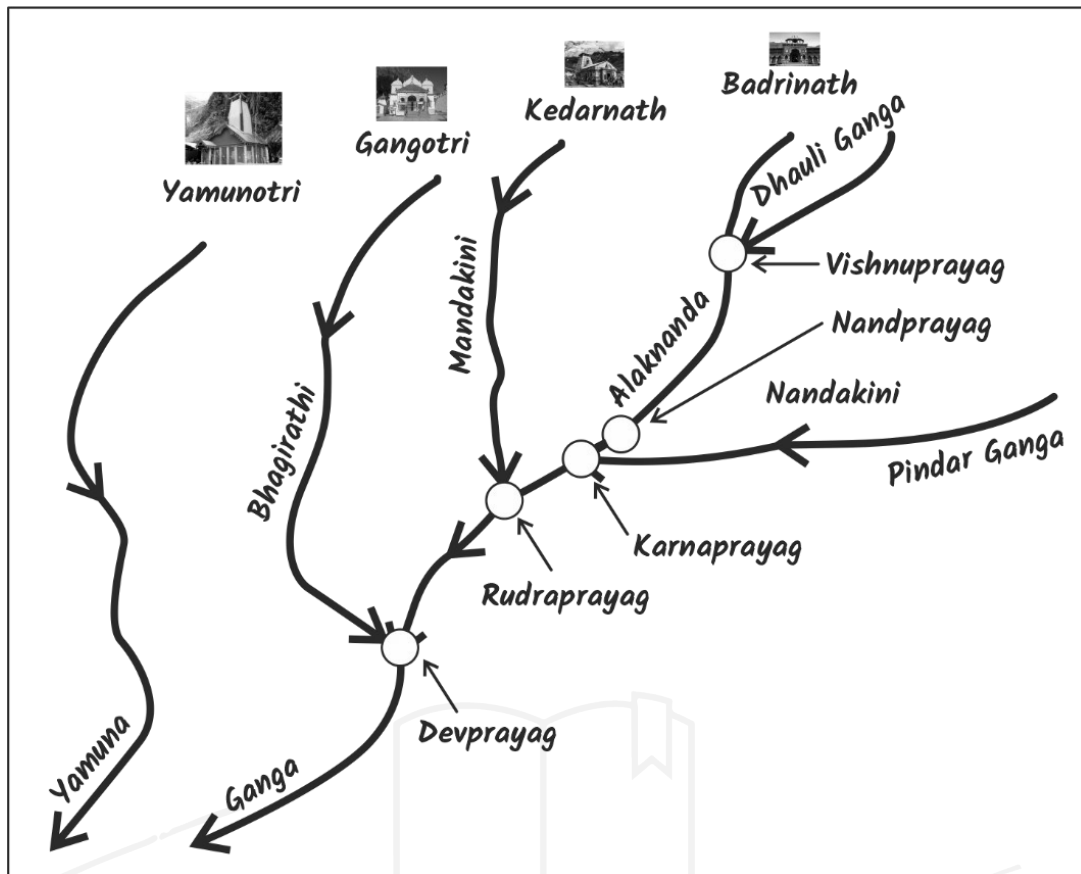
	<ul style="list-style-type: none"> <li>➤ Ranjit Sagar Dam (Thein dam) on this river.</li> <li>➤ Joins Chenab river in Jhang district of Pakistan.</li> <li>➤ Lahore city is located on the banks of this river.</li> </ul>
Satluj River	<ul style="list-style-type: none"> <li>➤ Also known as the Red River.</li> <li>➤ Origin: From Rakas Lake in Southern slopes of Kailash Mountain near Mansarover Lake and known as Longchen Kambha in Tibet.</li> <li>➤ Enters Himachal Pradesh at Shipki La.</li> <li>➤ World's highest gravity dam- Bhakra Nangal Dam, on this river.</li> </ul>
Beas River	<ul style="list-style-type: none"> <li>➤ Emerges from Beas kund near Rohtang pass in Himachal Pradesh.</li> <li>➤ Before entering Pakistan, it merges with Sutlej River at Hari-Ke-Pattan (Punjab)</li> <li>➤ Pong dam is situated here.</li> </ul>

## (ii) Ganga River System



- Formed from 6 headstreams (Alaknanda, Mandakini, Nandakini, Bhagirathi, Dhaul Ganga, and Pindar) and their confluences.
- Bhagirathi- source stream.
- Origin: Foot of Gangotri Glacier, at Gaumukh (3892m).
- Enters the plains from Haridwar and empties into the Bay of Bengal.
- Empties into the Bay of Bengal.
- Joined by Yamuna at Allahabad.
- Total length from source to its mouth - 2,525 km

## Panch Prayag



Vishnuprayag	Alaknanda + Dhauti Ganga
Nandprayag	Alaknanda + Mandakini
Karnaprayag	Alaknanda + Pindar
Rudraprayag	Alaknanda + Mandakini
Devprayag	Alaknanda + Bhagirathi = GANGA

### ➤ Major Tributaries:

“ Trick to remember the the Right Bank tributaries: Yummy SoDa

- Yamuna, Son and Damodar

”

“ Trick to remember the Left Bank tributaries of ganga:

Rama Ghumti hui Ghaghara Ganda Kar Mat.

- Ramganga, Gomati, Ghaghara, Gandak, Kosi and Mahananda

”



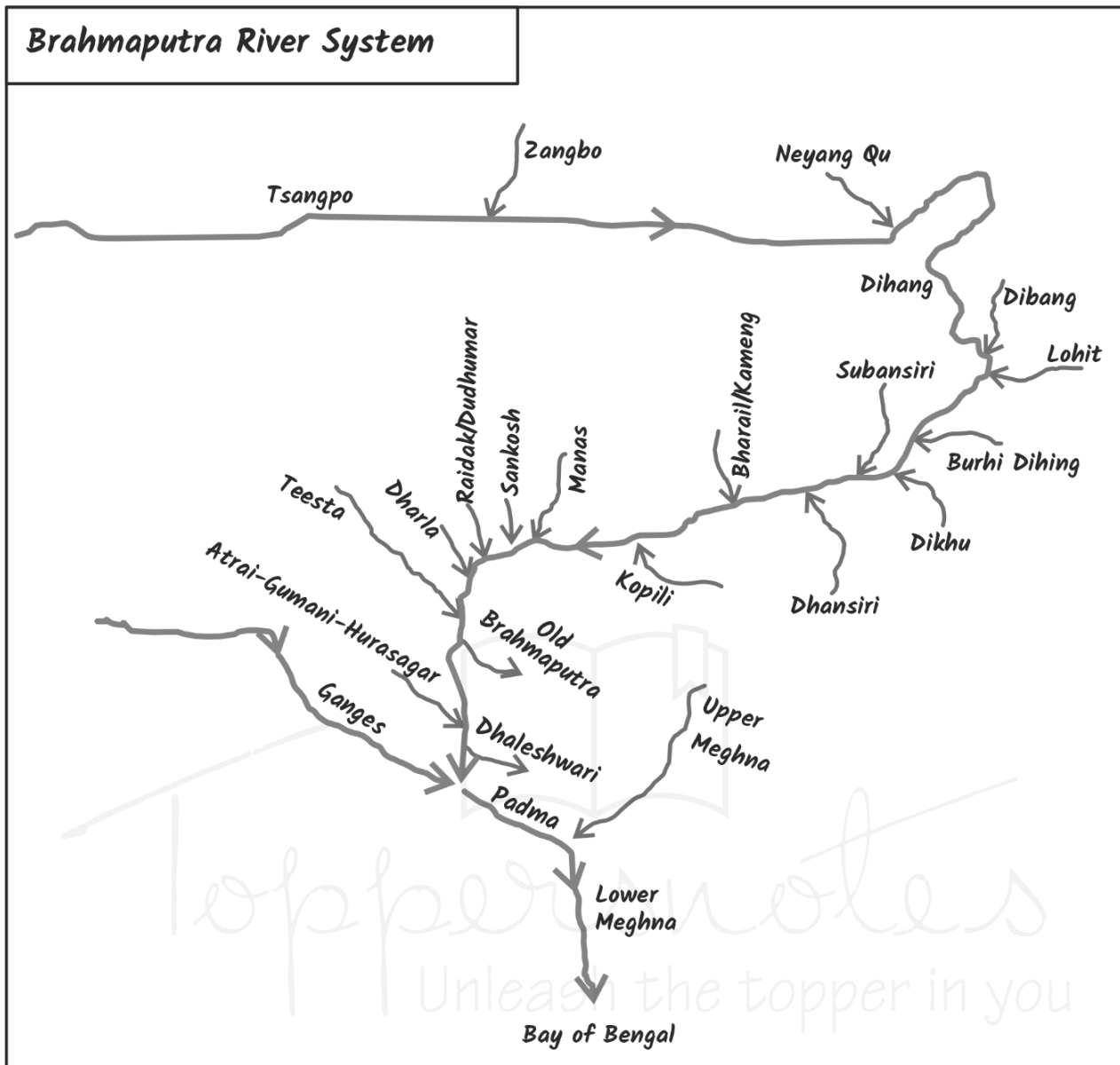
### Major Left bank tributaries:

Ramganga	<ul style="list-style-type: none"><li>➤ Origin: southern slopes of Dudhatoli Hill in Chamoli, Uttarakhand.</li><li>➤ Flows through the dun valley of Corbett National Park.</li><li>➤ Meets the Ganga near Kannauj.</li></ul>
Gomti	<ul style="list-style-type: none"><li>➤ Origin: Gomat Taal (aka Fulhaar jheel) near Madho Tanda, Pilibhit, UP.</li><li>➤ Meets the Ganges in Ghazipur.<ul style="list-style-type: none"><li>○ Location of the famous Markandey Mahadeo temple.</li></ul></li></ul>
Ghaghara	<ul style="list-style-type: none"><li>➤ Origin: in the glaciers of Mapchachungo.</li><li>➤ Source: near Gurla Mandhata peak, south of Mansarovar in Tibet.</li><li>➤ Also known as Karnali or Kauriala.</li><li>➤ Cuts through the Himalayas in Nepal.</li></ul>
Gandak	<ul style="list-style-type: none"><li>➤ Union of Kali and Trisuli rivers forms Gandak river.</li><li>➤ Merges with Ganga river opposite Patna at Sonapur.</li></ul>
Kosi	<ul style="list-style-type: none"><li>➤ Known as Saptakoshi in Nepal(has 7 Himalayan tributaries)</li><li>➤ Unstable nature causing flood in Bihar, therefore called - "The Sorrow of Bihar".</li></ul>

### Major right bank tributaries

Son	<ul style="list-style-type: none"><li>➤ Origin: near Amarkantak in Madhya Pradesh.</li><li>➤ Tributaries: - Rihand and North Koel.</li></ul>
Yamuna	<ul style="list-style-type: none"><li>➤ Largest and the most important tributary.</li><li>➤ Origin: Yamunotri glacier on Bandarpunch Peak in the Garhwal region in Uttarakhand(6,000 meters).</li><li>➤ Flows through Uttarakhand, Himachal Pradesh, Haryana, Delhi and joins Ganga river in Prayagraj (Uttar Pradesh).</li><li>➤ Right bank tributaries-Tons, Giri, Chambal, Sindh, Betwa, Ken.</li><li>➤ Left bank tributaries- Hindon and Sanger.</li></ul> <div><p>“ Trick to remember the tributaries of Yamuna: Yamuna, Chamba aur Sharda Beta send Tons of Cane to Sindh • Chambal, Sharda, Betwa, Tons, Ken and Sindh ”</p></div>

## Brahmaputra River System



**Trick to remember the tributaries of Brahmaputra:**  
Manas and Tista Watched Dabang Dhansiri and  
Subandiri Looting.  
• Manas, Teesta, Dibang, Dhansiri, Subansiri and Lohit

- One of the largest rivers in the world.
- Source of origin: Chemayundung glacier of Kailash range near Mansarovar Lake.
- Drains into Bay of Bengal before forming a huge delta along with the Ganga.
- Creates a deep gorge through the Himalayas near Namcha Barwa (Arunachal Pradesh).
- Enters India under the name of the Dihang.
- World largest riverine island Majuli is found on this river.
- Regional names of Brahmaputra:

Region	Name
Tibet	Tsangpo (meaning 'The Purifier')
Bangladesh	Jamuna River
Bangladesh	Padma River: Combined Waters of Ganga and Brahmaputra.
Bangladesh	Meghna: From the confluence of Padma and Meghna.

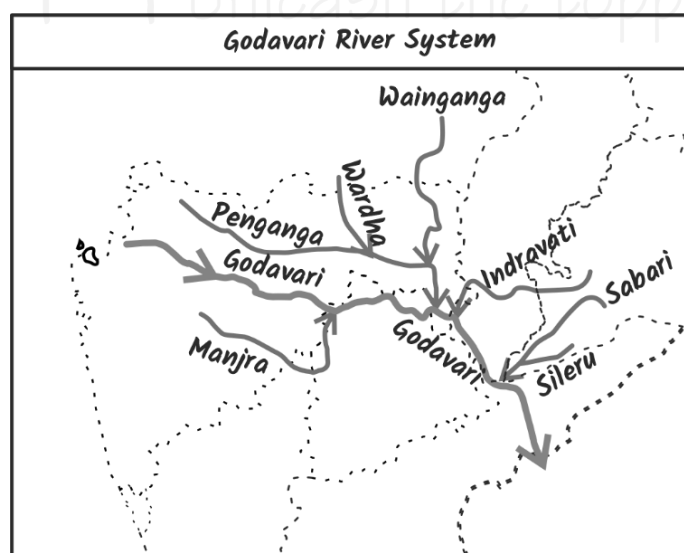
- Left bank tributaries: Lhasa River, Nyang River, Parlung Zangbo River, Lohit River, Dhansiri River, Kopili River.
- Right bank tributaries: Kameng River, Manas River, Sankosh River, Teesta River, Subansiri River.

## 2.2 Peninsular River System or Peninsular Drainage:

- Much older than Himalayan rivers.
- Non-perennial rivers- maximum discharge in the rainy season.
- Main water divide is created by the Western Ghats.
- East flowing rivers- Mahanadi, Godavari, Krishna and Cauvery -form deltas.
- West flowing rivers- Narmada and Tapi - form estuaries.
- Rivers that drain into Bay of Bengal: Mahanadi, Godavari, Krishna, Cauvery.
- Rivers that drain into Arabian Sea: Narmada, Tapi, Mahi.
- Rivers that drain into the Ganges: Chambal, Betwa, Ken, Son and Damodar

## 3. Major Peninsular Rivers

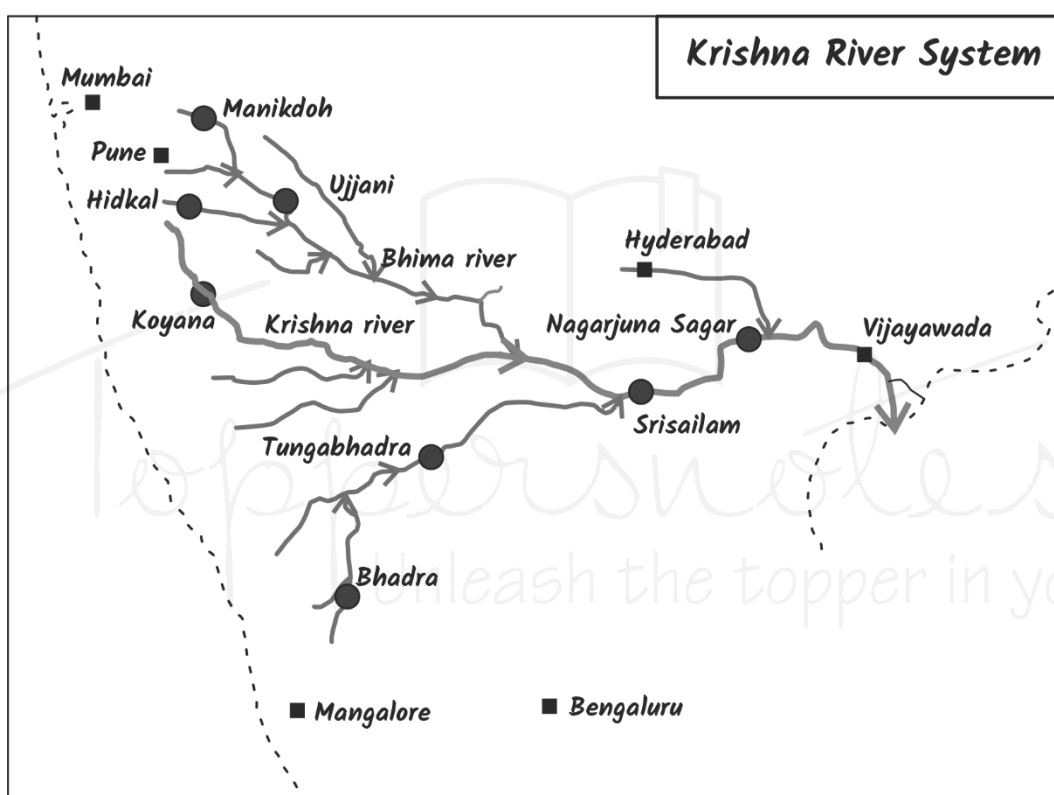
### 3.1 Godavari:



“ Trick to remember the tributaries of Godavari:  
Indravati ne Manjhari aur Bindu ke Sharbat Pila ke Pran  
Bachaye.  
• Indravati, Manjira, Bindusara, Sarbari, Penganga, Pranhita ”

- Second-longest course in India.
- Also known as Dakshin (South) Ganga or Vriddh (Old) Ganga.
- Origin: Trimbakeshwar, near Nasik in Maharashtra.
- Flows in southeast direction across south-central India.
- States: Madhya Pradesh, Telangana, Andhra Pradesh, and Odisha.
- Drains into the Bay of Bengal.
- Forms a fertile delta.
- Polavaram dam is located on this river (Andhra Pradesh).
- Tributaries-Purna, Pranhita, Indravati, Manjira, Penganga, Sabari.

### 3.2 Krishna

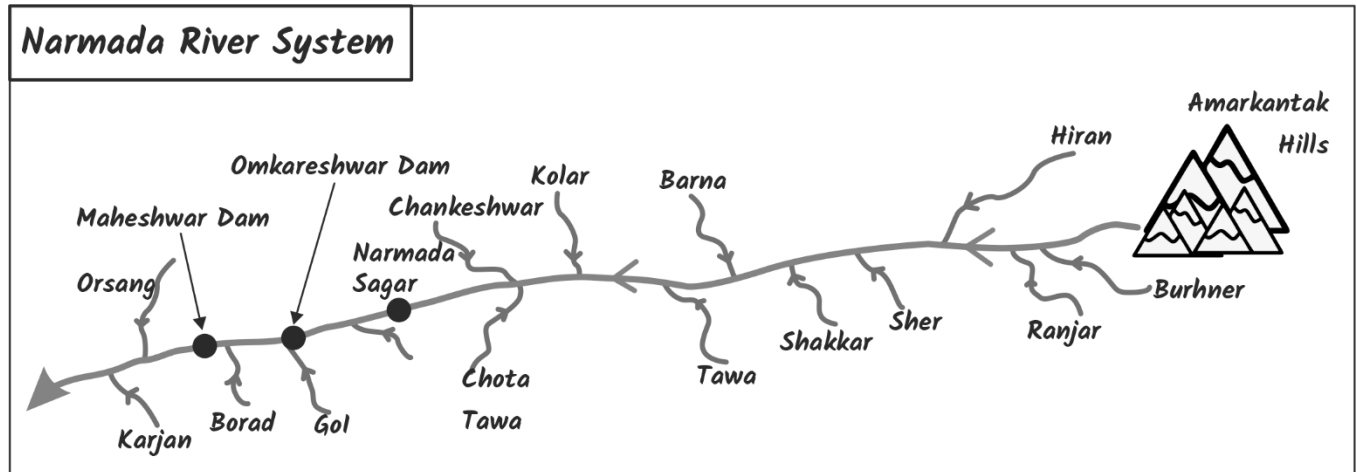


“ Trick to remember the tributaries of Krishna:  
 Bhima Tu Ghar per Ved ko Dundhna Warna Didi Masal degi.  
 • Bhima, Tungbhadra, Ghatprabha, Vedavati, Koyna,  
 Dudhganga, Warna, Dindi, Musi ”

- Origin: Mahabaleshwar.
- States: Maharashtra, Karnataka, Telangana, Andhra Pradesh.
- Total length- 1,400 km.
- Drains into Bay of Bengal.
- Major dams- Almatti Dam, Srisailem Dam, Nagarjuna Sagar Dam, and Prakasam Barrage.

- Right bank: Venna, Koyana, Panchganga, Dudhganga, Ghatprabha, Malaprabha and Tungabhadra.
- Left Bank: Bhima, Dindi, Musi, Paleru, and Munneru.

### 3.3 Narmada:



“ Trick to remember the tributaries of Narmada:  
Narmada Dhundhe Koyla aur Tawa to feel Bhukhi Hiran.  
• Dudhi, Kolar, Tawa, Bhukhi, Hiran ”

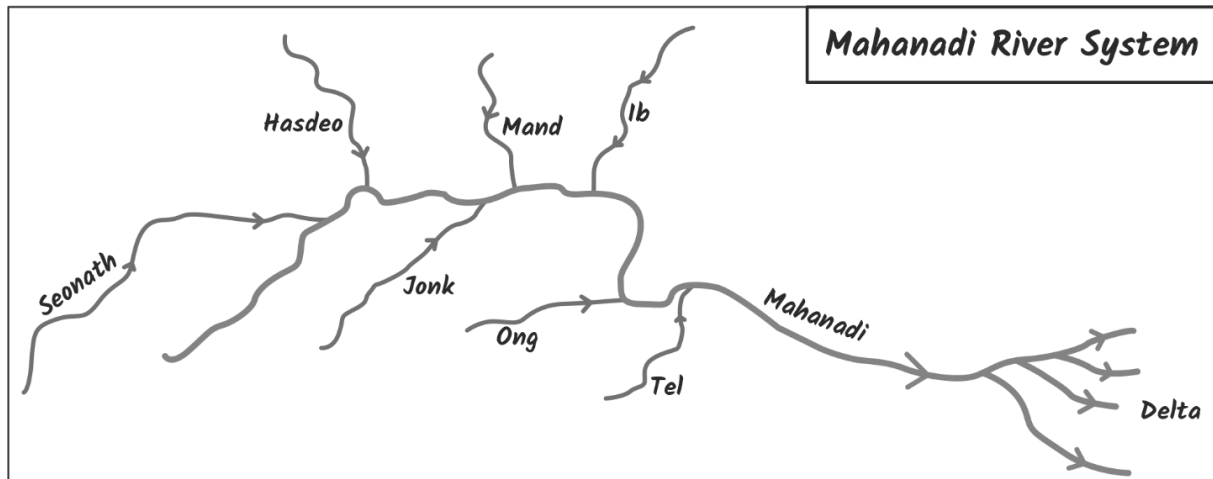
- Largest (1312km) west flowing river of peninsular India.
- Largest Estuary river in india.
- Rises from Maikal range near Amarkantak in Madhya Pradesh. Flows westwards through a rift valley between Vindhya Range (north) and Satpura Range (south).
- States- Gujarat, Maharashtra and Madhya Pradesh
- Waterfalls: Kapildhara, Dugdhadhara, Dhuadhaar, Mandhar, Dardi, Shahatradhara
- Major Projects:
  - Sardar Sarovar- (Bharuch), Gujarat- Biggest project in Narmada river
- Largest island: Aliabet.
- Tributaries: Tawa, Kundi, Sher, Hiran.

### Key Concepts

West flowing rivers do not form Deltas because:

- peninsular plateau have hard rock surface and lacks alluvial material- not enough sediments .
- less amount of rainfall compared to Himalayan Rivers.
- These rivers have small streams and flow rapidly from steep slopes short distance. They can estuaries not deltas.

### 3.4 Mahanadi:



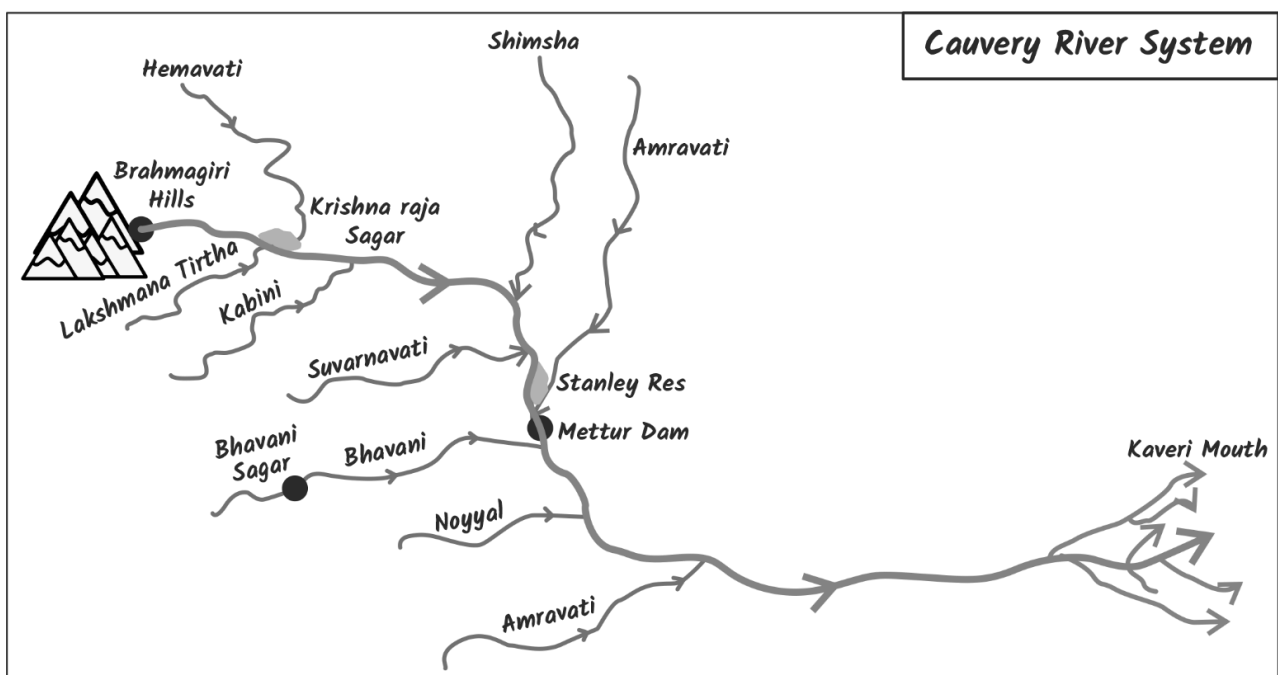
“ Trick to remember the tributaries of Mahanadi:

Seonath Ib Hasdo on the Joke Ong Telling Man.

• Seonath, Ib, Hasdeo, Jonk, Ong, Tel and Mand ”

- 3rd largest of peninsular India and largest river of Odisha.
- Mahanadi – compound of 2 Sanskrit words “maha” – “great” and “nad” – “river”.
- Source – Northern foothills of Dandakaranya, Raipur, Chhattisgarh.
- States- Chhattisgarh, Odisha, Jharkhand, Maharashtra, and Madhya Pradesh
- Hirakud Dam (one of the largest dams in India) has formed a man-made lake 35 miles (55 km) long.
- Drains into Bay of Bengal.
- Left bank Tributaries: Seonath, Hasdeo, Mand, and Ib.
- Right bank Tributaries: Ong, Tel, and Jonk.

### 3.5 Cauvery:



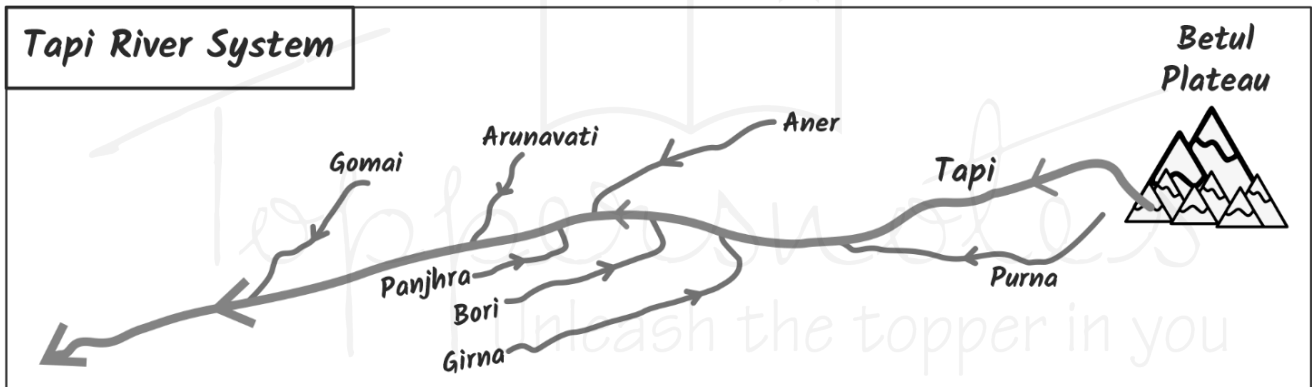
### ☛ Trick to remember the tributaries of Kaveri:

Amar Kabhi Akar Hema ki Nakal Lakshman ko Sikha.

- Kabini, Amravati, Hemavathi, Noyyal, Lakshmana Tirtha, Shimsha

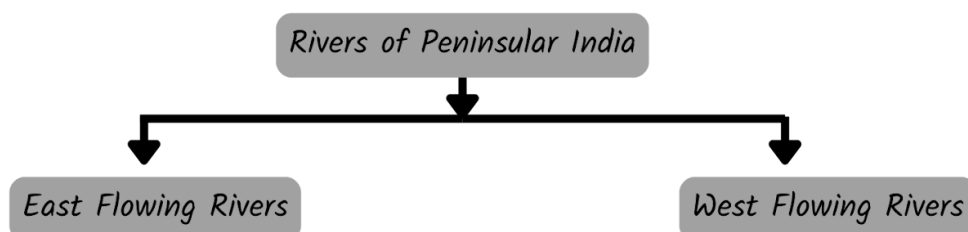
- Also known as 'Dakshin Bharat ki Ganga' or 'the Ganga of the South'.
- Origin: Talakaveri, Brahmagiri range, Cherangala village, Coorg, Karnataka.
- Length: 800 km.
- States- TN, Karnataka, Kerala and Puducherry
- Breaks into a large number of distributaries forming a wide delta called "garden of southern India"
- Drains into the Bay of Bengal.
- Left Bank tributaries: Hemavati, Shimsha, and Arkavati.
- Right Bank tributaries: Lakshmana Tirtha, Kabini, Suvarnavati, Bhavani, Noyyal, and Amravati.

### 3.6 Tapi or Tapti



- aka "Taap harne wali" or Surya Putri or Tapi.
- Second largest west flowing river of Peninsular India
- Origin: Multai (Betul district) reserve forest, Madhya Pradesh.
- Drains into Arabian Sea through the Gulf of Cambay [Gulf of Khambhat].
- States: Madhya Pradesh, Maharashtra and Gujarat.
- Right Bank: Suki, Gomai, Arunavati and Aner.
- Left Bank: Panjhra, Bori, Girna, Purna, Mona and Sipna.

### 3.7 Other Major rivers of Peninsular India



## 1. East Flowing Rivers

River	Course of River
Subarnarekha	Jharkhand, West Bengal and Odisha
Baitarani	Odisha
Brahmani	Jharkhand and Odisha
Pennar	Karnataka and Andhra Pradesh
Palar	Karnataka, Andhra Pradesh and Tamil Nadu

## 2. West Flowing Rivers

Rivers	Course of River
Sabarmati	Rajasthan and Gujarat
Mahi	Madhya Pradesh, Rajasthan and Gujarat
Dhandhar	Gujarat
Kalinadi	Karnataka
Sharavati	Karnataka
Bharathapuzha	Kerala
Periyar	Kerala

### Comparison between Himalayan and the Peninsular River of India

Characteristics	Himalayan Rivers	Peninsular Rivers
Place of origin	Himalayan mountains (covered with glaciers).	Precambrian Peninsular plateau and central highland.
Nature of flow	Perennial; water from glaciers and rainfall.	Seasonal; dependent on monsoon rainfall.
Drainage Pattern	Antecedent (Older than Himalaya). Eg- Indus, Brahmaputra etc. Non-antecedent (Younger than Himalaya) For example- Ganga, Yamuna, Jhelum etc.	Most of the rivers of peninsular India superimposed, rejuvenated resulting in trellis, radial, and rectangular patterns.
Nature of river	Long course, flowing through the rugged mountains experiencing headward erosion and river capturing; In plains, meandering and shifting off course.	Smaller, fixed course with well adjusted valleys.
Catchment area	Larger	Smaller
Age of the river	Young and youthful, active and deepening in the valleys	Old rivers with graded profile; almost reached their base levels.



## 4. Lakes

- Body of water of considerable size, localized in a basin.
- Surrounded by land apart from a river or other outlet that serves to feed or drain the lake.
- Not part of the ocean, and therefore are distinct from lagoons.
- Larger and deeper than ponds.

### 4.1 Important lakes of India

#### Fresh Water Lakes of India –

Lake	Features
Kolleru Lake (Andhra Pradesh)	<ul style="list-style-type: none"><li>➤ The largest lake in India.</li><li>➤ Located b/w Krishna and Godavari delta.</li><li>➤ Wetland of international importance in 2002 - Ramsar convention.</li></ul>
Pushkar Lake (Rajasthan)	<ul style="list-style-type: none"><li>➤ In Pushkar in Ajmer district of Rajasthan.</li><li>➤ A sacred lake of the Hindus.</li></ul>
Loktak Lake (Manipur)	<ul style="list-style-type: none"><li>➤ Keibul Lamjao - only floating national park in the world floats over it- last natural refuge of the endangered sangai of Manipur brow-antlered deer.</li></ul>
Nalsarovar Lake (Gujarat)	<ul style="list-style-type: none"><li>➤ Declared a bird sanctuary in 1969.</li></ul>
Tsomo Lake (Sikkim)	<ul style="list-style-type: none"><li>➤ Also known as Changu Lake</li><li>➤ A glacial lake in East Sikkim.</li></ul>
Bhimtal Lake (Uttarakhand)	<ul style="list-style-type: none"><li>➤ Largest lake in Kumaon region.</li></ul>
Periyar Lake (Kerala)	<ul style="list-style-type: none"><li>➤ An Elephant reserve and Periyar Wildlife Sanctuary on its banks.</li></ul>
Salim Ali Lake (Maharashtra)	<ul style="list-style-type: none"><li>➤ Renamed after great ornithologist, naturalist Salim Ali (birdman of India).</li></ul>
Kanwar Lake (Bihar)	<ul style="list-style-type: none"><li>➤ Asia's largest freshwater oxbow lake.</li></ul>
Nakki Lake (Rajasthan)	<ul style="list-style-type: none"><li>➤ In Mount Abu in Aravalli range.</li><li>➤ Mahatma Gandhi's ashes were immersed in it and Gandhi Ghat was constructed.</li></ul>
Wular Lake (Jammu Kashmir)	<ul style="list-style-type: none"><li>➤ Largest Freshwater Lake in India.</li><li>➤ Formed as a result of tectonic activity and is fed by the Jhelum River.</li></ul>
Ashtamudi Lake (Kerala)	<ul style="list-style-type: none"><li>➤ A lagoon in the Kollam district of Kerala.</li><li>➤ A wetland of international importance under the Ramsar Convention.</li></ul>
Vembanad Lake (Kerala)	<ul style="list-style-type: none"><li>➤ Longest lake in India; Largest lake in the state of Kerala.</li><li>➤ The Nehru Trophy Boat Race is conducted in a portion of the lake.</li></ul>
Roopkund (Uttarakhand)	<ul style="list-style-type: none"><li>➤ High altitude glacial lake situated in the lap of Trishul mountain.</li><li>➤ Also known as 'Skeleton Lake' due to the presence of human skeletons at its shores, believed to be from a historical event.</li></ul>

### **Saline Lakes of India –**

Lake	Features
Sambhar Lake (Rajasthan)	<ul style="list-style-type: none"><li>➤ India's largest inland salt lake.</li><li>➤ Ramsar wetland.</li></ul>
Lonar Lake (Maharashtra)	<ul style="list-style-type: none"><li>➤ Formed 50,000 years ago after a meteorite hit the Earth.</li></ul>
Chilka Lake (Odisha)	<ul style="list-style-type: none"><li>➤ Largest coastal lagoon in India</li><li>➤ Second largest lagoon in the world.</li></ul>
Dal Lake (Jammu Kashmir)	<ul style="list-style-type: none"><li>➤ k/a "Jewel in the crown of Kashmir" or "Srinagar's Jewel".</li><li>➤ Asia's largest Tulip garden is on the banks of Dal Lake.</li></ul>
Pulicat Lake (Border of Andhra Pradesh & Tamil Nadu)	<ul style="list-style-type: none"><li>➤ Second-largest brackish water lake on Coromandel Coast.</li><li>➤ Barrier island of Sriharikota separates it from the Bay of Bengal.</li></ul>

## **5. Water Resources of India**

- Natural resources of water potentially useful as a source of water supply.
- 97% of water on Earth is salt water and only 3% is freshwater;
- $>2/3^{\text{rd}}$  of this is frozen in glaciers and polar ice caps.
- Remaining unfrozen freshwater – groundwater or water vapour.

## **6. International Agreement for Surface Water Resources**

### **6.1 Indus Waters Treaty 1960**

- Signed between India and Pakistan in 1960.
- Ravi, Satluj Sutlej, and Beas were allocated Beas allocated to India exclusively.
- Indus, Jhelum, and Chenab were allocated to Pakistan except for specified domestic, non-consumptive, and agricultural use permitted to India.
- India was also given the right to generate hydroelectricity through the run of the river (RoR) projects on the Western Rivers.
- Major dams on eastern rivers for exclusive use of India:
  - Bhakra Dam on Satluj,
  - Pong and Pandoh Dam on Beas,
  - Ranjit Sagar on Ravi.

### **6.2 India-Nepal Treaty:**

- A Nepal-India Joint Committee on Water Resources (JCWR) was formed.
- Treaty on Integrated development of Mahakali River (1996).
- Pancheshwar Multi-purpose Project on river Mahakali- centrepiece.

### **6.3 India-Bangladesh Treaty:**

- About sharing water of Ganga at Farakka
- Signed on 12 December 1996.